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WORLDWIDE

International Bareboat Skipper

Passport Series 3 / Modules 14 to 17

Department of Transport
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INTERNATIONAL BAREBOAT SKIPPER CERTIFICATE

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INTERNATIONAL BAREBOAT SKIPPER CERTIFICATE
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INTERNATIONAL BAREBOAT SKIPPER CERTIFICATES

MODULE 14 / SECTION 1
INTRODUCTION

The **aim** of this module is to increase the candidates' nautical knowledge to competently take on the duties of a bareboat skipper.

The **objectives** of this module are to increase the student's confidence level in nautical matters and practical skill-set, appropriate to this modular level including:

Taking over a vessel
Tides and currents
Chartwork
General deckwork & Seamanship
Vessel handling
Meteorology
Passage Planning
Collision regulations

As with all IYT courses, depth of knowledge increases as students progress through the various levels of training. *This is not a beginner's course.*

<u>Important Notice</u>

This course focuses mainly on the practical application of boating rather than the theory aspects which will have been covered in the IYT International Crew Certificate and International Watchkeeper / Flotilla Skipper.

This book is generic in content. The contents of these notes are designed to be general in nature and when chartering in different locations, should be accompanied by local charts, local cruising guide, tidal information, local navigation rules and local sources of weather information.

Additionally, included in the beginning of these notes are revision sections on Safety and Nautical Terminology.

SAFETY
(Revision)

When it comes to survival at sea, there is nothing more important or comforting than being adequately prepared. This preparation could some day save your life. Understanding the dangers that can overcome you and your vessel while at sea is a crucial part of surviving. It is vitally important to thoroughly know your boat, your equipment, your crew, and your safety systems.

Life Jackets / Personal Flotation Devices (PFD's)
There should be at least one lifejacket per person on board every vessel, including small sizes for any children. A life jacket is designed to support a person's weight with their head turned upward with nose and mouth above the water.

There are many different types and designs of lifejackets such as Safety of Life at Sea approved (SOLAS). SOLAS jackets are recommended as they carry reflective tape, a light and a whistle. Essentially the jacket is placed over the wearer's head and is then tied or clipped around the front and sides. The buoyancy may be provided by a solid material that has extremely buoyant properties, or by CO2 or a combination of both. Some CO2 filled jackets have an automatic inflation device which inflates when the lifejacket is submerged in water.

Inflatable Lifejacket

SOLAS Approved Lifejacket

Adult Lifejacket

* Children's Lifejacket

Personal Flotation Device
(PFD)

* Children's Buoyancy Aid

* Note the groin straps on children's lifejackets and buoyancy aids.

Buoyancy Aids / Flotation Aids

Buoyancy aids are designed to provide buoyancy but will not turn an unconscious person upright or provide as much support as a lifejacket. They are mainly used for watersports such as windsurfing, dinghy sailing, water skiing and kayaking. They are best suited to inland waterways, coastal operations and calm waters where there is a good chance of quick recovery. They are useful on smaller vessels where bulky life jackets may be impractical. Generally, they are the most comfortable for continuous wear and are available in many colors and styles. All PFDs must be kept in operable condition by regular checks and maintenance.

Pyrotechnic Distress Signals (Flares)

Flares are used to attract attention in the event of emergencies at sea. There are four basic types of flares. These devices, being pyrotechnic, are in themselves dangerous and must be treated with respect. They must always be kept dry, such as in a watertight container. They must also be in date. They will only be of benefit if they are used when there is a high probability that there is someone in your immediate vicinity that will see the flares. When using one of these devices hold them away from the body and point downwind.

The four types are:

Red Parachute flare - These are magnesium flares on a parachute which go up to around 300m or 1000ft and then gradually float back down. Used to attract the attention of distant vessels.

Red Hand-held flare - These flares are used at night and produce a bright red light for around 60 seconds.

Orange Smoke - These flares are used during the day and produce a plume of orange smoke for around 3 minutes.

White hand-held flare - These flares burn bright white and are used to alert other vessels to the risk of collission.

Red Parachute

Red Handheld

Orange Smoke

White Handheld

SOLAS flares are recommended above all others due to their high luminescence and burn rate.

Life Raft (Requires annual inspection to keep in date)

A life raft is an inflatable survival craft packed in either a hard plastic canister or a soft valise which should be accessible in the event that the crew need to evacuate the boat in an emergency. They come in various sizes such as 4, 6, 8, 12, and 24 man capacities depending on the size of the vessel. There is a saying that one should only ever step "up"

Canister Liferaft

Valise Liferaft

Inflated Liferaft

Hydrostatic Release attached to the liferat

into a life raft, i.e. it is a last resort. After the disastrous 1979 Fastnet Yacht race in England, many of the yachts that were abandoned were later found afloat, however, many of the life rafts were never found. A liferaft should have a hydrostatic release attached to it for automatic deployment in the event of a sudden sinking (more details to follow). At least one member of the crew should have received basic sea survival training from a recognized authority.

The **Hydrostatic release** unit is mounted between the liferaft and the cradle which holds it. If you do not have a chance to manually deploy the liferaft when the ship is sinking, at a depth of 10-15' the Hydrostatic Release Unit will allow the raft to inflate and float free automatically. It has a 2 year life then it must be replaced.

Basic First Aid Kit

Every vessel however small should carry a basic first aid kit. There should also be a First Aid Manual on board for quick reference. The longer the voyage intended to be undertaken, the more comprehensive first aid contents should be. Any crew member taking prescription medications should ensure an adequate supply and notify the captain. At least one member of the crew should have received some first aid training from a recognized training authority. Contents of a basic first aid kit usually include the following: bandages & various gauze pads, aspirin, antiseptic wipes, motion sickness tablets, antacid tablets, insect bite relief swabs, alcohol prep. pads, cotton swabs, tweezers, synthetic gloves, eyewash & pads, calamine lotion, ice pack, antibiotic cream and first aid instruction booklet.

Fire Extinguishers (Requires annual inspection to keep in date)

It is imperative to know where the fire extinguishers are located on every vessel and how to use them. In general, fire extinguishers on boats will be either a dry powder or foam that smothers the fire or CO2 which starves the fire of oxygen. It is recommended that one of the crew members complete a basic fire fighting course from a recognized training authority.

There are four main types of fire extinguishers:

1. **Water - ordinary combustibles (class A)**
2. **Dry powder/chemical - multi purpose (class A,B,C)**
3. **Carbon Dioxide (CO2) smothering agent for gas, liquid and electrical fires (class B,C)**
4. **Foam - smothering agent for flame inhibition (class A,B)**

If a fire does break out, it must be contained and extinguished as quickly as possible. The correct actions must be taken as promptly and efficiently as possible otherwise the chances of containment are slim. The following is worth remembering:

FIRE: F = Find
I = Isolate and Inform
R = Report and Restrict
E = Extinguish or Escape

Safety Harness

Safety Harnesses

Mainly used on sailing vessels, safety harnesses are worn by crew members when on deck in bad weather, at night and if the crew member feels safer with one on. The harness comprises webbing shoulder straps and waistband which are adjustable,

and a tether of rope or webbing which has a karabiner clip on both ends. The wearer clips on to strong points on the vessel or onto a "jack stay" (a rope or webbing line attached at the bows and stern of the vessel) when moving up and down the deck.

Horseshoe Buoy / Ring Buoy

Horseshoe Buoy

These are type IV Personal Flotation Devices. They are lightweight, highly visible, throwable flotation devices which are used in the event of a man overboard (MOB). These devices are designed to be thrown to a person in the water to assist in keeping them afloat while the vessel manouvers to recover the person. All vessels should be equipped with at least one.

Ring buoy

Lifesling

A lifesling is another type of throwable man overboard (MOB) recovery device. It is normally attached to the sternrail or stanchion. They are commonly used aboard sailboats and are deployed by opening the bag and dropping the sling into the water. Forward momentum of the vessel will draw out a long line. The vessel is then manouvered in a wide circle around the MOB enabling the person to grasp the line and work back to the boat. The person places the sling under his arms, when ready and secure, the crew will recover the MOB by pulling the line back on board. Getting the MOB back on board may be as easy as dropping the swim ladder or may involve the use of a winch, halyard, or block and tackle to assist in MOB recovery.

VHF Radio

The Very High Frequency (VHF) radio is a transmitter and receiver combined in one instrument, called a "transceiver". When a message is sent from one transceiver it can be received by another transceiver provided that it is within range and tuned to the same channel or frequency. Both transceivers MUST be tuned to the same frequency to enable a conversation to take place.

VHF Radio

Microphone

VHF Handheld Radio

VHF radios are an essential piece of equipment in the event of on-board emergencies. Uses also include weather and coastguard information as well as routine ship to ship traffic and are used to transmit “Mayday”, “Pan Pan” and “Securite” information. A “Mayday” call is used when danger is imminent, a “Pan Pan” call is used when a vessel has a problem but danger is not yet imminent. A “Securite” call is used to alert other vessels of hazards to navigation.

A full explanation of the operation of a VHF radio is contained in the VHF Radio Operators notes.

Safety Checks, Engine Checks and Checklists

A series of checks should be carried out prior to every trip or voyage. It is important to know that the vessel and her equipment are in good order and everything is working properly. It is also a good opportunity to use the checks as a way to introduce the location of equipment and safety gear to new crew and as a reminder to those who have been on board before.

Hull Checks - Check the condition and operation of the following:

- Location and condition of through hull fittings
- Through hulls and sea cocks operate easily, hoses in good condition, hose clamps fitted (double)
- Spare hose clamps should be carried (two or three of each size)
- Through hull plugs attached to each sea-cock
- Bilges are clean and dry, bilge pumps operational
- Grab rails, life-lines in good condition

Safety Equipment

- Check all safety equipment is in date and has not expired
- Fire extinguishers in date
- Signal flares and other signaling devices with current expiration dates
- Life jacket suitable for each person on board, readily accessible, in good condition
- MOB equipment and throwable flotation easily accessible to helmsperson
- Flashlight and extra batteries
- Horn working.
- Bell
- First aid kit, with sunscreen, pain relievers and any special medications for crew
- VHF working and in good condition

Housekeeping Items

- Water tanks full with extra bottled water for emergencies.
- Propane gas including spare bottle, in outside locker with drain

Dinghy - Check the condition and operation of the following.

- Stowed properly
- If inflatable ensure it is in working order
- Paddles or oars.
- Outboard motor maintained and stowed properly
- Spares
- Safety equipment etc for dinghy
- Sufficient fuel for operation

NAUTICAL TERMINOLOGY
Revision

Types of Vessels

As the Greek philosopher Archimides discovered over 2000 years ago , All vessels float in water because the water creates an upward buoyant force. Different vessel shapes have evolved over time to maximize the efficiency of different methods of propulsion. For example, a sail boat has a deep keel to help with sailing efficiency and stability whereas a fast powerboat will have very little keel under the water which allows it to minimize resistance in the water and thus go faster. The keel is a weighted projecting fin which provides stability and reduces sideway drift of a vessel. Essentially there are two distinct types of hull, (and within these are many variations), **"displacement"** hulls and **"planing"** hulls.

Hull Types

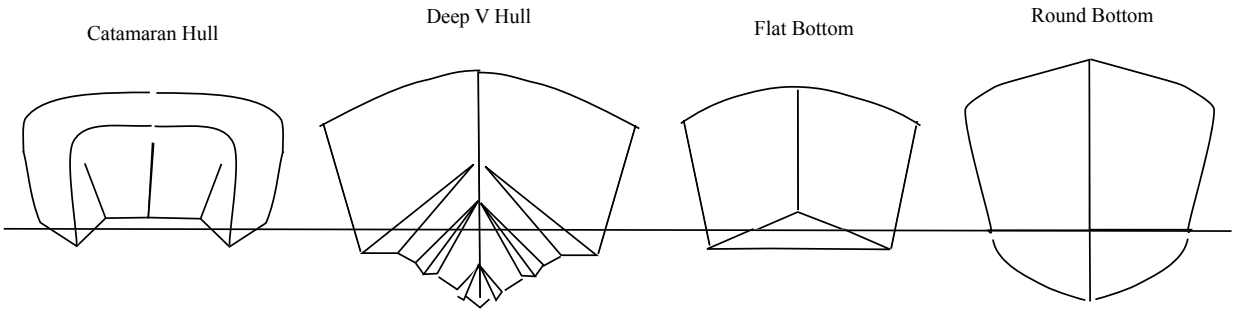
There are many types of vessel with an assorted combination of hull and engine configurations.

Planing Hull

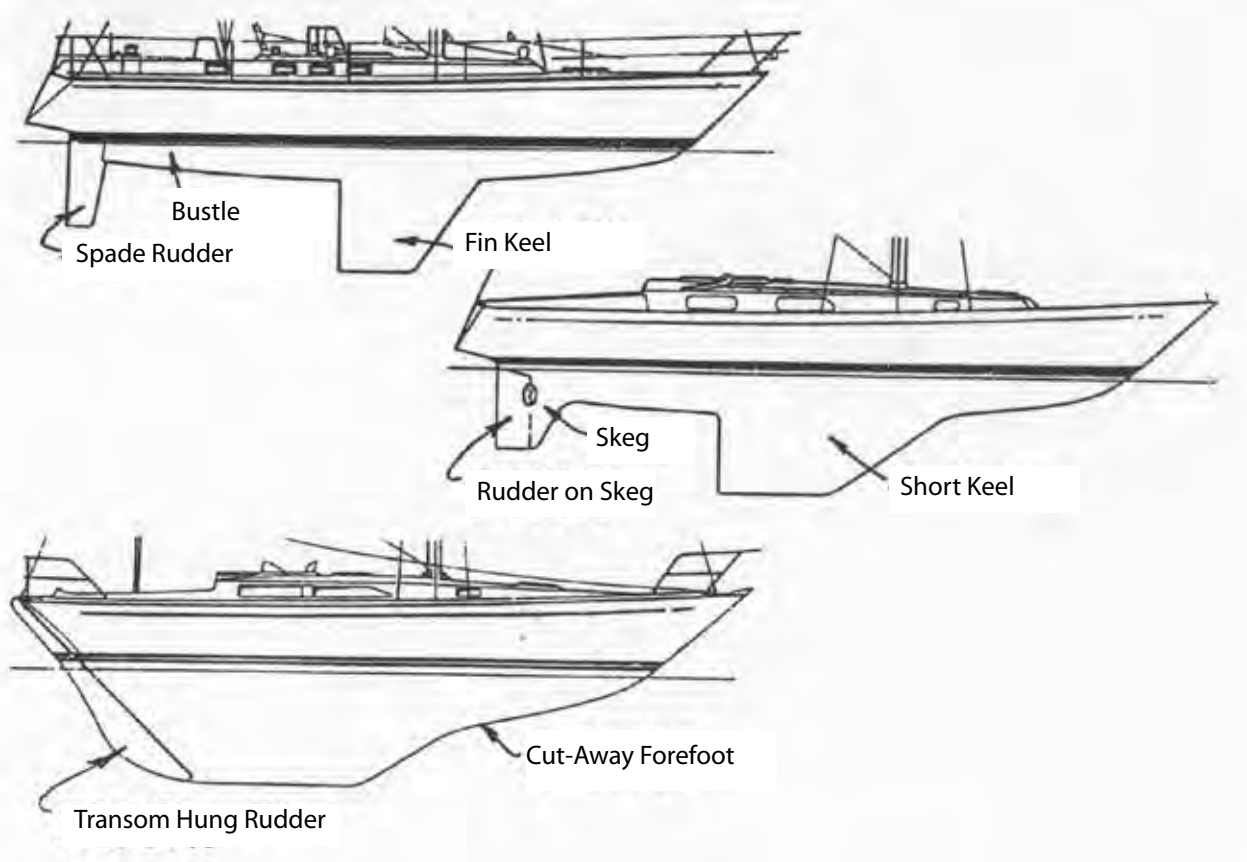
Displacement hulls, such as sailing boats and trawler type boats, are supported by the buoyancy created by the hull in the water. These types of vessels have a maximum speed based on the waterline length and no addition of power will increase this maximum speed. The advantages of a displacement hull are lower power requirements than a planing hull allowing a longer cruising range and increased load carrying ability.

Planing hulls are lifted clear of the buoyant support of the water by means of a combination of hull shape together with high power converted to speed. The vessel is lifted higher in the water as the speed is increased reducing the drag of the water as less of the hull is actually in the water. The advantages of a planing hull are shorter journey times, but this must be offset against the increased cost of larger more powerful engines and consequent increase in fuel consumption.

Power Vessel Hull Shapes



Sailing vessel hull shapes



Vessel Construction

Methods of construction and materials used in vessel construction are a subject in their own right and there are many reference books available for those who wish to pursue this subject in depth.

The earliest vessels were constructed from natural materials, mainly an all timber construction. Some boats are still built in this fashion. Most modern series production boats are built in a mold from man-made materials and composites such as glass-fiber, glass reinforced plastic (GRP) impregnated with resins or materials such as carbon fiber and Kevlar for their higher strength for the equivalent weight of materials. Large yachts are generally constructed from steel or aluminium or a combination of materials.

Inflatables & RIBs (Rigid Inflatable Boats)

The difference between a RIB and an Inflatable is essentially that the bottom of the RIB is made of aluminum or fiberglass, both have inflatable compartments or pontoons (inflated tubes which make the sides of the RIB). Inflatables have no rigid components and as a result are easier to stow. Both have good stability, are relatively lightweight and have generous carrying capacity. Designed initially for the military and rescue/service work they are increasingly popular with recreational users. Each configuration has advantages and disadvantages.

Rigid Inflatable Boat (RIB)

Definitions of types of vessels.
There is no globally accepted definition for when a boat becomes a yacht or when a yacht becomes a ship. However, a yacht can be carried on a ship but a ship cannot be carried on a yacht.

To be more specific and to further clarify the term yacht, these notes refer to "motor yachts" as those vessels that are driven by one or more engine, and those driven by sails as "sailing boats". Sailing boats for the most part also have engines for ease of manoeuvering in crowded marinas and anchorages where there is insufficient room to sail safely. These are commonly called auxiliary engines. In these notes, the word "boat" describes a recreational craft/vessel, either driven by engines or sails, or both, with covered accommodation and facilities which allow the individual to spend a night on board.

The word "yacht" also refers to the very large Motor and Sail vessels that can be seen in such exotic locations as the Caribbean and Mediterranean. Some of the larger Megayachts are really small ships and many operate for commercial purposes. This means that they carry passengers for hire or reward. Below are various types of boats.


Cabin Cruiser


Sailboat


Rigid Inflatable Boat (RIB)


Sportfish


Day Fisher


Day Cruiser


Speedboat


Dinghy


Multihull / Catamaran


Megayacht

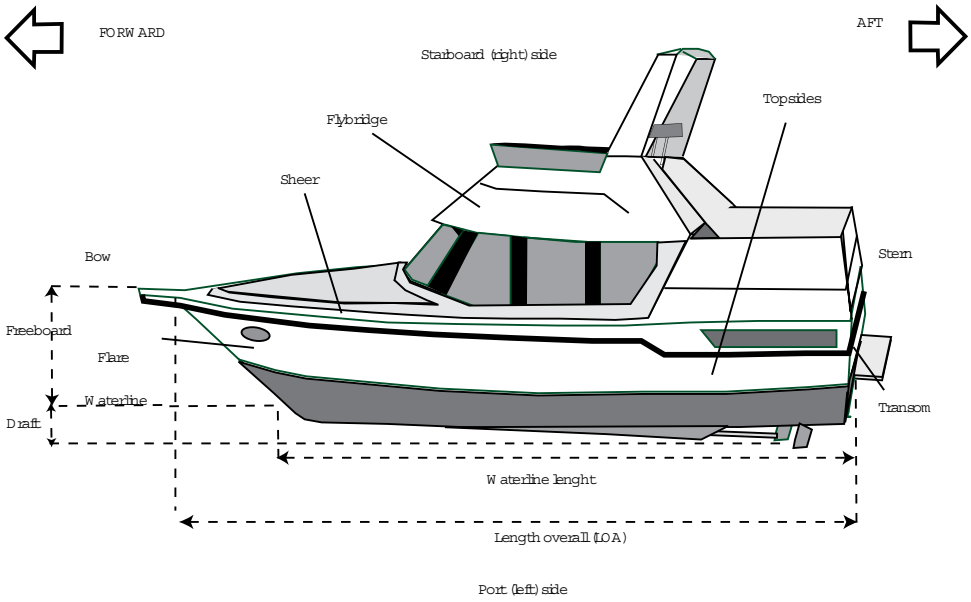

Sailing Catamaran


Container Ship

Parts of A Vessel and Nautical Terminology

General Terms to define a vessel.
When any vessel is in the water, the level that the water reaches on the hull is known as the **"waterline"**. The area that is below the waterline is painted with a special paint which inhibits growth of weed and shell fish and is called "antifouling paint"; the depth that this underwater area extends down is known as the **"draft"**. The distance from the water line to the upper edge of the hull is known as **"freeboard"**.

Length overall (LOA), The overall fore and aft length of the hull.
Waterline, The line where the surface of the water reaches on the hull.
Load waterline length (LWL), The fore and aft length of the hull measured at the waterline.
Beam, The width of a vessel at its widest point.
Freeboard, The height of the side of a vessel above the water.
Draught, The depth of the lowest part of the vessel in the water
Keel, A weighted projecting fin fixed on the centerline of a vessel which provides stability and reduces sideways drift.



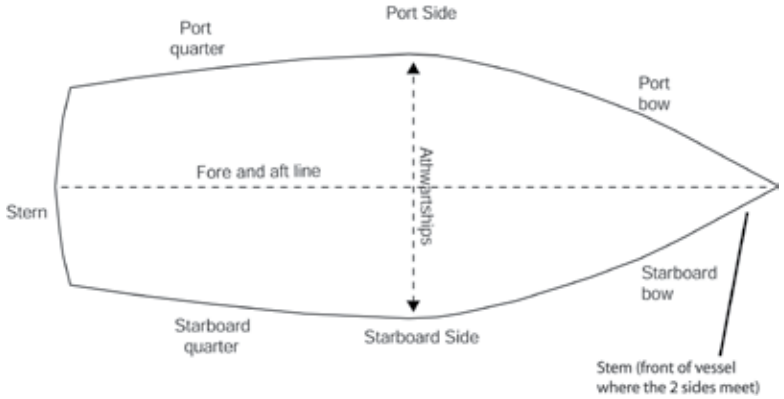
Parts of a Hull

The **"stem"** is the front part of the vessel where the two sides meet. The two sides of the hull where they meet at the stem are known as the **"bows"**. This comprises the **"forward"** section of the vessel. The mid section of the vessel is known as **"midships"** and going towards the rear, **"aft"**, to the back of the vessel which is known as the **"stern"**. The actual flat part of the back of the vessel is known as the **"transom"**.

The right hand side of a vessel is known as the **"starboard"** side, and the left is known as the **"port"** side. A useful memory jogger is the phrase

"There is a no RED PORT LEFT in the bottle", so that red, port and left all refer to the same side. The inclusion of "red" is also a reminder that the color of the port side navigation light is red, and the starboard side is therefore green.

Nautical terminology is vast, and there are nautical dictionaries naming thousands of nautical terms, some of which are contained in the glossary at the back of this book. However, in this module, we will address only the most commonly used terms.



Alongside

Generally a yacht will be kept in a Marina, which, depending on size, may have spaces for a few boats or thousands of boats. When tied up to a dock there will be a number of lines securing the vessel "alongside". These are known as **"mooring lines"**. The lines will be attached to secure points on the dock called **"cleats"** and lead through special fittings with smooth edges on the vessel known as **"fairleads"**. These are designed to prevent fraying or **"chafing"** and are secured to the vessel's cleats.

Deck Equipment and Fittings

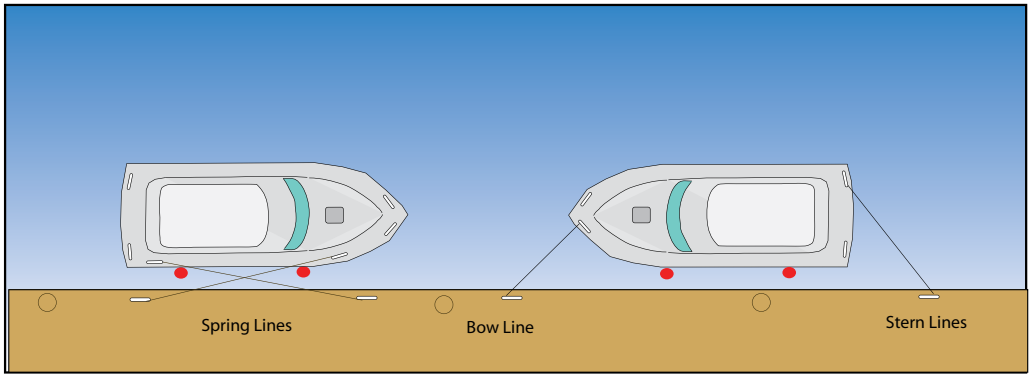
The docking lines required to secure a vessel properly are:

1. Bow line. A line that is lead forward from the bow of the boat.
2. Stern line. A line that is lead aft from the stern of the boat.
3. Spring lines One line leads from the bow of the vessel aft of midships to the dock and one from the stern of the vessel lead forward of midships to the dock. These stop the boat moving fore and aft and should be taut.


Fairlead


Boat Cleat


Dock Cleat



Inflated plastic or rubber cylinders or spheres protect the hull from damage while in contact with the dock or other vessels and are called **"fenders".** Adequate fenders both in size and quantity must be used to protect the hull and topsides.

When the vessel is attached to a **"mooring buoy"** or "anchored" away from the land, access to the vessel will then be by a smaller boat such as a RIB or dinghy. Dinghys and safe operation of dinghys are addressed in a later section.

Mooring Buoy

Fenders

Stanchion

Stanchions On deck there will generally be a protective rail to prevent a person falling overboard. These may be solid walls, "bulwarks" or wire ropes, attached at the bow and stern and supported at intervals by upright metal poles called "stanchions".

Pulpit

Pulpit On most boats there is usually a metal frame around the bows called the **"pulpit".** Additional protection at the stern will be the **"stern rail / taffrail"** or **"pushpit".**

Power Boat Pulpit

Sailboat Pulpit

Power Boat Stern Rail

Sailboat Stern Rail

Foredeck The forward part of the deck in front of the mast or raised accommodation on a boat is known as the foredeck. The foredeck houses the anchor chain and line for anchoring a vessel.

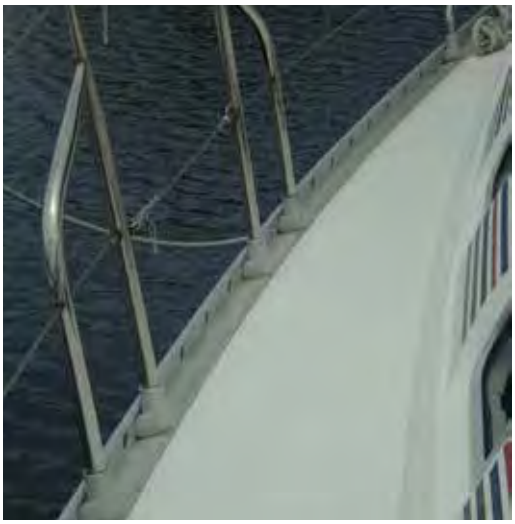
Power Boat Foredeck

Sailboat Foredeck

Coach Roof The raised part of the deck to create headroom below decks.

Grab Rails Rails attached either to the coach roof or inside the cabins for holding on to while at sea.

Jackstay A wire or webbing strap attached at the front and back of a vessel along the deck to which a safety harness line may be clipped. (mostly found on sailboats)



Toe rail A low timber or metal strip running around the outer edge of the deck to assist the crew in maintaining a foothold.

Cockpit A self draining recess in the after part of a vessel.

Companionway Steps giving access from the deck to the cabin.

Washboards Boards used to seal off the companionway to prevent the entry of water.

Hatch An opening in the deck that gives access to the space below.

Bowsprit A spar which projects from the bow of some boats to allow headsails to be secured further forward.

Dodger A demountable cover rigged over the companionway and the forward end of the cockpit to protect the crew from wind and water spray.

Bimini Top: A canvas canopy to shade an area of deck or cockpit from the sun.

Windlass: A winch which is positioned on the fore-deck and used for hauling in anchor chain and rope.

Anchor: A device attached to rope or chain which is lowered to the seabed to hold a vessel in place.

Saloon: This is the living room on board a boat and will consist of seating and possibly contain music, TV and entertainment center. The larger the boat the more lavish the equipment and fittings are likely to be.

Dinette: The dining area of the boat may be simply a small table with bench seating to a full scale dining room setting on a large boat.

Accommodation: In a vessel the floor is known as the **"cabin sole"**, the walls are **"bulkheads"** and the ceilings are **"deck heads"**.

Cabins/Staterooms: These are the **"bedrooms"** and may consist of a single **"bunk"** or bed to king size suites on megayachts.

Wardrobes are referred to as **"hanging lockers"**.

Forepeak: Is a space forward in the bows of the boat. Often this is where the anchor chain is stored.

Dinette

Ventilators: Movable devices fixed to the deck to carry fresh air below without permitting the entry of water. These are found both on power and sailing vessels.

Galley: The kitchen on a vessel and the equipment contained will depend on the size of the yacht and the number of crew it carries.

Console: Steering console, instrumentation and throttle control

Throttle Control / Transmission Control: Selects forward, neutral and reverse gears and controls propeller speed.

Typical **Twin Outboard** motor set-up.

Engines and Drives

Outboards are by far the most popular type of motor for small craft. They are a demountable self-contained unit available in 2 stroke or 4 stroke configurations with a wide range of power/size applications. Easily removed for maintenance, storage and cleaning they have the ability to be raised/tilted hydraulically or manually for shallow water operations.

A Kill Cord is an engine cut-out device, one end of which is attached to a switch near the throttle and the other to the driver's body. In the event of the helmsman falling overboard this device will stop the engine. Runaway powerboats cause serious injuries and even deaths. Use the cord at all times. Carry a spare one on board so that the engine can be restarted to pick up the person in the water.

Kill Cord

Outboard Motor

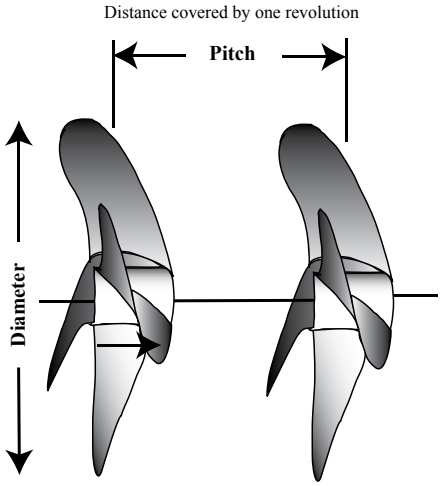
Console Steering & Throttle Control

Steering/Propellers

Smaller outboards steer the boat by turning the whole motor using the attached tiller, which is fitted with a twist-grip type throttle control. On RIBs and larger vessels controls are center console mounted. Steering is normally wheel controlled through hydraulic rams or cables and steers just like a car.

Propellers

A power driven vessel requires an engine or engines to drive a "**propeller**" commonly known as a "**screw**" which is a rotating device with a number of different "blades", from 2 to 5 depending upon hull type and performance requirements. Propellers are classed by 3 different features- "**hand**", "**diameter**" and "**pitch**". For example a 3 bladed prop may be R 10" x 28" which means it will turn "**right hand**" or clockwise in forward gear, has a diameter of 10 inches and the pitch (the angle that the blades are set) is 28 inches which is the (theoretical) distance the prop would travel in one rotation.



Thru hull fitting

Thru hull fitting

Thru hull fittings are designed to allow water to pass through them from inside a boat, such as the sinks, toilets, impellers and for engine water cooling.

Instruments and Electronic Aids to Navigation

Not all vessels will be equipped with all the instruments discussed below. There are many different types and makes of instruments but the information they relay is the same.

Hand-bearing Compass

The Magnetic Compass

The compass is perhaps the most important instrument on a boat. It is essential for navigation when out of sight of land, during the hours of darkness and at times of restricted visibility, e.g. fog, rain etc. when the compass is used to steer pre-determined magnetic courses. A hand-bearing compass is also used for some position fixing techniques.

Gimballed Compass

How does a Compass work?

A magnetic compass is an instrument used to find direction. All magnetic compasses operate on the same principle; the compass is simply a circular card, graduated with 0º - 360º (degrees) marked on it's circumference and supported on a pivot point in a sealed bowl filled with a water/alcohol mixture which dampens or slows the movement of the card on the pivot. Two or more bar magnets are attached to the underside of the card, aligned to the north/south (0º - 180º) axis of the card. The bar magnets in the instrument follow the magnetic lines of force that circle the earth and the compass card "north point" will always point to the north magnetic pole. (These lines of force are generated by the earth's magnetic field).

The compass is "gimbal" mounted which means that no matter how the vessel heels/rolls or pitches the compass card will remain level.

The inside of the compass bowl is marked with a "lubber line" which is aligned exactly parallel to the fore and aft centerline of the yacht. The direction of the vessel's heading or the "compass course" being steered is indicated by the card graduation nearest the lubber line. There will be a small light in the compass to enable it to be read at night.

Depth Sounder

Depth Sounder

A depth sounder determines the depth of water beneath a vessel. The equipment comprises of a transmitter with a digital or pictoral display screen close to the helm, and a transducer sensor mounted through the vessels hull near the bottom of the hull. The transmitter sends pulses through the transducer, which picks up the returned pulse after it has "bounced" off the sea floor. The time the returning echo takes to return is interpreted by the transmitter, which displays the water's depth on the screen.

Barometer

A barometer is an instrument which indicates the atmospheric pressure. A single reading of barometric pressure gives no worthwhile information, it is the rate of change of pressure that is important in itself and this can only be gained from a series of readings, hence the importance of recording barometer pressure in the boat's log book. A **"barograph" is** available which records the pressure variance either on paper charts or electronically.

Barometer

Log

The log is an instrument for measuring the vessel's speed through the water. Boat speed is usually measured in "knots" (nautical miles per hour, that is approximately 2000 yards per hour). One "knot" is approximately 1.15 statute mile. The navigator uses this to determine how far the vessel has traveled and to estimate likely arrival time at the destination.

The log comprises a receiver with a digital display close to the helm, and a paddle wheel impeller mounted through the hull near the bottom of the boat. As the vessel moves through the water the paddle wheel spins and sends the information to the receiver which computes the speed through the water. The impeller requires regular maintenance in the form of cleaning to ensure that the paddle wheel has not become jammed with marine growth or debris.

GPS (Global Positioning System)

The current "state of the art" satellite radio positioning system is called 'Global Positioning System' or GPS for short. GPS was developed by the U.S. Government for use by the US Navy, Army and Air Force and offers precise position in latitude and longitude 24 hours a day, worldwide. The GPS navigation system is composed of 29 active satellites (24 fully operational in 1999) in orbit around the earth together with a land based master station based in Colorado.

GPS System

GPS is a global navigation system using radio signals from a transceiver which communicates with a number of satellites and automatically computes the vessels location, heading and speed. The transceiver will have a display mounted close to the helm. There is a digital read-out of the vessel's speed and position (Latitude and Longitude) together with additional information for use by the navigator. The GPS receiver may have a charting function or may be connected to a "Chart Plotter" which will show the position of the vessel graphically on a chart displayed on the screen.

Each satellite knows its exact position and sends out an individual signal, which is picked up by the receiver. The receiver then measures how long it took for this signal to reach the receiver. Using this information, the receiver can calculate its distance from the satellite. In other words, the receiver has found a position centered on the satellite's known position. A second position from another satellite will give a position fix and a third position will confirm this fix with greater accuracy.

GPS Accuracy

The GPS satellites transmit signals on two frequencies, one solely for military use and one for civilian use. The frequency available to civilians gives less precise accuracy than the military frequency. The design parameters for GPS are that it provides an accuracy of 8 meters horizontally, 10 meters vertically, speed to 0.1 of a knot and time to a fraction of a microsecond.

Selective Availability (SA)

In order to reduce the potential threat that the accuracy of the civilian signals allows, the U.S. introduced what is called Selective Availability. The U.S. can introduce random errors, degrade the signal available on the civilian frequency as and when they wish. Selective availability is at present in operation giving an expected inaccuracy of between 100 and 150 meters 95% of the time. This is of course more than adequate for normal navigation. However,

this accuracy can, and will, be further degraded if and when required, nor will there necessarily be any prior warning to civilian users. The civilian frequency can also be switched off totally should the U.S. military decide to do so.

Differential GPS (DGPS)

DGPS has been introduced commercially in some parts of the world in order to cancel out the effect of selective availability. With DGPS the GPS signal is received at a place (such as a lighthouse), the exact position of which is known. The signal error is removed and the corrected signal re-transmitted to suitably equipped receivers. A special (add on) DGPS receiver must be purchased to avail of this information.

Accuracy using DGPS is often quoted in terms of about 10 meters or 33' and sometimes figures of 5 meters are quoted, - BUT remember that in many cases charts are not produced to anything like this level of accuracy, indeed some charts are based on surveys carried out in the 1800's. Note the warning from the British Admiralty at the end of this section. Generally speaking, it would seem to be most unwise to attempt to navigate in a fashion totally dependent upon quoted accuracies of these magnitudes.

GPS Instruments

A GPS set actually consists of a radio receiver tuned to receive the signals transmitted from the satellites and a computer, which processes these signals to display the receiver's position in terms of latitude and longitude. Many different models, either fixed or handheld (portable) are available but essentially they all do the same thing and give the user the same range of information. Fixed models generally use the boat's battery whereas handhelds use replaceable portable batteries.

Using a GPS

When switched on, a GPS may take from a couple of minutes to 15 minutes to work out its position which, when found, will be shown on the display in latitude and longitude. Once it has worked out its initial position it will continue to update this position every second or so until it is switched off, thus when the boat moves, the latitude and longitude shown on the GPS display will change.

The art of navigation is based on being able to find your position at any moment in time because it is from your position that most other navigational information is derived. When the GPS knows your position it will also be able to give you information such as speed, direction, estimated time of arrival and so on.


Radar Screen

Radar

Radar is used to detect another vessel or object, and show the "range" (distance) and bearing to the object. Detection is achieved by transmitting a short burst of electromagnetic energy so that it can strike an object, reflect back, and be detected by the receiver. The data is then processed and displayed on a screen mounted close to the helm.

The main purpose of radar is collision avoidance but obviously it is most useful at night and in periods of restricted visibility. The International Regulations for Preventing Collisions at Sea states (Rule 7b) "Proper use shall be made of radar equipment if fitted and operational, including long range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects". Assumptions shall not be made on the basis of scanty information, especially radar information. (Rule 7c). An increasing number of smaller vessels have radar installed. The prudent mariner is encouraged not only to thoroughly read and understand the operators manual but also take a dedicated radar operator course.

MODULE 14 / SECTION 2
TAKING OVER A VESSEL / VESSEL CHECKOUT

Vessel Check – Out.

- Hull & Rig Checks
- Machinery & System Checks
- Safety Equipment Checks
- Spares, Tools & Equipment
- Fuel & Water Capacity/Range
- Menus/Quantities
- Float Plan/Trip Plan/Documentation

A series of checks should be carried out prior to every trip or voyage. It is important to know that the vessel and her equipment are in good order and everything is working properly. It is also a good opportunity to use the checks as a way to introduce the location of equipment and safety gear to new crew and as a reminder to those who have been on board before.

The outline list suggested below is not complete but may be used as a guide. It is prudent to compile your own check-lists specifically for you own boating needs and for your vessel.

Manual Bilge Pump

Hull Checks

❖ Check the condition and operation of the following:
✓ Location and condition of through hull fittings.
✓ Through hulls and sea-cocks operate easily, hoses in good condition, hose clamps fitted. (double)
✓ Spare hose clamps should be carried. (two or three of each size).
✓ Through hull plugs attached to each sea-cock.
✓ Bilges are clean and dry, bilge pumps operational.
✓ Grab rails, life-lines in good condition.

Through Hull Fitting

Engine Checks

❖ Check the condition and operation of the following:
✓ Engine warning lights and alarms working.
✓ Emergency stopping of runaway engine, fuel cut off, etc.
✓ Steering and shift mechanisms in good condition.
✓ Interior spaces are well ventilated.
✓ Run the blowers for several minutes before starting to clear the engine space of any vaporized fuel.
✓ Fuel supply full, estimate a reasonable margin of safety approx 1/3 tank.
✓ Fuel system free of leaks.
✓ Engine oil and transmission fluid levels correct.
✓ Cooling Water full.
✓ Electrolyte level in the battery full.
✓ Belt tension correct and in good condition.
✓ Check all hoses, especially fuel.
✓ Prop shafts clear – no engine room materials left out of place.
✓ Stern gland and stuffing box, seal secure.

Twin Outboard Engines

- ✓ Bilge free of fuel vapors and excess water.
- ✓ Steering and shift mechanisms in good condition.

Air Filter

Spares – Engine

- ❖ Check to make sure you have the following:
- ✓ Oil Filters.
- ✓ Belts.
- ✓ Water Impellers.
- ✓ Lubrication Oil.
- ✓ Transmission fluids.
- ✓ Hose clamps, assorted, two or more of each size.
- ✓ Engine Hoses.
- ✓ Flexible fuel line.
- ✓ Air filters.
- ✓ Engine Drain Plugs.
- ✓ If gasoline/petrol engine - spare spark plugs.

Spares - Other

- ❖ Check to make sure you have the following:
- ✓ Replacement fuses in the correct sizes.
- ✓ Spare bulbs for running lights.
- ✓ Bulbs, every type used on board.
- ✓ A selection of shackles of various sizes.
- ✓ Spare Blocks.
- ✓ Spare parts for the heads.
- ✓ Tie wraps.
- ✓ Electrical tape
- ✓ Assorted screws, nuts & bolts.
- ✓ Two-part epoxy.
- ✓ Wooden bungs, assorted sizes.
- ✓ Silicon sealant.
- ✓ Assorted electrical connectors.
- ✓ WD-40 or slick lube.

Spares

Tool Kit

- ❖ Make sure all tools are included and in good working order.
- ✓ Socket set – basic.
- ✓ Wrenches assorted.
- ✓ Screw driver set - slotted & cross heads.
- ✓ Pipe wrench
- ✓ Vice grips assorted.
- ✓ Pliers - regular and needle-nose.
- ✓ Assorted Allen wrenches.
- ✓ Hammer.
- ✓ Wire cutters/strippers.
- ✓ DC test light.
- ✓ Multi meter.
- ✓ Utility knife.
- ✓ Hacksaw and blades.
- ✓ Tape measure.
- ✓ Oil and fuel filter wrench.

Tool Kit

- ✓ Drill and bits.
- ✓ Assorted punches.

Navigation Equipment and Navigation Lights

- ❖ Check the condition and operation of the following:
- ✓ Depth finder, radio and other electronics are working.
- ✓ Radio, call the local coastguard or marina office and ask for a radio check.
- ✓ All navigation lights working.
- ✓ Compass properly adjusted.
- ✓ Charts for the area, up to date.
- ✓ Books and publications, for example pilot or cruising guides.
- ✓ Navigation tools.

Safety Equipment

- ❖ Check all safety equipment is in date
- ✓ Heavy line with life buoy
- ✓ Fire extinguishers.
- ✓ Signal flares and other signaling devices with cur rent expiration dates.
- ✓ Life jacket suitable for each person on board, readily accessible, in good condition.
- ✓ MOB equipment and throwable flotation easily accessible to helmsperson.
- ✓ Flashlight and extra batteries.
- ✓ Horn or sound signaling device.
- ✓ Bell.
- ✓ Comprehensive first aid kit, including sunscreen, pain relievers and any special medications for the crew.
- ✓ Bailer or manual water pump
- ✓ Sufficient foul weather gear, warm clothing & safety harnesses for all crew

Vessel Equipment – General

- ✓ Anchors.
- ✓ Anchor lines in good condition ready to use, bitter end made fast.
- ✓ Boat hook.
- ✓ Mooring lines and fenders appropriate for the vessel.

Housekeeping Items

- ✓ Taps or faucets working as necessary
- ✓ Water in the tanks and also carry some extra bottled water for emergencies
- ✓ Propane gas including spare bottle, in outside locker with drain.
- ✓ Heads flushing or pumping as necessary
- ✓ Ample food and water for the voyage intended.

Rigging Checks – Sail boats

❖ Check the condition and operation of the following:
✓ Sail wardrobe for the intended voyage and conditions expected.
✓ Standing rigging, no kinks, broken strands, especially at rigging screw terminals.
✓ Rigging screws unfrozen and in good condition.
✓ Mast, boom and mast fittings.

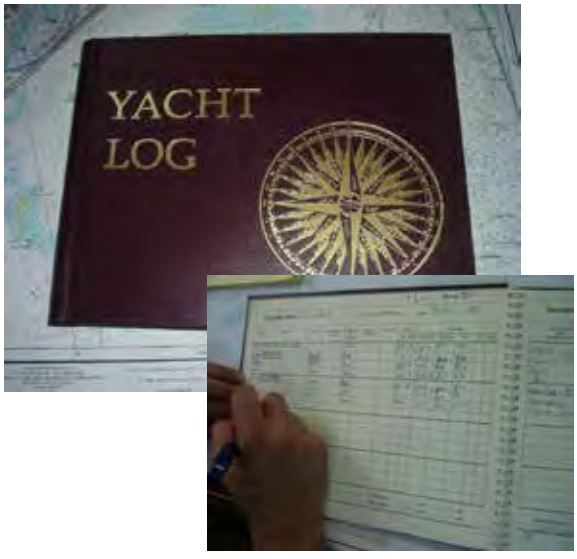
Dinghy

❖ Check the condition and operation of the Following:
✓ Stowed properly.
✓ Inflatable in working order.
✓ Paddles or oars.
✓ Outboard motor maintained and stowed properly.
✓ Spares.
✓ Safety equipment etc for dinghy.
✓ Additional fuel properly stowed

Float Plan

File a Float/Passage plan with a responsible person ashore with your intended course and estimated time of arrival and any additional information that accurately describes your vessel with instructions as to when to call for assistance.

Documents



✓ Personal papers and Passports, if required.
✓ Ship's papers registration or documentation certifi cate.
✓ Radio Station License, radio operator 's certificate or license.
✓ Crew list, with names of next of kin and contact de tails.
✓ Insurance agreements.
✓ Charter Agreement. (if applicable)
✓ Manuals for all equipment on board.
✓ Large scale charts for the area.
✓ Tidal almanac
✓ Symbols & abbreviations
✓ Cruising guide or sailing directions
✓ List of lights and radio signals
✓ Collision regulations

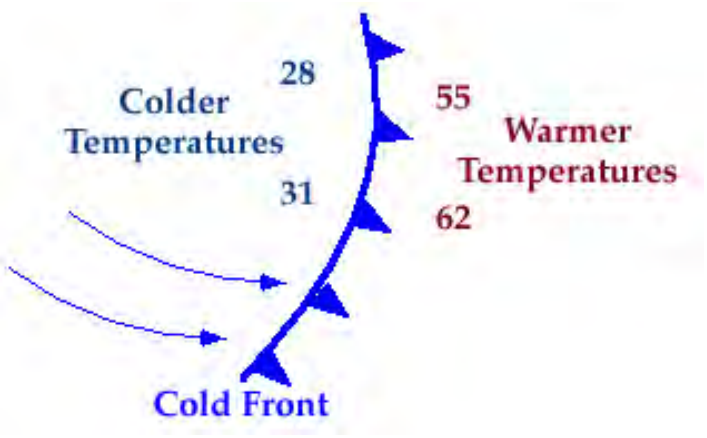
Departing the Marina or Dock

- Disconnect all power cords and water lines.
- Instruct passengers and crew to keep limbs inside the vessel when maneuvering.
- Release and stow all lazy dock lines.
- Sound proper whistle (horn) signals.
- Remove last dock lines.

- Appoint one crewmember to be the “roving fender”. If it looks like the vessel will touch the dock they should drop the fender into the gap to protect the hull. Especially keep watch on the corners of the dock. If the yacht is caught by a wind gust and blown onto the corner the impact with the corner can cause serious hull damage.
- After clearing the dock area, take in all lines and fenders; keep lines clear of the propeller.
- Proceed slowly using just enough power to maintain control whenever leaving or returning to a dock.

Remember to always consult your local maritime authority or coastguard for information on the safety equipment required for your vessel. This may vary from country to country and with the different lengths or capacity of boats.

MODULE 14 / SECTION 3
METEOROLOGY



Meteorology is the study of weather, which is caused by the movement or transfer of energy occurring with the movement of air in the atmosphere. Meteorology is a vast and very complex subject; it is worth bearing in mind that some of the most powerful computers in the world are the ones designed to assist in the forecasting of weather, such is the complexity and difficulty involved.

However, it is of great importance to all who venture out on the water to obtain a weather forecast for the duration of the proposed trip. The result of obtaining such a forecast will dictate to the mariner whether to sail or not to sail. What information is important for people on the water? Wind speed and strength, visibility and what may reduce this, rain, fog, smoke, mist, etc., Wave height, possibly temperature and sun strength.

Sources of Weather Information

There are many sources of weather information available to the mariner, some are very general and may not give the information that is important when at sea. The most useful sources for mariners will be those either from maritime organizations, for example the Coastguard or a Port Authority or direct from the government meteorological office. However all sources give an overall picture upon which to base the decision. The list below is not complete and depending on where in the world you are other sources may be available.

a) Internet
b) Radio
c) Newspapers
d) Television
e) Marina Offices
f) Port Authority Offices
g) Coastguard Organisations
h) Telephone Company recorded forecasts
i) Weather fax
j) Meteorological Office

Once the forecast has been received the decision to go or not will have to be made. If in doubt err on the side of caution and postpone the trip.

Having decided to make the passage updates can be received over the radio from Coastguard offices or Marine radio offices or via weather fax. You should plan to receive these updates on a regular basis throughout the passage, for example twice daily.

One of the most important aspects of weather is your personal observation based on your geographic position and the conditions that apply on the day. It is important to visually monitor local weather systems on a constant basis.

Weather Patterns

Air Masses

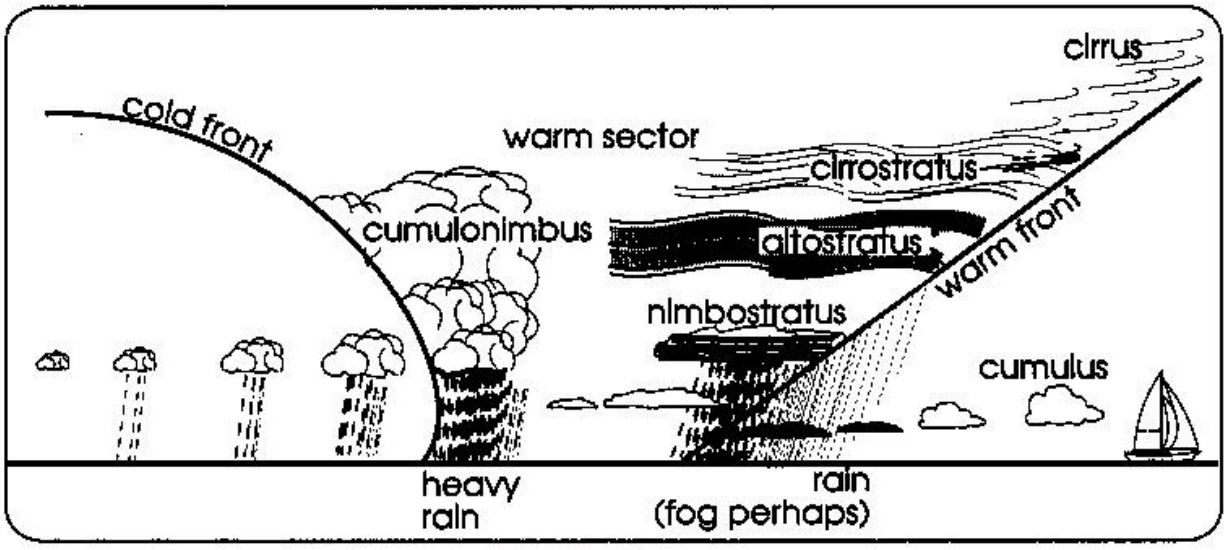
Our weather is formed mainly in the layer of the atmosphere that is called the troposphere, the first 11 miles. It is driven by the energy of the sun and the rotation of the Earth. The sun heats up the surface at different rates causing the warmer air to rise above its cooler counterparts. As this air rises, it is pushed outward by more air rising beneath it. Generally these air masses will rise in the equatorial regions and drift towards the poles. The rotation of the Earth creates what is called the Coriolis Effect, this is what causes the circular movement in weather systems. As the Earth rotates on its axis, through the poles, the surface will be moving at different rates.

To illustrate this, let us think of a person standing on the equator, the circumference of his rotation will be about 24,000 miles. To complete one rotation in 24 hours he will have to travel at about 1,000 mph. If we take another person standing about 4 miles from the North Pole, the circumference of his rotation will be 24 miles so his velocity will only be about 1 mph. The warm air spilling out towards the poles from the Equatorial region will retain this velocity, which, in the Northern Hemisphere, will cause it to be deflected to the right. So as this air descends and so creates an area of high pressure it will acquire its clockwise spin. In the Southern Hemisphere the deflection is to the left and so the rotation is counter clockwise. Therefore, low pressure systems in the Northern Hemisphere will rotate in an counter clockwise direction and in a clockwise direction in the Southern Hemisphere. Similarly, high pressure systems in the Northern Hemisphere rotate in a clockwise direction and in a counter clockwise direction in the Southern Hemisphere.

Following are diagrams showing the principle air masses that affect the weather in the U.S. As the names suggest, the polar air mass will be cold and the tropical warm, the maritime will be moist and the continental will be dry. It is the meeting and mixing of these in conjunction with the rising thermals created by the suns' energy that make up the complex energy patterns that we term weather.

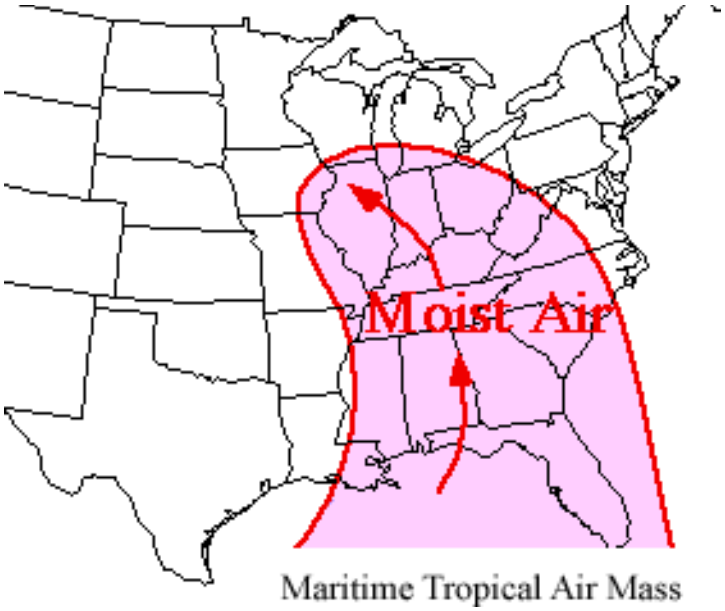
Fronts

A front is the term used to describe the dividing line between two air masses. An approaching front will often signal its arrival with a variety of discernable signals, the most visible of these are usually cloud formations, other signs will be changing wind direction / strength, visibility and temperature changes.



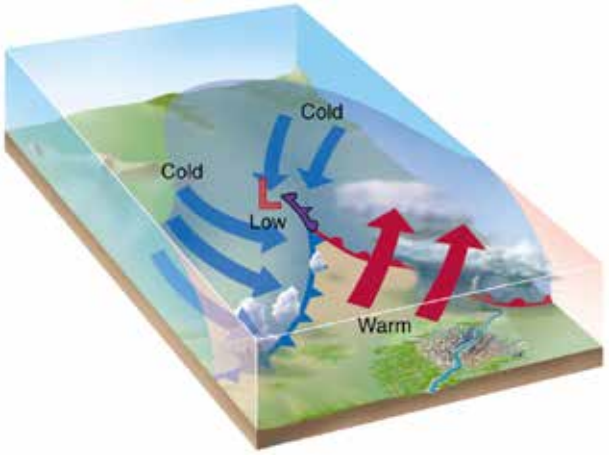
Warm Front

A warm front will tend to rise over the colder more dense air. As the warm air rises, the moisture it contains condenses into clouds, rain and drizzle. At high altitudes the leading edge of this front may extend as much as 600 miles ahead of the front at ground level. As the warm front approaches the cloud layer becomes thicker and just ahead there will often be fog along with poor visibility and rain.



Cold Front

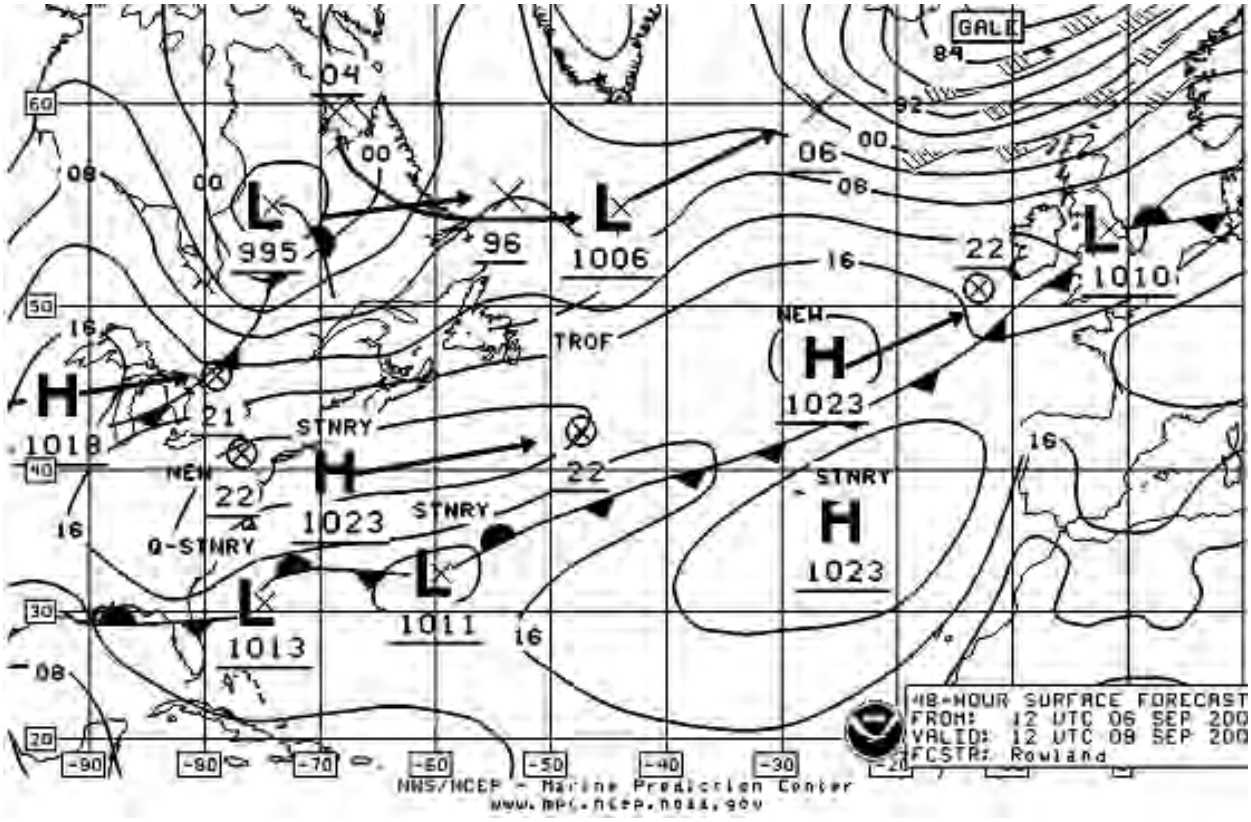
A cold front is the leading edge of a cold air mass and as the cold air is denser it will slide under the warmer air mass like a wedge. This will cause the warm air to rise, in some cases vertically, consequently, rapidly cooling the warm air. This results in heavy rain and squally conditions as the swiftly rising air sheds its moisture and heat energy.



Synoptic Chart

In the example shown, which is a chart covering the North Atlantic at 1200 UTC on the 6th of September 2000, we can see many of these features displayed.

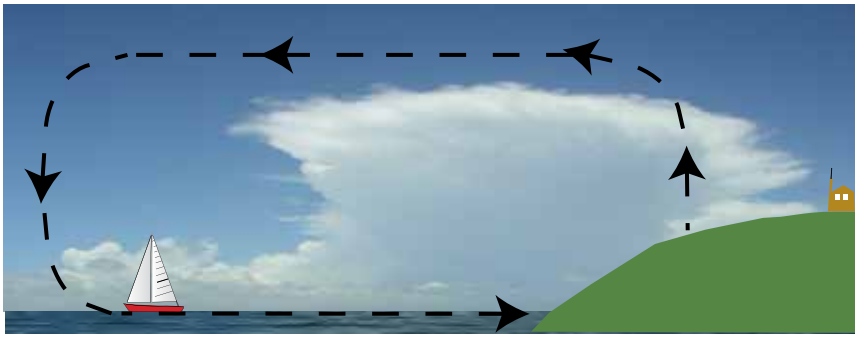
The Azores High sitting at 35ºN 25ºW is a large semi permanent feature dominating the weather in the Atlantic and is responsible for driving the ocean currents as well as having a major effect on weather patterns in Northern Europe. Stretching for over 4,000 miles from the Gulf of Mexico to Denmark we can see a front or the dividing line between the Polar and Tropical air masses. To the north of Scotland are the tightly packed isobars spiraling counter clockwise around a depression or low pressure system with a central pressure of 980mb, the wind arrows show wind speeds of 45 knots, a severe gale force 9 is raging there. Meanwhile, the widely spaced isobars over Florida suggest very little wind but the front creeping down from Georgia is bringing a lot of rain with it as it pushes the leading edge of cold air into the tropical air mass coming up from the Caribbean.



Sea Breeze

A sea breeze is a wind which blows locally from the sea towards the land during the daytime. If the land becomes heated by the sun during the day the air in contact with the land is heated and rises upwards. Cool air flows in from the sea to replace the air rising off the land and so a circulation system is set up.

Usually sea breezes begin about half a mile offshore around about 1000 to 1100 hours, reach their strongest by 1400 and have stopped by 2000. If there is no appreciable gradient wind the sea breeze will initially flow from the sea directly towards the land but as the day passes the wind will be deflected to the right and will end up blowing more or less parallel to the shore.



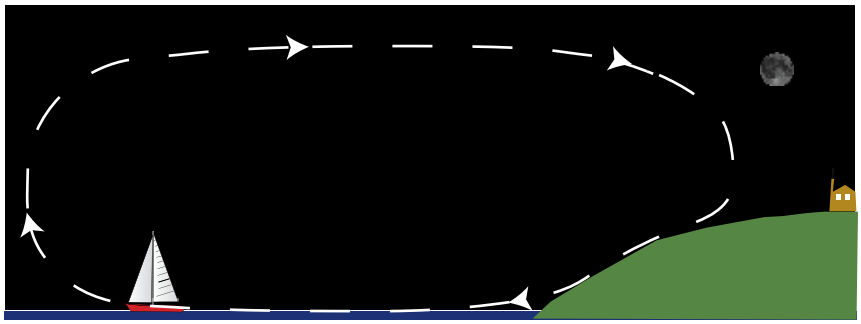
How a sea breeze is generated during the day

Sea breezes are common during weather associated with high- pressure systems. A sea breeze will modify the wind direction and strength of the gradient wind, that is the wind associated with the isobars of the prevailing weather system. Sea breezes can be as strong as force 4 and if this combines with an onshore gradient wind the overall wind will be strong.

A sea breeze will not develop if the gradient wind is 25 knots or more. If the sea breeze and the gradient wind are in opposition one may cancel out the other, giving calm conditions. Sea breezes here seldom extend more than 10 miles offshore and are strongest near the coast.

Land Breeze

How is a land breeze generated at night? At night the land cools and the air in contact with it is cooled and flows down and out to sea. Contact with the sea, which is relatively warm, heats the air which rises up and flows back towards the land where it is cooled and a circulation is set up. A land breeze starts at the land and works its way out to sea. Land breezes are not as strong as sea breezes and they are not felt as far out to sea as a sea breeze might be.



How a land breeze is generated at night

Katabatic Winds

Katabatic winds are found in many areas of the world and are usually cold winds that flow from high elevations to the valleys and planes below. A good example of this phenomenon is the 'Mistral' which blows down the Rhone Valley in S. France and out into the Mediterranean. As it funnels down the valley it can become a very strong wind and reach speeds of 80 mph or more!

Anabatic Winds

Anabatic winds occur locally when sun warmed air rises and flows up mountain slopes and valleys. More useful for hang-gliders than sailors.

Clouds

These are the visible manifestation of rising columns of warm, moist air or of parcels of saturated air, which has reached its dew point. The warmer a parcel of air is the more moisture it can carry, so as warm air rises it carries moisture that it has collected from the surface through evaporation. This rising air begins to cool, this occurs because the higher the elevation the lower the air pressure. This drop in pressure causes the parcel of air to expand, this expansion in

BEAUFORT FORCE	GENERAL DESCRIPTION	SEA STATE	WIND SPEED	WAVE HEIGHT
0	Calm	Sea like a mirror	0 - 1 kn	
1	Light air	Small ripples without foam crests	1 - 3 kn	
2	Light breeze	Small wavelets, short but more pronounced, crests glassy but do not break	4 - 6 kn	1/2 foot
3	Gentle breeze	Large wavelets, crests start to break, scattered white	7 - 10 kn	2 feet
4	Moderate breeze	Small waves becoming longer, fairly frequent white horses	11 - 16 kn	3 1/2 ft
5	Fresh breeze	Moderate waves, becoming longer. Many white horses some spray	17 - 21 kn	6 ft
6	Strong breeze	Large waves, extensive white foam crests and spray	22 - 27 kn	9 1/2 ft
7	Near gale	Sea heaps up, white foam streaks blown in wind direction	28 - 33 kn	13 1/2 ft
8	Gale	Moderately high waves, crests break off, visibility affected	34 - 40 kn	18 ft
9	Strong gale	High breaking waves, dense streaks of foam	41 - 47 kn	23 ft
10	Storm	Very high tumbling waves, sea looks white with large patches of foam, visibility badly affected.	48 - 55 kn	29 ft

turn causes the air temperature to fall. This phenomenon is called adiabatic cooling. Eventually, the air cools to a degree at which it can no longer retain all the moisture that it carries and at this point the excess moisture is condensed in the form of water vapor or clouds.

Basic cloud types

There three basic cloud types--cirrus, cumulus, and stratus.

1. **Cirrus -** Thin, white clouds, separated or detached, which have a feathery or fibrous appearance. They form at heights of 30,000 feet or more above the earth's surface. They are the highest of all clouds above the earth's surface. Cirrus clouds are formed by ice needles or spicules.
2. **Cumulus** - Flat-based, billowing clouds with vertical doming. Tops of the cumulus clouds will often have a "cauliflower-like" appearance. Cumulus clouds are most prominent during the summer months.
3. **Stratus** - Thin, sheet-like clouds, often occuring as continuous layers with some rippling. They cover large areas of the sky and are frequently thick and grey.

Cirrus Clouds

Cumulus Clouds

Stratus Clouds

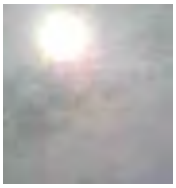
Other common cloud types

There are seven variations of these basic cloud types:

1. **Cirrostratus -** High, thin clouds that give the sky a milky-white appearance. Like cirrus clouds, cirrostra tus clouds are formed by ice needles or spicules.
2. **Cirrocumulus -** Delicate clouds appearing in bands or ripples across the sky. Cirrocumulus are among the least common of the cloud types, forming most commonly as cirrus or cirrostratus clouds degenerate. They too are often formed of ice needles or spicules.
3. **Altostratus -** Blue-gray or whitish in color and often cover large portions of the sky. Altostratus clouds are thinner if formed at higher altitudes but are heavier and more dense if closer to the ground. They too are formed by water and ice particles.
4. **Altocumulus** - Often oval or eliptical in shape and can have gray undersides. They often have a "cotton ball-like" appearance.
5. **Nimbostratus -** Often associated with steady precipitation and occur in thick, continuous layers. They are often dark gray in color. Sometimes, broken smaller nimbostratus clouds line the underside of the nimbostratus layer.
6. **Stratocumulus** - Often cover the sky in dark heavy masses. They are long and grey and often form in bands across the sky.
7. **Cumulonimbus** - Taller, towering versions of cumulus clouds. They can have heights of two to five miles. Cumulonimbus clouds often form thunderstorms.

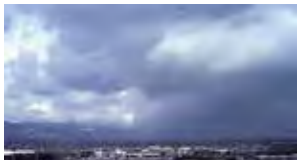
Cirrostratus

Cirrocumulus



Altostratus

Altocumulus

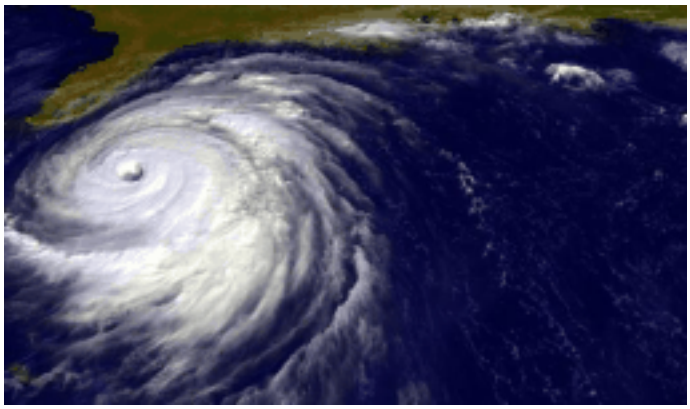


Nimbostratus

Stratocumulus

Cumulonimbus

Hurricanes, Typhoons & Cyclones



What is a hurricane, typhoon, or tropical cyclone?

The terms "hurricane" and "typhoon" are regionally specific names for a strong "tropical cyclone". A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection (i.e. thunderstorm activity) and definite cyclonic surface wind circulation.

Tropical cyclones with maximum sustained surface winds of less than 17 m/s (34 kt, 39 mph) are called "tropical depressions". Once the tropical cyclone reaches winds of at least 17 m/s (34 kt, 39 mph) they are typically called a "tropical storm" and assigned a name. If winds reach 33 m/s (64 kt, 74 mph)), then they are called:

"hurricane" (the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean east of 160E)
"typhoon" (the Northwest Pacific Ocean west of the dateline)
"severe tropical cyclone" (the Southwest Pacific Ocean west of 160E or Southeast Indian Ocean east of 90E)
"severe cyclonic storm" (the North Indian Ocean)
"tropical cyclone" (the Southwest Indian Ocean)

On the East Coast of the USA and the Caribbean the hurricane season begins June 1 and continues through to November 30. Hurricanes are tropical cyclones in which winds reach a sustained speed of at least 64 knots (74 mph – Category 1) and may gust to 175 knots or more. Their heavy bands of spiral clouds may cover an area several hundred miles in diameter and generate torrential rains and tornadoes. The "eye" or middle of the hurricane is deceptively calm, almost free of clouds, with light winds and warm temperatures.

Hurricanes are born between 8º and 20º North Latitude in the weather patterns that blow westwards across the Atlantic Ocean from the Saharan regions of North Africa. Their precise paths are difficult to predict but in general they will skirt the Southern then Western extremities of the Azores High. This is a semi permanent weather feature that dominates the weather of the North Atlantic Ocean that can be seen on the synoptic chart in the previous section. This track will bring them though the Caribbean and then northwest either into the Gulf of Mexico or further to north where they often strike the Eastern Seaboard of the US.

All of these systems gather their strength from warm bodies of water and generate energy by the release of heat as the moisture they pick up is condensed into the torrential rains that are associated with these storms. These systems will generally start to lose their ferocity if they hit a body of cold water or cross a coastline as once they are over land they are deprived of their supply of moisture. The only tactic for guaranteeing survival in a hurricane, typhoon or cyclone is to avoid them.

Tropical Wave or Disturbance: A cluster of clouds and/or thunderstorms without organized circulation.

Tropical Depression: An organized, tropical, low-pressure system with sustained winds less than 35 knots.

Tropical Storm: An organized system of strong thunderstorms with defined circulation and sustained winds of 35 to 63 knots. Tropical Storms can quickly develop into hurricanes. Storms are named where they reach Tropical Storm strength.

Hurricane: An intense tropical weather system with well defined circulation and sustained wind speed of 64 knots or greater.

Storm Surge: A large wall of water that builds up as a hurricane moves over the ocean. The surge can produce flooding up to 20 feet deep in places and can affect more than 100 miles of coastline.

Precipitation

When cloud particles become too heavy to remain suspended in the air, they will fall as precipitation, which can manifest as rain, snow, hail or sleet. Obviously, precipitation will affect any passage in terms of visibility etc. and the prudent skipper will make appropriate allowances.

Fog

Fog is basically a cloud that occurs at ground level; it is usually caused by either cold air blowing over a body of warm water or by a warm moist air-mass being pushed over a cold surface area.

Fog is defined by meteorologists as <1 kilometer of visibility. Fog is composed of droplets of water, formed when air is cooled to it's dew point,

Types of fog

- Advection fog, or sea fog, occurs when warm moist air flows over a cold sea surface. This condition is more likely to arise in the late spring, or early summer before the sea has warmed fully.
- Radiation fog, a land based fog, occurs during cold clear nights when the land radiates the heat it absorbed during the day. The cold land cools the air in contact with it causing dew to develop. If there is a breeze it will spread the cooling effect through a greater depth of air and fog may form.
  Fogs which develop on land in this way can drift out to sea. Radiation fog is most likely to occur during anticyclones in the winter months; industrial areas are especially prone to radiation fog due to the higher concentration of dust particles in the air.
- Frontal fog may occur where two air masses of different temperatures meet. If both air masses have a high moisture content fog will form at the front between them. Frontal fog will usually be less than 50 miles in width. When rain, after descending through a layer of warm air aloft, falls into a shallow layer of colder air at the earth's surface, there will be some evaporation from the warm raindrops into the colder air. Under certain conditions this will raise the water vapor content of the cold air above the saturation point and frontal (also called rain, or precipitation) fog will result.
- Arctic smoke is the name given to fog caused by extremely cold air passing over warm water.

How fog is dissipated

- If the sun warms the air enough the water droplets will be reabsorbed as water vapour and the fog will disappear. During our winter months the sun may not generate sufficient heat to clear the fog and it may remain for some days.
- Wind can clear fog by mixing the layers of air.

Fog should clear with a change of wind direction bringing air from a different source, such as occurs at the passage of a front.

MODULE 14 / SECTION 4
PILOTAGE & PASSAGE PLANNING

Pilotage may be defined as navigating a vessel in inshore waters by using marks which can be seen at sea and on land as visual references. Pilotage is quite simple. It is the proximity to land and its dangers that makes pilotage so important. In local waters pilotage is normally undertaken with very little conscious effort because you know your position by reference to well known buoys and landmarks; in other words pilotage by 'local knowledge'. However, in strange waters it will be important to work out a simple pilotage plan before arrival by collating all the information available from pilot books, charts and almanacs. Pilotage will be easier if you can write this information in a clearly understood fashion. At all costs avoid writing an essay; rather try to assemble all the information in pictorial form which is readily understood, if you can.

Books and Charts

The secret of pilotage is planning ahead. You will need:

The relevant chart(s), corrected to date.
As pilot books (also called sailing directions).
A nautical almanac (such as Reed's Nautical Almanac) for the current year.

Pilot Books

Sailing direction and pilot books contain information which will enable you to decide, for example, which approach channel to use if there is more than one option. One channel may be preferable to another when the wind is from a certain direction or when the tide is setting in a particular direction. Not all channels are marked with buoys which are lit at night or have sufficient depth of water at low tide and some channels can only be used safely with local knowledge.

NOS publishes a series of excellent United States Coast Pilots covering U.S. coastal waters at $30 each (in 2005). These pilots are available as follows:

Atlantic Coast
1. Eastport to Cape Cod
2. Cape Cod to Sandy Hook
3. Sandy Hook to Cape Henry
4. Cape Henry to Key West
5. Gulf of Mexico, Puerto Rico and Virgin Islands

Great Lakes
6. The Lakes and their Connecting Waterways.

Pacific Coast
7. California, Oregon, Washington, Hawaii.
8. Alaska - Dixon Entrance to Cape Spencer
9. Alaska - Cape Spencer to Beaufort Sea.

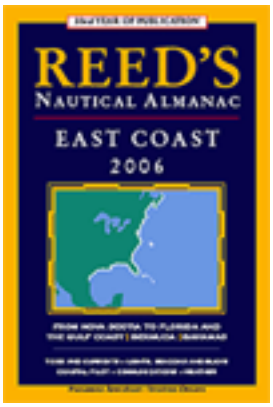
Sailing Directions

The Defense Mapping Agency publish Sailing Directions containing information on harbors, coasts, and waters of the world. Sailing Directions (Enroute) include detailed information regarding port approaches and the general coastline, mostly in written form, with a small amount of sketches, chartlets and photographs. Sailing Directions (Enroute) publication 147, for example, covers the Caribbean Sea and Bermuda.

The British Admiralty publishes Pilots covering much of the world; BA Pilots are intended for use by commercial shipping but in recent years they have included much information of use to the small boat navigator. Cruising orientated clubs in the area or country usually produces pilot books and sailing directions. For example, the Florida Cruising Directory contains advice on navigation, marinas and similar facilities.

Nautical Almanacs

There are many nautical almanacs available ranging from small, inexpensive, locally produced versions to the best known, Reed's Nautical Almanac. The local ones usually contain tide tables and various brief items of general interest. Reed's is one of the best almanacs presently available, containing many pages of valuable information. Reed's publish almanacs covering most ports on the U.S. East coast, West coast and Caribbean. There are chartlets for many harbors together with all sorts of navigation and general information such as shelter, lights, marks, VHF radio channels used, telephone numbers, town facilities, availability of fuel and water and so on. There are tidal heights and current tables for reference ports together with subordinate station differences for most areas covered by the almanac. Reed's North American East Coast Almanac cost $32 in 2005.



Eldridge, Tide and Pilot Book covers tides and currents from Boston to Miami on the East Coast and includes useful additional information; at $12 in 2005 it represents good value for money but Eldridge does not include harbor entrance chartlets.

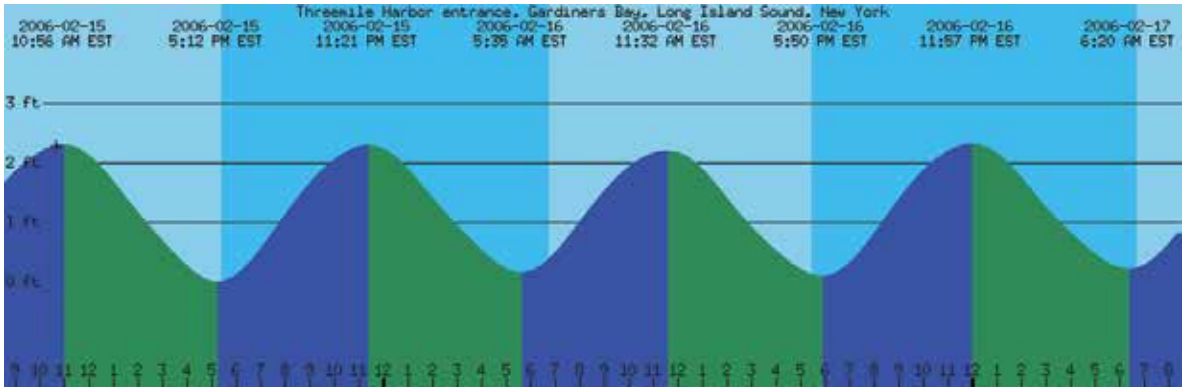
Almanacs must be replaced every year. Reed's issue corrections each year, which are mailed to you, free of charge, on request; you should fill out the request form in the almanac and keep the corrections with the almanac. Eldridge will also mail a supplement, listing changes to lights, buoys, fog signals, etc., to you on request.

Planning a passage - considerations

Suppose you are planning the pilotage for entry to a harbour which has a channel marked with some buoys. Using the pilot books in conjunction with the chart(s) you can start to plan the pilotage.

- Decide on the best channel to use from the pilot books, if there is a choice.
- Decide on a definite starting point such as a cardinal mark or buoy at the start of the channel.
- Draw the planned track on the chart from the start through to the finish, this will consist of a number of different tracks rather than a single straight line.
- Try to draw the tracks so that any turning points are clearly defined by a buoy or similar mark.
- Make sure that you have availed of all the marks that could be useful.
- If you are passing through an area requiring pilotage without stopping at a port find some way, such as a buoy or bearing, of defining clearly when you have completed the pilotage plan.
- If tidal heights are a factor draw up the tidal curve beforehand; do the same for tidal streams.
- Bearings should have variation and deviation applied so they relate to the boat's compass.
- Wherever possible use suitable ranges rather than courses to steer; it is much easier to hold a boat on a precise heading by keeping two objects in line than by steering a compass course. A boat held on a range is automatically compensating for tide, leeway, etc.

Threemile Harbor entrance, Gardiners Bay, Long Island Sound, New York
Local time: 2006-02-15 10:38 AM EST



- If you are entering a harbor note any signals used by the harbor to regulate traffic and switch your VHF to dual watch Ch 16 and the channel the harbor or marina works on. Some of the busier ports require you to call them on VHF to obtain permission to enter; check in the almanac.
- Try to put all this information in an easily understood and quickly accessed pictorial form.

Routine for navigating a vessel on a coastal passage

- Stick to your pilotage plan, don't take short cuts. The area will often appear to be very different to the picture you have built up in your mind - this is why you drew up the pilotage plan.
- Start at the first mark and clearly identify it to be sure it is the right one.
- Check the identity of each mark as you pass it and mark it off on your pilotage plan.
- Do not assume that the mark ahead is the next one, check its bearing against your notes.
- As soon as you change course and are pointing at the next mark pick any fixed object, or shore light, directly in line with the mark to use as a range to steer by. The object does not have to be on the chart, but it must be fixed.
- Keep a wary eye on the depth sounder, the depth may show any gross error in your pilotage.
- Set the depth sounder's shallow alarm, if it has one, to a sensible safety margin.
- It is usually best for someone other than you to helm, leaving you free to concentrate on the pilotage.
- Make sure that your instructions to the helmsman, or helmswoman, are clear and un ambiguous. Don't give vague orders like "steer for that light", rather pick a suitable range and make sure that whoever is on the helm understands your wishes.

Port Control

When approaching a harbor switch your VHF to dual watch the port working channel and check whether it is obligatory to contact the port authority. If it is, contact them and ask for their instructions or permission to enter.

Lock Gates and Marinas

If there are lock gates or a sill at the entrance to the harbor or marina check whether you can go directly in or will have to wait. If you must wait find out from the almanac where you can tie up, moor, or anchor. If a marina is your final stop call them on their working channel and arrange your berth together with directions if needed. At the same time ask the marina which side you should place your fenders in order to avoid having to change them all around at the last minute. If you need a hand to berth ask for assistance from the berthing master on the pontoon. Check in with the harbor master's office or marina office as soon as practicable to complete their forms.

Customs, Immigration & Crew Lists

Every vessel is required by law to clear customs and immigration upon entry into a foreign port. Just as one would do on arrival at any international airport. Customs forms will be provided by the customs officials at the port you are visiting. It is important to bring your vessel's documentation and registration ashore when clearing customs.

The master of every boat must furnish Immigration with a list of passengers and a crew list upon arrival. The vessels crew list should consist of name, nationality, passport number and date of birth of each crew member.

Fees for both customs and immigration authorities are usually charged in the local currency which you should plan to have in advance.

Cruising permits may also be required in many countries to cruise their territorial waters. A fee will also be charged for the permit.

MODULE 14 / SECTION 5
VESSEL HANDLING

Anchoring, Mooring and Man Overboard (MOB)

Note: Although many anchors described below are found on larger vessels a good understanding of the various types and their applications is appropriate to all module levels. The anchoring techniques do apply to all vessels.

Types of Anchors

There are a number of different types of anchor; each has its own advantages and disadvantages. The principle types are:
(a) Fisherman/Admiralty anchor
(b) CQR/Plough anchor
(c) Danforth anchor
(d) Bruce anchor
(e) Grapnel anchor (folding type). Some manufacturers produce their own "improved " versions based on these basic types.

Fisherman

Fisherman/Admiralty
The traditional type of anchor is sometimes known as an Admiralty Pattern anchor.
Advantages

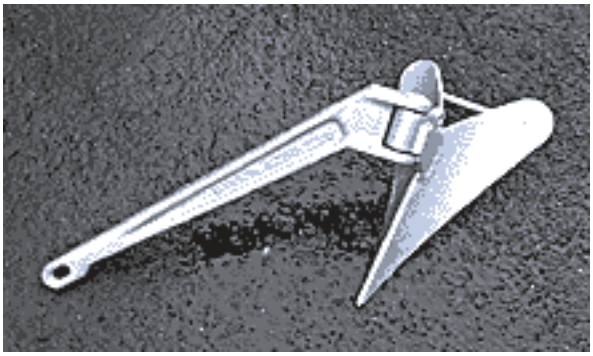
1. Can be stowed flat.
2. Good holding power in sand and mud.
3. Few moving parts to get fouled up.

Disadvantages

1. A heavier anchor needed than some other types to give equal holding power.
2. When stowed on deck, the flukes can do damage in heavy seas unless well secured.
3. Because there is a vertical fluke when it is on the seabed, there is a possibility of the anchor chain or warp fouling this, or the boat settling on it.

CQR/Plough Type

The CQR is a proprietary type of anchor as shown in (b). It is also called a plough. Copying manufacturers' versions are sometimes of inferior quality.



CQR/Plough

Advantages

1. Holds well in soft sand and mud.
2. Lighter anchor required than a Fisherman to give equal holding power.
3. Usually digs in well.

Disadvantages

1. There may be stowage difficulties, and special chocks are needed to secure it unless fitted over the bow roller.

2. Movable parts can become fouled and damage the fingers.
3. Can capsize.
4. Can be difficult to break out of mud unless a tripping line is used.
5. Does not hold too well in kelp or hard sand.

Delta

Delta Anchor

A fixed version of the Plough. Easy to stow in bow roller

Danforth Anchor

The Danforth is a flat twin fluke anchor with the stock built into the head.

Advantages
1. Good holding power in sand and mud.
2. Less weight needed to equal holding power compared with a Fisherman but about equal to a CQR.
3. Can be stowed flat.

Disadvantages
1. Movable parts can become fouled and can damage fingers.
2. Not too good in rock.
3. Can be difficult to break out of mud unless a tripping line is used.

Danforth

Danforth

Bruce Anchor

Advantages

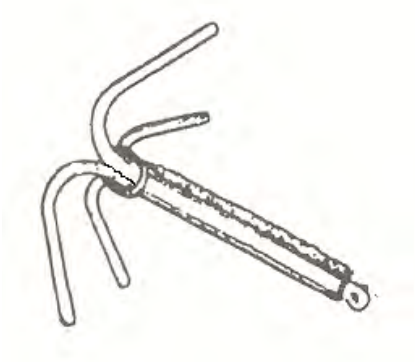
1. A much lighter anchor needed to equal the holding power of the other types.
2. No movable parts.
3. Digs well into the seabed however it lies, and quickly buries itself.
4. Good holding power in sand and mud.
5. Easy to break out.

Bruce

Bruce

Disadvantages

1. Difficult to stow without a special chock which, due to lack of space on the fore-deck, cannot always be fitted. It can, however, be stowed over the bow roller if well secured.



Grapnel

Grapnel Anchor

A good holding anchor on coral and rock and useful to use as a kedge.

Kedge Anchor

A more portable smaller anchor of any appropriate type used for anchoring temporarily, for emergencies such as help to re-float after going aground, as a stern anchor or for assisting the main anchor.

Anchoring

Anchors hold best in soft bottoms such as sand and mud, but will hold in hard sand, shingle or pebbles. Smooth rock and weed are not good holding. The Fisherman is probably the best for holding in rock. It is best to carry two main anchors of different types, and a kedge.

Whichever type of anchor is used, to hold the vessel without dragging, a horizontal pull along the seabed must be created. This requires the correct amount of scope; at least 5 times the maximum depth of water for chain and at least 7 times the maximum depth for warp. **Scope** is defined as the ratio of length of anchor line in use to the vertical distance from the bow of the vessel to the bottom of the water. Larger boats generally carry all chain while smaller boats are more likely to carry a short length of chain attached to a nylon warp. The anchor line is called **"rode".** The rode may be line (nylon warp or fiber rope), chain, wire rope or a combination of line or wire rope and chain.

The advantages and disadvantages of both are listed below:

Anchor Chain

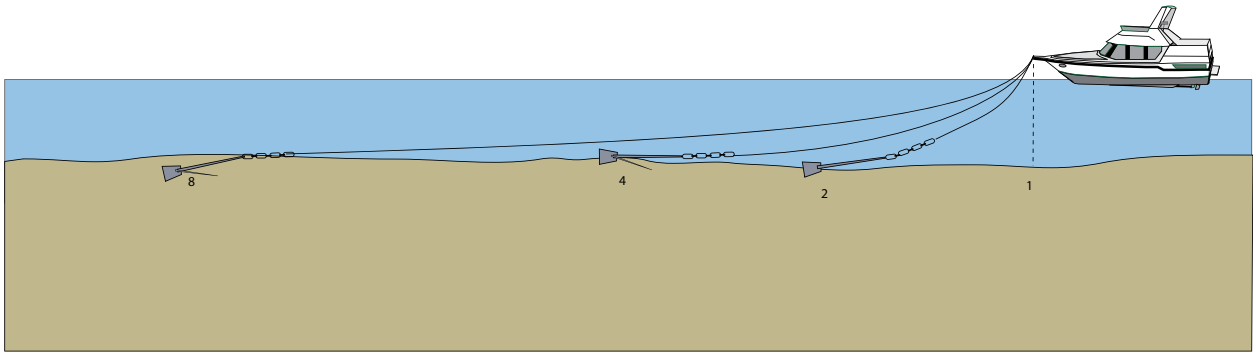
1. The heavier weight gives better horizontal pull.
2. The weight of chain increases the catenary, which reduces the chances of snatching when anchored in rough seas.
3. All chain rode is very heavy.

4. Chain is harder to handle and needs a chain gypsy on the anchor windlass.

Anchor Chain and Anchor Warp
1. Even the short length of chain helps the horizontal pull on the anchor.
2. The elasticity of the nylon warp helps to reduce snatching when anchored in rough seas.
3. Chain and warp is lighter.
4. Warp is easier to handle.

Scope

Scope is defined as the ratio of length of anchor line in use to the vertical distance from the bow of the vessel to the bottom of the water. The scope of chain or nylon warp will vary with conditions, the type of anchor and size and type of boat but, if the anchor is dragging, more should be let out. Whether chain or nylon warp is used, both ends must be made fast securely. The inboard end should be lashed with a light line so that it can be quickly released, by cutting if necessary. At the anchor, shackles should be fastened with stainless steel wire (moused) to stop the pin turning. Nylon warps should be attached either with a fisherman's bend or with a hard eye spliced in the line (around a metal thimble), fastened with a moused shackle.



Fouled Anchor

If the seabed is covered with spoil and debris the anchor can become fouled. A trip line can save the ground tackle and before deployment it should be fastened to the anchor so that the crown can pull it up. There is a hole or ring on most anchors for the attachment of such a line. The other end of the line may be attached to a small buoy (which has the advantage of marking the position of your anchor) or led back to the boat and secured on board (a longer line is required if the latter method is used, but it avoids the danger of the buoy becoming a hazard to other boats).

Anchoring

It is important to make clear that it is not the anchor alone that holds the yacht in place but the combined effect of both anchor and chain. The anchor fixes the chain to the seabed and the weight of the chain and the friction of it on the seabed hold the yacht in place. One of the most important considerations is the depth of water and one must remember that it will change according to the tide. The procedure requires a minimum of two people, one to work the anchor gear and the second to steer the vessel.

Setting the Anchor.
- ✓ Do not anchor in prohibited areas, for example where there are submarine cables, these will be marked on the chart.
- ✓ Having established the depth of water at high tide in the location you wish to anchor you will prepare to lay out your anchor and chain. Under average conditions you will need to lay out five times the maximum depth if you are using all chain or eight times if you are using a mixture of rope and chain. In light

conditions this can be less and if you are expecting it to be rough then lay down more.

- ✓ First examine the way yachts on the other moorings are lying this will help you evaluate the best place to anchor. Yachts will either be lying head to wind called wind rode or if the current is stronger heading into the current called current rode.
- ✓ If the anchorage is crowded it is best to plan to anchor among vessels that are similar to your own, power boats and sailing boats have different characteristics in the way they lie at anchor and it best to swing with a similar group of vessels.
- ✓ Remember the yacht will swing on its anchor so you need room between you and other vessels to allow your yacht to possibly swing through 360 degrees.
  Go forward from the point where you wish your vessel to finally lie by slightly less the length of the chain you intend to use.
- ✓ Let the effect of the wind or current on your vessel bring you to a virtual stop. Make a visual note of this spot.
- ✓ Let the anchor go, your chain should be marked to show the length of chain let out and when the anchor hits the bottom the chain will slacken momentarily.
- ✓ Once the anchor is on the bottom go astern slowly and at the same time pay out the anchor until you reach the length you decided to use.
- ✓ At this point when you stop paying out the anchor chain will become taught and run forward from the vessel at a shallow angle, close to horizontal.
- ✓ You should feel the vessel slow as the chain becomes taught, take the engine out of gear and the boat should pull back forwards until the chain is hanging close to vertical from the bow.
- ✓ Once the yacht has settled, after a short while take compass bearings off objects that you can clearly define, or take a reading from the GPS if fitted.
- ✓ Repeat the last process after a period of time, the figures should match reasonably closely. Even if the yacht turns with the wind or current to head in a different direction these bearings should remain constant.
- ✓ If there are large changes in the bearing the anchor is dragging and will have to be reset.

Man Overboard Procedure. (Sail)

In the event of a man being lost over the side the process discussed above must be followed. It may be necessary to carry out the process under sail and it is important to know how to do this in a prompt and efficient manner.

- ✓ Call “Man Overboard”
- ✓ A spotter is appointed, remember their sole job is to keep an eye on the man in the water at all times; they should do nothing else.
- ✓ Throw anything that floats towards the man, not only to help them float but also to increase the target area for the helmsman.
- ✓ Immediately the helmsman will bring the boat onto a beam reach, one rea son is that this is because it is the most comfortable and controllable point of sail.
- ✓ The helmsman or skipper should reas sure the crew.
- ✓ After running off for somewhere between five and ten boat lengths the boat should tack.
  DO NOT GYBE

Photos by John Rousmaniere and Phil Cowley

THE BOAT, this is a stressful time and a moment's inattention could cause a violent gybe that might cause damage to the boat or even cause another per son to be taken off the deck by the boom mak ing the situation much worse.

Photos by John Rousmaniere and Phil Cowley

- ✓ Come back onto a beam reach on the other tack, this is the other reason for going onto a beam reach after tacking the boat will be on a reciprocal course.
- ✓ Head slightly down wind of the man by approximately two boat lengths, he will be vis ible on the bow.
- ✓ Keep the yacht de-pow ered to avoid building too much speed and as the boat comes be low the man turn up to windward and the boat will stall and come to a stop with the man on the windward side.
- ✓ The sails will be flap ping around at this time if possible drop the sails.
- ✓ If the yacht has a "lifes ling" this should be trailed so the man can catch it otherwise one crewmember should prepare a line with a large bowline so that the man can pass it around his body.

Photos by John Rousmaniere and Phil Cowley

- ✓ Do not put another person in the water unless the first person is unconscious the second person must be roped onto the boat.
- ✓ Getting the man back onto the deck is another issue, some modern yachts have a boarding ladder on the "sugar scoop" at the stern which is easy in light weather, however in a heavy swell this could be dangerous as the yacht may rise and fall a substantial distance.

MOB (Power)

This most effective technique should someone fall overboard on a power driven vessel is called the Williamson Turn; the procedure is as follows:

- ✓ Shout Man Overboard and throw over the side any life-rings or flotation aids.
- ✓ Appoint one of the crew to keep a good lookout on the person in the water. This person should do nothing else.
- ✓ Look at the compass for the course you were steering when the person fell.
- ✓ Put the wheel hard over towards the side where the person fell. This will take the stern of the vessel and the propellers away from the person in the water.
- ✓ Turn to about 60 to 70 degrees from your course and then put the wheel hard over to the other side.
- ✓ Come back on to the reciprocal of your original course. For example if you were steering 105 degrees then you would come back onto 285 degrees this will put you on course straight back towards the person.
- ✓ When you reach the person in the water stop the engines so they can be recovered safely.

Note: Under instruction, the candidate will demonstrate good practical understanding and application of MOB procedures.

Photos by John Rousmaniere and Phil Cowley

Boat handling under power

A sailing vessel under the power of its auxiliary engine behaves fundamentally the same as a single engine power vessel. There are some differences in how the vessel responds due mainly to the effect of the deeper keel on sailing yachts compared to most power vessels.

Most propellers on yachts are "right hand" that is to say, they turn clockwise when seen from astern. This will have the effect of swinging the stern to starboard and the bow to port when going ahead. When going astern the opposite happens the stern swings to port and the bow to starboard. Additionally when going astern the flow of water over the rudder created by the propeller is less efficient and thus will effect the yachts responsiveness to the helm this also means that the vessel will be more susceptible to the "paddle-wheel" or **"transverse thrust"** effect when going astern.

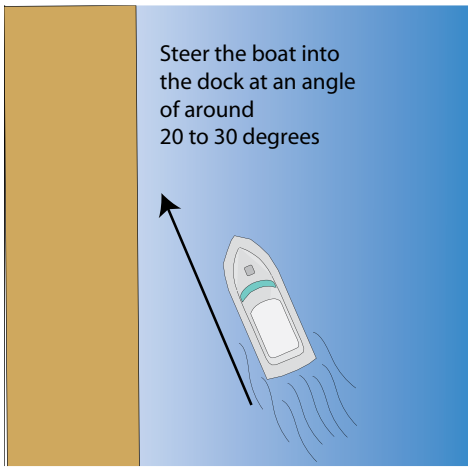
The effects of wind tide and current will also influence power driven vessels. Many power cruisers have quite substantial superstructures, and shallow draughts meaning little lateral resistance under the water. Wind pressure on these can act as virtual sails and cause the yacht to be blown off course. The same effect can happen to sailing yachts with their sails completely furled there is still pressure on the rig that can push the yacht off course. If going upwind the wind can act on the bow of the vessel and cause it to change direction. Likewise the flow of the tide and currents will need to be considered when holding a course. Both in terms of the leeway caused and also the effect on the vessel's speed through the water.

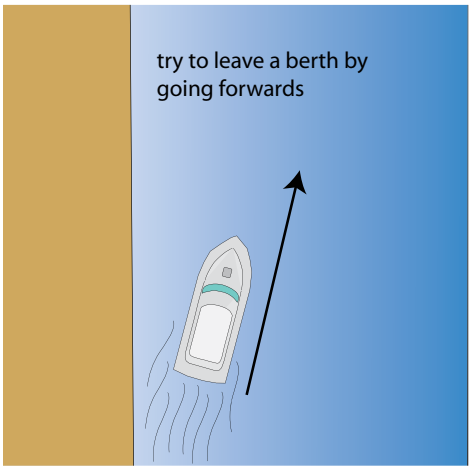
Another point to be aware of is that a vessel has no brakes, its momentum can carry it quite a long way, the only way to slow it down is to engage reverse if one is going forward and vice versa.

When maneuvering a vessel under power particularly in confined spaces we need to keep all of the above in mind. For example, assuming a right hand propeller, it is best to make a right hand turn to maximize the effect of the propeller.

Coming Alongside (wharf or dock)

Aim the yacht into the dock at an angle of around 20 to 30 degrees with just sufficient way on the vessel to have good control. When the bow is close to the wharf put the engine in neutral and then reverse, as this is done it will have the twofold effect of stopping the boat and the reverse thrust will tuck the stern in neatly alongside. Have your mooring line prepared in advance and crewmember designated to step ashore and tie up the vessel. Where there are mooring lines attached to the dock it may be easier to have the crewmembers who step on to the dock pass those lines to people on deck.





Clearing (wharf or dock)

Whenever possible you should try to leave a berth by going forwards though this will always be dependant on the wind and current at the time. The order in which you untie your mooring lines is dependant on the wind and current. If the wind is coming from ahead or off the dock hold the yacht on the after spring to stop her drifting back onto any vessel astern, the wind will take the bow out and once clear one can leave the dock. Conversely if the wind or current is astern one will swing out on the bow spring until the stern is clear and then one can go astern to clear the berth.

Multiple Engines.

If a boat is fitted with multiple engines one will be less concerned with the “paddle wheel” effect. This is because the propellers will be arranged so they turn in opposite directions. One will not need to use the wheels as much and one can steer the vessel by using the balance between the engines. The vessel can often be turned in its own length by having one engine ahead and the other astern.

When running under normal operating conditions it is important to ensure that the thrust from the engines is balanced. This will produce a very neutral helm where very little or no rudder angle is required to keep the vessel on course. This has the added benefit of minimizing friction and giving the best fuel consumption. The best way to ensure engine balance is to run the engines at the exact same RPM (revolutions per minute).

Power vessels are often fitted with “trim tabs” these flaps on the stern of the boat are designed to help the boat run level. As increasing amounts of power are fed into the vessel the bow will rise. This is necessary so that the vessel will eventually start to plane, that is to skim on the surface of the water rather than pushing through it. However the vessel can become unstable with the bow riding high by applying the trim tabs the bow will be forced down and the vessel will run flat on the water. The trim tabs should also be adjusted to keep the vessel level in the port / starboard plane as well.

When slowing a vessel and coming down off the plane this should be done gradually otherwise the vessels stern wave will can be traveling very much faster than the boat and will rise up and swamp the stern. If the vessel must be stopped quickly in an emergency turn the boat through ninety degrees as the power is cut, the motion will be unpleasant but at least the risk of taking on water and being swamped will be minimized.

Alongside

Generally a yacht will be kept in a Marina, which, depending on size, may have spaces for a few boats or thousands of boats. When tied up to a dock there will be a number of lines securing the vessel "alongside". These are known as **"mooring lines"**. The lines will be attached to secure points on the dock called **"cleats"** and lead through special fittings with smooth edges on the vessel known as **"fairleads"**. These are designed to prevent fraying or **"chafing"** and are secured to the vessel's cleats.

Deck Equipment and Fittings

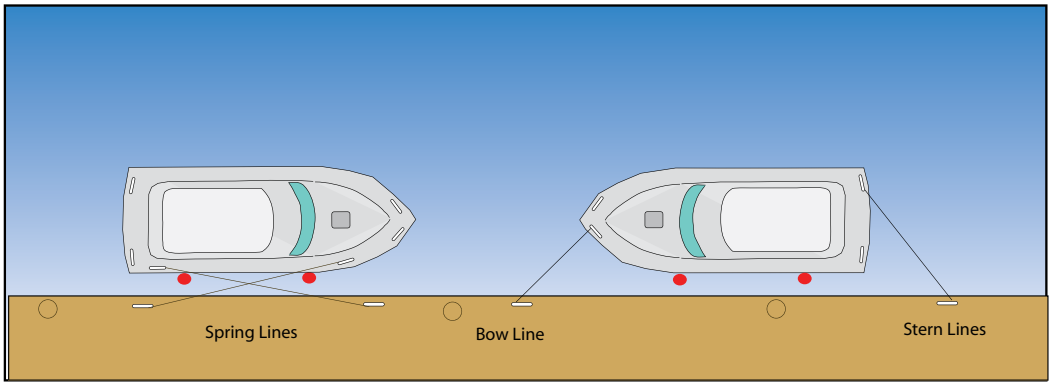
The docking lines required to secure a vessel properly are:

1. Bow line. A line that is lead forward from the bow of the boat.
2. Stern line. A line that is lead aft from the stern of the boat.
3. Spring lines One line leads from the bow of the vessel aft of midships to the dock and one from the stern of the vessel lead forward of midships to the dock. These stop the boat moving fore and aft and should be taut.

Cleat

Fairlead

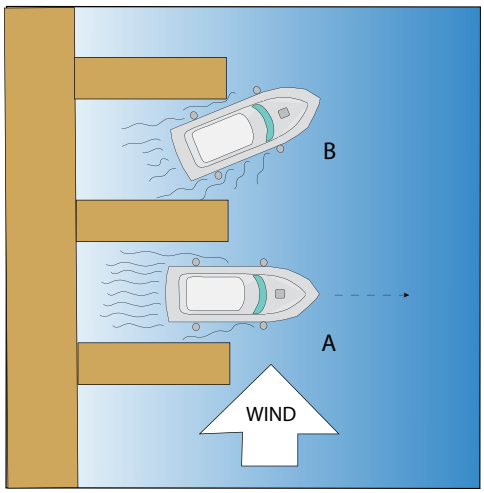
Dock Cleat



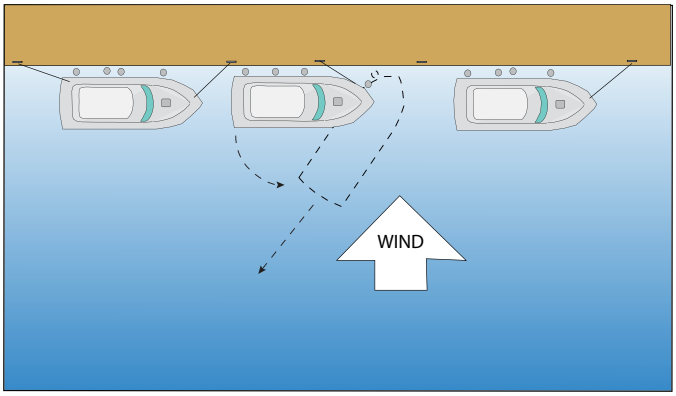
Handling Skills

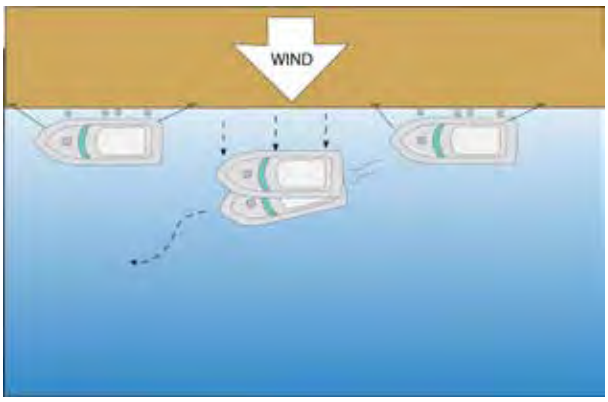
Departure From a Dock

Before departing make sure the engine is running smoothly. In this instance with a cross wind, the vessel must be given enough power to exit the dock quickly (Boat A), or else the wind will blow the boat on to the dock (Boat B). Remove the spring lines, slip bow and stern lines together.



With a wind blowing the vessel onto the dock, slip all lines except the forward spring, power gently ahead to kick the stern out. Slip the spring and motor astern into the channel.





With the wind blowing the vessel off the dock, slip all lines except the stern line. The bow will be blown out into the channel. When clear, the stern line can be slipped.

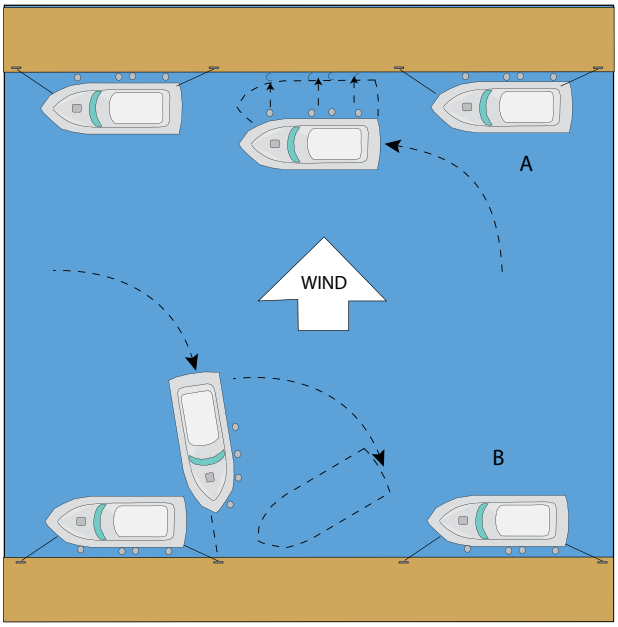
Arrival at a Dock

Always have lines and fenders prepared.

In situation A, the vessel is positioned in the gap by nosing into the space and allowing the wind to push the vessel alongside.

In situation B, with the vessel being blown off the dock, approach the dock bow first, attach a bowline and with the rudder/engine to port, gently go astern which will gradually pull the stern into the dock.

Candidate will demonstrate good and safe practical application of vessel handling covered above.



MODULE 15 / SECTION 1
VESSEL CHECK OUT
Practical Subject

A series of checks should be carried out prior to every trip or voyage. It is important to know that the vessel and her equipment are in good order and everything is working properly. It is also a good opportunity to use the checks as a way to introduce the location of equipment and safety gear to new crew and as a reminder to those who have been on board before.

Refer to the outline suggested in the theory module 14, section 2 an apply practically. It is prudent to compile your own checklists specifically for you own boating needs and for your vessel.

Tool Kit

First Aid Kit

Manual Bilge Pump

Air Horn

Through Hull Fitting

Spares

Foul Weather Gear

Air Filter

Compass

Handheld VHF

Twin Outboard Engines

MODULE 15 / SECTION 2
RESPONSIBILITIES OF THE SKIPPER
Practical Subject

Communication with Crew

The skipper is responsible at all times for operation and safety of the vessel and the crew, even when asleep or down below. This is especially important in bad weather or if the boat is in jeopardy. It is important that the skipper clearly informs each crew member of each of their duties while they are on board. As skipper you should have a plan for every eventuality and be able to express you requests in such a way that there is no misunderstanding. There is no need to shout nor should there be a need to say "please" all the time; a brief order is all that is needed provided you have a plan and have explained to the crew what is expected of each of them well in advance.

The crew must respond to instructions and commands quickly and efficiently.

Delegation to Crew

Depending upon the length of voyage the skipper will need to set up a watch system. For a short day trip this is not really needed, as long as there is always someone on the helm steering and another keeping a good lookout. It is essential to log your progress in a Navigational Logbook and on a chart at regular intervals.

For longer trips a watch system will need to be set up to allow adequate rest for the crew and the skipper. The allocation of duties will depend upon the size and experience of the crew. In addition to the above duties there will be a need for preparation of meals and general housekeeping whilst on passage as well a general maintenance and repairs as needed.

MODULE 15 / SECTION 3
SEAMANSHIP
Practical Subject

General Deckwork
Candidate will demonstrate safe and seamanlike handling of lines, fenders, winches, capstans etc. and show competence in all aspects of deckwork as well as effective movement in carrying out necessary tasks.

Ropes, Knots & Splices (and their care / use)
Please note that much of this section will have been covered in previous modules.

Under instruction, candidate will demonstrate proper use and appropriate application of the following knots and bends.

Ropes are used for a number of purposes on board a vessel, particularly on a sailing vessel. There are a number of different types of rope, each will be used for a different purpose.

Ropes can be expensive to buy but will last a long time if looked after properly. If the rope has been stored badly, it will be weakened and it will deteriorate in use. Misuse and incorrect handling will hasten this process. Contact with chemicals, gasoline/petrol, paint etc. will cause serious damage to ropes, in time salt water will also have an adverse effect on them. Man made fiber ropes are badly affected by ultra-violet radiation and require protection from direct tropical sunlight. Ropes should be inspected and condemned if there are obvious defects such as broken strands, kinks or signs of rot.

Ropes should regularly be taken ashore and washed in fresh water and dried. Salt crystals harden the rope and their abrasive action shortens the life of the rope.

Coiling a Line
Ropes and lines should always be coiled neatly so that they are easy to access and use when needed quickly. Properly coiled lines allow the rope to run freely and not become kinked; it is also more easily stowed.

With stranded rope always coil with the lay, and for the more common right lay rope, this will be by coiling clockwise using a slight twist about half a turn, in the direction of lay as each coil is formed. When coiling a braided rope which has no lay less twist must be used.

Securing to a Cleat

The rope should be lead to the back of the cleat and a full turn taken around the base. This will hold the load. The second step is to make two figure of eight turns around the cleat finishing with another full turn around the base of the cleat. The general rule for securing a line to a cleat is "nearest side, furthest point, one round turn."

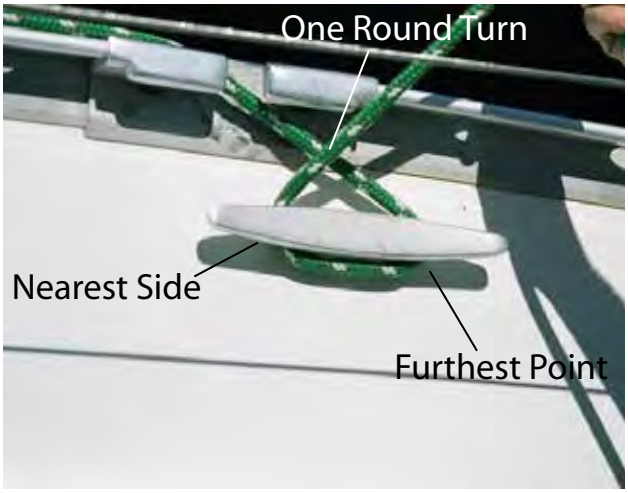
1

2

3

4

5



Knots

The correct selection of the right type of knot, bend, or hitch for any job is essential to prevent it undoing as well as having the ability to be readily untied when required. Knots, Bends, and Hitches are all ways of fastening one or more ropes together or for attaching a rope to an object such as a spar or ring.

The following selection of knots, bends and hitches and their purpose are adequate for most requirements on a yacht.

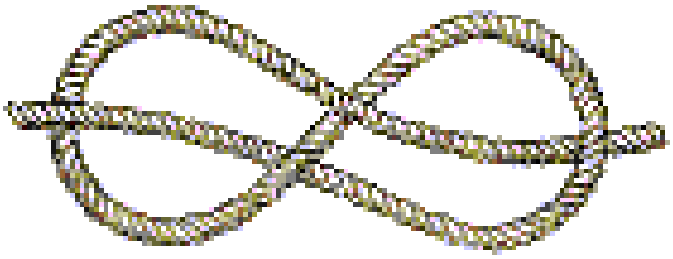
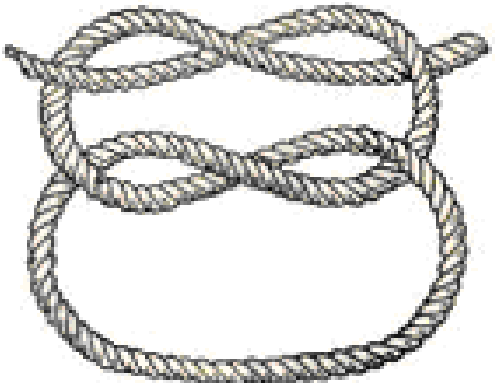
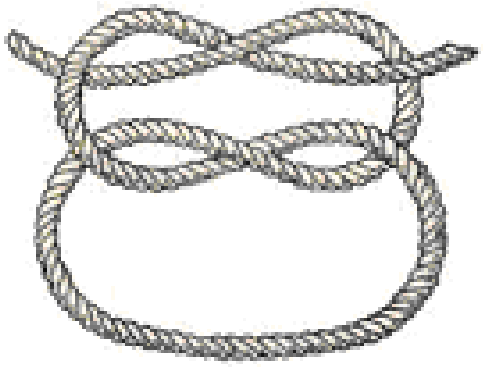


Figure of Eight is a stopper knot used to prevent the end of a rope running out through a block or fairlead. It is easy to undo and is mostly used on the ends of sheets, halyards and deck lines.

Reef Knot is used mainly for fastening reef ties when shortening sail. Because it will undo easily if the load is not constant it should never be used to join two ropes together, especially if the two ropes are of different diameters. A better knot to join two ropes is the "sheet bend' or "double sheet bend" described below. An improperly tied reef knot is known as a "granny knot".

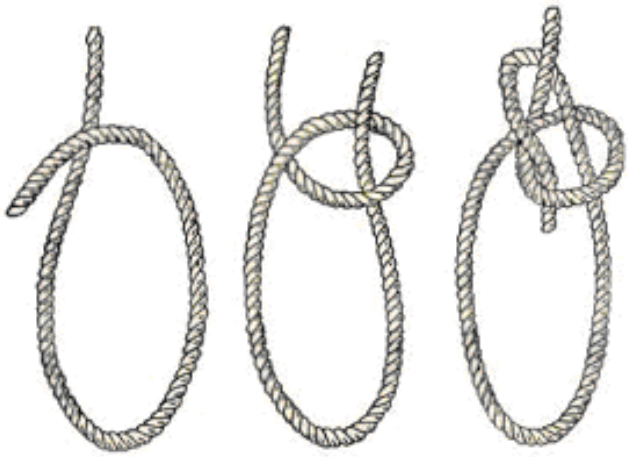


Granny Knot



Reef or Square Knot

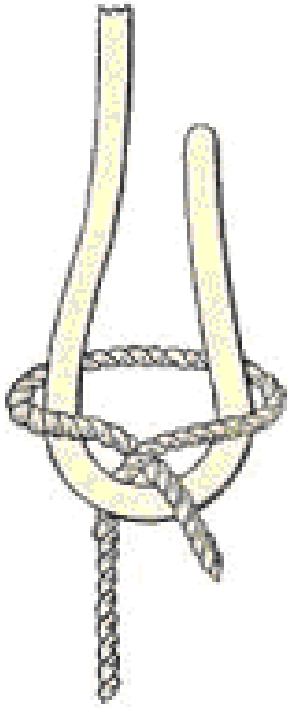
Bowline creates a fixed loop in the end of a rope. It is a secure knot that is unlikely to slip or untie itself, and has the advantage of being relatively easy to untie even after being under load. Used for a number of applications such as creating a loop in a dock line of for attaching sheets to a headsail.



Bowline

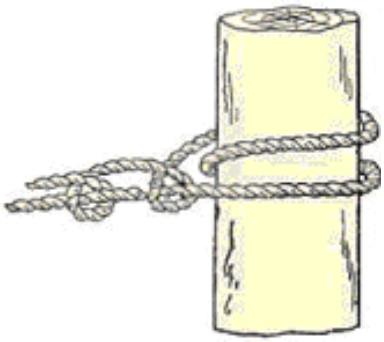
Sheet Bend is used to join together 2 ropes.

Double Sheet Bend is used to join together 2 ropes but is more secure and works better if there is a difference in the thickness of the two ropes.



Sheet Bend

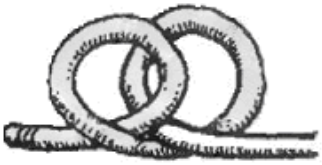
Sheet Bend

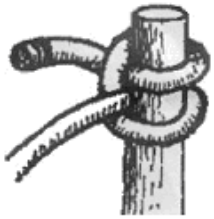


Round Turn and Two Half Hitches

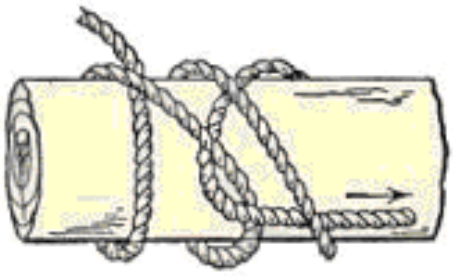
Round Turn and Two Half Hitches is mainly used for securing to a post or ring. The round turn creates friction, which allows the load to be held while the 2 half hitches are made.

Clove Hitch may be difficult to untie after being under heavy load and is usually used for tying the painter of a dinghy to a bollard or attaching fenders to lifelines.





Clove Hitch

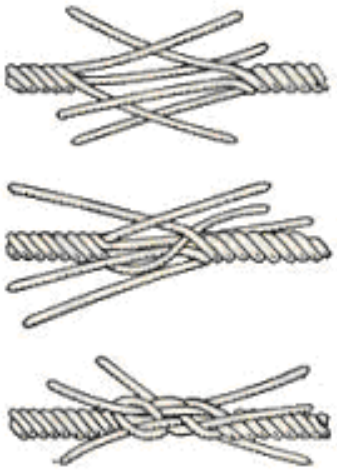


Rolling Hitch

Rolling Hitch is used for a number of purposes where a load on one rope needs to be transferred to another, for example when load need to be taken off a winch with an overriding turn.

Whipping and splicing

Loops or “eyes” may be formed in a rope by means of an “eye splice”. To protect the ends of ropes and to prevent them fraying a “whipping” is applied. These topics will be covered in future modules.



Short Splice

Whipping

MODULE 16 / SECTION 1
TIDES AND CURRENTS

Tides

The navigator requires a detailed knowledge and understanding of tides in order that they may be used to help in making a safe and secure passage. Tides have two significant effects for the navigator, and these change constantly. They are depth of water and the speed of horizontal flow.

In most places there are two tidal cycles every day, comprising two high tides and two low tides, and this phenomenon is known as a semi diurnal tide. A few places have only a single tidal cycle each day, this is known as a diurnal tide. Still fewer places have a combination known as mixed tides.

Tides are the vertical rise and fall in the sea level brought about by the movement of the earth, moon and sun and the effect of the gravitational attraction between these bodies. In effect the combined gravitational pull of the sun and moon causes a "tidal wave" to revolve around the earth. Tides originate in the open waters of the earth's seas and oceans, but are only noticeable and significant close to shore.

Tidal currents are the horizontal flow of water that result from the "tidal wave" meeting landmasses and shallow areas and are easily observed along beaches, bays and sounds and up rivers.

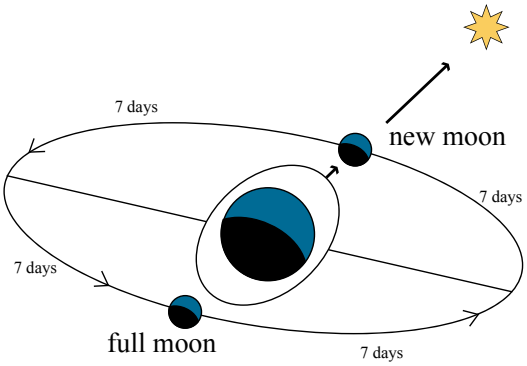
Cause of tides and currents

Tides result from the differences between centrifugal forces and gravitational forces of mainly the moon and earth. (However to a lesser extent the sun also exerts gravitational pull). Although the mass of the moon is only a tiny fraction of that of the sun, it is much closer to the earth and its pull is about twice as powerful. As a result, tides are mainly lunar.

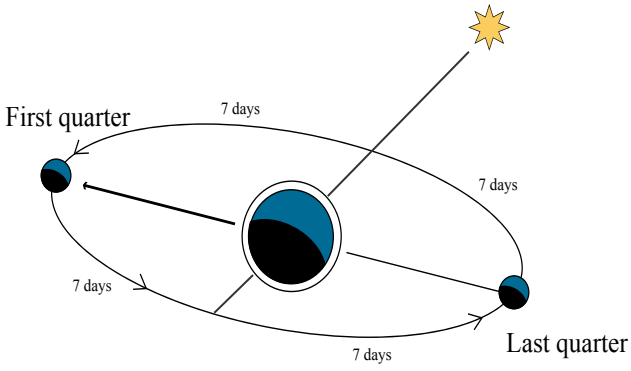
This gravitational pull from the moon "pulls" the surface of the sea towards it causing a "bulge". As the moon rotates around the earth the gravitational pull causes the water to bulge, the resulting wave is then carried around the earth. On the opposite side of the earth the moon's gravitational pull is diminished, which allows the water to move away from the earth causing a second bulge.

Tidal rhythm therefore is generally in tune with the rotation of the moon around the earth. Since this "lunar day" is 24 hours and 50 minutes, the two high and two low waters each day occur about 50 minutes later than the corresponding tides of the previous day.

In the course of any one lunar month, the sun, moon and earth are lined up twice, technically, in conjunction. The new



Spring Tides



Neap Tides

moon is when the order is sun moon earth and full when the order is sun earth moon. In both cases, the sun's gravitational pull lines up with that of the moon, which results in higher tidal ranges called spring tides.

Similarly, twice during the course of a lunar month, the relative positions of the moon and sun are at 90º to each other. In this instance the sun counteracts to some extent the pull of the moon, which results in lower tidal ranges called neap tides.

Spring tides produce higher high water and lower low water, whilst neap tides produce lower high water and higher low water. Because of the greater volume of water moving between high and low water, the rate of flow of the current is much greater during a spring tide. Calculating this rate of flow will be dealt with in later modules.

Tidal Definitions and Tidal Heights

Chart Datum
Chart Datum is the reference point from which all depths and drying heights or lowest level of tide are measured on a nautical chart. American charts commonly use Mean Lower Low Water (MLLW). British Admiralty metric charts use Lowest Astronomical Tide (LAT).

Charted Depth
The distance below chart datum of an object or feature often referred to as soundings.

Drying Height
This is the height of an object or feature above chart datum; these features such as rocks or submerged objects may be uncovered at low water.

Duration
This is the interval of time between successive high and low tide.

Height of Tide
This is the height of water above Chart datum and is found by using the tide tables to find high or low water and then applying the corrections derived from the appropriate tables.

High Water
The time at which a tide reaches its maximum height. The tide tables predict the times that high and low water are expected to occur as well as the heights expected. (These predictions assume normal weather conditions)

Low Water
The time at which a tide reaches its minimum height.

Lowest Astronomical Tide (LAT)
LAT is the lowest tide level that can be predicted to occur under normal meteorological conditions and so using this datum there will rarely be less water than is shown on the chart.

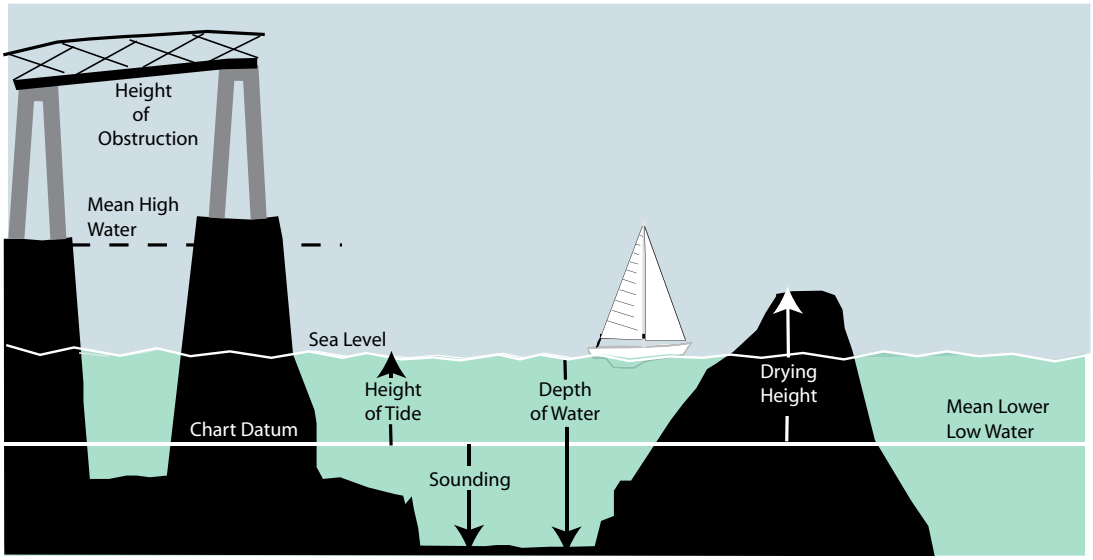
Mean High Water (MHW)
This is the average height of high waters for a particular place: this average is worked out over a 19 year period. This is the point from which the height of structure such as bridges and lighthouses are measured.

Mean Lower Low Water (MLLW)
The average of the lower low waters of each tidal day over a 19 year period. Used as Chart Datum on US charts. Using this datum there will often be less water than is shown on the chart.

Spring Tides
A spring tide has a higher high water and a lower low water than the average tide for the area, therefore, a spring tide

has a big range. Spring tides occur at about the time of new and full moon.

Neap Tide
Neap tides occur about a week after spring tides and feature smaller ranges therefore slower flows.



Range
The difference between the height of successive high and low waters, this is found by subtracting the height of low water from the height of high water.

Primary Ports
These are usually larger ports that have their own tide tables published which contain complete tidal information with the time and height of every tide.

Secondary Ports
These are places that do not have their own tide tables so the information has to be calculated by using the Tide Differences Table.

Spring Tide
Two spring tides occur every lunar month, just after the full and new moons. The spring tide features the higher high water and the lower low water and therefore much faster tidal flows.

Rule of twelfths
In most places where the tide has a regular cycle there is a simple way to estimate the height of the tide. It is important to note that this is a very rough approximation and will only work where the rise and fall are uniform over a six hour period. The rule of twelfths works on the basis that the rate of rise or fall is slow at the beginning and end of the cycle but reach a maximum at mid tide.

To reflect this we take the range and divide it into twelfths, then say that in the first hour the tide will be as follows:

1st hour	1/12 of the range	1/12 cumulative rise or fall
2nd hour	2/12 of the range	3/12 cumulative rise or fall
3rd hour	3/12 of the range	6/12 cumulative rise or fall
4th hour	3/12 of the range	9/12 cumulative rise or fall
5th hour	2/12 of the range	11/12 cumulative rise or fall
6th hour	1/12 of the range	12/12 cumulative rise or fall

Examples of tidal height problems

Height for a time, time for a height

Remember that all the problems which involve working with tidal height problems will require that one of two things to be found:

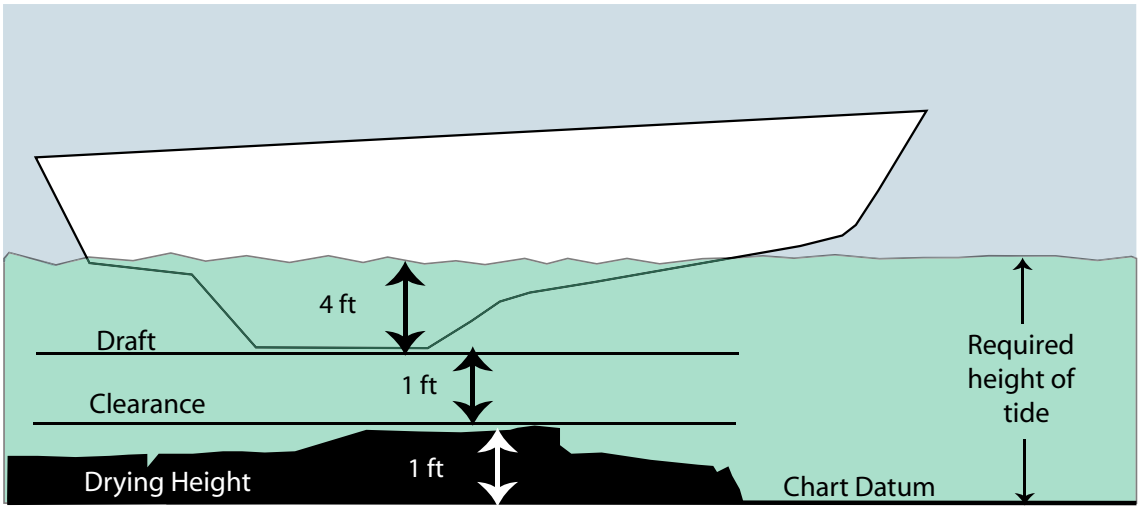
1. the Height of Tide at a specific time, or
2. the Time for a specific Height of Tide

What is the latest time during the falling tide on the evening of June the 1st that a yacht can pass over an area near Boston shown on the chart as having a drying height of 1 ft? The yacht has a draft of 4 ft and an extra clearance of 1 ft will be allowed for safety.

A quick sketch is usually a help when you are trying to understand the problem. Here, the height of to allow the boat to pass must be:

1 ft to cover the drying height
+ 1 ft for the safety clearance
+ 4 ft for the boat's draft.

The height of tide required to cover in height of 1 ft	
Drying height 1 ft	1 ft
+ the draft of 4 ft	4 ft
+ the clearance of 1 ft	1 ft
Height of tide required	6 ft



CURRENTS

Currents are the horizontal movements of water from any cause, such as tidal phenomena, prolonged wind activity or river flow. A boat moving at a speed through still water where there is no current will be traveling at the same speed and direction over the bottom. When this same boat moves into a body of water that is affected by a current it's speed and direction of travel over the bottom will change. Before we look at how to work out the allowances that have to be made for current we need to understand the terms involved.

Definition of Terms

Flood Stream
This usually refers to the flow of water associated with an incoming tide.

Ebb Stream
The "falling" or outgoing tide is called the EBB, so a tide may be said to be ebbing or flooding dependant upon whether it is going out or coming in.

Slack Water
Slack is the period between the flood and ebb tides when the movement of the water tails off sometimes to a complete stop before the tide turns and flows in a new direction.

Spring and Neap Rates
The speed of the currents associated with Spring tides are greater than those of Neaps because of the greater volume of water flowing between high and low water at Springs.

Current Tables
These are published tables containing the data collected by the various organisations. Based on your voyage plan you must obtaining information supplied by the U.S. National Ocean Service (NOS), The Canadian Hydrographic Service (CHS), The Australian Hydropgraphic Servie and The National Oceanic and Atmospheric Administration (NOAA) to name a few. REEDS Nautical Almanac publishes tide tables and information for the East Coast of North America.

Direction
The information about direction is always given in degrees true so can be plotted directly on the chart without correction.

Rate
The rate is the speed, given in knots, at which the current is moving. Normally two rates are given, one for springs and one for neaps.

CHESAPEAKE BAY ENTRAN

CURRENT TABLE 2004 — 36°58.80'N 75°59.88'W

Eastern Time (75°W) — Corrected for Daylight Saving Time

MAY

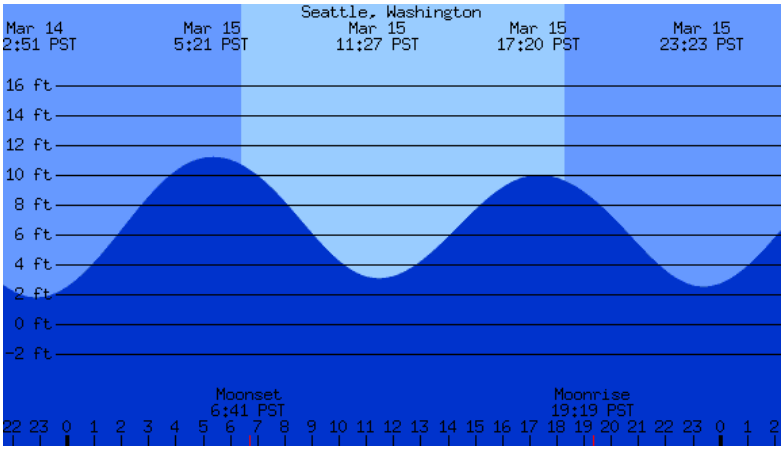
	Slack time	Max time	Fld knots	Ebb knots
1 Sa	0330	0016		1.1
	0855	0601	0.7	
	1558	1237		1.3
	2154	1838	0.9	
2 Su	0420	0108		1.2
	0937	0642	0.8	
	1631	1319		1.5
	2243	1915	1.2	
3 M	0509	0159		1.4
	1019	0726	0.9	
	1707	1403		1.6
	2329	1956	1.4	
4 Tu ○	0557	0250		1.6
	1103	0815	0.9	
	1748	1449		1.7
		2042	1.5	
5	0016	0338		1.7
	0648	0906	0.9	
16 Su	0502	0153		1.2
	0959	0709	0.6	
	1648	1345		1.2
	2314	1936	1.0	
17 M	0547	0241		1.3
	1032	0750	0.6	
	1721	1421		1.2
	2351	2011	1.0	
18 Tu	0631	0322		1.3
	1104	0833	0.5	
	1754	1454		1.2
		2049	1.1	
19 W ●	0028	0358		1.2
	0714	0915	0.5	
	1137	1525		1.2
	1830	2126	1.0	
20	0104	0432		1.2
	0757	0956	0.5	

JU

	Slack time	Max time	Fld knots	Ebb knots
1 Tu	0448	0136		1.4
	0937	0657	0.8	
	1636	1330		1.6
	2308	1926	1.5	
2 W ○	0538	0230		1.6
	1030	0748	0.8	
	1723	1423		1.7
	2358	2016	1.6	
3 Th ○	0629	0321		1.7
	1124	0843	0.9	
	1813	1516		1.7
		2108	1.6	
4 F	0049	0411		1.7
	0723	0938	0.9	
	1220	1607		1.7
	1907	2201	1.6	
5	0142	0502		1.7
	0819	1031	0.9	

Tidal Current Charts

In places where the direction and rate of flow varies in a given area or is too complex to be conveyed purely in figures a chart is often published, this can also be called a Tidal Stream Atlas. This is actually a series of chartlets, each of which represents one hour in the life of the tidal cycle. The direction of the current is shown with arrows, each of which will have a figure showing the associated rate. These have the advantage of showing the navigator a picture of the tide and how it is flowing.



Using the Current Tables

The Navigator needs to be able to make allowances for the current so he needs information about these currents. As with the tidal heights this information is found in a nautical almanac like REEDS under the heading of Current tables.

The Current tables give the following information.

- The time of slack water
- The time and rate of the maximum flow of the flood tide.
- The time and rate of the maximum flow of the ebb tide.
- The direction of flow of both the flood and ebb tides in ºT.

In the example shown, taken from the current table for The Race, Long Island Sound, we can see the following:

- The current on the flood runs in the direc tion of 302ºT and the current on the ebb runs in the direction of 112ºT.

Taking April 1st as an example we see that:

- Slack water will occur at 0221, 0848, 1456 and 2103.
- The ebb reaches a maximum speed of 3.8 knots at 0528 and 3.3 knots at 1754.
- The flood reaches a maximum speed of 3.1 knots at 1135 and 3.1 knots at 2357.

THE RACE, LONG ISLAND SOU

Flood 302ºT Ebb 112ºT

Corrected for daylight saving time

	Slack time	Max Time	Flood Knots	Ebb Knots		Slack Time
	0221	0528		3.8		0244
1	0848	1135	3.1		**16**	0916
W	1456	1754		3.3	Th	1518
	2103	2357	3.1			2122
	0318	0625		3.4		
2	0947	1233	2.8		**17**	0327
Th	1557	1853		2.9	F	1003
	2205					1606

Extract of current table for The Race, Long Island Sound.

Tidal Atlas and Tidal Diamonds

A tidal atlas is used to predict the direction and speed of tidal currents.

A tidal atlas usually consists of a set of 12 or 13 diagrams, one for each hour of the tidal cycle, for a coastal region. Each diagram uses arrows to indicate the direction of the flow at that time. The speed of the flow may be indicated by numbers on each arrow or by the length of the arrow. Areas of slack water may be indicated by no arrows or the words “slack water”.

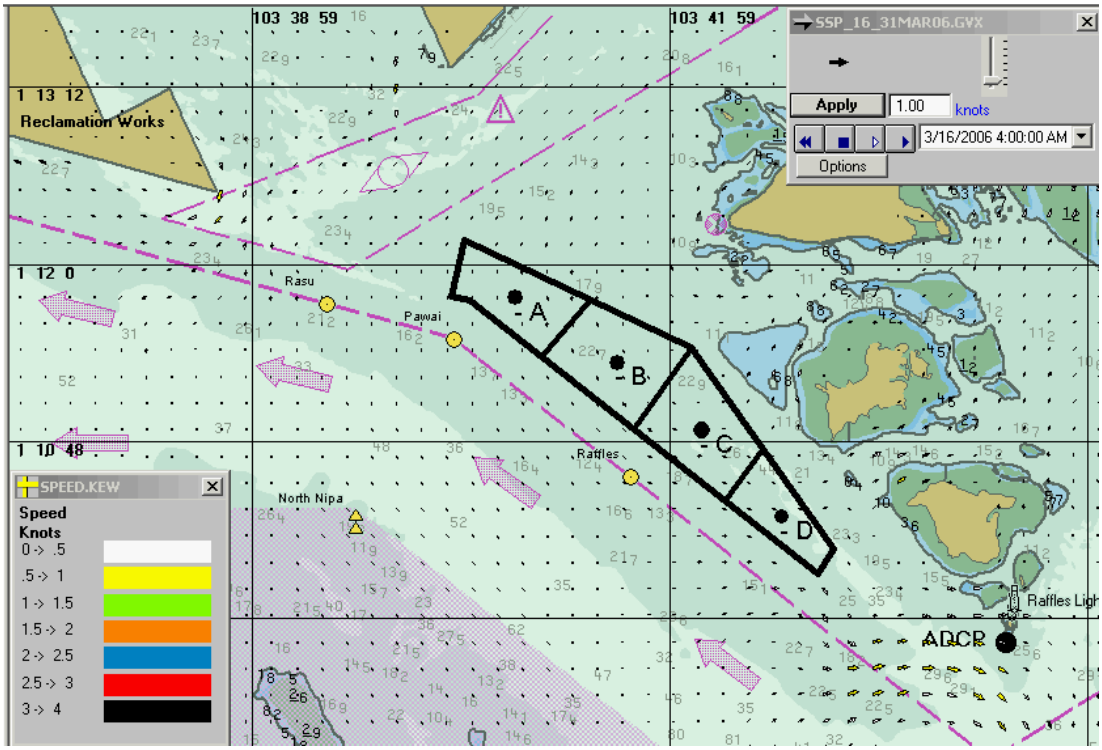
Below is an example of a tidal atlas.

View Tidal Atlas at Sudong Anchorage

Please read & understand the methodology of how the tidal current information is derived.

The tidal current information for the selected area is a simulated current only.
The model bathymetry is generated based on the seabed information in navigational charts and sounding data.
The model is calibrated and validated based on the measured current during a joint survey carried out in 1978 by four countries.
The model was further customized and developed for the selected area.The customized model was further validated using a recent Acoustic Doppler Current Profiler ("ADCP") transect. Any inaccuracy in the measured current may affect the accuracy of the simulated current.
The non-tidal current caused by surface wind, temperature and atmospheric pressure included in the simulation is a yearly average value.
The actual non-tidal current may vary according to these conditions.
The current conditions in the selected area are inherently complex and other factors may affect the accuracy of the simulation.

Tidal Times are in Singapore Time(GMT + 8 hours)



To view tidal atlas for other times on 16/03/2006, please click on the relevant link below.
All links given below are in Singapore Time (GMT+0800 hours) Disclaimer

0000	0030	0100	0130	0200	0230	0300	0330
0400	0430	0500	0530	0600	0630	0700	0730
0800	0830	0900	0930	1000	1030	1100	1130
1200	1230	1300	1330	1400	1430	1500	1530
1600	1630	1700	1730	1800	1830	1900	1930
2000	2030	2100	2130	2200	2230	2300	2330

An alternative to a tidal atlas is a nautical chart that provides tidal diamonds. Tidal Diamonds are symbols on British Admiralty Charts that indicate the direction and speed of tidal streams.

The symbols consist of a letter of the roman alphabet in a rhombus, printed in purple ink. On any particular chart each tidal diamond will have a unique letter starting from “A” and continuing alphabetically.

Somewhere on the chart, generally on land, will be a Tidal Diamond table. This contains a grid of thirteen rows and three columns for each Diamond. The rows are the hours of the tidal cycle showing the 6 hours from low water to

high water, high water itself and the 6 hours from high water to low water. The columns show the bearing of the tidal stream and its speed, in knots, at both spring tide and neap tide. The times on the table are related to the high water of the Standard Port displayed on the table.

		A 50 42'.3N 0 26'.5E			B 50 53'.0N 1 00'.0E			C 51 01'.0N 1 10'.0E		
Hours		Dir	Sp	Np	Dir	Sp	Np	Dir	Sp	Np
Before HW	6	248	0.8	0.4	213	1.6	0.9	224	0.9	0.5
	5	067	0.5	0.3	214	2.1	1.2	239	1.0	0.6
	4	068	1.9	1.0	215	1.8	1.1	235	1.1	0.6
	3	071	2.6	1.5	213	0.9	0.5	242	0.6	0.4
	2	069	2.3	1.3	*Slack*			*Slack*		
	1	068	1.2	0.6	033	0.8	0.5	052	0.6	0.3
HW		067	0.1	0.1	032	1.5	0.8	049	1.2	0.7
After HW	1	248	0.9	0.5	031	1.9	1.1	049	1.3	0.7
	2	247	1.4	0.8	030	1.7	1.0	056	1.0	0.5
	3	251	1.8	1.0	031	1.2	0.6	054	0.5	0.3
	4	253	1.7	1.0	032	0.4	0.2	*Slack*		
	5	250	1.6	0.9	211	0.4	0.2	219	0.4	0.2
	6	249	1.2	0.7	212	1.3	0.7	217	0.8	0.4

Tidal and current calculations will be covered in greater detail in the IYT Yachtmaster Coastal and IYT Yachtmaster Offshore courses.

MODULE 16 / SECTION 2
CHARTWORK

A prudent navigator takes every opportunity that presents itself to find his position and plot it on a chart. Even with the advent of modern electronic navigation aids, a regular check by traditional methods should be made. Obviously weather conditions will dictate how regular these should be; fog, low visibility and bad weather are some examples when the time between fixes should be reduced.

Breton Plotter (top)
Dividers (bottom)

The practical navigator does not require expensive equipment to work effectively. The basic needs are as follows:

Pencils - 2B pencils should be used for chartwork to avoid scoring the surface of a chart and to allow easy removal. Mechanical pencils work well as they do not require sharpening.

Parallel Rules - Used to measure courses, bearings, lines of position etc. by reference to a compass rose printed on a chart. Worked by walking or rolling (depending on type) the rule across the chart to/from compass rose. These are not very accurate in a rolling sea or in bad weather.

Dividers - Used to measure distances (in nautical miles from the latitude scale.). A cheap school type is adequate, but the single-handed brass type makes life easier.

Breton Type Plotter - (preferred instrument) this comprises a circular protractor mounted on a rectangular base, all made of plastic. The protractor is marked in degrees and incorporates a grid for easy alignment. The rectangular part acts as the ruler.

This type of plotter eliminates the need for the compass rose on the chart, can be used on rough surfaces, and on any size vessel. This is the most accurate of plotters having a correction factor of 1º.

Using a chart, parallel rules or plotter/protractor and dividers, most basic navigational problems can be solved. It is possible to determine the position (latitude and longitude) of a given point on the chart, plot a position on the chart whose latitude and longitude are known, plot a course from one point to another, plot bearings and lines of position and measure and mark off distances.

Other useful items include:
Note book.
Pencil sharpener.
Eraser.

CHARTS

Charts are essentially maps of sea areas showing coastlines and their prominent features, depths, objects in on and under the water and include many other pieces of useful information. They are intended primarily for use by mariners to assist in route planning, pilotage and navigation, as well as to find information concerning the depth of water, hazards to navigation, aids to navigation, channels, anchorage areas, harbors,

tides, water levels, magnetic variation and information on currents. Many maritime nations have agencies that publish charts which are readily available through the usual sources.

In addition to charts there are a number of other publications required by the navigator.

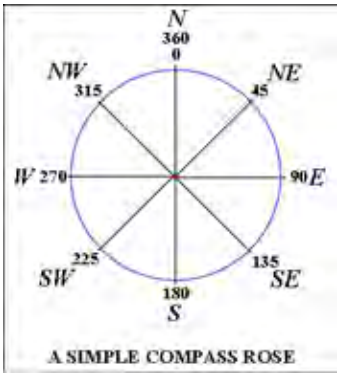
Scale
The scale to which the chart is drawn is important as it indicates how much detail is included. Large-scale charts are used when more detail is required, for example harbor charts which show a small area in great detail. Smaller scale charts are used when detail is less important and show a larger area in less detail. As the scale of the chart increases, a smaller area is shown with more detail. It is best to use the largest scale of chart available.

Distances are measured using the latitude scale of the chart, with one minute of latitude being equal to one nautical mile.

Heights and Depths
In the USA the standard of measurement will be imperial rather than metric. Depths or soundings will be given in feet or fathoms (1 fathom = 6 feet) and heights of objects will be shown in feet, these will be marked on the title block and on the upper/lower margins, "SOUNDINGS IN FATHOMS". European and some other charts are likely to be metric - these will be marked on the title block and on the upper/lower margins, "SOUNDINGS IN METERS".

Special Notes Cautions and Warnings
Lists certain features, dangers and other information in the area covered by the chart and which the navigator must make him/herself aware for safe passage making.

North/Compass Rose



A SIMPLE COMPASS ROSE

True North is always at the top of the chart and South is always at the bottom. This may vary with strip charts and chart books. The compass rose is printed in several locations on the chart and the outer ring shows true degrees from 000º to 359º whilst the inner ring shows magnetic degrees from 000º to 359º. The difference between the two is the variation (at the time printing). In the center of the rose the variation is noted along with the annual change.

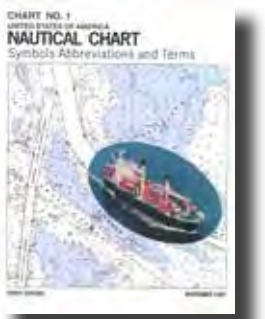


Chart No 1 (USA)

Chart Symbols and Abbreviations

NP 5011 (UK) or Chart No 1(USA) This publication illustrates all the symbols and abbreviations in use on most nautical charts.

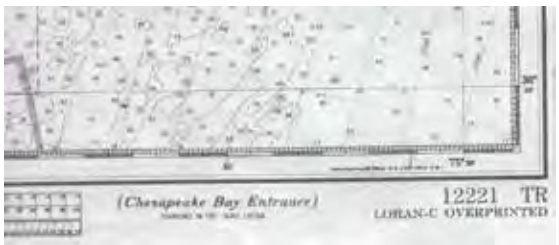
(Where possible the symbols used are common sense.
e.g. the symbols for a church ….looks like a church…!)

Chart Information

Title & Number - Charts are titled and numbered according to the area they cover, such as Falmouth to Plymouth - English Channel - New York Harbour - Port Everglades.

Scale - Large or small scale.

Note: Anything colored yellow is dry land and its height is measured from mean high water springs (MHWS).



Example of Title & Number on a Nautical Chart

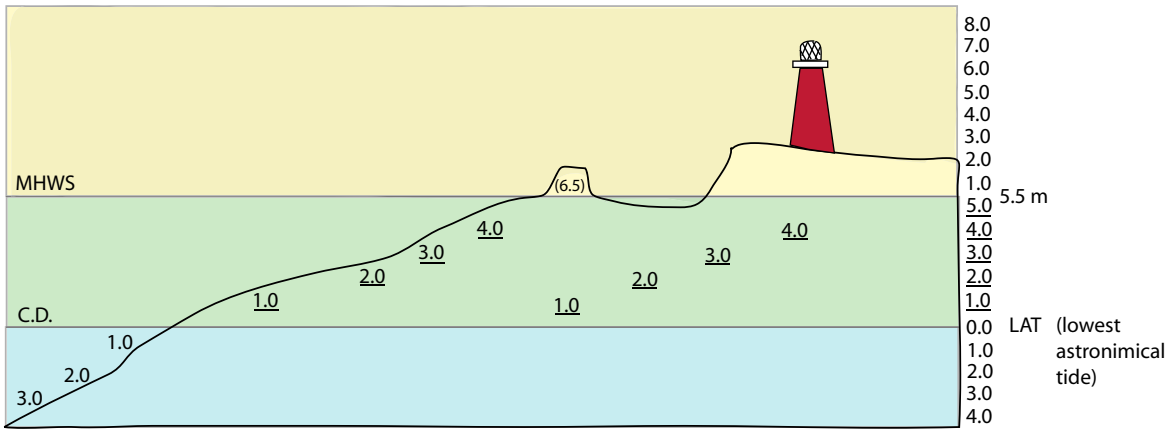
Anything colored green is land, which covers and uncovers with the tides. Drying heights (underlined) are measured from C.D. or L.A.T. (Lowest astronomical tide) up to MHWS.

Anything blue or white shows the soundings below the Datum of Latitude.

(With Tidal height there will nearly always be more depth than charted)

SOUNDINGS – Fathoms, feet, or metric. Generally noted below the name of the chart.

CAUTIONS – Cautions draw the attention of the user to navigational instructions, hazards and dangers. Such as:
Traffic separation scheme.
Restricted area.
Firing ranges.
Historic wrecks.
Radio reporting points etc…
ALWAYS READ THE CAUTIONS BEFORE USING THE CHART

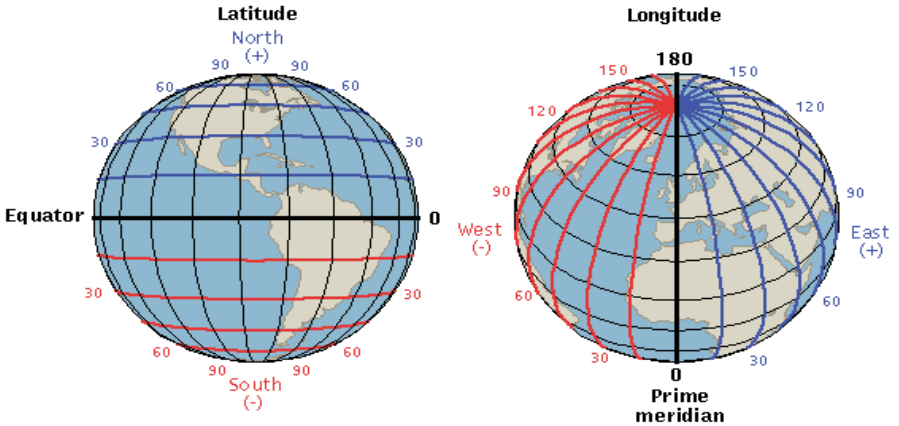


Colors and Levels

Charts are laid out in the form of a grid, much like land maps, and these co-ordinates enable the navigator to identify a position anywhere on the earth's surface.

Latitude
The imaginary lines which run East / West on the earth's surface are called Parallels of Latitude and are graduated from zero degrees at the equator to ninety degrees at the North and South Poles.

Longitude
The lines, which run North/ South from the poles, are called Meridians of Longitude. Longitude is



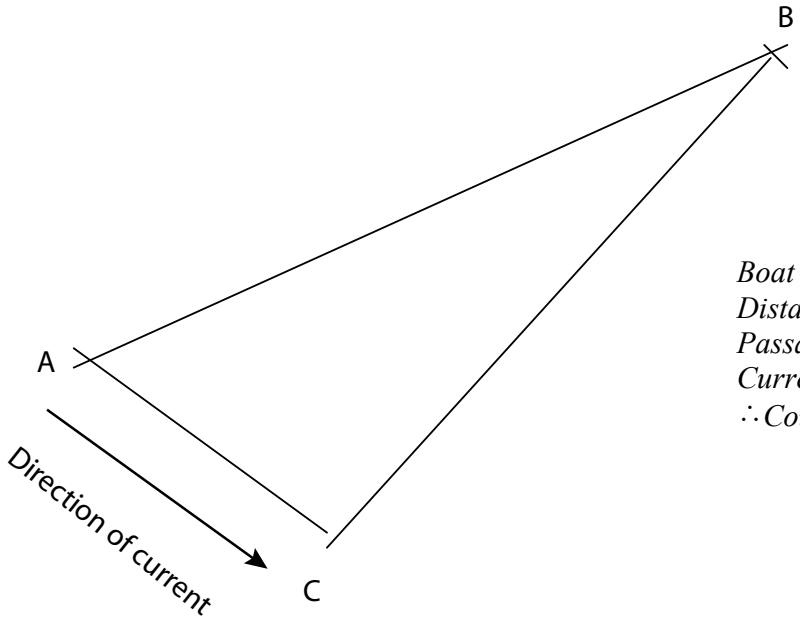
measured East /West (0º - 180º) from the Internationally agreed 0º or "**Prime Meridian**" which runs through the Old Royal Observatory building in Greenwich, London, England.

Measuring the angular distance between two points on the surface and a point at the center of the earth derives both latitude and longitude.

Course / Distance

Direction

The navigator needs to be able to express in the appropriate terms the direction to shape a **CTS** (course to steer) in order to get a vessel from one location to another as well as obtaining a bearing from the vessel to a specific object. Direction is measured as an angle starting at 000° (True North) and continuing clockwise (through East, South, West and back to North) to 360° or 000°. The position of a vessel can be described in relation to a feature on the chart by establishing the distance and bearing from that feature. For example if you were approaching Port Everglades, Ft Lauderdale from due east you could describe your position as being 090º from Port Everglades entrance.



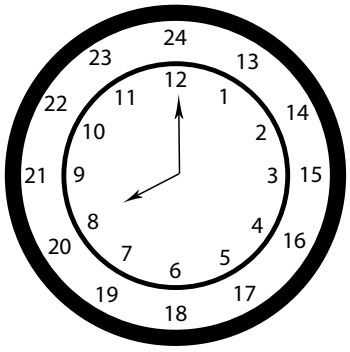
Boat speed = 6.5Kts
Distance A – B = 9.6N Miles
Passage time = 1.5hrs approx
Current at point A = 137º at 4.5Kts
∴ Course to steer (C-B) = 040ºT

Time

Time is always expressed using the 24 hour clock format and not "am/pm". Ambiguity is avoided in this way. The day starts at 0000 hours (midnight) and progresses through the day to 2400 hours (midnight again).

e.g. 1.00 am is expressed as "Oh one hundred", 5.20 am as "Oh five twenty", 1.00 pm as "Thirteen hundred" and 5.20 pm as "Seventeen twenty". The use of the word 'hours' after the numbers is incorrect, e.g. say "fifteen twenty" **not** "fifteen twenty hours". In nautical terminology speed is expressed in knots, where 1 knot is one nautical mile per hour. **Remember, one knot equals one nautical mile per hour, therefore you would say that the speed of an object is "one knot" it is never expressed as "one knot per hour". One nautical mile = 1.1 statute mile.**

Twenty Four Hour Clock



Conversion of conventional time to marine time

1. Delete colons and AM/PM designators
2. Add first digit zero to hours between 1:00 a.m. and 9:00 a.m. to arrive at marine time.
3. Delete colons
4. Add 12 hours to all hours between 1:00 p.m. and 11:00 p.m.
5. Midnight is 2400 or 0000

Examples:

10:00 a.m.	=	1000 or ten hundred
9:00 a.m.	=	0900 or O nine hundred
12:00 noon	=	1200 or twelve hundred
1:00 p.m.	=	1300 or thirteen hundred
1:15 p.m.	=	1315 or thirteen fifteen
7:00 p.m.	=	1900 or nineteen hundred
10:05 p.m.	=	2205 or twenty two O five

Never use the longitude scale at the top or bottom of charts to measure distance.

Great care must be taken when going from one chart to another, be aware that the "new" chart may have a different scale. It is a common mistake to mark off the wrong distance because of a change in scale between two charts.

Line of Position (LOP)

A position line is a line (drawn on the chart) somewhere on which the vessel's position lies. On its own, a single LOP cannot give the vessel's exact position, other information is required, but a single LOP, when plotted on a chart, can confirm that you are/are not close to a point of danger.

Take a bearing of a light house using a hand bearing compass. In the picture the bearing to the light house from your position on the boat is 280° (C).

Fixes

A fix is a reasonably accurate determination of a vessel's position. It requires two or more LOPs, derived from simultaneous compass bearings, crossing each other to establish the position of the vessel fairly accurately. However, a fix that uses only two position lines is not as accurate as one that uses three. It is preferable always to take compass bearings of three different objects when possible.

Two Point Fix

Two Point Fix

The point of intersection of two simultaneous bearings of two charted objects (LOPs) gives a reasonable fix of the position of the vessel.

Three Point Fix

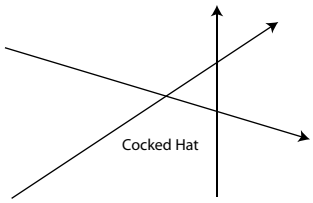
Three Point Fix

Better than a two-point fix for reliability, the third LOP gives greater accuracy or highlights an error in one or both of the other LOPs. If the three LOPs coincide closely it indicates a reasonably accurate fix.

Cocked Hat

When a three-bearing fix is plotted the result will often be a triangle. In the event that the cocked hat, as it is known, is small, it is customary to take the position at the center point of the triangle. When the cocked hat is large, good navigation practice dictates that the Navigator should assume his position to be that which is closest to the point of danger. If it is a very large cocked hat the bearings should be re-taken if possible.

Except in the most favorable conditions, a cocked hat is most likely to be the result due to one or more LOPs not being accurate.



Hand Bearing Compass

Compass Bearings

The main source of position lines is by a compass bearing of a known object ashore or fixed navigational mark. These are usually obtained with the use of a hand-bearing compass, used away from any magnetic influence on the vessel. Write down the bearings as they are taken, and the time and the distance shown on the ship's log. The bearings must then be converted to true before they can be plotted on a chart using the true compass rose and parallel ruler or a plotter.

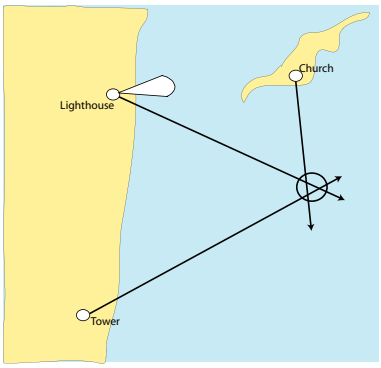
Bearings can be taken of any thing or object that is conspicuous and marked on the chart, such as lighthouses, buoys, beacons, TV antennae, chimneys, water towers, conspicuous buildings and also islands, hills and headlands that are easily identified.

Planning a Fix

Identify all objects on the charts and then identify those same objects on the land.
Make sure that the object you are looking at is the object you plan to use on the chart.
Write down the bearings as they are taken.
Take the bearings as quickly as possible. The bearings on the beam should be taken last because their angle will change more rapidly. The angle between bearings should be at least 40º and less than 120º; the best angle of cut is about 90º for a two-point fix and about 60º for a three-point fix.

Running Fix

A running fix, employed when only one object for a fix is visible, is obtained from two separate bearings taken of the same object, combined with the direction and distance traveled by the vessel. It is only as accurate as the information that goes into plotting it - in particular, the vessel's course and speed. If there is a large amount of current and leeway present, then the running fix's accuracy is greatly reduced, although allowance for both can be made.



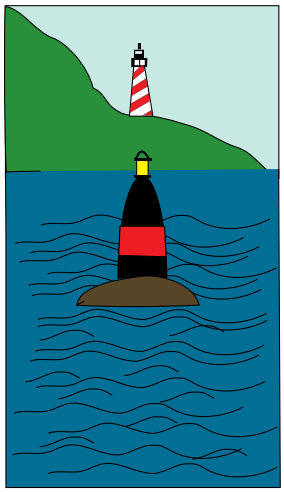
Running Fix
(shows the cocked hat)

The procedure for a running fix is as follows:

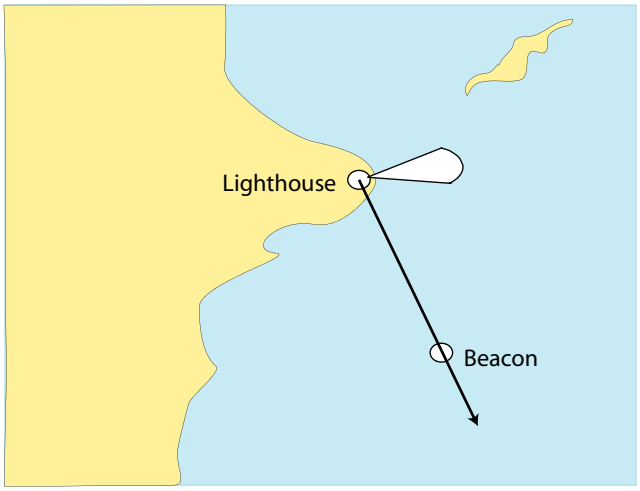
Take and plot a LOP from the single object, note the time, the log reading and the course being steered.
Wait until the bearing of the object has changed at least by 30º or more, then take and plot a second LOP, note the time, the log reading.
On the chart, from anywhere on the first LOP, transfer the first LOP in the same direction and distance traveled between the times of the two bearings. The point at which the transferred LOP cuts the second LOP is the fix.

Other sources of position lines

A range or transit where two identifiable objects on the chart line up, the vessel must be positioned on this line, and this may be crossed with one or more other LOPs to give a fix.
Sectored lights will give a LOP when on the line where the change over of the color occurs.



As seen from the boat



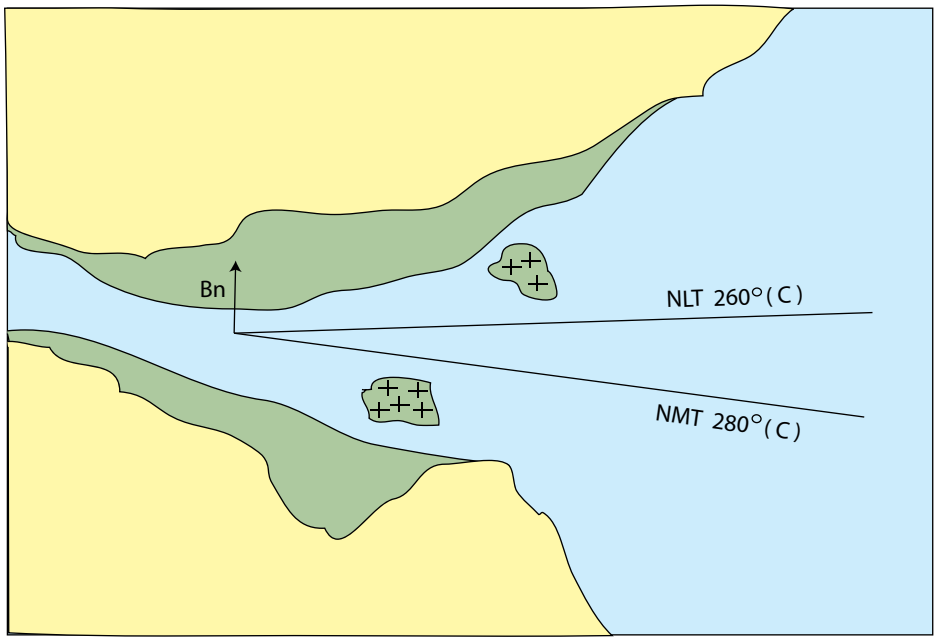
As plotted on the chart

Clearing lines

When piloting a vessel through a narrow passage or when avoiding a shoal or other hazard it is good practice to use a lead mark or, if not available, a clearing bearing is drawn on the chart and used to steer on to ensure safe passage. These lines are bearings that pass a certain distance off a known danger. Ideally they should be as close to parallel to the course steered as possible. These bearing lines will be marked, either:

NMT - Not more than
NLT - Not less than

Should either of these be more or less than the bearing specified on the clearing bearing, the vessel will be standing into danger.



Not Less Than 260° (C) Not More Than 280° (C)

Leading Lines/Marks
Ideally the leading mark should be a range/transit; however if one is not available select a compass bearing on an object either directly ahead of (easier to steer on) or astern of (known as a back bearing) the planned course on the chart. If the bearing changes, the vessel is being set off track and will need to alter course to regain track.

When rounding points of land or shoals, allow plenty of room - cutting corners is dangerous.

Dead Reckoning and Estimated Position

It is important always to know the vessel's position on the chart and in the absence of reliable fixes there are two methods of obtaining an estimate of position.

Dead Reckoning Position (DR)
It is not always possible to fix the boat's position at regular intervals, because suitable objects from which to take bearings may not be available. In this case the navigator will keep a log of courses steered and distances traveled to enable an approximate position to be maintained however the result will not be as accurate as a fix.

The position arrived at by this method, when only course steered and distance traveled are taken into account, is called a Dead Reckoning Position (DR) from Deduced reckoning. It is shown on the chart by a dot on the course line with a half circle around it, alongside which is written the time and the log reading in brackets.

To "work up" a DR position, the plot must be started from a known position. The course steered, converted to true, is plotted and the distance traveled is marked on the line.
The accuracy of any DR position is only good if there is no current, tide or wind setting the vessel off course, the distance log is accurate and the course steered is accurate.

Estimated Position (EP)
In order to improve on the results obtained by a DR plot, further information can be applied as known or estimated. By estimating the sideways drift, caused by the wind (leeway), and the effects of the tidal stream or current and applying

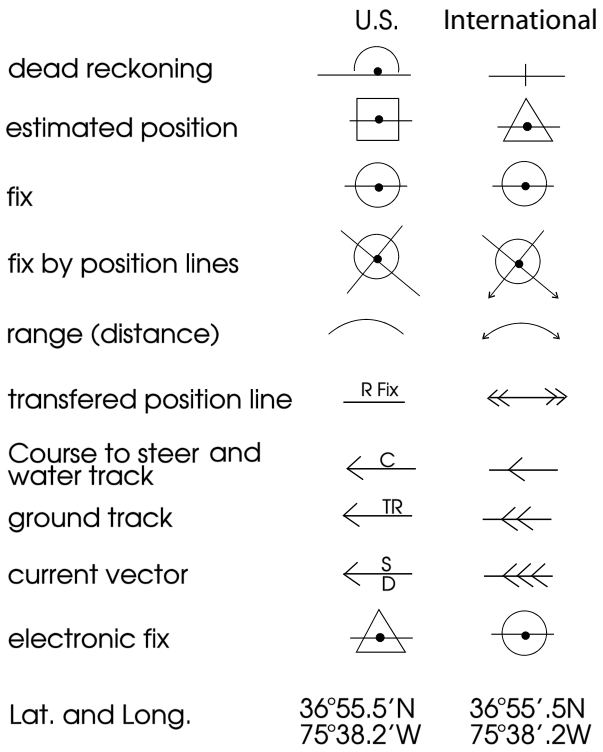
these to the DR position, the more accurate position arrived at is called an Estimated Position (EP). This is shown on the chart by a dot with a square around it. An estimated position is more accurate that a dead reckoning position but not as good as a fix.

To work up an EP, the plot must be started from a known position. The course steered, converted to true and with leeway applied away from the direction the wind is blowing (the boat will have been blown sideways downwind), the water track is then drawn. The distance traveled is marked on the line and from the end of the water track a line representing the direction and speed of the current is drawn (set and drift).

If the tidal stream is from ahead or astern, only the boat's speed over the ground will be affected. If the tidal stream is acting across the course of the boat she will be set sideways at a rate dependent on the set (direction) and rate (speed) of the stream.

It is important to update regularly the DR/EP, because it shows at a glance, the vessel's approximate position (for emergency purposes). It also allows the navigator to make important decisions as to the proper action to be taken in event of fog, bad weather, equipment failure etc. and, most importantly, it shows the intended course does not place the vessel close to or on a navigational hazard.

Chartwork Symbols



Course to Steer to Counteract a Current

We have accessed the sources of information to obtain information the direction and speed of currents. Armed with this information it is possible to predict how far off your desired course the current would push you and so work out a course to counteract this. This is called your course to steer (CTS).

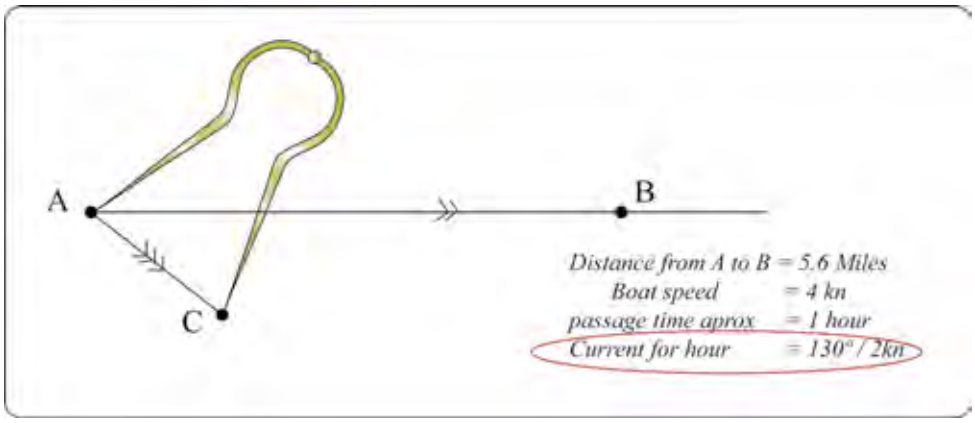
To work out a Course to Steer; we construct a triangle from the information that we have extracted from the current tables or atlas.

1. Decide what you expect your boat speed to be.

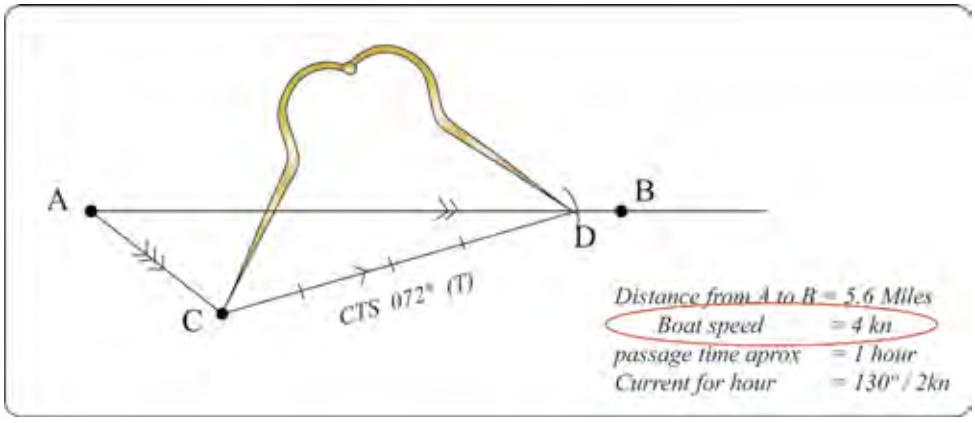
2. Now measure the distance between your point of departure and destination then divide this by the boat speed. This will give you an initial estimate of the duration of the passage.
3. To begin with we will work with periods of one hour but as you gain experience you can vary this to suit the circumstances.
4. Draw a line from the point of departure (A) through the destination (B). This represents the track that we wish to follow and will be our course over the seabed.
5. Again from the point of departure (A) draw a line representing the direction or set of the current and then mark a distance along this line that represents the drift or distance that the current will travel in one hour. We will call this point (C).
6. Now set your dividers to the distance that the boat will travel in one hour and from point (C) scribe an arc to intersect the track (Line A-B) and we will call this point (D).
7. The line (CD) is the COURSE TO STEER.

N.B. A common mistake is to connect point (C) to the destination (B), be sure to set the boat speed on the dividers and mark the track. This is the point to join with the end of the current vector that will give you your CTS.

When traveling over a greater distance it is possible to plot more than one hour at a time by plotting the first hour then from that point plot the next hour and so on. However the same number of hours of current must then be plotted.



Plotting the current, set and drift for the first hour.



Plotting the distance the boat will travel through the water during the first hour

Plotting of Tides/Currents & Leeway Effects

1. Apply estimated leeway to the True course steered to find the "water track".
2. From the last known position draw a line in the direction of the water track;
3. Mark off the distance run along the water track.
4. From the end of the water track draw a line representing the current set and drift.

This current vector (a vector is a line which has both direction and length) is drawn in the same direction as the current was moving and its length is the distance in miles the current has moved during the period of time for which the EP is being plotted.

For the sake of the example which follows below -- it is assumed that the current was flowing 182°(T) at rate of 1.2 knots. This means that in 1 hour the current will have moved the sea surface, and therefore the boat, 1 mile in the direction of 182°T this can be written simply as 182°/1M.

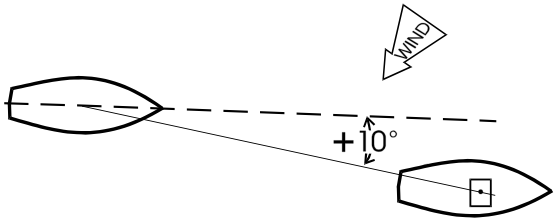
Example of an EP using an extract from a yacht's Log Book:

Time	Position	log	Course° (C)	Wind	L'way.	Current
1300	36°54'.3N 75° 42'.8W	300	165°	NE 18	nil°	
1400		306.5	100°	NE 18	10°	182°/1.2M

Plot the yacht's position at 1400.
Do all the 'math' first, then the plot.

Course 100° (C)
Deviation + 4° E
= 104° (M)
Variation - 11° (W)
= 93° (T)
Leeway + 10°
= 103° (T)

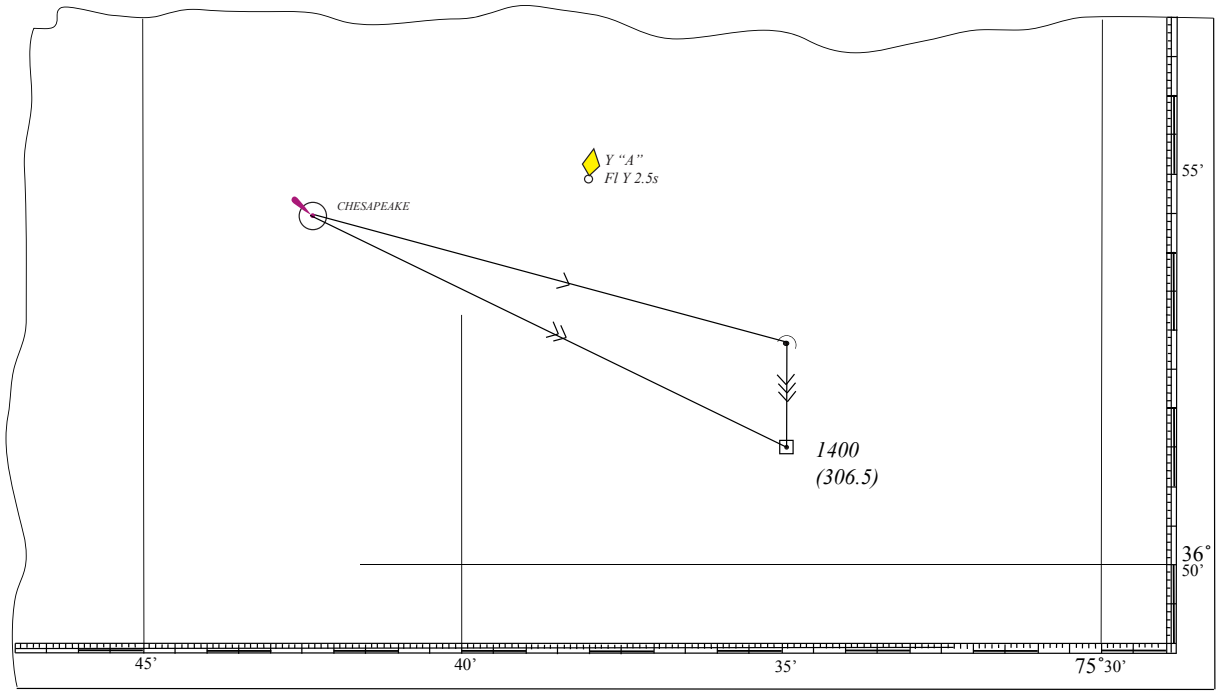
Log at 1400 306.5
Log at 1300 300.0
= 6.5 Miles



Leeway was estimated at 10°. As the wind was from the northeast it will have pushed the boat 10° to the south of its true course, i.e. +10°.

Now, from the position at 1300:

1. Plot a vector 103°(T) / 6.5M, and then, from the end of this vector, plot the current vector 1182° / 1.2M.



Note that the water track is marked with one arrow, the ground track with two arrows and the tidal vector is marked with three arrows. The Estimated Position is shown by a square with a dot in the center at the boat's position. Usually with an EP the only requirement is to find the estimated position so the ground track would not normally be plotted.

Plotting an EP for longer periods of time

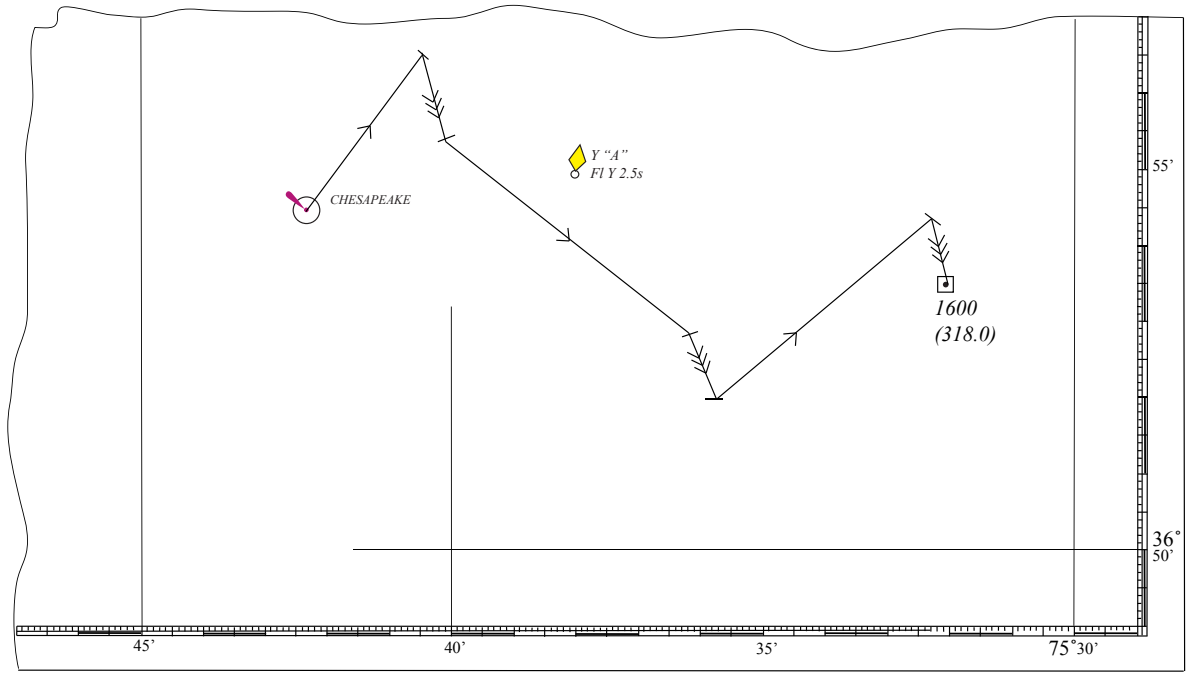
So far the examples have been for periods of one hour, which require only one current vector to be drawn representing the set and drift of the current. Most passages will take longer than an hour and will also probably involve course changes due to wind direction, hazards to be avoided and so on. An EP involving multiple course and current streams changes can be worked up in one of two ways.

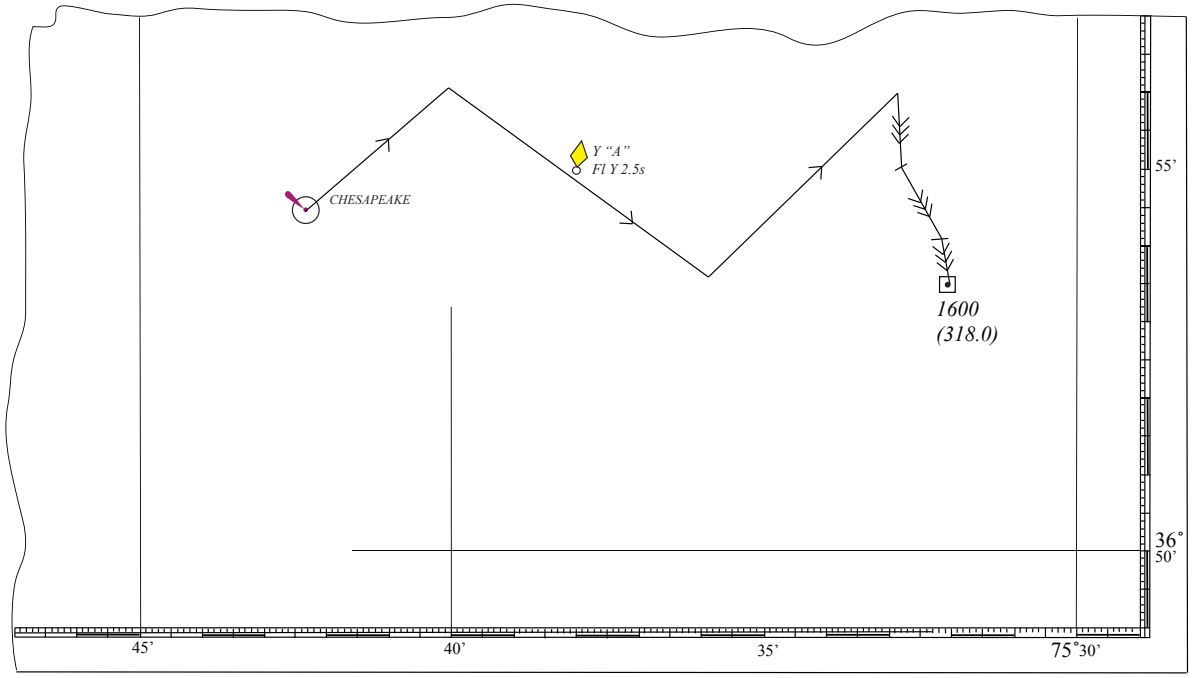
The first way is to plot the course, distance and current stream separately for each individual hour and the second way is to plot all the courses and distances first and then plot all the current vectors together.
Obviously each method must give the same final EP but the second approach is by far the easiest to plot, to read and to correct if mistakes are made. The two examples below show the result of plotting an EP using both methods based on the following 'log book' extract.

Time	Log	Course° (M)	Wind	L'way.	Position
1300	307.0	061°	W2	0°	Fix 36°54'.3N 75°42'.8W
1400	309.8	061°	W2	0°	a/c to 141°(M)
1500	313.8	141°	W3	0°	a/c to 061°(M)
1600	318.0	061°	W4	0°	EP at 1600?

Water track and current vector plotted for each individual hour.

The vectors which must be plotted to find the EP are:
From 1300 to 1400: water track = 050°(T)/2.8M; current = 174°/1.0kn
From 1400 to 1500: water track = 130°(T)/4.0M; current = 164°/0.9kn
From 1500 to 1600: water track = 050°(T)/4.2M; current = 172°/0.8kn
(The current direction and rate given are just for the sake of this example.)





Water tracks plotted first, then all the current vectors.
The EP position is the same as that in figure above.

MODULE 16 / SECTION 3
COLLISION REGULATIONS

All activities on the water are governed by a set of international regulations. These regulations are known as the INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, (1972). (COLREGS). This set of regulations runs to many pages and the full text is beyond the scope of this module, we will however discuss the most important sections.

The Collision Regulations were agreed upon by a conference of the International Maritime Organization and are usually referred to as the COLREGS. Amendments have subsequently been made to the Rules bringing them to where they are today. It is not necessary to know all of the Rules off by heart but a thorough knowledge of the COLREGS is essential.

Definitions
Here are some important definitions contained in the Colregs. The type of vessel defined will dictate what action should be taken.

The word "vessel" includes every description of watercraft, including seaplanes, capable of being used as a means of transportation on water.

The term "power-driven vessel" means any vessel propelled by machinery.

The term "sailing vessel" means any vessel under sail provided that propelling machinery is not being used.

The term "vessel engaged in fishing" means any vessel fishing with nets, lines, trawls or other fishing apparatus which restrict maneuverability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict maneuverability.

The term "vessel not under command" means a vessel which through some exceptional circumstance is unable to maneuver as required by these Rules and is therefore unable to keep out of the way of another vessel.

The term "vessel restricted in her ability to maneuver" means a vessel which from the nature of her work is restricted in her ability to maneuver as required by these Rules and is therefore unable to keep out of the way of another vessel. . (e.g. dredging, surveying, pipe or cable laying, towing, etc.).

The term "vessel constrained by her draught" means a power-driven vessel, which, because of her draught in relation to the available depth and width of navigable water, is severely restricted in her ability to deviate from the course she is following.

The word "underway" means that a vessel is not at anchor, or made fast to the shore, or aground.
The term "restricted visibility" means any condition, in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.

STEERING & SAILING RULES

This section defines what action must be taken by vessels to avoid collisions under specific circumstances.
One of the most important of all the Rules is Rule 5 which is given here verbatim:

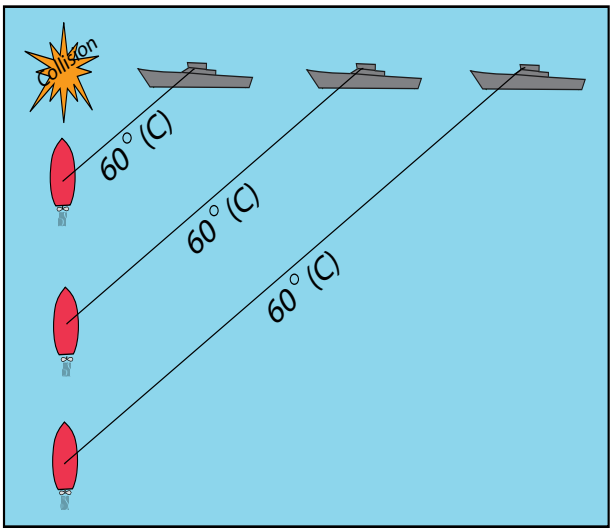
"Rule 5. Lookout

Every vessel shall at all times maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision."

Safe speed
Vessels shall at all times proceed at a safe speed taking into consideration visibility, traffic density, maneuverability of the vessel, background lights at night and sea state.

Determining if risk of collision exists
Vessels shall use all available means to determine if risk of collision exists. Risk of collision shall be deemed to exist if the compass bearing of an approaching vessel does not appreciably change; risk of collision may sometimes exist with a large vessel, a tow or a vessel at close range even if the bearing does change appreciably. If there is any doubt, risk of collision shall be deemed to exist.

Assumptions shall not be made on the basis of scanty information, especially scanty radar information.



Risk of collision exists if the compass bearing to the other vessel remains constant.

Action to avoid a collision
Any action taken to avoid collision shall be positive, made in ample time and with due regard to good seamanship. A change of direction and/or speed shall be large enough to be obvious to the other vessel - avoid small successive changes in speed and/or direction.

Action when in a Channel
When in a channel all vessels should stay to the right hand
or Starboard side, as near to the outer limit of the channel as is safe and practicable (Rule 9)

Narrow channels
Vessels should keep as close as practical to the starboard side of a channel or fairway. A vessel less than 20 meters, a sailing vessel or a fishing vessel shall not impede the passage of a vessel that can only safely navigate within a narrow channel or fairway.

'Give Way', 'Stand On'
If risk of collision exists between two vessels correct application of the Rules will require one vessel to give way and confer right of way to the other vessel. The vessel required to give way is called the Give Way vessel and the vessel with right of way is called the Stand On vessel; both vessels have specific responsibilities under the Rules.

Action by Give Way vessel
The Give Way vessel shall take early and substantial action to keep clear.

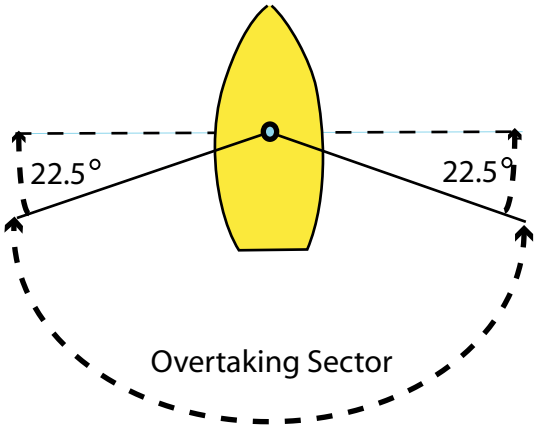
Action by the Stand On vessel
The stand on vessel must maintain her course and speed. The stand on vessel may, however, take action to avoid collision by her maneuver alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.

When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.

Overtaking

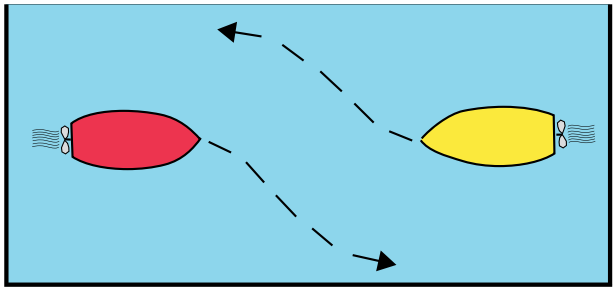
Any vessel overtaking any other vessel shall keep out of the way of the vessel being overtaken. A vessel is deemed to be overtaking if she is coming up with another vessel from a direction more than 22.5° abaft her beam. In other words at night time only the stern light of the vessel being overtaken would be visible.

If a vessel is in any doubt as to whether she is overtaking she must assume that she is overtaking and act accordingly.



Power driven vessels meeting head on

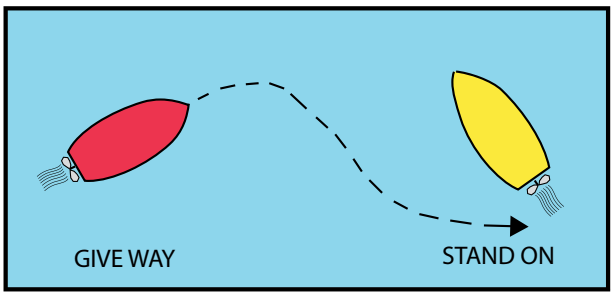
When two power driven vessels are meeting head on both are required to alter course to starboard.



Power vessels meeting head on - both turn to starboard

Power driven vessels crossing

When two power driven vessels are crossing, or converging, and risk of collision exists the vessel which has the other on her own starboard side must give way.
The give way vessel must not 'give way' by crossing ahead of the other vessel.



Power vessels crossing or converging:
give way to vessel on your starboard side
stand on for vessel on your port side

Action to Avoid Collision

One of the main rules specifically requires action to avoid collisions and any action taken needs to be made in good time and in a clear and unambiguous fashion. (Rule 8)

The most important rule for avoiding collision is to maintain a proper lookout at all times by watching, listening and all other means possible such as radar or binoculars. It is imperative that when you first encounter another vessel, the question needs to be asked "is there any risk of a collision?". Every vessel is required to travel at a safe speed which means that proper and effective action can be taken to stop the boat within a safe distance or to manoeuver while maintaining control of the vessel.

Make your decision Early

When you encounter another vessel, take action to avoid it as soon as possible. Make your avoiding manoeuver large

enough to be clearly seen by the other vessel. A clear alteration of course is more easily seen than a reduction in speed. Give the other vessel a wide clearance at all times.

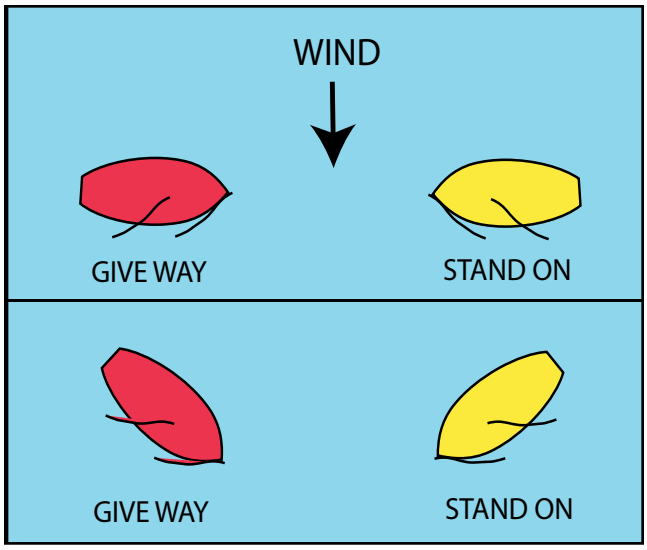
Before altering course, make sure that your alteration will not place you in a collision situation with another vessel. After altering course be sure to keep watching until the other vessel has passed safely.

Sailing Vessels
When two sailing vessels are approaching one another, so as to avoid risk of collision, one of them shall keep out of the way of the other as follows:

i. when each has the wind on a different side, the vessel which has the wind on the port side shall keep out of the way of the other.

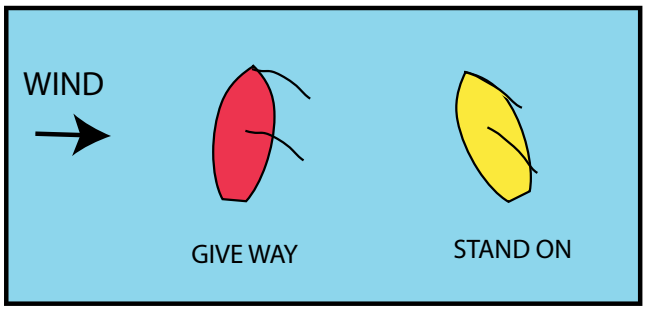
In other words a sailing boat on port tack gives way to a sailing boat on starboard tack. A sailing vesssel with the wind coming over the port side is said to be on port tack, when the wind is coming over the starboard side the vessel is said to be on starboard tack.

The main sail indicates visually which tack the vessel is on as it will be carried on the opposite side to the side over which the wind is blowing.



Port tack gives way, Starboard tack stands on

ii. When both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward;

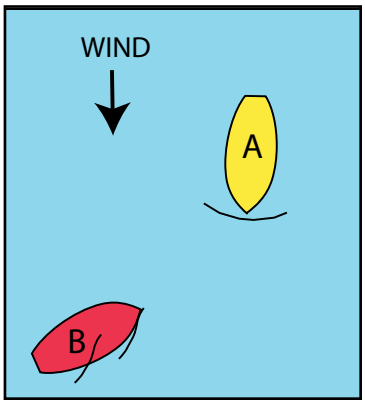


Same tack: windward boat gives way

iii. If a vessel with the wind on the port side sees a vessel to windward and cannot determine with certainty whether the other vessel has the wind on the port or on the starboard side, she shall keep out of the way of the other.

In this diagram the yacht B, on port tack, cannot see which side the mainsail of the other boat, A, is being carried on as it is obscured by the large headsail.

To fully understand the rules it is necessary to read through them carefully, and like any legal document is open to interpretation and every situation is different. If in any doubt, give way, it's usually the safest thing to do.



Power meeting Sail
A power-driven vessel underway shall generally keep out of the way of a sailing vessel (Rule 18)

This rule must be treated with respect and intelligence, for example, in various harbors around the world the working boats like ferries have a right of way under a "local rules" exemption to the general rules in the regulations. Equally if you are in a sailboat and see a large cargo ship in front of you flying a black barrel shaped object at it's mast this means that it is "constrained by draught", or in other words can only go down the deep water channel into a harbor, and cannot get out of your way.

Inland Navigation Rules
Special rules, called the Inland Navigation Rules apply on the inland waterways of the United States. Collision Regulations (COLREGS) demarcation lines are printed on charts and given in United States Coast Pilots Publications of the respective area. Generally the International and Inland Rules are similar, the main differences under the Inland Rules are indicated briefly below.

- Submarines may exhibit an all-round amber light flashing three times at three second intervals followed by dark for three seconds.
- A power driven vessel in narrow channels or fairways on the Great Lakes, Western Rivers (i.e. Mississippi and its tributaries) proceeding downstream with a following current shall have the right of way over an up-stream vessel. The vessel proceeding up-stream against the current shall hold as neces sary to permit safe passing.
- Under some conditions the use of VHF communications may replace sound signals.
- A power driven vessel crossing a river must keep out of the way of a power driven vessel going up or down stream.
- A vessel pushing ahead or towing alongside exhibits two towing lights over the stern light.
- A vessel being pushed ahead or towed alongside shall exhibit, at the forward end, sidelights and a special light flashing yellow at a rate of 50 to 70 flashes per minute and covering an arc forward of between 180° and 225°.
- When vessels are towed alongside on both sides of the towing vessel a stern light shall be exhibited on the stern of the outside vessel on each side of the towing vessel, and a single set of sidelights as far forward and as far outboard as is practicable, and a single special flashing light.

Buoys and Marks

To help ensure safety and to clearly mark out obstacles and hazards that exist both in and under the water there exists and internationally agreed sets of marks and lights. These are developed with the assistance of the "International Association of Lighthouse Authorities" (IALA.) There are two major systems.

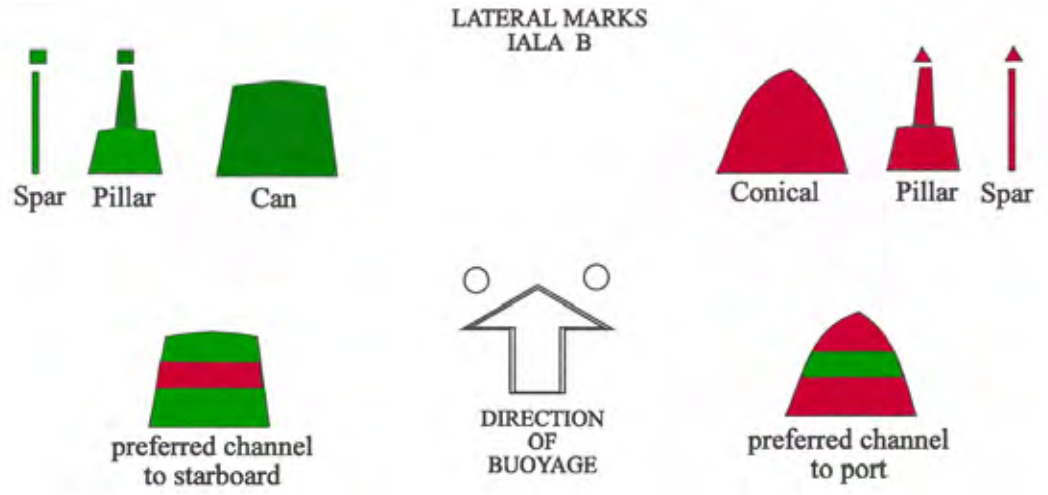
Region A (IALA A) covers all of Europe and most of the rest of the world except for the areas covered in Region B (IALA B) which is The United States, Japan, The Philippines and Korea. Fortunately most of the differences between the two systems are few. The most important is that which deals with the "direction of buoyage" which defines on which side of a channel the Lateral or Channel Buoys or Marks are placed.

Under IALA B red buoys or marks are on the right hand side of the channel when proceeding in from the sea i.e. going into a harbor. Under IALA A the red (port) markers are on the left hand side of the channel when heading into a harbor. These Lateral or Channel Marks define the limits of the navigable water across a channel, though designed in principle to define the limits for large commercial ships they are also vital for the safety of smaller vessels. It is almost never wise to attempt to pass between a channel mark and the shore behind.

Marks can either be a buoy floating in the water or a pole set into the rocks or sea bed which will be painted in the correct color and carry the required shape at the top.

Starboard **Marks** are Red in color, flash a red light at night and Cone Shaped for IALA B.

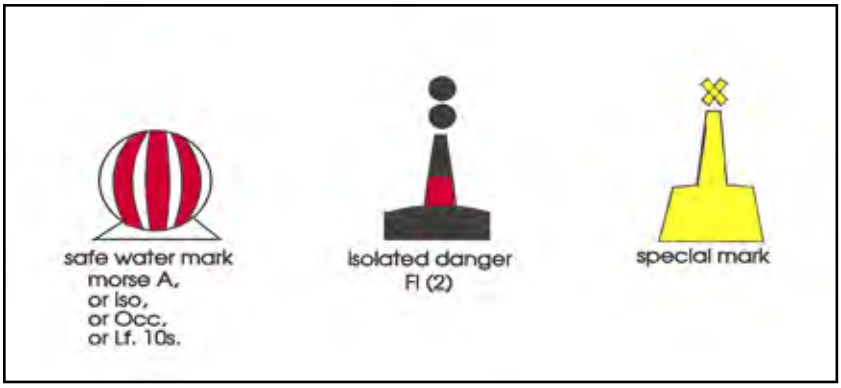
Port Marks are Green in color, flash a green light at night and are Can shaped for IALA B.



Safe Water Marks are red and white vertical stripes; the other striped marks have horizontal stripes and usually have a continuous white light.

Isolated Danger Marks indicate a point of potential hazard, are Red and Black in Colour, have two round black balls at the top and flash a white light in a group (e.g. two flashes) at night.

Special Marks are yellow in color and display a yellow light if lit. They are not intended to assist in navigation but rather to alert the mariner to some special feature such as: spoil reas, Pipelines, Traffic Separation Schemes, jetties or exercise areas.

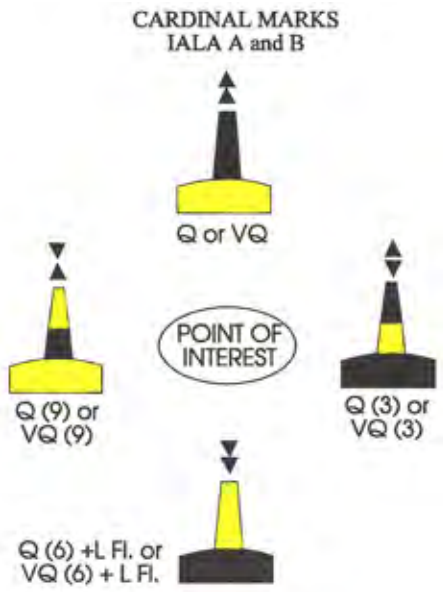


Cardinal Buoyage System

Cardinal Marks (while rare in the United States) indicate the safe side to pass a hazard on. For example, a North Cardinal Mark indicates that a vessel should pass to the North of the marker and a South Cardinal Mark would indicate passing to the South of the mark. Each Cardinal Mark has a unique pattern, color scheme and is defi\ned by a white flashing light. Cardinal Marks are used extensively throughout the world and are an excellent system for making safe passage around shallows, sunken objects, reefs, rocks and other hazards.

North Cardinal	Black over Yellow	Triangles point up	Continuous flash
East Cardinal	Black/Yellow/Black	Triangles point away	Flash in a Group of 3
South Cardinal	Yellow over Black	Triangles point down	Flash in a Group of 6, followed by 1 long flash
West Cardinal	Yellow/Black/Yellow	Triangle points in	Flash in a Group of 9

North



West East

South

Q (9) This indicates quick flashing flight 9 times
VQ (9) This indicates very quick flashing flight 9 times
Q (6) + L Fl. This indicates quick flashing light 6 times and a long flash

INTRODUCTION TO LIGHTS, SHAPES AND SOUND SIGNALS

Lights

Lights using combinations of white, red, green and yellow colors are used at night to convey information regarding a vessel's

- Direction of movement;
- Method of propulsion;
- Size.

Additional lights are used to indicate if the vessel is:

- Towing;
- Fishing;
- Not Under Command;
- Restricted in Ability to Maneuver;
- Constrained by Draft;
- Aground;
- At anchor.

When attempting to decipher the meanings of a vessel's lights, try breaking the lights down into sections by identifying the basic lights and then concentrate on the lights that remain. Usually the most important decision is whether risk of collision exists. If risk of collision does exist it is obviously necessary to work out details of the other vessel before deciding on the correct course of action.

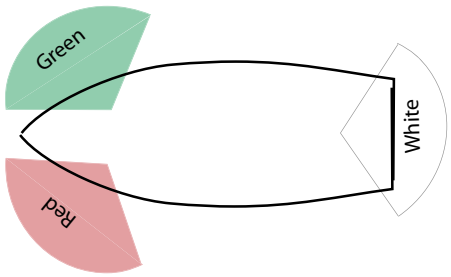
Perhaps the best sequence is to decide the vessels':

1. Aspect (ahead, astern, port, starboard);
2. Propulsion (i.e. under power, under sail, being towed);
3. Length;
4. Other information (i.e. towing, fishing, Restricted in Ability to Maneuver, Not Under Command, etc.)

Side lights and stern light

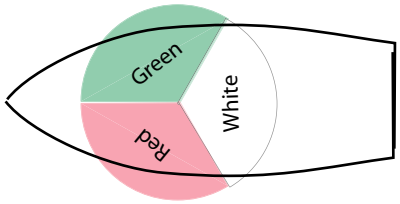
A sailing vessel underway (not at anchor, or made fast to shore, or aground) shows three basic lights, two sidelights and a stern light:

- a green light on the starboard side,
- a red light on the port side, and
- a white light at the stern.

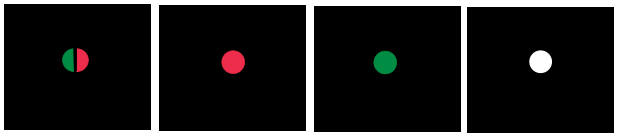


Sidelights and stern light of vessel underway

Or a sailing vessel less than 20 meters (65 ft) in length may combine side and stern lights in one lantern carried at or near the top of the mast. Note that this combined lantern must not be used when the yacht is using her auxiliary engine.

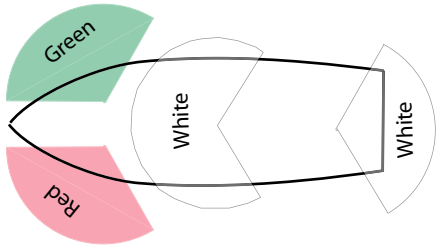


Sailing vessels less than 20 meters may use a combined side and stern light

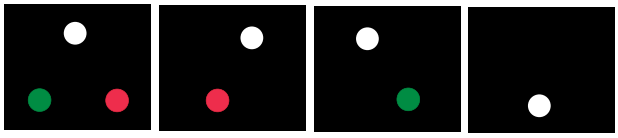


Seen From: *Ahead* *Port* *Starboard* *Astern*

A power driven vessel underway less than 50 m (164 ft) in length shows a white masthead light above the sidelights. A masthead light covers the same arc as the sidelights combined. Also a white stern light.

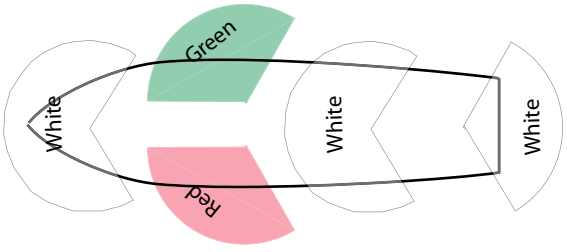


Power driven vessel underway, less than 50 meters in length

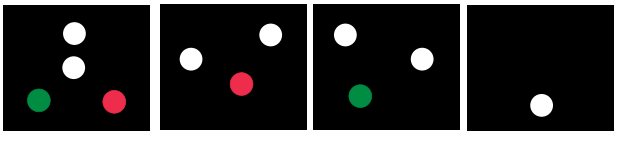


Seen From: *Ahead* *Port* *Starboard* *Astern*

A power driven vessel underway greater than 50 m in length shows a white masthead light forward and a second masthead light behind and higher than the forward masthead light.



Power driven vessel underway, greater than 50 meters in length



Seen From: *Ahead* *Port* *Starboard* *Astern*

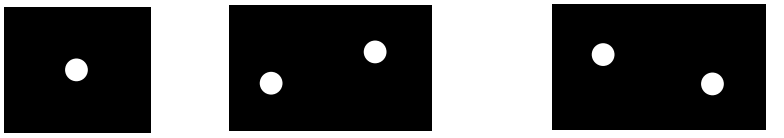
Vessels at Anchor

A vessel at anchor, less than 50 m in length, must show an all round white light where it may best be seen.

A vessel at anchor, greater than 50 m in length, must show in the fore part an all round white light and a second all round white light at or near the stern which is lower than the forward light.

If a vessel at anchor is greater than 100 m in lenght she shall use available lights to illuminate her deck.

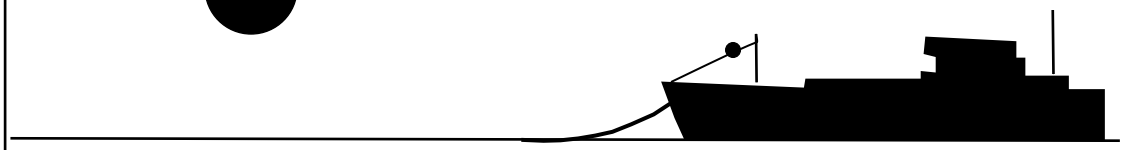
Vessels at Anchor



< than 50 m *> than 50 m, side, starboard* *> than 50 m, port side*

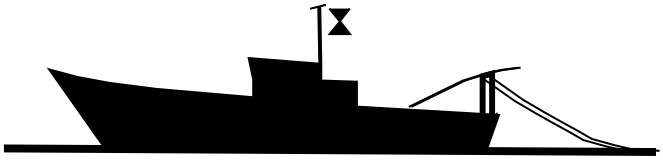
DAY SHAPES

Anchored

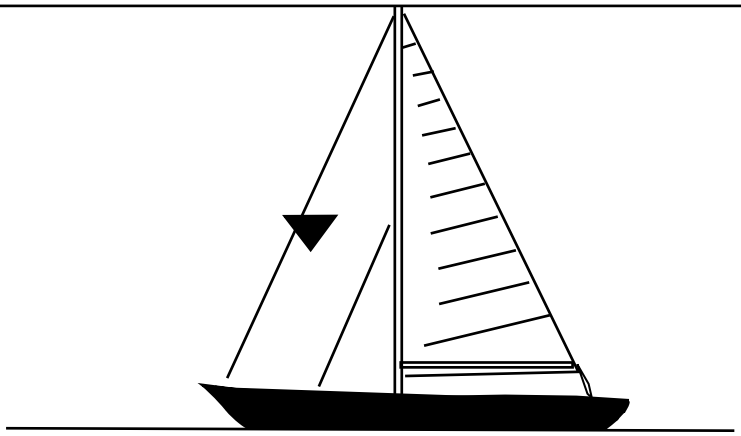


Fishing

+, when outlying gear extends more
than 150 m horizontally,
cone, apex up, in direction of gear.

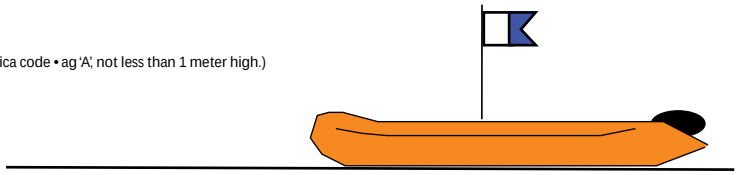


Motor Sailing



Diving
Operations

(Rigid replica code • ag 'A', not less than 1 meter high.)



= 1 second horn blast = short

= 4 to 6 second horn blast = prolonged

Morse 'U'

Means "You are running into danger":
This signal is often used by oil rigs, etc.

Sound Signals In Poor Visibility

Sound Signal		Every
	Power underway, making way	2 min
	Power underway, not making way	2 min
	Vessel sailing; vessel fishing; restricted in ability to maneuvre; constrained by draft; not under command; vessel towing or pushing	2 min
	Last manned vessel of tow	2 min
	Warning from vessel at anchor	when required
	Pilot vessel on duty	
5 secs	Vessel at anchor: Rapid bell for 5 secs. (+ gong aft for 5 s if vessel > 100 m)	1 min
1 2 3 — 5 secs — 1 2 3	Vessel aground As for at anchor + 3 strokes on bell before & after rapid bell rings	

Maneuvering and Warning Signals For Vessels In Sight Of Each Other

	I am altering course to starboard
	I am altering course to port
	I am operating astern propulsion
(Or More)	I do not understand your intentions! I doubt you are taking sufficient or appropriate action to avoid collision
	I intend to overtake on your starboard side
	I intend to overtake on your port side
	Agreement by overtaken vessel
	Approaching blind bend in channel
	Reply from vessel on other side of bend

Glossary of Terms

A

Aback.	A sail sheeted so that the wind fills the "back" of the sail.
Abeam.	At right angles to the side of the boat.
Aboard.	Situated on the boat.
Adrift.	A boat drifting without being propelled.
Aft.	At or towards the stern or behind the boat.
Aground.	A boat whose keel is touching the bottom.
Amidships.	Towards the center of the boat.
Apparent wind.	The wind aboard a moving boat
Astern.	Behind the stern of the boat.
Athwartships.	Across the boat from side to side.

B

Backstay.	The standing rigging running from the stern to the top of the mast, keeping the mast from falling forward.
Back.	1. To Sheet a sail to windward and fill the back of the sail and thus stop the boat or propel it backwards. 2. In the case of the wind - to shift counter clockwise from its previous direction.
Bail.	To empty the boat of water.
Ballast.	Weight in the keel of a boat that provides stability.
Barometer.	An instrument that measures air pressure, an aid to forecasting the weather.
Batten.	A thin wood or fiberglass slat that slides into a pocket in the leech of a sail, helping to maintain an aerodynamic shape.
Beam.	The width of a boat at its widest point.
Beam reach	(Point of sail) Sailing in a direction at approximately 90º to the wind.
Bear away.	To "fall off" or head away from the wind.
Bearing.	The direction from one object to another expressed in compass degrees.
Beating	A course sailed up wind.
Below.	The area of a boat beneath the deck.
Bend.	To attach a sail to a spar or a headstay or to attach a line to a sail.
Bight.	A loop in a line.
Bilge.	The lowest part of the boats interior where water on board will collect.
Bitter end.	The end of a line.
Blanket.	To use the sail or object to block the wind from filling a sail.
Block.	A pulley on a boat.
Boat hook.	A pole with a hook on the end used for grabbing hold of a mooring or retrieving something that has fallen overboard.
Boat speed.	The speed of a boat through the water.
Boltrope.	The rope that is sewn into the foot and luff of some mainsails and the luff of some jibs by which the sails are attached to the boat.
Boom.	The spar extending directly aft from the mast to which the foot of the main sail is attached.
Boom vang.	A block and tackle system, which pulls the boom down to assist sail control.
Bottom.	The underside of a boat.
Bow.	The forward part of the boat.
Bow line.	A line running from the bow of the boat to the dock or mooring.
Bow Spring.	A line running from the bow of the boat parallel to the dock or mooring that stops the boat from moving forward along the dock.
Bowline.	A knot designed to make a loop that will not slip and can be easily untied.
Breastline.	A short line leading directly from the boat to the dock.
Broach.	An uncontrolled rounding up into the wind, usually from a down wind point of sail.
Broad reach.	(Point of sail) Sailing in a direction with the wind at the rear corner (the quarter) of the boat. Approximately 135º from the bow of the boat.

Bulkhead. A wall that runs athwart6ships on a boat, usually providing structural support to the hull.
Buoy. A floating navigation marker.
Buoyancy. The ability of an object to float.
Bulwark. A solid side wall, often about waist high, from the outside edge of the deck to prevent someone falling overboard.
Burdened vessel. The vessel required to give way for another boat when the two may be on a collision course.
By the lee. A sailboat running with the wind coming over the same side of the boat as the boom.

C

Cabin. The interior of the boat
Can. In the U.S. an odd numbered green buoy marking the left side of the channel when returning to harbor.
Capsize To tip or turn a boat over.
Cast off . To release a line when leaving a dock or mooring.
Catamaran. A twin hulled vessel with a deck or trampoline between the hulls.
Catboat. A boat with only a mainsail and an unstayed mast located at the bow.
Centerboard. A pivoting board that can be lowered and used like a keel to keep a boat from slipping to lee ward.
Centerline. The midline of the boat running from bow to stern.
Chafe. Wear on a line caused by rubbing.
Chainplates. Strong metal plates which connect the shrouds to the boat.
Channel. A (usually narrow) lane, marked by buoys, in which the water is deep enough to allow a vessel safe passage.
Chart. A nautical map.
Charter. To rent a boat.
Chock. A guide mounted on the deck through which docklines and anchor rode are run.
Chop. Rough, short, steep waves.
Cleat. A nautical fitting that is used to secure a line.
Clew. The lower aft corner of a sail. The clew of the mainsail is held taut by the outhaul. The jib sheets are attached to the clew of the jib.
Close hauled. (Point of sail). The point of sail that is closest to the wind, when the sails are hauled close to the centerline of the boat.
Close reach. (Point of sail) Sailing in a direction with the wind forward of the beam (about 70º from the bow).
Coaming. The short protective wall that surrounds the cockpit or hatch.
Cockpit. The lower area of the deck in which the steering and sail controls are located.
Coil. To loop a line neatly so it can be stored, or a reel of line.
Come about. See tack.
Companionway. The steps leading from the cockpit or deck to the cabin below.
Compass. The magnetic instrument which indicates the direction in which the boat is headed.
Compass rose. The circles on a chart which indicate the direction of true and magnetic north.
Course. The direction in which the boat is being steered.
Crew. Besides the skipper, anyone on board whom helps run the boat.
Cunningham. A line running through a grommet a short distance above the tack of the mainsail which is used to tension the luff of the main.
Current. The horizontal movement of water caused by tides, wind and other forces.
Cutter. A single masted boat rigged with both jib and staysail.

D

Daysailer. A small sailboat.
Dead downwind. Sailing in a direction straight downwind.
Deck. The mostly flat area on top of the boat.
De-power. To reduce the power in the sails by:
1. Luffing, pointing the boat too close to the wind so that the sails are unable to draw power.

2. Easing the sheets so that the sails flutter.
3. Stalling. Sheeting the sails in so hard that the airflow over them stalls.

Dinghy. A small sailboat or rowboat.

Displacement. The weight of the boat; therefore the amount of water that it displaces.

Dock. 1. The quay or pontoon where a boat may be tied up.
2. The act of bringing a boat alongside to rest alongside.

Dockline. A line used to secure a boat to the dock.

Dodger. A canvas protection in front of the cockpit of some boats that is designed to keep spray off the skipper and crew.

Downhaul. A line used to pull down on the movable gooseneck on some boats to tension the luff of the mainsail. The cunningham has the same function.

Draft. The depth of a boat's keel from the waters surface.

E

Ease. To let out a line or sail.

Ebb. An outgoing tide.

F

Fairlead. A fitting that guides sheets and other lines in a way that reduces friction and therefore chafe.

Fairway. The center of a channel.

Fake (flake). Lay out a line on the deck using large loops to keep it from becoming tangled.

Fall off. (See also head down & bear away) Alter course away from the wind.

Fast. Secured.

Fathom. A measure of the depth of water. One fathom equals six feet.

Fender. An inflated rubber or plastic bumper used to protect a boat by keeping it from hitting the dock.

Fend off. Push off.

Fetch. The distance of open water to windward between the shore and the boat

Fid. A tapered spike used to open the lay of a rope when splicing.

Flood. An incoming tide.

Following sea. Wave pattern hitting the stern of the boat.

Foot. The bottom edge of the sail.

Fore. Forward.

Forepeak. An accommodation or storage area in the bow below the deck.

Foresail. A jib or genoa.

Forestay. The standing rigging running from the bow to the mast top and to which the foresail is secured.

Forward. Towards the bow.

Fouled. Tangled.

Fractional rig. When the forestay is attached to the mast some distance below the top.

Foul weather gear. Water resistant clothing.

Freeboard. The height of the hull above the water's surface.

Full. Not luffing.

Furl. To fold or roll up a sail.

G

Gaff. On some boats, a spar along the top edge of a four sided fore and aft sail.

Genoa. A large fore sail whose clew extends aft of the mast.

Give way vessel. The vessel required, by the regulations, to give way in a collision situation.

G.M.T. Greenwich Mean Time. The time at the prime meridian in Greenwich, London, England. Now referred to as Universal Time Coordinated U.T.C.

Gooseneck. The strong fitting that connects the boom to the mast.

Great Circle A line drawn on a chart which is accurate over a long distance, a section of the Earth which intersects the center of the Earth.

Grommet. A reinforcing ring set in a sail.

Ground tackle. Collective term for the anchor and rode (chain and line).

Gudgeon. A fitting attached to the stern into which the pintles of a rudder are inserted.
Gunwale. (gunnel) The edge of the deck where it meets the topsides.
Gybe. See jibe.

H

Halyard. A line used to raise or lower a sail.
Hank. A snap hook which is used to secure the luff of a foresail to the forestay.
Hard a-lee. (also Helms a-lee, lee oh, lee ho) The call given to the crew that will initiate the action of tack ing.
Hard over. To turn the helm or tiller as far as possible in one direction.
Hatch. A large covered opening in the deck.
Haul in. to tighten a line.
Head. 1. Top corner of a sail.
2. The toilet on a boat.
Headboard. The small reinforcing board affixed to the head of a sail.
Headed. A wind shift which causes the boat to head down or causes the sails to be sheeted in.
Heading the direction of the boat expressed in degrees.
Head down. To fall off , changing course away from the wind.
Head off. See head down.
Head up. To come up, changing course towards the wind.
Headsail. A jib, genoa attached to the forestay.
Headstay. See forestay. The standing rigging running from the bow to the top of the mast.
Head to wind. When the bow of the boat is dead into the wind.
Headway. Forward progress.
Heave. To throw.
Heave to. To hold one's position in the water by using the force of the sails and the rudder to counteract each other.
Holding ground. The seabed or bottom ground in an anchorage.
Hove to. A boat that has completed the process of heaving to with its aback, its main trimmed and its rud der positioned to hold the vessel close to the wind.
Heavy weather. Strong winds and large waves.
Heel. The lean of the boat caused by the wind.
Helm. The tiller.
Helmsman. The person responsible for steering the boat.
Hull. The body of the boat, excluding the rig and sails.
Hull speed. The theoretical maximum speed of a sailboat determined by the length of its waterline. The for mula is 1.4x the square root of the waterline length in feet.

I

Inboard. Inside of the rail of the boat.
In irons. A boat that is head to wind and unable to move or maneuver.

J

Jackstay. A wire or webbing strap attached at the front and back of a vessel along the deck to which a safety harness line may be clipped.
Jib. The small forward sail of a boat that is attached to the forestay.
Jibe. See also gybe. To change the direction of the boat by steering the stern through the wind.
Jibe oh. The command given to the crew when starting a jibe.
Jiffy reef. See slab reefing. A quick reefing system allowing a section of the mainsail to be pulled down and tied to the boom.
Jury rig. An improvised temporary repair.

K

Kedge. A smaller anchor than the main or bower anchor. Often used for maneuvering or kedging off.

Kedge off. To use an anchor to pull a boat into deeper water after it has run aground.

Keel. The heavy vertical fin beneath a boat that helps keep it upright and prevents it from slipping sideways in the water.

Ketch. A two masted sailboat on which the mizzen (after) mast is lower than the mainmast and is locat ed forward of the rudderpost.

Knockdown. A boat heeled so far that one of its spreaders touches the water.

Knot one nautical mail per hour.

L

Land breeze. A wind that blows over the land and out to sea.

Lash. To tie down.

Lay. To sail a course that will clear an obstacle without tacking.

Lazerette. A storage compartment built into the cockpit or deck.

Lazy sheet. The windward side jib sheet that is not under strain.

Lead. To pass a line through a fitting or block.

Lee helm. The boats tendency to turn away from the wind.

Lee shore. Land which on the leeward side of the boat. A potential danger because the wind will be blowing the boat towards it.

Leech. The after edge of a sail.

Leeward. The direction away from the wind that is the direction that the wind is blowing to.

Leeward side. The side of the boat or sail that is away from the wind.

Leeway. The sideways slippage of the boat in a downwind direction.

Lifeline Rope or wire supported by stanchions, around the outside of the deck to help prevent crew mem bers from falling overboard.

Lift.
1. The force that results from air passing by a sail or water past a keel that moves the boat forward and sideways.
2. A change in the direction of the wind which allows the boat to head up.

Line. A rope.

LOA. The maximum Length Overall fore and aft along the hull.

Lubber line. A line on a magnetic compass to help the helmsman steer the correct course.

Luff.
1. The leading edge of a sail
2. The fluttering of a sail caused by aiming too close to the wind.

Lull. A decrease in wind speed for a short duration.

LWL. The length fore and aft along the hull measured at the waterline.

M

Magnetic. In reference to the magnetic north rather than true north.

Mainmast. The taller of two masts on a boat.

Mainsail. The sail hoisted on the mast of a sloop or cutter or the sail hoisted on the mainmast of a ketch or yawl.

Mainsheet. The controlling line for the mainsail.

Marlinspike. A pointed tool used to loosen knots.

Mast. The vertical spar in the middle of a boat from which the mainsail is set.

Masthead. The top of the mast

Maststep. The fitting in which the foot of the mast sits.

Mizzen. The small aftermost sail on a ketch or yawl hoisted on the mizzenmast

Mizzenmast. The shorter mast aft of the main mast on a ketch or yawl.

Mooring. A permanently anchored ball or buoy to which a boat can be tied.

N

Nautical mile. Standard nautical unit of distance, equal to one minute of arc of the Earth's latitude or 6080 feet.

Navigation rules. Laws established to prevent collisions on the water.

No-go zone. An area into the wind in which a sailboat cannot produce power to sail.
Nun. A red even numbered buoy marking the right side of a channel when returning to port. Nuns are usually paired with cans.

O

Offshore wind. Wind blowing off (away from) the shore and out to sea.
Offshore. Away from or out of sight of land.
Off the wind. Not close-hauled.
On the wind. Sailing up wind, close-hauled.
Outboard. Outside the rail of a boat.
Outhaul. The controlling line attached to the clew of a mainsail used to tension the foot of the sail.
Overpowered. A boat that is heeling too far because it has too much sail up for the amount of wind.

P

Painter. The line attached to the bow of a dinghy.
Pay out. To ease a line.
P.F.D. Abbreviation for Personal Flotation Device such as a life jacket.
Pinching. Sailing too close to the wind.
Pintle. Small metal extension on a rudder that slides into a gudgeon on the transom. The gudgeon/pintle fitting allows the rudder to swing back and forth.
Point.
1. To steer close to the wind.
2. A compass point equals 11¼ degrees. Compass annotation used before headings were referred to in 360º notation.

Points of sail. Boats direction in relation to the wind - i.e., close hauled, reaching etc.
Port.
1. The left hand side of the boat when facing forward.
2. A harbor.
3. A window in a cabin on a boat.

Port tack. Sailing on any point of sail with the wind coming over the port side of the boat.
Prevailing wind. Typical or consistent wind direction.
Puff. An increase in wind speed.
Pulpit. A guardrail at the bows of a vessel.

Q

Quarter. The sides of the boat near the stern.

R

Rail. The outer edges of the deck.
Rake. The angle of the mast.
Range. The alignment of two objects that indicate the middle of a channel.
Reach. One of the several points of sail across the wind.
Ready about. The command given to the crew to prepare to tack.
Ready to jibe. The command given to the crew to prepare to jibe.
Reef. To reduce the area of a sail.
Reeve. To pass a line through a ring or block.
Rhumb line. A straight line drawn on a Mercator chart, which intersects all meridians at the same angle. Accurate enough for courses of less than 600 miles. For great distances a Great Circle route is used.
Rig.
1. The design of a boat's masts, standing rigging and sail plan.
2. To prepare a boat to go to sea.

Rigging. The wires and lines used to support and control sails.
Roach. The sail area aft of a straight line running between the head and clew of a sail.
Rode. The line and chain attached from the boat to the anchor.
Roller-furling. A mechanical system to roll up a headsail around the headstay.
Rudder. A vertical blade attached to the bottom of the hull which is used to steer the boat.

Run. Point of sailing when the wind is coming from dead astern.
Running rigging. The lines used to control the sails.

S

Sail ties. Lengths of line or webbing used to secure sails when they are dropped or to secure the unused portion of a reefed sail.
Schooner. A two masted boat whose foremast is the same height or shorter than its mainmast.
Scope. The length of anchor rode paid out in relation to the maximum depth of water.
Scull. To propel a boat with a single oar fixed in a notch through the transom.
Scupper. A cockpit or deck drain.
Sea breeze. A wind that blows from the sea onto the land.
Seacock. A valve which opens and closes a hole used as an intake or discharge from the boat.
Secure. The make safe or tie down.
Set. 1. The direction of the current
2. To trim the sails.
Shackle. A metal fitting at the end of a line used to attach the line to a sail or another fitting.
Shake out. To remove a reef.
Sheave. The wheel inside a block or fitting over which the line runs freely.
Sheet. A line used to control a sail by pulling it in or easing it out.
Shoal. An area of shallow water.
Shroud. Standing rigging at the side of the mast.
Singlehanded. Sailing alone.
Skeg. A vertical fin in front of the rudder.
Sloop. A single masted sailboat with mainsail and headsail.
Sole. The floor in a cockpit or cabin.
Spar. A pole used to attach a sail on a boat, for example the mast, the boom or a gaff.
Spinnaker. A large down wind headsail not attached to the head stay.
Splice. The joining of two lines together by interweaving their strands.
Spreader. A support strut extending athwartships from the mast used to support and guide the shroud from the top of the mast to the chainplate.
Spring line. A dockline running forward or aft from the boat to the dock to keep the boat from moving fore or aft.
Squall. A fast moving short intense storm.
Stanchions. Stainless steel or aluminum supports at the edge of the deck which hold the lifelines.
Standing rigging. The permanent rigging of a boat, including the forestay, backstay and shrouds.
Starboard. The right hand side of the boat when looking forward from the stern.
Starboard tack. Sailing on any point of sail with the wind coming over the starboard side of the boat.
Stay. A wire support for a mast, part of the standing rigging.
Staysail. On a cutter, a second small inner jib attached between the bow and the mast. Any sail which is attached to a stay.
Steerage Way. The minimum speed of the boat through the water that allows the rudder to function efficiently.
Stem. The foremost tip of the boat.
Stern. The aft part of the boat.
Stern Spring. A line running from the stern of the boat parallel to the dock or mooring that stops the boat from moving backward along the dock.
Stow. To store properly.
Swamped. Filled with water.

T

Tack. 1. To alter course so as to cause the bow of the boat to pass through the eye of the wind.
2. The forward lower corner of a sail.
Tackle. A series of blocks and line that provide a mechanical advantage.
Tail. To hold the end of a line so as to keep it under tension on a winch.

Telltales.	Short lengths of yarn or cloth attached to the sails which indicate when the sail is properly trimmed.
Tide.	The rise and fall of water level due to the gravitational effects of the sun and the moon.
Tiller.	A long handle attached to the rudder which is used to steer the boat.
Toe rail.	A low rail around the outer edge of the deck.
Topping lift.	A line used to hold the boom up when the mainsail is lowered or stowed.
Topsides.	The sides of a boat between the waterline and the deck.
Transom.	The vertical surface of the stern.
Trim.	To adjust the sail controls to create optimum lift from the sails.
Trimaran.	A three hulled vessel.
True wind.	The actual speed and direction of the wind as you would feel when standing still.
Tune.	To adjust the boats standing rigging.
Turnbuckle.	A mechanical fitting (a bottlescrew) attached to the lower ends of stays allowing the standing rig ging to be adjusted.

U

Underway.	A boat that is not attached to the ground by either anchor or mooring lines is said to be under way.
Upwind.	Towards the direction of the wind.
USCG.	United States Coast Guard.
U.T.C.	Universal Time Coordinated. The modern term for Greenwich Mean Time, this is the standard reference time which is used internationally for navigational information.

V

Vang.	See boom vang.
Veer.	A clockwise change in the wind direction.
Vessel.	Any sailboat, powerboat or ship.

W

Wake.	Waves caused by a boat moving through the water.
Waterline.	The horizontal line on the hull of a boat where the surface of the water should be.
Weather helm.	The tendency of the boat to head up towards the wind, this increases as the sailboat becomes overpowered.
Weather side.	See windward side.
Whip.	To bind together the strands at the end of a line.
Whisker pole.	A pole temporarily mounted between the mast and the clew of the jib. Used to hold the sail out and keep it full when sailing down wind.
Winch.	A deck-mounted drum with a handle offering mechanical advantage when used to trim sheets. Winches may also be mounted on the mast to assist with raising sails.
Windward.	Towards the wind.
Windward side.	The side of the boat closest to the wind.
Wing-and-wing.	Sailing downwind with the jib set on the opposite side to the mainsail.
Working sails.	The mainsail and the standard jib.
Working sheet.	The leeward sheet that is under tension.

Y

Yawl.	A two masted vessel on which the mizzenmast is mounted aft of the rudderpost.

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