2018

INTERNATIONAL FLOTILLA SKIPPER & BAREBOAT SKIPPER COURSE NOTES

POWER & SAILING VESSELS UP TO 24 METERS / COMMAND

(IYT PASSPORT TRAINING PROGRAMME MODULES 13-25)

International Yacht Training

WORLDWIDE

Revised September 19, 2019

LIST OF IYT COURSES

Recreational Courses

Dinghy Sailing - Bronze Level – Start Sailing
Dinghy Sailing – Silver Level – Safe Sailing
Dinghy Sailing – Gold Level - Independent Sailing
Dinghy Sailing – Platinum Level – Perfected Sailing
International Yacht Racing
Introduction to Yachting
International Crew Power or Sail
International Flotilla & Bareboat Skipper Power or Sail
International Flotilla & Bareboat Skipper Sail - Catamaran
VHF Radio Operator
Personal Watercraft Operator (PWC)
Small Powerboat & RIB Master (MCA Approved)
Powerboat Skipper
Navigation Master
Weather Master
International Certificate of Competency <10m Power Coastal
International Certificate of Competency <10m Power Coastal & Inland
International Certificate of Competency <24m Power Coastal
International Certificate of Competency <24m Power Coastal & Inland
International Certificate of Competency <24m Sail & <10m Power Coastal
International Certificate of Competency <24m Sail & <10m Power Coastal & Inland
International Certificate of Competency PWC Coastal
International Certificate of Competency PWC Coastal & Inland
Yachtmaster Coastal Power or Sail
Yachtmaster Offshore Power or Sail
Yachtmaster Ocean
IYT Commercial Tender License

Professional Courses

VHF Radio Operator
Small Powerboat & RIB Master (MCA Approved)
Superyacht Crew
Professional Superyacht Hospitality
Superyacht Chef
STCW Elementary First Aid
STCW Basic Fire Prevention & Fire Fighting
STCW Proficiency in Maritime Security Awareness
STCW Personal Survival Techniques
STCW Personal Safety & Social Responsibilities
Master of Yachts Coastal/Mate 200 Tons

Master of Yachts Limited
Master of Yachts Unlimited
MCA/IYT Master of Yachts Inshore Power <80gt

Diveboat Courses

IYT Dive Boat Crew
IYT Diveboat Master <10M
IYT Diveboat Master <24M

Commercial-Tactical-Rescue

Marine Police Powerboat Operator –Crew
Marine Police Powerboat Operator –Coxswain
Marine Police Powerboat Operator –Commander
Fast Rescue Boat
Inshore Master < 80gt.

We also offer instructor courses for all levels of training.

PREFACE

Introduction

If you are undertaking this course, you will have completed IYT Passport to Boating and Sailing modules 1 through 11 or have training qualifications recognised to that level. You must also be in possession of a VHF Certificate of Competency or undertake our VHF Radio Operator's course.

IYT Worldwide has recognised the need for a standardised approach to yacht training globally and has successfully established a partnership programme offering courses to candidates through a network of existing and high quality established recreational sailing and motor yacht training schools around the globe. The model has been enthusiastically embraced by a growing number of countries and schools.

Currently, over twenty countries accept our commercial Master of Yachts Certificates of Competency and recreational Yachtmaster Certificates. IYT Worldwide is continuing to promote their yacht training certification programmes globally. The Company delivers over 30 courses to both professional and recreational yachtsmen and women and enjoys a first class international reputation. The quality positioning of the Company's training has resulted in stand-alone approval of certifications as outlined by the United Nation's International Maritime Organization (IMO).

The IYT Worldwide Training Programme

IYT Worldwide has developed a recreational programme to allow a candidate to learn and develop the skills needed to run a power or sailing boat, from absolute beginner to Yachtmaster Ocean. It is designed to be infinitely modular; the modules are structured to guide the complete novice from beginner to an internationally recognised and safe standard of competence.

This training programme also leads candidates who wish to operate vessels commercially, toward attaining Professional Certificates of Competence, COC, as required by a growing number of international maritime authorities for operators of commercial vessels less than 24 metres or 80 feet in length. These Commercial COCs are the Master of Yachts (MOY) Coastal/Mate, Limited and Unlimited certificates. (The Master of Yachts Certificates are internationally recognised not only for vessels less than 24 metres, but also for vessels over 24 metres in length and up to 200 gross tons)

The modules can be taken either singularly or in groups depending on the time available to the candidate, (i.e. days, weekends or weeks). The objective is to allow the theory modules to be achieved by intensive classroom training, with the practical elements done at a later

time, or for the theory and practical courses to be run as a complete stand alone course/s or almost any other variation convenient for the participants.

(It is suggested that all the modules of a particular course should be completed within a maximum of two years in order to keep the content fresh in the candidates' mind).

Module Completion / Certification

The International Crew certificate requires the completion of all course modules 1 through 11 before being awarded the International Crew, Certificate of Competency.

The IYT VHF-SRC Marine Communications certificate requires the completion of module 12 before being awarded the International Flotilla or Bareboat Skipper Certificate of Competency, OR, the candidate must hold a recognised VHF Radio operator certificate from another recognised issuing authority.

The International Flotilla and Bareboat Skipper certificate requires the completion of all course modules 13 through 25 before being awarded the International Flotilla or Bareboat Skipper Certificate of Competency.

The "depth of knowledge" required for the theory portion of the International Flotilla Skipper Certificate is the same as required for the International Bareboat Skipper Certificate, therefore, the course material is exactly the same for both.

For International Flotilla Skipper – no prerequisite sea time is required for this certificate, however, it is not a beginner's course. Sea time while training for the flotilla skipper certificate will be considered toward certification and experience.

For International Bareboat Skipper – candidates must have logged over 200 miles and 10 days at sea by the end of the course in order to obtain the International Bareboat Skipper Certificate of Competency. The school principal or instructor will order the appropriate certificate for your level of experience.

The International Certificate of Competency (ICC) may also be awarded to candidates who hold the International Bareboat Skipper provided the course has been taken at an IYT school authorised to complete this level of training. The ICC is mandatory for chartering in some areas of the European Union. The ICC is a qualification stating that an individual is competent to meet the standards required by the United Nations Economic Commission for Europe, Inland Water Committee (UN ECE IWC) Resolution 40. The ICC is required in most European Countries in order to operate a pleasure craft up to 24 meters in both inland and coastal waters.

An Inland Waters Endorsement (CEVNI) is required to operate vessels in inland waterways and canals throughout Europe. To receive this endorsement, the candidate may take the E learning CEVNI Course and examination at www.IYTworld.com which is a theory examination on Inland waterways, navigation and safety.

ICC endorsements will be discussed further in the International Bareboat Skipper course or further information is available at www.IYTworld.com.

- **A substantial part of the training will rely on the "hands on" practical application of the theory modules.**

In Canada, completion of the section on Canadian specific requirements can also be awarded the **PCOC (Pleasure Craft Operator Card).**

Course Objectives

The objective of the course is for the student to develop the knowledge and skill sets to competently command a vessel up to 24 meters in length with knowledge described in the scope section of this framework for both International Crew and International Bareboat Skipper.

As with all IYT courses, depth of knowledge increases as student's progress through the various levels of training.

A substantial part of the training will rely on the "hands on" practical application of the theory modules.

Important Notice

While every effort has been made to insure their accuracy, these notes are designed to be accompanied by additional materials that contain local navigation knowledge, sources of weather information, local tides, currents and weather conditions as applicable to the area of operation.

Any comments or suggestions for this document should be directed to International Yacht Training. Please e-mail: support@IYTworld.com or telephone Canada 778-477-5668.

Scope

The scope of this 5 to 6 day course is for the student to obtain the theory and practical knowledge required to safely and competently operate as skipper/captain with full understanding and application of contents of these notes.

Amendments

Amendments and updates to the Publication will be published as and when necessary. Edition number and date will be noted on the footer of each stage.

Record of Changes

June 23, 2018	**Page iv – module completion** Prior statement "For International Bareboat Skipper - candidates must prove they have acquired the 200 miles and 10 days at sea as skipper or chief mate to obtain the International Bareboat Skipper Certificate of Competency.." New statement "For International Bareboat Skipper – candidates must have logged over 200 miles and 10 days at sea by the end of the course in order to obtain the International Bareboat Skipper Certificate of Competency.."
August 7, 2019	Changed information and image on running fix in Chapter 19.
Sept 9, 2019	Changed information regarding CPR, Choking & Treatment of Carbon Monoxide Poisoning

Publication information

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CANADA

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Module 13 SMALL POWERBOATS & RIGID INFLATABLE BOATS (RIBS)

13.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO FAMILIARISE THE STUDENT WITH SMALL POWERBOATS AND RIB'S, THE VARIOUS TYPES, ENGINES, GENERAL OPERATING, LAUNCHING, RECOVERY, BEACHING, FAULT FINDING, STABILITY, RECOVERY, TOWING AND CRASH STOPS.

13.2 Types – Advantages and Disadvantages

Small powerboats, sailboats and rigid inflatable boats are commonly called dinghies, but should not be confused with sailing dinghies. These vessels are designed for short passages between harbours and boats at anchor, or taking guests to and from the beach. Designs vary in shape and size.

	ADVANTAGES	DISADVANTAGES
Wood & Fiberglass	Mostly puncture resistant	When coming alongside another vessel they can scratch the hull.
Inflatable	They will not damage vessels when coming alongside as they are flexible	Can be easily punctured by reefs or sharp objects.

FIGURE 13-3 INFLATABLE DINGHY

FIGURE 13-3 RIGID DINGHY

FIGURE 13-3 SMALL POWERBOAT DINGHY

13.3 Inboard Motors

Only large dinghies (10 passengers or more) tend to have inboard engines and are very heavy to lift and tend to be expensive to purchase. Due to their weight they are more popular on superyachts which have special "hydraulic cranes" to lift them onto davits on board deck.

13.4 Jet Drives

FIGURE 13-4 JET DRIVE

- Jet drive dinghies have the same propulsion system as a jet ski's or personal watercraft. They have no propellers, therefore, they are safer to use around swimmers.

- A disadvantage of jet drives is that they can easily suck in plastic bags, debris or jellyfish which will shut down the motor.

13.5 Outboard Motors

The outboard motor is fitted to the transom of the dinghy either by means of a stern bracket and clamps or on larger dinghies by bolts and nuts. There is a tilt mechanism, which may be either manual on small engines or electric on larger ones. This allows the engine to be raised when in shallow water or when launching.

FIGURE 13-5 SINGLE OUTBOARD ENGINE

- Most outboard engines are fuelled by petrol/gasoline and may be 2 stroke or 4 stroke. A 2 stroke engine has oil mixed into the petrol/gas tank (newer engines have a separate oil reservoir and pump which mixes the oil and petrol/gas before injection). 4 Stroke engines are petrol/gasoline driven with a separate oil lubrication system.

- 2 stroke engines are generally cheaper than 4 stroke engines. 4 stroke engines generally run smoother, quieter and are more environmentally friendly.

FIGURE 13-6 MULTIPLE OUTBOARD ENGINES

13.6 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.

FIGURE 13-7 STEERING WITH A TILLER

13.7 Ventilation & Cavitation

- If air is drawn onto the blades of a rotating prop it will lose grip, causing a sudden rise in the RPM and loss of speed. This may cause "cavitation", which is the loss of effective propeller thrust. This phenomenon also has a corrosive effect on the blades. Stainless blades, being sturdier and thinner are less affected.

- One other effect of the propeller is that it produces stern thrust as well as a sideways "paddle-wheel effect" and will swing the bow of the boat to port or starboard depending on the hand of the propeller and whether the boat is moving forwards or astern. This effect is called "prop-walk". Most single screw motors turn clockwise when viewed from astern.

FIGURE 13-8 CORRODED PROP DUE TO CAVITATION

13.8 Pre-Launch Procedures

1. Check that the outboard motor is firmly clamped or bolted to the transom and the safety cable/chain is connected to a strong point on board.

2. Stow safety, signaling and PFD equipment, where it will not be in the way but is readily available if needed.

3. Fuel tank should be full and positioned safely to assist in overall stability.

4. Anchor and warp should be checked for utility and 'bitter end' for security. (Make sure the end of the anchor line is tied on!)

5. Make sure the drain hole bungs are in place.

6. Take adequate personal supplies of food and water for the duration of the voyage.

Fueling (see Module 7 – Refueling)

Ensure you know whether you are dealing with a 2 stroke of 4 stroke engine before fueling. There should be no naked flames when fueling, i.e. smoking. Keep a fire extinguisher handy. Avoid overfilling and make sure there is good ventilation.

13.9 Engine Starting & Stopping

Pre-Start Checks:

1. Ensure the fuel tank is full, shake the fuel tank to mix the contents (where applicable).
2. Check fuel lead is connected.
3. Prime the engine by squeezing the primer bulb.
4. Check the engine is firmly secured.
5. Check the tilt mechanism is locked in the 'run' position.
6. Ensure the kill cord is connected.
7. Put gear shift into neutral.
8. If the engine is cold, use choke, be careful not to over-choke and flood the engine.

Starting the Motor

FIGURE 13-9 KILL CORD

1. Do not start the motor unless you know how to stop it! The stop device is usually a red button that is pushed and held until the motor stops. Can also be a key operated mechanism much like a car ignition or the kill cord. (consult your manual)

2. Check that the motor is securely mounted and water intake is submerged so that cooling water is pumped around the motor.

3. Connect the fuel line, open the breather vent on the fuel tank and pump the bulb to prime the system. (bulb will become firmer)

FIGURE 13-10 PRIMER BULB

4. Make sure kill cord/cut out device is in place and gear lever in neutral. Use choke if starting from cold. Gear lever on side has three positions forward, neutral and reverse.

5. With the throttle position on 'start' either pull the starter cord firmly until motor starts or turn ignition key for electronic starting.

FIGURE 13-11 THROTTLE CONTROL

6. If motor fails to start after a few pulls open choke and try again. Be careful of back-elbowing an unsuspecting crewmember! As soon as the motor fires, push in the choke and ease the throttle.

7. Check for cooling water circulation. Do not engage gears at high RPM.

13.10 Fault Finding

Sometimes an outboard motor will not start for simple reasons, however, with larger and more modern engines utilizing electronics all but the very simplest problems will need to be dealt with by a qualified mechanic.

Common reasons for an outboard not to start are:

POSSIBLE CAUSE	WHAT TO CHECK
No Fuel Flow	Check for fuel in the tank
	Check fuel line is properly connected and primed. Some tanks have a rubber hand squeeze pump in the fuel line for priming the engine.
	Clean fuel filter in power head.
Kill Cord	Make sure is connected
	Not turning over?, Check battery, battery switch and all electrical connections.
	Check fuses.
	Remove and check spark plugs.

13.11 Dinghy Stability and Handling

- Crew or passengers must take great care when entering or leaving a dinghy and be aware that their weight and position in the vessel affects its stability.

- Before casting off from the yacht or the dock the helmsman should make sure that he is satisfied with the distribution of weight in the dinghy both in the port to starboard plane and also fore and aft as this will affect stability.

- Weight distribution may be changed according to sea conditions and speed, especially if the dinghy is capable of getting up on the 'plane', which may require weight forward to assist.

FIGURE 13-12 DINGHY STABILITY / ENSURE BALANCE OF PASSENGERS

- Before departure, all passengers should be aware of the location of all lifejackets (if they are not wearing them) and all safety equipment and how to use it.

- A safety briefing should be conducted for all passengers including what to do in the event of an emergency.

- Once in the dinghy, passengers should sit down and hold on.

- To preserve stability, passengers and any other items should be placed to spread the load evenly, both from side to side and fore and aft. *For example, if there are four passengers and the crewmember in charge of the dinghy, traditionally known as "the helmsman" then they should sit two and two evenly with the helmsman at the stern to operate the outboard and steer.*

- Being low in the water, the visibility for the helmsman is not good and passengers must take care not to obscure his vision.

- If the helmsman is satisfied with the trim, he/she should ensure that all crewmembers or passengers are seated and holding on before casting off.

- Acceleration should be applied smoothly and evenly and the speed adjusted to the conditions and to safety requirements.

- The helmsman should always ensure that proper control of the vessel is maintained at all times. On larger dinghies/RIBs (with fixed equipment) it is advisable to keep one hand on the wheel and the other on the throttle at all times.

- When throttling back to come off the plane this should be done smoothly to ensure that the stability of the dinghy is not compromised.

- The boat should be allowed to slow before going into neutral and should never be taken from full speed ahead to going astern.

13.12 Beaching

- If there are big breakers or a deep swell, do not try to beach the vessel. It can be an unnerving and dangerous experience. It is relatively easy in calm seas with little swell or breaking waves near the beach.

- The type of shoreline will also have to be taken into account, smooth sand will present few problems, however, rocky coastlines will need to be treated with respect to avoid puncturing the boat.

- Approach with controlled speed, shift weight aft to raise the bow. Have someone at the bow looking out for rocks/coral heads. When getting close to the beach, tilt your outboard up 1/3 of the way, then kill the engine and coast onto the beach.

- If the approach is wrong and the desired effect is not achieved one of the crew will have to jump in the water to pull the dinghy ashore. Before leaving the beach, pull the dinghy above the water line and tie it to a tree, a rock or anchor it on the beach as shown.

- When launching it will be necessary to carry/drag it down the beach until it is floating. Initially one may have to row or paddle until the water is deep enough to lower the outboard back to its normal operating position and start the motor.

Approach with controlled speed, someone at bow as lookout, tilt outboard engine up 1/3

Kill engine and coast to beach, crewmember to pull line & anchor/boat to beach, secure anchor onto beach.

FIGURE 13-13 BEACHING SEQUENCE

13.13 Dinghy Equipment

This is very dependent on the size and intended use of the dinghy, ideally it should have the following:

- Lifejackets
- Flashlight, this will be also used at night as a navigation light. If the dinghy is less than 7m (20') in length it is not required to have the standard navigation lights. (Check local regulations)
- Sufficient oars or paddles, in addition to an outboard motor, if fitted.
- A bailer.
- Compass
- A painter (bowline) of sufficient length.
- Whistle or equivalent sound signal.
- A first aid kit.
- A boat hook.
- A knife or small hatchet.
- A portable fire extinguisher.
- Flares
- Anchor and line.
- VHF radio, most conveniently a hand-held.
- GPS
- Tool box
- Binoculars

13.14 Trailer Launch

Safety/Preparation

- Driving and reversing a trailer should be practiced in a safe and open environment until the operator feels comfortable enough to attempt a slip-launch under the critical gaze of fellow boaters!

- Maneuver the trailer to launch position. How far the trailer is reversed into the water depends on the size/weight of the vessel, the gradient and the availability of helping hands.

- The rear of the boat needs to float so that it can be pushed or driven off the trailer. If possible, keep car wheels out of the water.

- On a shallow gradient lower the trailer jockey wheel and use an extension bar or a length of rope attached between the tow ball and the trailer. This will enable the load to be reversed further into the water. Make sure the winch cable is attached to the boat while carrying out this maneuver. Slippery ramps can cause the towing vehicle to slide into the water!

- To prolong their life, allow time for trailer bearings to cool down before immersing in water.

- Make sure the vessel's bungs are in place and there is no damage to hull during transit.

FIGURE 13-14 BUNG PLUG

- Disconnect and remove trailer lights, boat cover etc. If the ramp is steep, the boat may enter the water rapidly, be prepared, and keep control of the hand winch at all times.

- Whether using power or hand winch… launch slowly!

- Painter should be attached to prevent boat floating away when launched. Inspect launch mechanism and winch cable for wear and fraying.

- Protective footwear is recommended; there may well be sharp objects, broken glass, stones etc. on ramp. Expect ramp to be slippery, especially at low tide.

- Ensure that the slipway/launch-point selected is suitable and appropriate to accommodate your trailer and vessel and make sure you have everything you need on board prior to launching. It may be easier to stow prior to launching.

- Check in advance that there is enough water for launch and recovery at convenient times. Are conditions safe for launching? Strong winds, especially on-shore winds can make launching hazardous.

FIGURE 13-15 TRAILER WINCH

FIGURE 13-16 TRAILER LAUNCH SEQUENCE

13.15 Trailer Recovery

- The preferred method of recovery is to drive the boat on to the pre-positioned trailer. The alternative is to slip over the side of the boat in shallow water and guide the boat gently over the rollers. Hook the cable to the D-ring winch point and crank up.

- On approach, tilt the engine up so as not to ground the propeller. The trailer should be partially submerged to allow the boat to be driven or manually guided and floated on for easy recovery.

- Use fresh water to flush the engine cooling system (see owner's manual) and wash the boat and trailer especially after use in salt water as corrosion will occur.

- Great care must be taken when around trailers, winches and hitches and ramps. All launch and recovery operations should be carried out slowly, safely and under control. Beware of rapidly spinning winch handles they can break bones!

- Reconnect trailer lights and check function, replace cover and make fast. Remove loose items, which may be lost in transit. Before commencing tow make sure boat is secure in its cradle and the hitch is connected according to manufacturer's recommendations.

13.16 Launching Procedures

- Rigid dinghies are often carried on davits at the stern of the vessel from where they may be lowered to the water.

- If the dinghy has been stowed on deck it may require the use of a halyard to help lift it over the lifelines and down into the water, this should be done before attaching the outboard motor.

- Make sure the dinghy's painter is attached to the yacht before lowering it over the side. (a bow line on a small dinghy is called the "painter". Larger yachts will have crane operated launching facilities.

- One crewman should then get in the dinghy and make it secure alongside the yacht, the outboard motor can then be passed down, again, use a halyard to help lift it over the lifelines and down into the dinghy. It can then be located on the transom, the fuel tank passed down and connected to the motor.

- Fuel for outboard engines should be treated with extreme care on a yacht, store the dinghy fuel on deck or in a separate vented locker.

FIGURE 13-17 CRANE LAUNCH

FIGURE 13-18 HALYARD LAUNCH

FIGURE 13-19 STERN LAUNCH

13.17 Emergency / Crash Stops

A crash stop should only be used in an emergency such as a man overboard situation. Always warn the crew prior to performing a crash stop.

There are two methods:

1. Throttle back to neutral and turn the boat to either port or starboard and present the beam of the boat to the wake.

2. Throttle back to neutral while watching the stern carefully, throttle ahead as the wake arrives.

13.18 Towing

- Picking up a tow requires care and communication. Picking up the tow is usually best achieved by crossing ahead of the vessel to be towed depending on what proves most practical. Weather conditions, manpower and maneuverability of the boat will also dictate the manner of the transfer.

- When towing, bear in mind that the tow will have little or no steerage, therefore all turns should be gentle. You can easily turn inside of your tow, colliding with it or picking up the towline in your propeller.

- When bringing the towed craft alongside a rescue vessel, quay wall, etc. remember that the tow cannot give a kick astern to stop, so use wind and tide to best effect.

Towing Procedure

1. Attach towline to vessel to be towed.
2. Approach 90 degrees or possibly 45 degrees.
3. Tow attached to strong point on tow boat – ideally a bridle.
4. Set scope of towline.
5. In enclosed waters, tow should be kept as short as possible.
6. In open waters tow should be lengthened according to sea conditions.
7. Commence gently taking up the strain.
8. Crewman watches tow at all times.
9. Towed vessel weight should be kept aft and steered if rudder is available.

At night the correct navigation lights should be displayed for towing operations.

Towing Alongside

The purpose of a side tow is to maneuver the disabled boat in confined areas.
Pre-rigging the line for the side tow (this is done by a second crewman while the disabled boat is in stern tow).

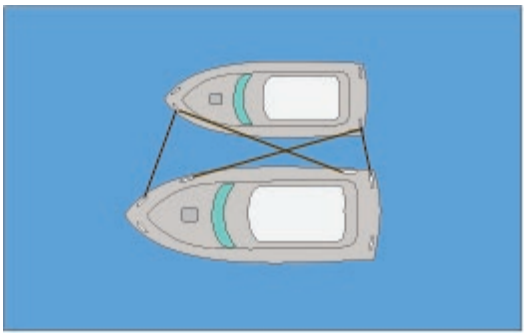


FIGURE 13-20 TOWING ALONGSIDE

1. Attach bowline to bow and sternline to stern of disabled boat
2. Attach springlines fore and aft to disabled boat
3. Manoeuver slowly and cautiously to destination.

Bridle Towing

In the case of outboard motors, it is always best to rig a “bridle” for towing. This will prevent the towing vessel from being pulled from side to side by the uneven distribution of the weight of the vessel being towed. To rig a bridle, attach a short line from both aft cleats as shown. The towing line is then attached to the center of the bridle thus reducing the probability of catching the towing line in the propeller.

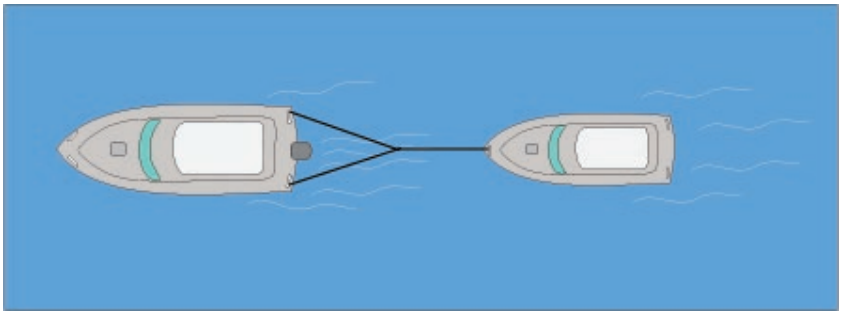


FIGURE 13-21 BRIDLE TOWING

13.19 Knowledge Review

1. Explain the different types of dinghy and their advantages and disadvantages.
2. Explain the different types of motors and generally how they work.
3. Explain ventilation, cavitation, steering and propellers.
4. Know how to start and stop the engine and all the checks that must be made.
5. Understand stability on a dinghy.
6. Explain how to beach a dinghy.
7. Explain towing procedures and types of towing manoeuvers.
8. Explain how to start and stop the engine and all the checks that must be made.
9. Explain how to launch from a trailer and recover using a trailer
10. Explain how to crash stop.
11. Explain towing procedures and types of towing manoeuvers.

Module 14 BOAT HANDLING UNDER POWER

14.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO GET THE STUDENT TO UNDERSTAND HOW TO HANDLE A BOAT WHILE UNDERWAY TAKING INTO ACCOUNT THE EFFECTS OF WIND, TIDE AND CURRENTS. DEPARTURE FROM A DOCK, AND ARRIVING AT A DOCK.

- ***It is very important to understand the limitations of your vessels maneuvering ability whether under sail or power, so make sure to practice.***

- 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 affect 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.

14.2 The Effects of Wind, Tide and Current

- The effects of wind, tide and current will influence power driven vessels. Many cabin cruisers have 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 push 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.

14.3 Alongside

Deck Equipment & Fittings

FIGURE 14-1 FAIRLEAD & CLEATS

Docking Lines (revision) - required to secure a vessel properly are:

- Bow line. A line that is lead forward from the bow of the boat.
- Stern line. A line that is lead aft from the stern of the boat.
- 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.

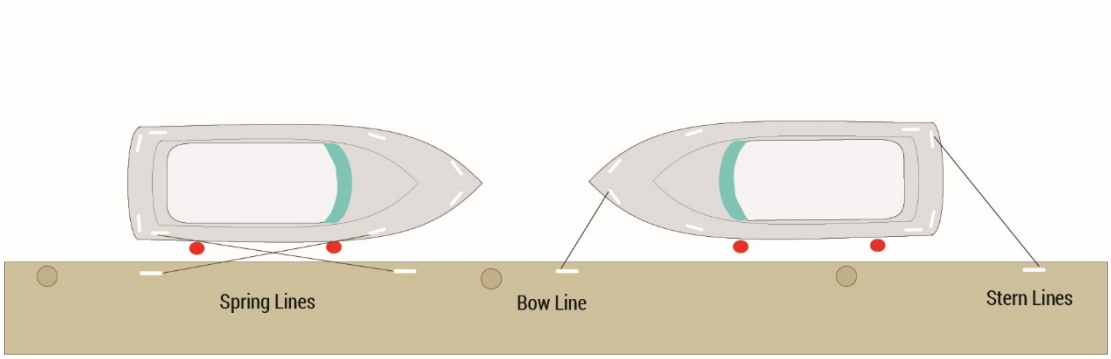


FIGURE 14-2 DOCKING DIAGRAM / CLEATS ON DOCK AND BOAT

14.4 Coming Alongside (wharf or dock)

1. Steer the boat into the dock at an angle of around 20 to 30 degrees with just sufficient way on the vessel to have good control.

2. One should approach upwind if possible. Coming in to a moored or anchored boat should be relatively easy as the vessel will probably be lying “head to wind”.

3. 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.

4. Have your mooring line prepared in advance and crewmember designated to step ashore and tie up the vessel.

5. 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.

Small boats are quite susceptible to the effect of wind and current and will generally make a fair amount of leeway, careful course and speed corrections may have to be made by the coxswain to counter leeway effects.

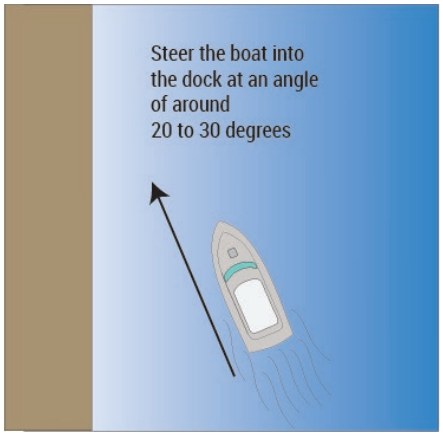


FIGURE 14-3 COMING ALONGSIDE A DOCK

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.

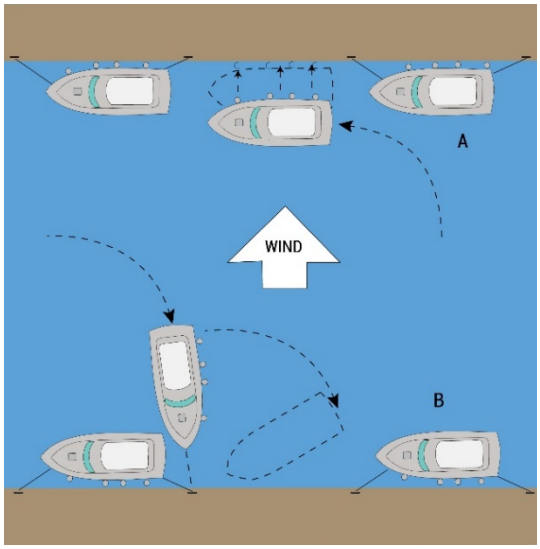


FIGURE 14-4 ARRIVAL AT DOCK

14.5 Handling Skills

Departure from Dock

Before departing a dock 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.

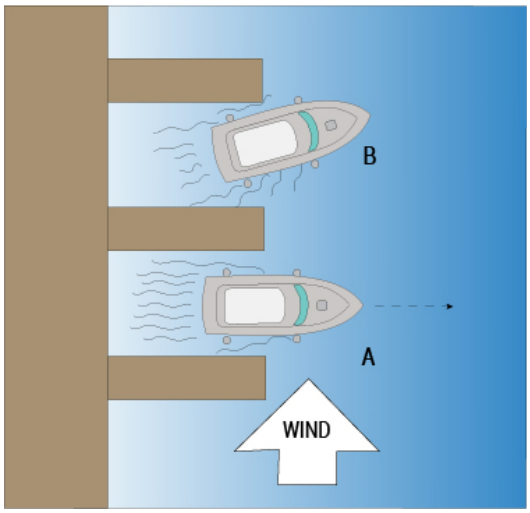


FIGURE 14-5 DEPARTURE FROM DOCK WITH CROSSWIND

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.

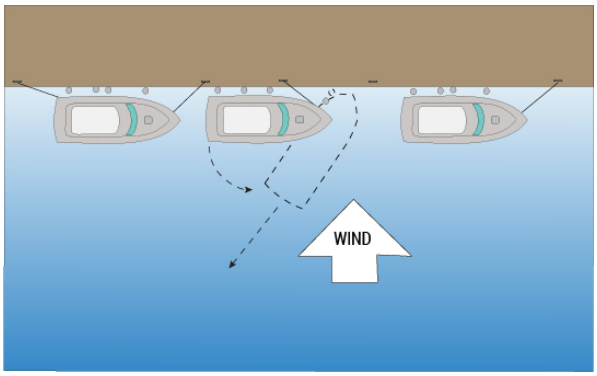


FIGURE 14-6 DEPARTURE FROM DOCK WITH WIND BLOWING ONTO DOCK

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.

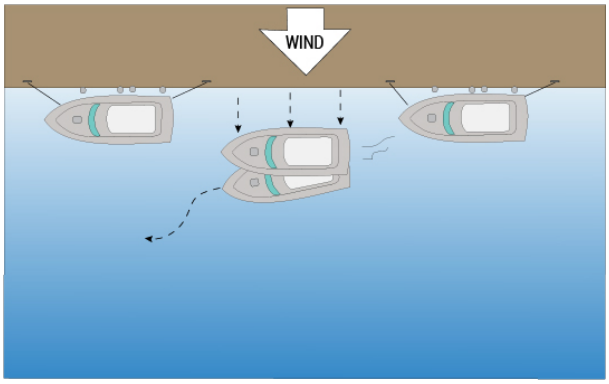


FIGURE 14-7 DEPARTURE FROM DOCK WITH WIND BLOWING OFF DOCK

14.6 Clearing (wharf or dock)

- Whenever possible you should try to leave a berth by going forwards though this will always be dependent on the wind and current at the time.

- The order in which you untie your mooring lines is dependent on the wind and current. If the wind is coming from ahead or off the dock hold the yacht on the after spring line to stop her drifting back onto any vessel astern, the wind will take the bow out and once clear you can leave the dock.

- Conversely if the wind or current is astern you will swing out on the bow spring until the stern is clear and then you can go astern to clear the berth.

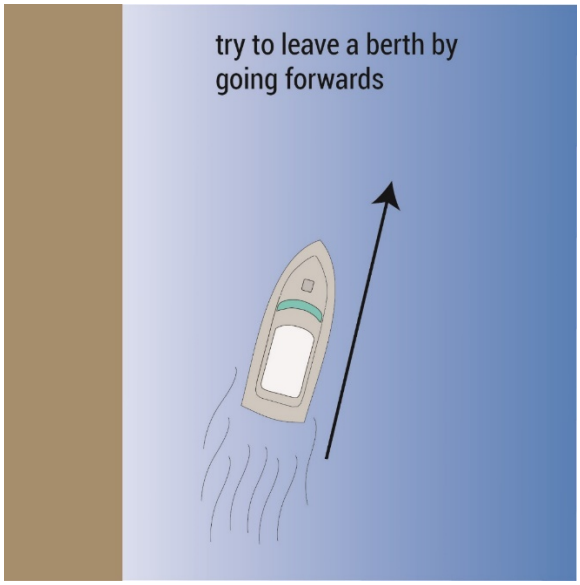


FIGURE 14-8 CLEARING A DOCK

14.7 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 so by applying the trim tabs, the bow will be forced down and the vessel will run flat on the water. The trim tabs can also be adjusted to keep the vessel level in the port / starboard plane as well.

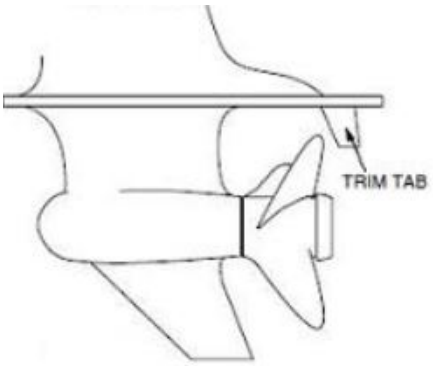


FIGURE 14-9 TRIM TAB

- When slowing a vessel, coming down off the plane, it should be done gradually otherwise the vessels stern wave which can be traveling faster than the boat, 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.

14.8 Vessel Handling Skills

Traveling at Speed (Planing)

FIGURE 14-10 PLANING BOAT

- Always prepare your crew for any rapid changes of speed or direction.
- Make a full appraisal of the surrounding area and be alert for waves and wash generated by other vessels as well as yours.
- Keep a good lookout at all times.

Most of the power output of the engine will be needed to get the boat on “the plane”. This is the most efficient use of hull design. When ‘on the plane’ ease back on the throttle to conserve fuel. Speed must be monitored constantly and adjusted to the proximity of traffic and conditions. A displacement or semi-displacement hull will not be able to plane, as top speed is limited by waterline length and hull design.

- Do not try to plane the boat in rough seas.
- Make good use of ‘trim tabs’ if fitted to achieve efficiency in speed and fuel consumption.
- Do not engage in reckless manoeuvers.
- Keep a good lookout and be mindful of submerged objects.

A small wash may be safely crossed as long as all on board are holding on. A large wash needs some careful consideration. Slow down to a speed that allows for control to raise the bow and cross the wash at an angle of about 45 degrees. Adjust speed through wash to keep bow up. Resume safe operation once through the wash.

High Speed Turns

- Make sure the crew are aware of your intentions, have plenty of space and good throttle control.
- Look out for wash, traffic and possible submerged obstructions. Do not turn so sharply that the prop starts to ventilate (suck in air) and lose grip.
- Careful throttle management and situational awareness is paramount.

- Trim down before starting to turn to maintain grip on the water.

- Do not exceed design limitations of the hull or motor(s).

Heavy Weather Operations

- It is important to match your speed to sea conditions; this often means slowing down.

- Generally speaking, waves are generated by wind and tend to come from the same direction. (there are important exceptions to this e.g. wind against tide/current which can make for a 'bumpy' ride)

- Driving upwind/upwave usually means 'trim' down with controlled power, ease throttle at the top of the wave to ensure you do not 'drop off' the wave. Gently accelerate down the back of the wave speeding up sufficiently to raise the bow as the trough is reached. Drive up the wave towards the next crest.

- Meet each wave as it comes, where possible avoid steep and breaking waves.

- Wavelength determines the level of speed and comfort. In short seas, the helmsman has little time to react to adjust the throttle so it may be easier to drive at an angle of 30 – 45 degrees to the wave front. This method may allow you to increase speed using a zig-zag course towards your destination.

- Large, breaking beam seas can potentially capsize a small boat. Steer a course between breakers and if you are caught on the downwind side of a breaker steer and power over the crest or turn away and try to outrun the breaker.

- Following seas can be most dangerous to small vessels. If a breaking wave catches the stern the confused water will adversely affect the props ability to grip the water. The following wave then will turn the vessel abeam thereby making capsize almost inevitable.

- Match the vessel speed to the waves to avoid being overrun. If the vessel is going too fast down the face of a wave, there is a danger of burying the bow causing the vessel to slow and pivot the vessel abeam causing it to be swamped or to capsize. Sometimes, if surfing down a wave it may be prudent to put the engines in reverse to avoid burying the bow into the oncoming wave.

- Sandbar/Harbour Bar Large following seas at restricted/shallow entrances should be avoided. As the water shoals the waves get higher and confused, breaking more violently.

14.9 Engine failure

Engine failure or multiple engine failure can lead to very hazardous situations at sea. The most common causes are insufficient fuel or contaminated fuel. If such an event occurs, it is essential to be equipped with a cellphone, VHF or SSB radio (depending on your distance offshore) in order to call for assistance. You should also have your signalling devices ready if you need to attract the attention of other boaters. It is imperative that engines are serviced and maintained regularly to avoid engine failure. Thorough checks of fuel levels, oil levels and filter cleanliness are essential. A comprehensive tool box should be carried at all times to repair any faults should they arise.

14.10 Single engine handling

It is important that boats fitted with a single engine are regularly serviced and maintained to avoid engine failure. Vessels with one engine do not have the same handling characteristics of multi-engines so due care and attention should be taken when docking or berthing.

14.11 Picking up mooring buoy

Mooring is tying up to an object in the water, such as a mooring buoy.
Approach mooring buoy slowly and if possible into the wind, waves or current, whichever is strongest, when close, select reverse gently to stall forward momentum. Select neutral, pick up mooring painter and secure to the deck. When leaving, use reverse to back off the buoy to keep propeller away from the line. REMEMBER that a boat has no brakes. Many authorities strongly discourage the use of anchors for environmental reasons and will provide 'mooring fields' for use by small craft.

14.12 Knowledge Review

1. Describe how can tide and current affect a vessel when docking?
2. Describe the procedure for coming alongside a dock or wharf
3. Describe the procedure for departing a dock or wharf
4. Describe how you would dock – with the wind
5. Describe how you would dock – against the wind
6. Describe the affect that multiple engines has on a vessel
7. What are “trim tabs?
8. Describe how to get a vessel “up on a plane”
9. What precautions would you take during high speed turns?
10. Describe 6 conditions to take into considerations during heavy weather preparations
11. What would you do in the event of engine failure?
12. Describe the procedure for picking up a mooring ball

Module 15 BASIC SAILS AND SAILING

15.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO GIVE THE STUDENT AN UNDERSTANDING OF THE TYPES OF SAILS, SAIL HANDLING AND SAIL MATERIAL AND CONSTRUCTION.

15.2 How Sails Work

- Sails work when the wind flows over the sails (effectively an aerofoil, like an aircraft wing) thus creating a driving force which moves the yacht through the water.
- The wind acts on each sail creating "lift" from the aerodynamics of the sail. The lift causes forward movement of the boat through the water and the sideways drift causes leeway. These two factors generate the aerodynamic forces which interact with the underwater part of the hull and the keel, to produce forward motion of the vessel.

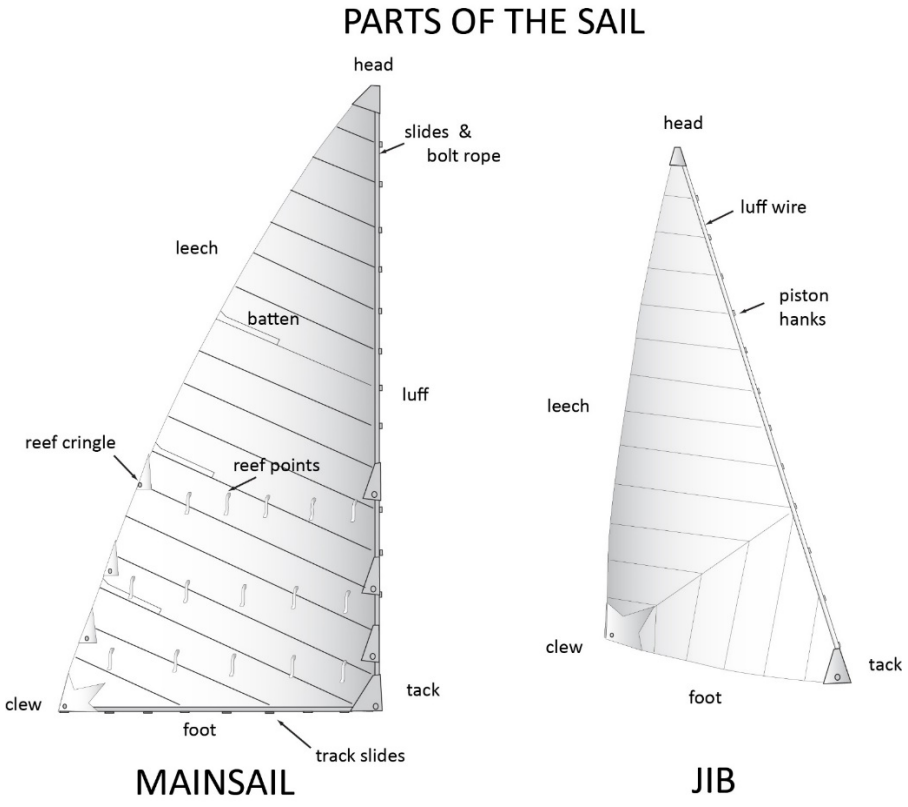


FIGURE 15-1 PARTS OF THE SAIL

15.3 Parts of the Rigging, Standing and Running

Standing rigging is the fixed parts of the rigging that hold the mast in place… they are the forestay, backstay and sidestays.

Running rigging refers to the lines and sheets that adjust the angle of the sails to the wind.

- Most modern sailing yachts use what is called a "Bermudan Rig" or "Sloop Rig" where the sails are triangular in shape. The top corner of the sail is the head, the bottom corner of the leading or forward edge of the sail is the "tack" and the rear corner the "clew".

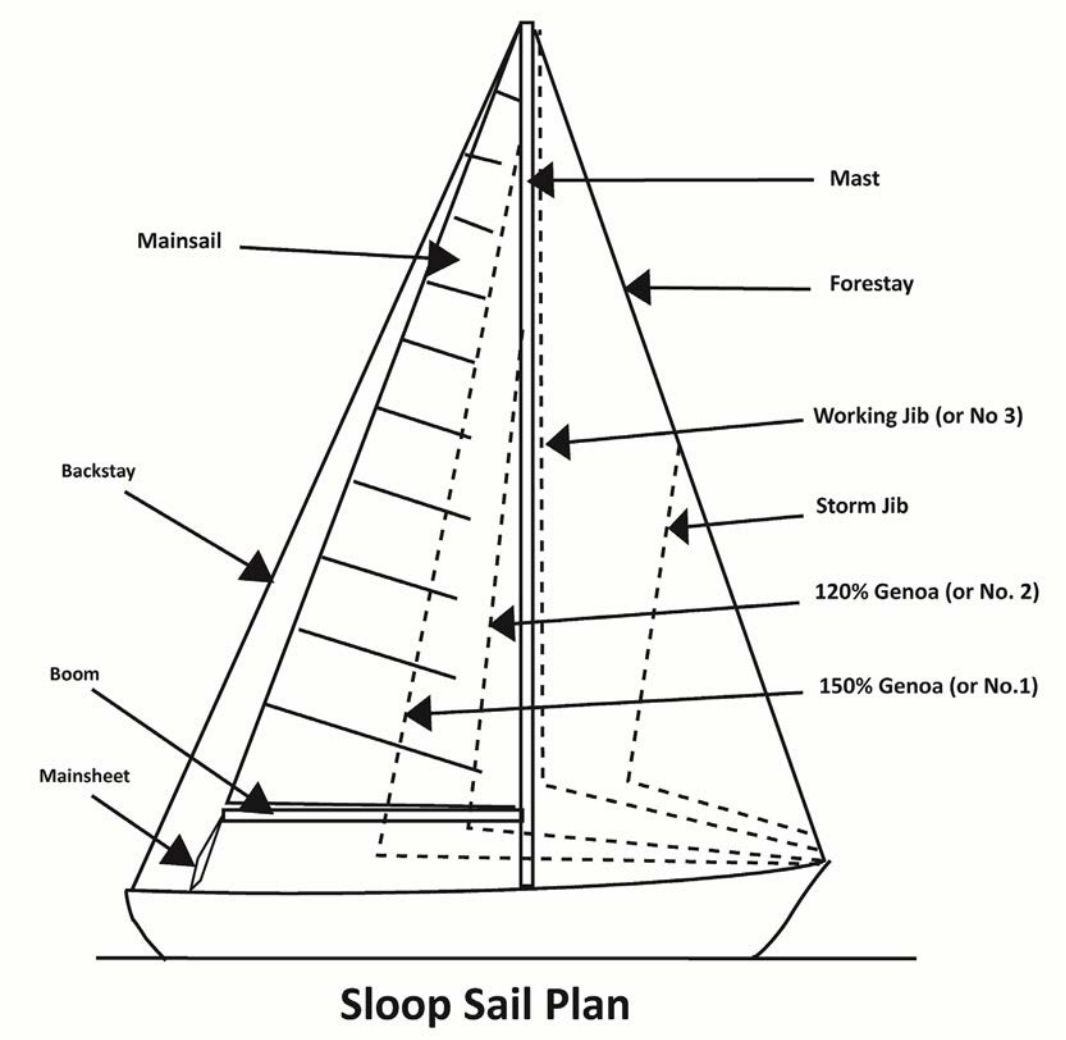


FIGURE 15-2 SLOOP SAIL PLAN

- The three sides of the sail are the leading edge called the "luff", the back edge is the "leech" and the bottom of the sail is the "foot".

- The simplest rig commonly seen on yachts has one mast. There is a single sail in front of the mast called a "jib" or a "headsail" attached to the "forestay" which is part of the standing rigging; and a second sail the "mainsail" that is hoisted up a track in the mast while its foot is attached to the horizontal spar on the back of the mast called the "boom".

- The foot of the mainsail may either be in a track on the boom or just attached by the corners in which case it is called "loose footed".

- The mainsail often has "battens" or stiffeners sewn into pockets in the sail to help support its shape, these can either be just at the trailing edge "leech" of the sail or can extend right across the sail. Having full length battens that extend right across the sail helps the sail hold better shape.

A "jib" becomes a "genoa" as soon as the clew of the sail passes the mast. A 120% genoa means that 20% of the sail is past the mast and a 150% genoa means that 50% of the sail area is past the mast.

FIGURE 15-3 UNFURLING A ROLLER REEF HEADSAIL

15.4 Points of Sail and Sailing Terms

The angle that the wind hits a boat, dictates how the sails are set to gain maximum performance. Each of these angles and settings are known as a "Point of Sail".

A sailing boat cannot sail directly towards (into) the wind. The wind just passes equally down both sides of the sails and there is no "lift" (drive forward). In this situation the vessel is stopped dead in the water and this is known as being "in irons".

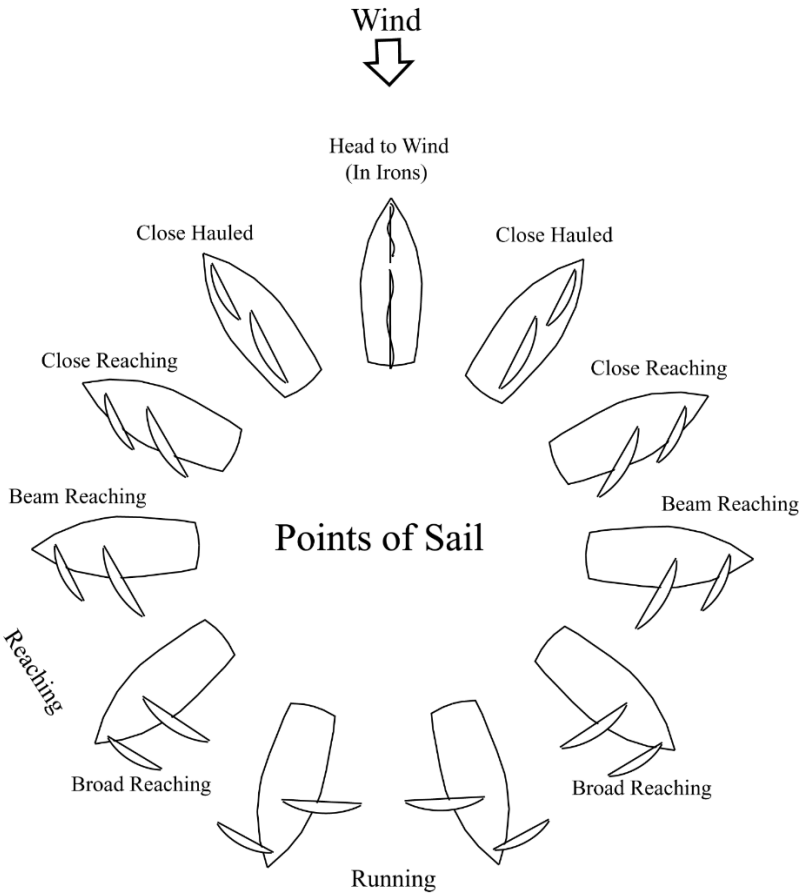


FIGURE 15-4 POINTS OF SAIL

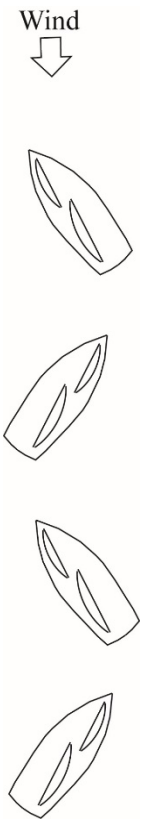


FIGURE 15-5 TACKING OR BEATING

- The closest to the wind a boat can efficiently sail is about 40 degrees either side of the wind's direction, effectively this area is a **"no go zone"**. This closest point of sail is known as close hauled. Therefore, to sail towards a destination from where the wind is blowing, a boat must **"tack"** or zigzag called **"beating"**).

- To tack or "go about" the vessel changes from one tack to the other by steering the bow through the wind.

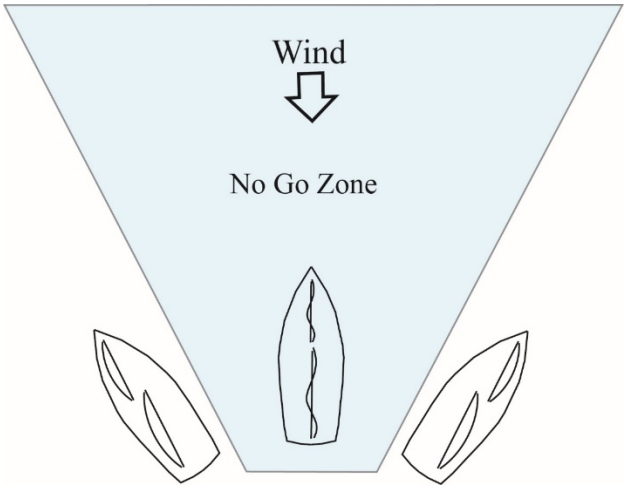


FIGURE 15-6 NO GO ZONE

- When sailing as close to the wind as possible the point of sail is known as **"close hauled"**. The sails themselves will be **"sheeted"** in tight (pulled in). To establish the closest point to the wind that the yacht can sail, the helmsman, as he turns the yacht upwind, watches the front edge, or luff, of the headsail until it starts to flutter, this is called **"luffing"**; once he sees this happening he should ease gently away from the wind. If he turns further upwind, then the whole sail will start to flog back and forth and eventually the yacht will stall and come to a stop.

- As the boat moves away from the wind, or "bears away", the sails will be let out a little and the point of sail becomes a **"close reach"**.

- Bearing away still more and easing out the sails a little more the boat reaches the point of sail known as a **"Beam Reach"** (when the wind is over either beam at 90º or half way down the boat). The sails will be about half way out at this stage. This is the most comfortable and controllable point of sail and is also, for most yachts, the fastest.

- Further away from the wind again, the sails should be about 2/3rds out, the point of sail is known as a **"broad reach"**, this is when the wind comes from either quarter.

- The last point of sail is known as a **"dead run"** or "running before the wind" is when the wind is blowing directly from astern and the sails are all the way out.

- To go further away from the wind, the wind must pass across the stern of the boat. This is called a **"gybe"**; that is to let the sails change sides by putting the stern through the wind.

- **"Starboard Tack"** is when the wind comes over the starboard side

- **"Port Tack"** is when the wind comes over the port side.

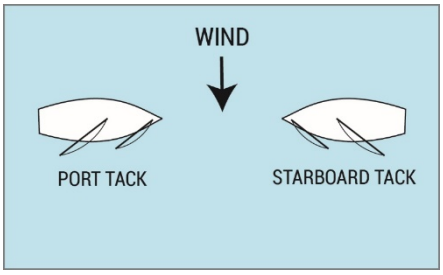


FIGURE 15-7 PORT AND STARBOARD TACK

Shackles are a "U" shaped device for attaching a halyard (the line that hoists the sail) to a sail. They come in 3 basic forms. The most common is with a screw-in pin. Some have a captive pin which is pushed and turned or a snap shackle which is operated by pulling a pin.

FIGURE 15-8 SHACKLES

Blocks come in different sizes and with up to 4 "sheeves" (wheels that are grooved to take rope). Rigging a line through a series of blocks gives a mechanical advantage allowing line under load to be more easily handled. For example, blocks are normally used on a sailing vessel for the main sheet.

FIGURE 15-9 BLOCKS

Cam cleats, Rope Clutches and Jam Cleats

Used for securing a line under load but that can be quickly and easily released.

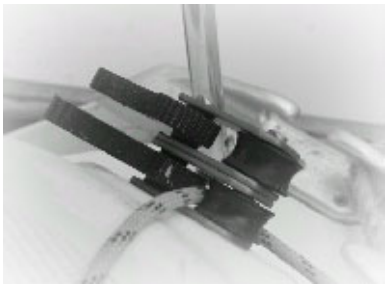


FIGURE 15-10 CAM CLEATS

FIGURE 15-11 LOCKING CLEATS OR ROPE CLUTCHES

FIGURE 15-12 JAM CLEAT

The Mainsheet traveller is used to adjust the angle of the mainsail to the wind by moving the boom to port or starboard.

Boom topping lift is used to secure the boom in position above deck when the mainsail has been furled.

The **Mainsheet** is used to adjust the tension of the mainsail relevant to the wind direction.

FIGURE 15-13MAINSHEET TRAVELLER

FIGURE 15-14 BOOM TOPPING LIFT

FIGURE 15-15 MAINSHEET

15.5 Use of Winches

Of primary importance are "winches" which are mechanical devices giving extra power for handling these ropes under load. Some yachts also have electrical winches.

- Winches provide the extra power necessary to pull in rope under load such as halyards and sheets.

- Winches often have two or even three speeds provided by internal gearing, giving an increase in power for the same effort applied to the winch handle.

FIGURE 14-16 WINCH HANDLE

- In addition to the fittings described above which will be found on all types of vessels, a sailing vessel will have additional fittings which are designed to enable the crew to use the mast, spars and rigging to harness the power of the wind.

- Under full sail, even with only a light wind, huge forces are created by the sails and rigging which require fittings to allow the crew to control the sails efficiently.

- Most winches have a star shaped hole in the top of the winch into which the star shaped head of the handle is fitted. There is often a locking arrangement to hold the handle securely in the top of the drum.

Self-Tailing Winch and sequence of how to operate

It is imperative when operating a winch to be aware of safety issues. It is recommended that jewelry such as rings and necklaces be removed when operating winches as sheets can carry excessive loads. Many have actually crushed fingers due to lack of care in operating winches.

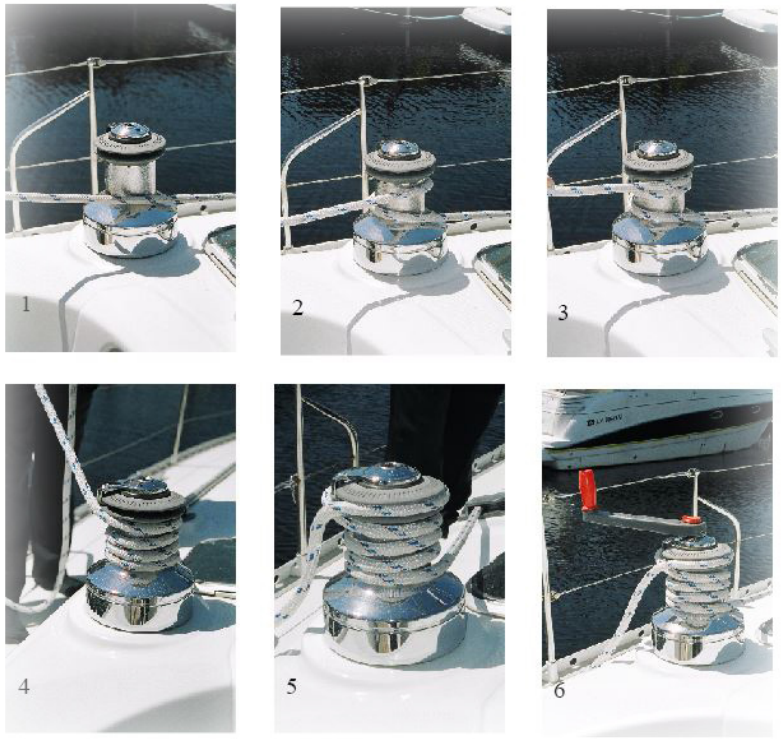


FIGURE 15-17 SELF TAILING WINCH SEQUENCE

15.6 Types of Sails

Triangular sails are the most commonly used sails and will be the focus of this section. This sail configuration is known as a "Bermuda" or "Sloop" rig.

The mainsail is the large sail situated behind the main mast or the sail that is attached to the boom. It is tensioned by an outhaul at the end of the boom.

The leech can be stiffened by battens inserted into the batten pockets.

In stormy weather a trysail may be used instead of a mainsail. This is a very strong sail made of very thick canvas specifically for bad weather.

FIGURE 15-18 TRYSAIL

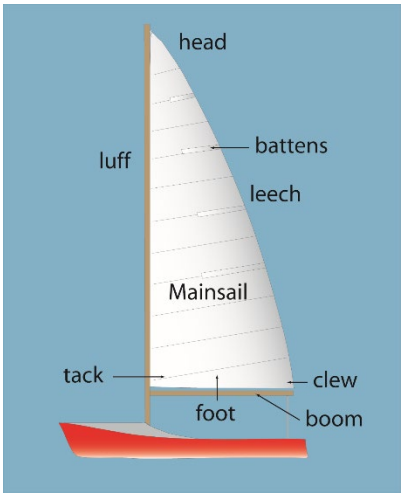


FIGURE 15-19 MAINSAIL - PARTS OF

Headsails

Headsails vary in size to allow the optimum sail area for most conditions. For example, jibs and genoas (see diagrams). A jib becomes a genoa when the clew of the sail passes the mast.

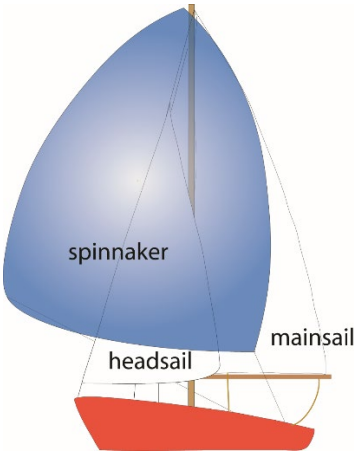


FIGURE 15-20 SAILS

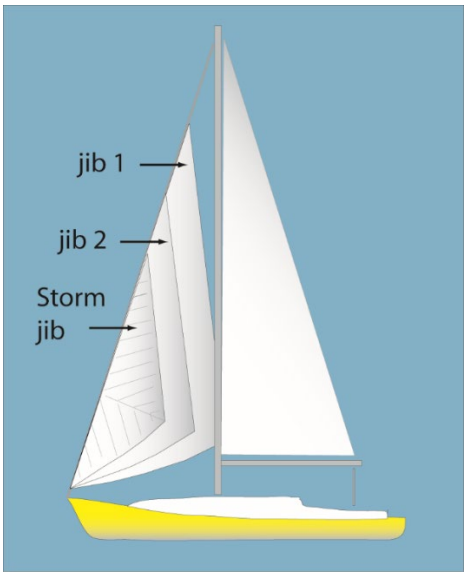


FIGURE 15-22 JIB SAILS

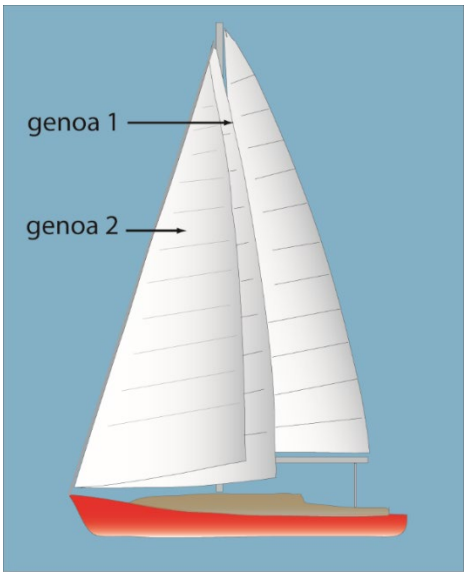


FIGURE 15-21 GENOA SAILS

Spinnaker

The spinnaker is the largest sail on a boat. It is a very light headsail used when sailing downwind (running), or on a broad reach. Just like the main, the top of the spinnaker is the head, and the bottom is the foot. The luff is the windward edge, and the leech is the leeward edge.

There are two main categories of spinnakers, symmetric and asymmetric.

Asymmetric spinnakers, are multi-purpose spinnakers (MPS) which operate more like a jib, generating lift from the side, rather than the top like a symmetric spinnaker. This makes asymmetric a better choice for "reaching" than symmetrical spinnakers, which excel when running downwind. While a fully equipped racing boat might have a number of spinnakers, both symmetric and asymmetric, to cover all courses and wind conditions, cruising boats almost always use an asymmetric (MPS spinnaker) due to the broader application and easier handling.

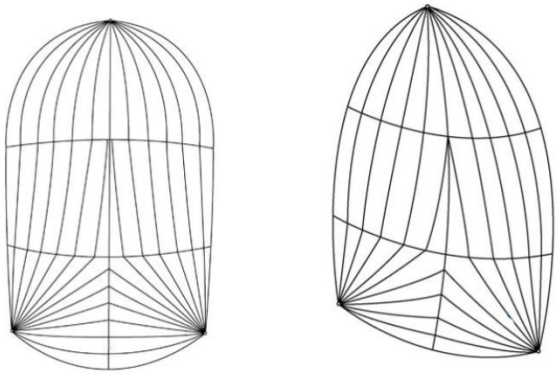


FIGURE 15-23 SYMMETRIC / ASSYMETRIC SPRINNAKERS

Spinnakers have various designs, which are determined by the design of the cloth panels: vertical (radial), horizontal, star, and tri-radial. The tri-radial cut is a combination of the remaining three, and is the most universal of them, with good handling and power characteristics. The radial head cut is a lighter weather sail, the star cut is a good strong wind reaching sail, and the horizontal cut is also a good light wind sail.

FIGURE 15-24 RADIAL HEAD

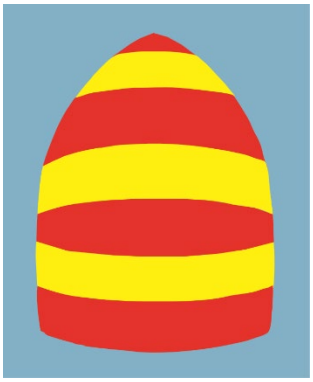


FIGURE 15-26 HORIZONTAL

FIGURE 15-25 TRI-RADIAL

15.7 Sail Handling

1) As wind increases, a boat gradually becomes overpowered. This makes the boat hard to handle and so the amount of sail carried will need to be reduced. This sail reduction is carried out progressively as the wind increases.

2) The rule for reducing sail is to do it sooner rather than later, if left too late the vessel will be harder to control as conditions worsen.

3) On a sloop rigged vessel, usually the first reduction will be to change from a large number 1 genoa to smaller number 2 genoa. The next reduction will be to take in a reef in the main. A reef will require the sail to be partially lowered and attached to the boom by a series of ties.

4) The sail reduction process is continued with reductions of headsail and main as the wind strengthens. Once the wind becomes too strong to carry double or triple reefed mainsail and number 4 jib there are 2 storm sails which can be rigged to allow some progress to be made in very strong winds.

5) The storm jib is a very toughly constructed, triple sewn, small jib attached to the fore stay and a trysail. The main sail can be replaced by a storm trysail.

Roller Reefing

Where boats are equipped with a roller reefing system, it is possible during heavy weather to reduce the sail area by rolling in the headsail. The same applies to mainsails that have an in-mast or in-boom roller furling system.

FIGURE 15-27 ROLLER REEFING

Slab Reefing (Jiffy Reefing)

1) "Reefing" the mainsail is lowering the mainsail partially to reduce its size when the wind strength increases to reduce heeling or capsizing.

2) You should reef the mainsail if you notice the wind begin to build and before it is too late to manage the reefing process due to wind gusts.

3) If wind speed is above 15 knots many sailors will begin with a reefed sail.

Remember also to pay close attention to the direction of the wind as it can be conceived to be "manageable" when sailing downwind and the boat is not heeling.

Basic Slab Reefing Steps

- Turn boat toward the wind and ease the mainsheet to reduce pressure on the sail.
- While slowly easing the main halyard, take in the reefing control line. This will pull the bottom of the mainsail down toward the boom.
- When the sail reaches the desired reef point, secure halyard and reefing line.
- Return to course and trim the sail.

- After reefing, you can secure the loose part of the sail to the boom by passing a sail tie through the grommets and tying it off around the boom as shown below.

FIGURE 15-28 HOW TO SLAB REEF

FIGURE 15-29 SLAB REEFED SAIL

15.8 Sail Materials and Construction

Originally sails were made of canvas and cotton. As man-made fabrics became available these natural fibers were replaced by polyester, known as Dacron. This has now been eclipsed by more modern materials such as Mylar, Kevlar and Spectra.

The advantages of modern materials are their strength, weight and ability to create a better shape.

Sail construction will depend on the type of sail and material used. However, generally speaking, the head, luff and tack are all reinforced to allow cringles to take big loads. The remainder of the sail will usually be panels of sailcloth sewn together, double stitched. The panels will be aligned to maximize the finished sail shape.

15.9 Knowledge Review

1. Describe the difference between standing rigging and running rigging
2. Name 6 parts of a sail
3. What is a “Bermuda Sloop”?
4. Name 4 points of sail
5. Describe: no-go zone, tacking, gybing, close hauled, luffing, close reach, beam reach, running, starboard tack, port tack
6. Describe the function of: shackles, blocks, cam cleats, rope clutches, and jam cleats.
7. What is a mainsheet traveller, boom topping lift and mainsheet.
8. What are the dangers associated with winches?
9. Name 5 different types of sails
10. Name 2 types of spinnaker
11. At what wind speed should you start reducing sail?
12. Describe how to use: roller reefing and slab reefing.

Module 16 BASIC METEOROLOGY

THE OBJECTIVE OF THIS MODULE IS TO UNDERSTAND WEATHER PATTERNS, SEA AND LAND BREEZES, KATABATIC AND ANABATIC WINDS, THE BEAUFORT SCALE, CLOUD TYPES, TROPICAL REVOLVING STORMS, LIGHTENING, THUNDERSTORMS AND WHAT TO DO IN THE EVENT OF ADVERSE WEATHER.

16.1 Key Objectives

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.

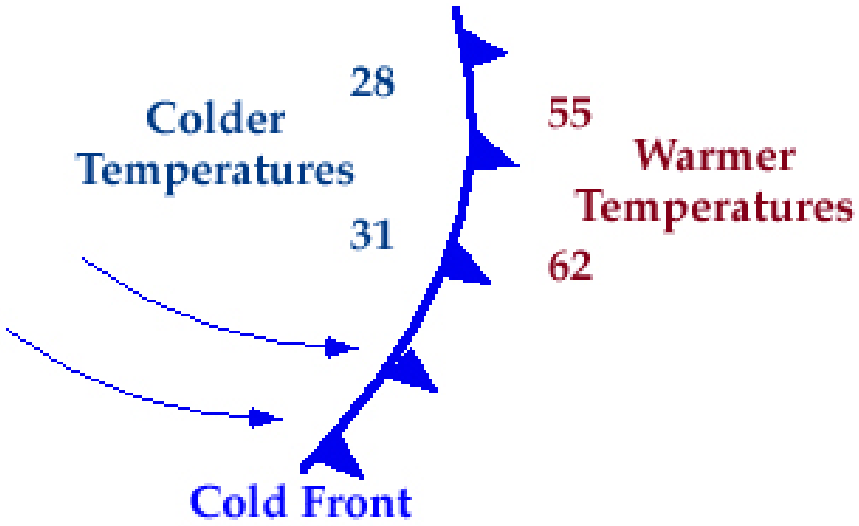


FIGURE 16-1 COLD FRONT DIAGRAM -FAHRENHEIT

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. This information you need is important: wind speed, direction and strength, visibility, heavy rain, fog, smoke, mist, wave height, temperature and sun strength are just a few.

16.2 Sources of Weather Information

- Meteorologists obtain information from a wide range of different sources including dedicated weather satellites, weather balloons, ocean weather ships, aeroplanes, commercial shipping, weather buoys, manned and unmanned weather stations, radar installations, and so on.

- Yachtsmen and women are interested principally in wind strength and wind direction as these are usually the two single factors which have the most effect on anyone taking a small boat to sea, both from the point of view of safety and of enjoyment.

- There are many sources of weather information available to the mariner, the most useful sources for mariners will be those from maritime organisations, for example the Coastguard or a Port Authority or directly from the government meteorological office.

- Once the forecast has been received the decision to go or not will have to be made. If in doubt error 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, and at least 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.

16.3 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, the surface will be moving at different rates.

Due to the earth's rotation, low pressure systems in the Northern Hemisphere rotate in a 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.

16.4 Meteorology Information Sources

- When we use the term 'weather' we mean the atmospheric conditions existing at a specific place over a relatively short period of time. The conditions of general interest to us normally are whether it is warm or cold, raining or dry, sunny or cloudy, foggy or clear, windy or calm and so on

- When cruising away from coastal waters (crossing an Ocean or such) a Single Side Band (SSB) MF/ HF radio receiver is required but sometimes it can be difficult to catch all the forecast information so a small handheld voice recorder is a great help to replay the forecast if needed.

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 list below is not complete and depending on your location, other sources may be available.

- Internet
- Radio
- Newspapers
- Television
- Marina Offices
- Port Authority Offices
- Coastguard Organisations
- Telephone Company recorded forecasts
- Weather fax
- Meteorological Office

16.5 Monitoring the Forecast

It is very important to monitor the weather forecast on a regular basis because if bad weather is forthcoming, it may be necessary to alter your trip and seek shelter in a safe anchorage or marina. Forecasts should be monitored throughout the trip and most importantly, constant personal observation of the weather signs must be made to determine whether an alternative

plan needs to be initiated. Signs of change include changes in cloud formation, shift in wind direction and speed, sudden change of atmospheric pressure, changes in visibility etc. Always listen out for small craft warnings on the VHF radio.

16.6 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 signs, the most visible of these will be a change in cloud formations, other signs will be changing wind direction / strength, visibility and temperature changes. Air pressure is measured differently in various countries. However, meteorologists use milibars so it is important to become familiar with this system.

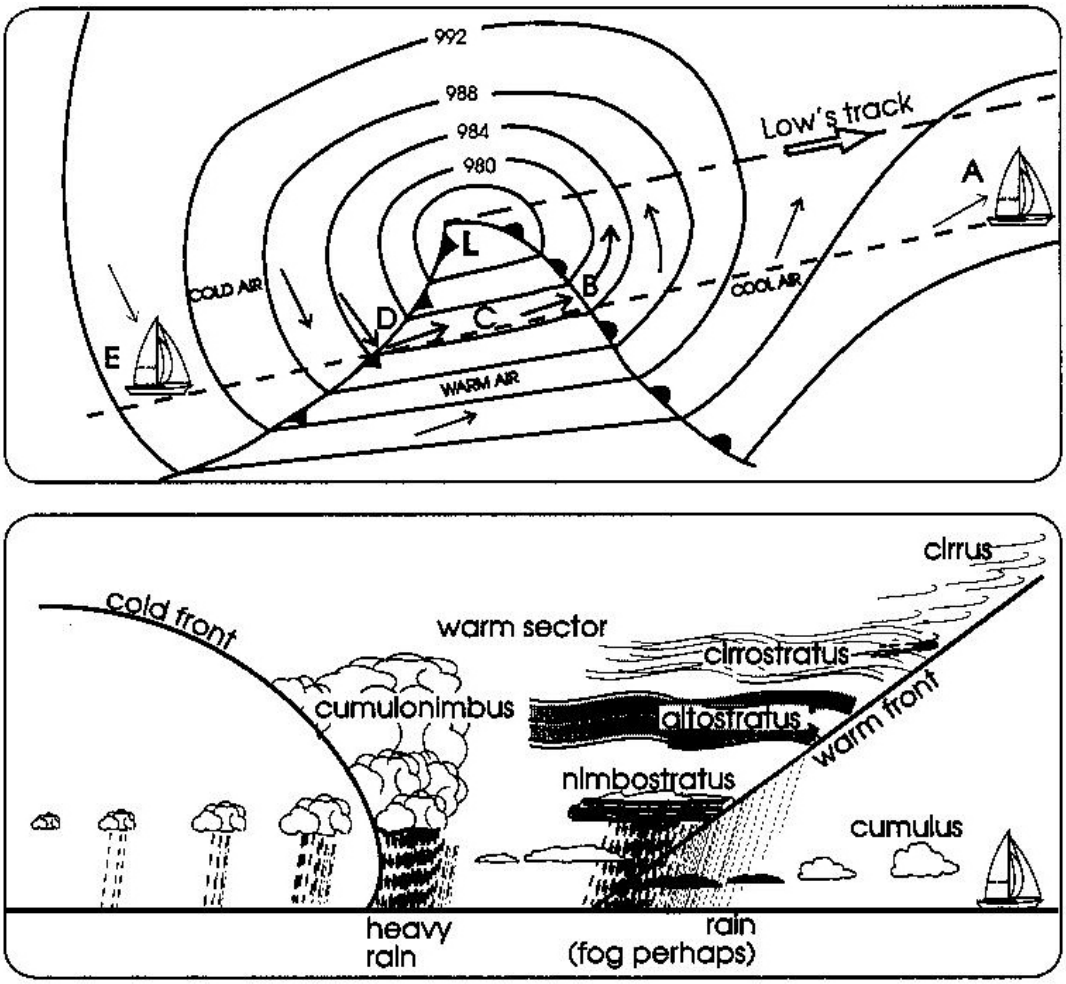


FIGURE 16-2 FRONTS COLLIDING

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 of it there will often be fog along with poor visibility and rain.

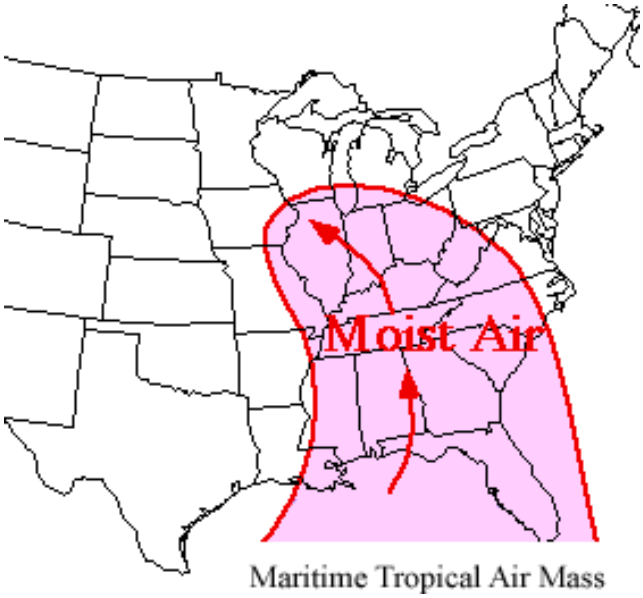


FIGURE 16-3 MARITIME TROPICAL AIR MASS

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.

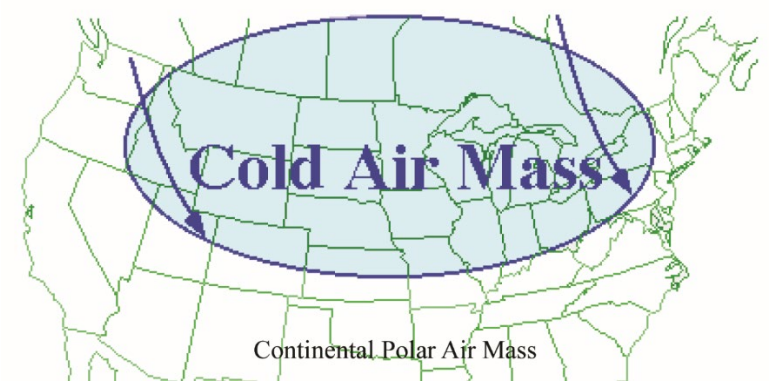
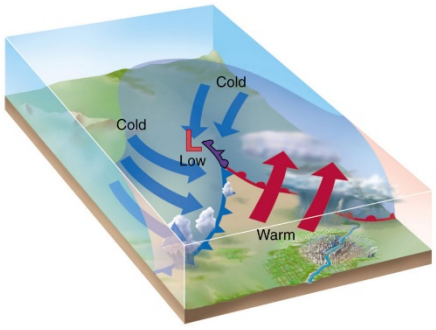
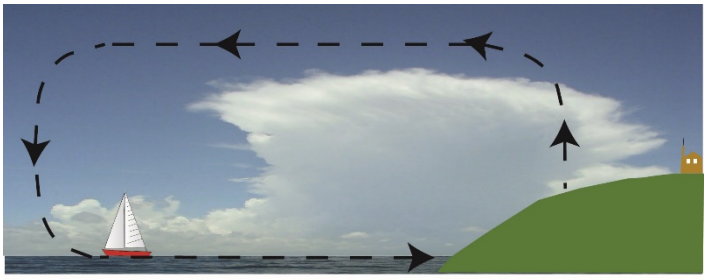


FIGURE 16-4 CONTINENTAL POLAR AIR MASS



16.7 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 (often referred to as an "onshore" breeze).
Usually, sea breezes begin about half a mile offshore around about 10.00 to 11.00 hours. They reach their strongest by 14.00 and have usually stopped by 20.00.



How a sea breeze is generated during the day

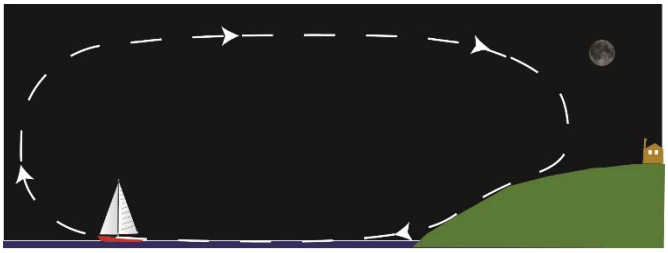
FIGURE 16-5 SEA BREEZE

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 seldom extend more than 10 miles offshore and are strongest near the coast.

16.8 Land Breeze

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 continues. 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

FIGURE 16-6 LAND BREEZE

16.9 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. Katabatic winds can cause you to drag anchor if anchored in a bay with high mountains surrounding it.

16.10 Anabatic Winds

Anabatic winds occur locally when air warmed by the sun rises and flows up mountain slopes and valleys. It is probably more useful for hang-gliders than sailors!

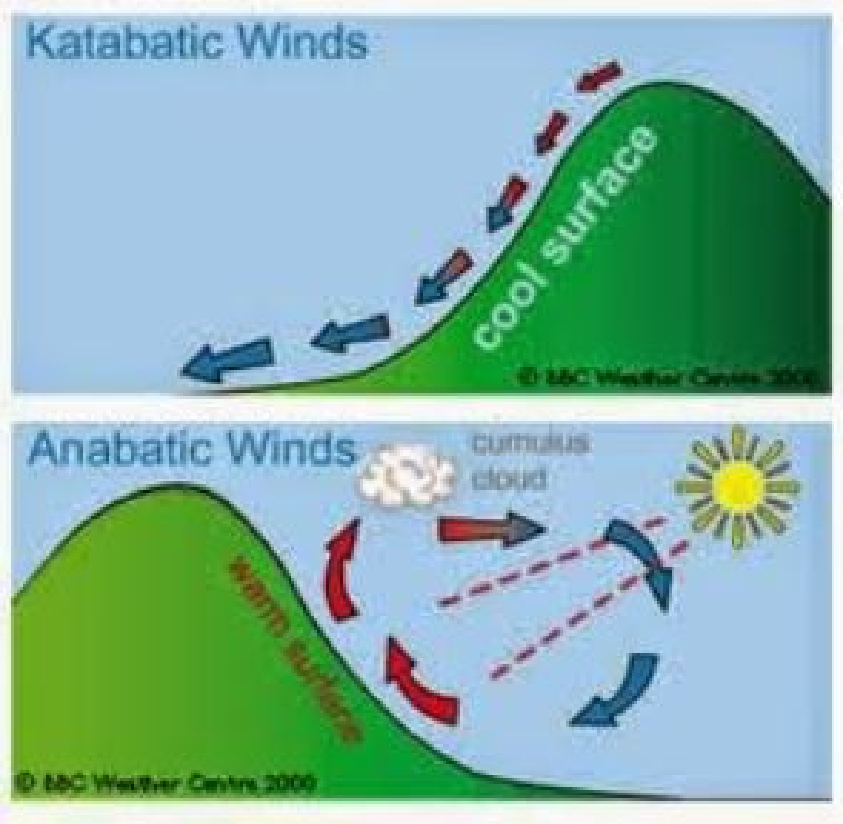


FIGURE 16-7 KATABATIC & ANABATIC WINDS

16.11 The Beaufort Wind Scale

The Beaufort wind scale is a measurement of wind speed to observed conditions at sea or on land. Marine forecasts will refer to the Beaufort scale when issuing a forecast, it is important to become familiar with it.

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
11	Violent Storm	Exceptionally high waves, foam patches cover sea, visibility very reduced	56 - 63 kn	30 - 45 ft
12	Hurricane	Air filled with foam, sea completely white with driving spray, visibility greatly reduced	64 + kn	over 45 ft

FIGURE 16-8 BEAUFORT FORCE SEA STATE/WIND SCALE

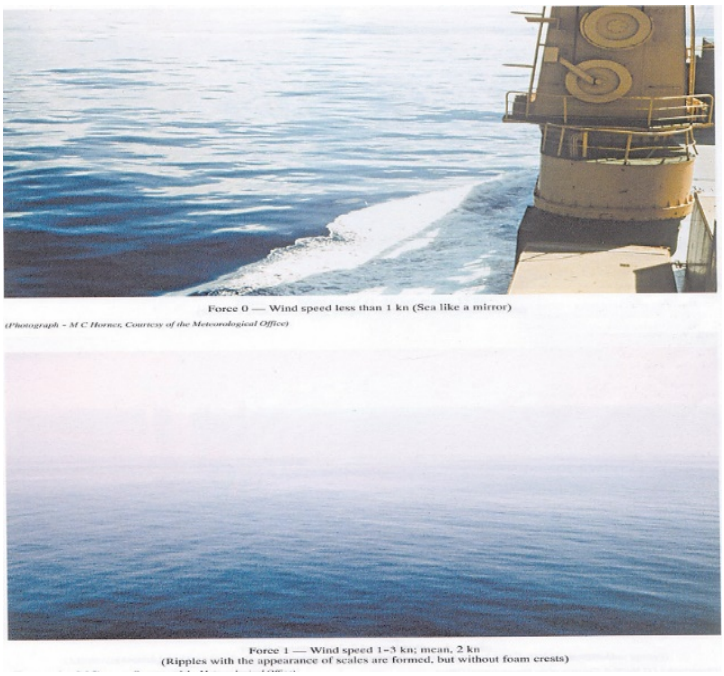


FIGURE 16-9 BEAUFORT FORCE 0 & 1 PHOTO

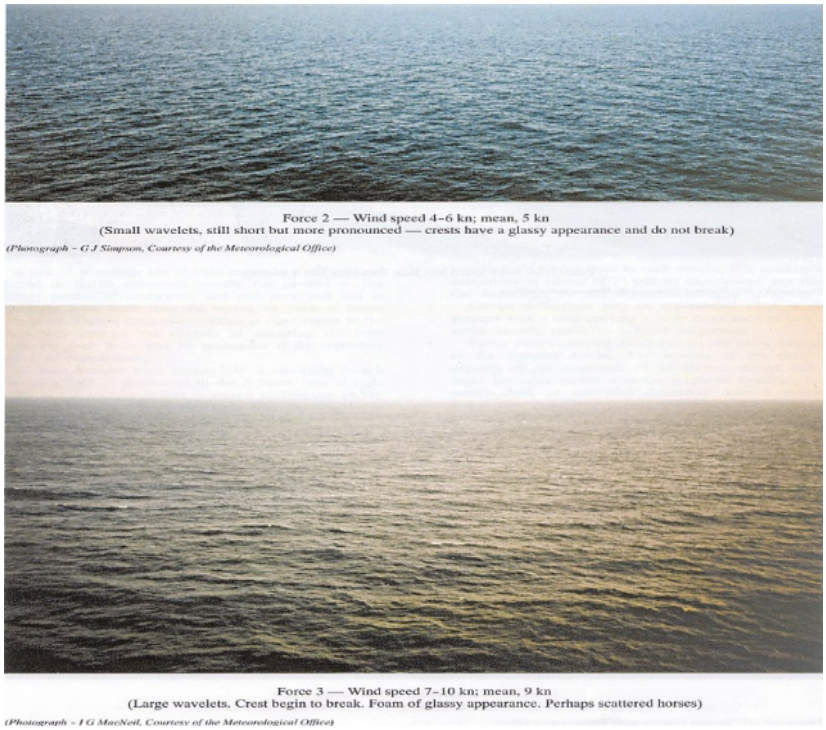


FIGURE 16-10 BEAUFORT FORCE 2 & 3 PHOTOS

Force 4 — Wind speed 11–16 kn; mean, 13 kn
(Small waves, becoming longer; fairly frequent white horses)
(Photograph – I G MacNeil, Courtesy of the Meteorological Office)

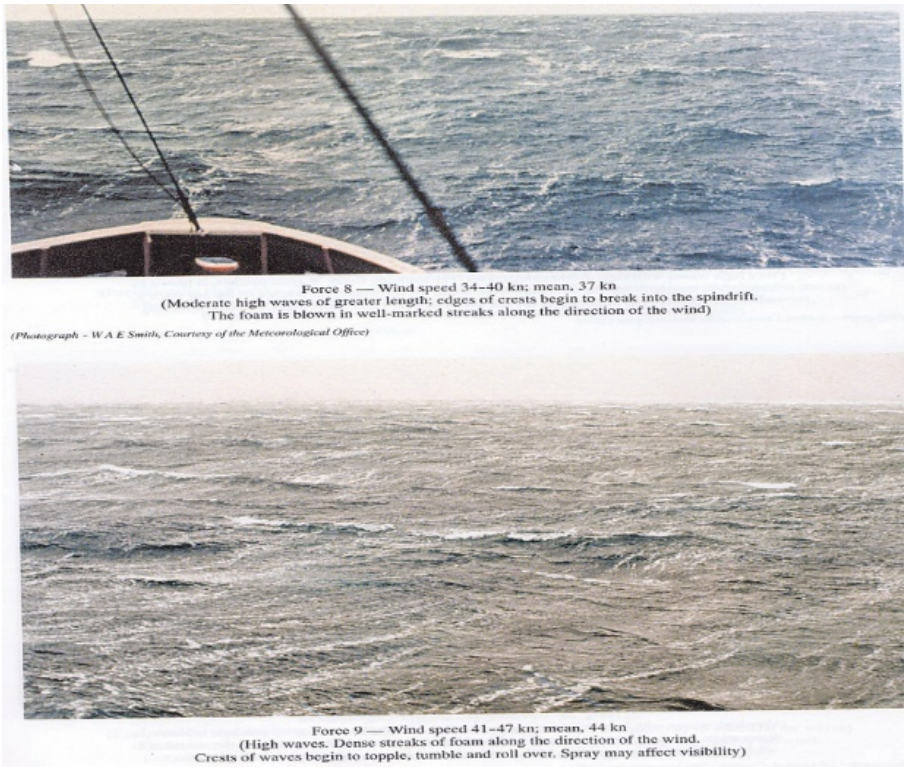
Force 5 — Wind speed 17–21 kn; mean, 19 kn
(Moderate waves, taking a more pronounced long form; many white horses are formed (Chance of some spray))
(Photograph – I G MacNeil, Courtesy of the Meteorological Office)

FIGURE 16-11 BEAUFORT FORCE 4 & 5 PHOTOS

Force 6 — Wind speed 22–27 kn; mean, 24 kn
(Large waves begin to form; the white foam crests are more extensive everywhere (Probably some spray))
hotograph – I G MacNeil, Courtesy of the Meteorological Office)

Force 7 — Wind speed 28–33 kn; mean, 30 kn
(Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind)
Photograph – G J Simpson, Courtesy of the Meteorological Office)

FIGURE 16-12 BEAUFORT FORCE 6 & 7 PHOTO

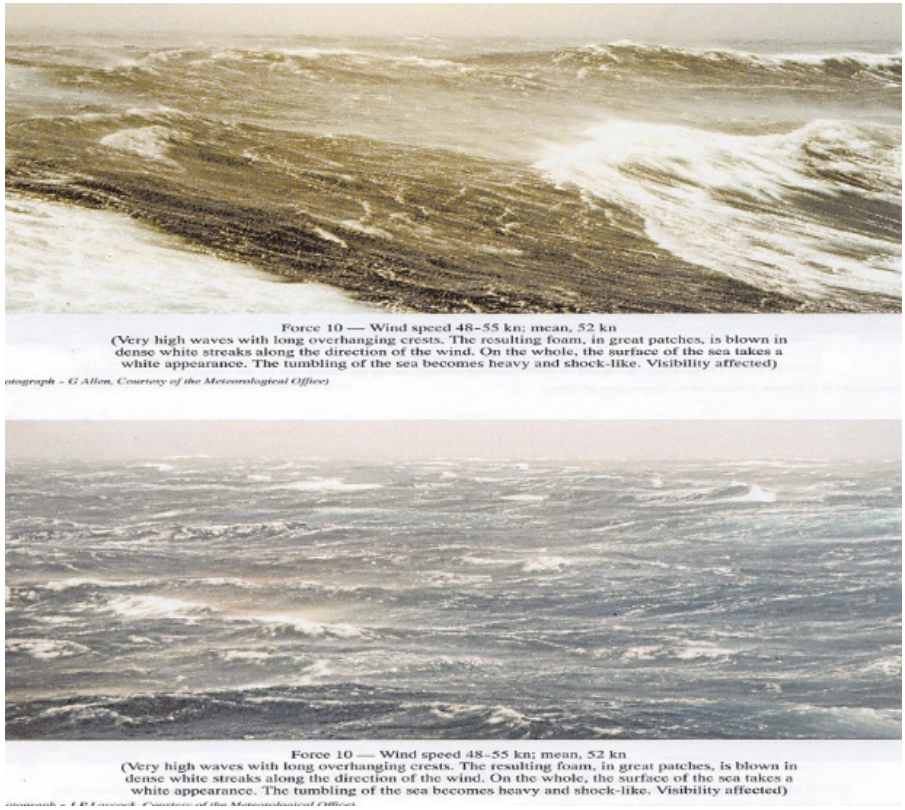


Force 8 — Wind speed 34–40 kn; mean, 37 kn
(Moderate high waves of greater length; edges of crests begin to break into the spindrift.
The foam is blown in well-marked streaks along the direction of the wind)

(Photograph – W A E Smith, Courtesy of the Meteorological Office)

Force 9 — Wind speed 41–47 kn; mean, 44 kn
(High waves. Dense streaks of foam along the direction of the wind.
Crests of waves begin to topple, tumble and roll over. Spray may affect visibility)

FIGURE 16-13 BEAUFORT FORCE 8 & 9 PHOTO



Force 10 — Wind speed 48–55 kn; mean, 52 kn
(Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in
dense white streaks along the direction of the wind. On the whole, the surface of the sea takes a
white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected)

otograph – G Allen, Courtesy of the Meteorological Office)

Force 10 — Wind speed 48–55 kn; mean, 52 kn
(Very high waves with long overhanging crests. The resulting foam, in great patches, is blown in
dense white streaks along the direction of the wind. On the whole, the surface of the sea takes a
white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected)

FIGURE 16-14 BEAUFORT FORCE 10 PHOTOS

FIGURE 16-15 BEAUFORT FORCE 11 PHOTOS

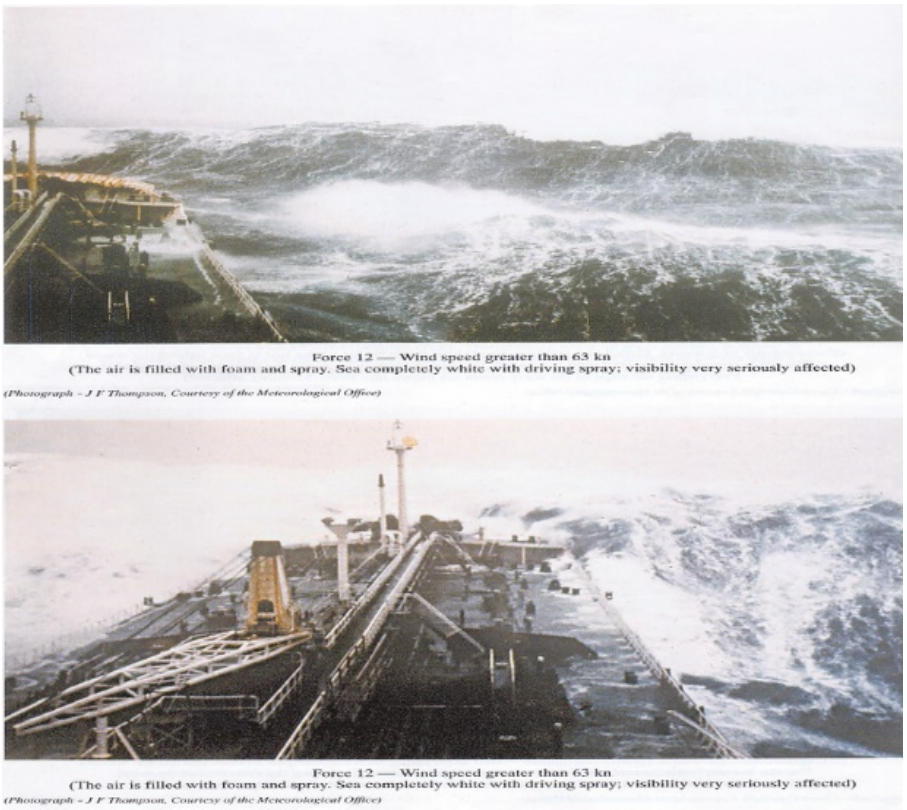


FIGURE 16-16 BEAUFORT FORCE 12 PHOTOS

16.12 Clouds

- Clouds are rising columns of warm, moist air or parcels of saturated air, which has reached its dew point.

- The warmer the air is the more moisture it can carry, so as warm air rises it carries moisture that it has collected from the sea surface through evaporation. This rising air begins to cool, this occurs because the higher the elevation the lower the air pressure and lower the temperature.

- This drop in pressure causes the air to expand, this expansion in 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.

It is important for the mariner to understand the types of weather associated with the various types of clouds.

Basic Cloud Types

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

1. **Cirrus** – These are the most common of the "high cloud" group of clouds (5,000-1,3000m). They are composed of ice and are long thin wispy clouds. They are usually white and predict fair weather.

FIGURE 16-17 CIRRUS CLOUDS

2. **Cumulus** - Flat-based, billowing clouds with vertical doming. The tops of the cumulus clouds will often have a "cauliflower-like" appearance. Cumulus clouds are most prominent during the summer months and can be associated with good or bad weather and generally contain showers.

FIGURE 16-18 CUMULUS CLOUDS

3. **Stratus** – These are low clouds (up to 2,000m), grey in color and cover most of the Sky and can sometimes look like fog that does not reach the ground. Mist or drizzle are associated with this formation.

FIGURE 16-19 STRATUS CLOUDS

Other Common Cloud Types

There are seven variations of these basic cloud types:

1. **Cirrostratus** – these clouds belong to the "high cloud" group (5,000-1,3000m). They are "sheet-like" thin clouds that usually cover the entire sky and usually appear 12-24 hours before a rain or snowstorm.

2. **Cirrocumulus** – these clouds also belong to the "high cloud" group and look like small rounded puffs that appear in long rows and is often called a "mackerel sky". They are usually seen in the wintertime and indicate fair but cold weather.

3. **Altostratus** – these belong to the "middle cloud" group (2,000-7,000m) are blue-gray or whitish in color and often cover large portions of the sky. Altostratus clouds usually form ahead of storms with continuous rain or snow.

4. **Altocumulus** - These belong to the "middle cloud" group (2,000-7,000m). They often have a "cotton ball-like" appearance with gray undersides. If they occur on a warm humid morning, it is a sign to expect thunderstorms by late afternoon.

5. **Nimbostratus** – these belong to the "low cloud|" group, they are often associated with steady rain or snow and occur in thick, continuous layers. They are often dark gray in color.

6. **Stratocumulus** – these belong to the "low cloud" group (up to 2,000m) Often cover the sky in dark heavy masses. They are long and grey and often form in bands across the sky. They are associated with light drizzle or rain.

7. **Cumulonimbus** – these are tall, towering versions of cumulus clouds. They can have heights of two to five miles. Cumulonimbus clouds are associated with hail, rain and snow.

FIGURE 16-210
CIRROSTRATUS

FIGURE 16-21
CIRROCUMULUS

FIGURE 16-22
ALTOSTRATUS

FIGURE 16-23
ALTOCUMULUS

FIGURE 16-24 NIMBOSTRATUS

FIGURE 16-25 STRATOCUMULUS

FIGURE 16-21 CUMULONIMBUS

16.13 Hurricanes, Typhoons & Cyclones

A tropical cyclone is a rapidly rotating storm system characterized by a low-pressure center, strong winds, and a spiral arrangement of thunderstorms that produce heavy rain. Depending on its location and strength, a tropical cyclone is referred to by names such as hurricane, typhoon, tropical storm, cyclonic storm, tropical depression, and simply cyclone.

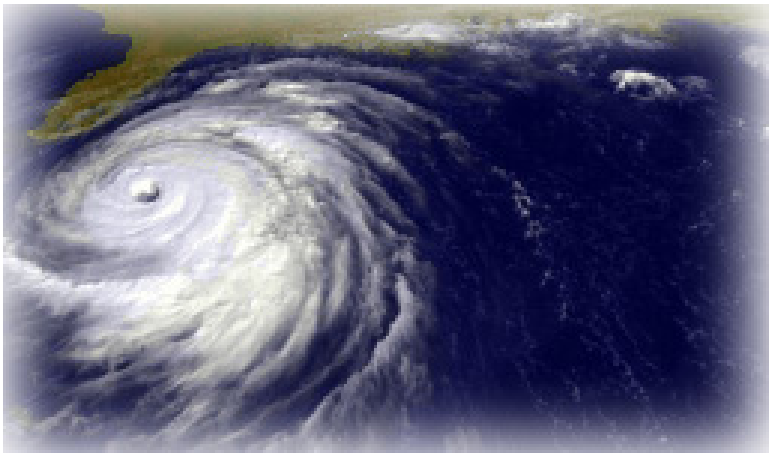
Tropical cyclones typically form over large bodies of relatively warm water. They derive their energy through the evaporation of water from the ocean surface, which ultimately re-condenses into clouds and rain when moist air rises and cools to saturation. They dissipate when they pass over land.

A **tropical depression** is an organized system of clouds and thunderstorms with a defined, closed surface circulation and maximum sustained winds of less than 34 knots (63 km/h). It has no eye and does not typically have the organization or the spiral shape of more powerful storms. However, it is already a low-pressure system, hence the name "depression".

A **tropical storm** is an organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds between 34 knots (63 km/h) and 64 knots (119

km/h). At this point, the distinctive cyclonic shape starts to develop, although an eye is not usually present.

A **hurricane or typhoon** (sometimes simply referred to as a tropical cyclone, as opposed to a depression or storm) is a system with sustained winds of at least 34 metres per second (66 kn) or 74 miles per hour (119 km/h). A cyclone of this intensity tends to develop an eye, an area of relative calm (and lowest atmospheric pressure) at the center of circulation. The eye is often visible in satellite images as a small, circular, cloud-free spot. Surrounding the eye is the eyewall, an area about 16 kilometres (9.9 mi) to 80 kilometres (50 mi) wide in which the strongest thunderstorms and winds circulate around the storm's center. Maximum sustained winds in the strongest tropical cyclones have been estimated at about 85 metres per second (165 kn) or 314 kilometres per hour (195 mph).



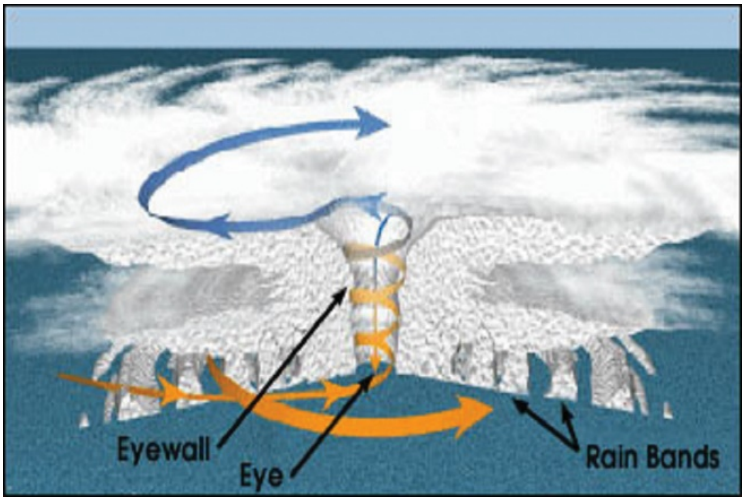


FIGURE 16-22 HURRICANE DYNAMICS

16.14 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.

16.15 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 its dew point.

FIGURE 16-23 FOG – SAN FRANCISCO BAY

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 is** a land based fog which 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 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.

- **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 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.

During fog or restricted visibility, it is best to seek shelter in an anchorage or marina and wait for the fog to dissipate. Navigating through fog can be a dangerous and frightening experience. It is easy to lose your "sense of direction" and become disorientated so make sure to check your compass heading and stay on course. If fog is forecast, head for shelter or a safe haven immediately.

16.16 Thunderstorms

Thunderstorms are an extremely dangerous type of weather phenomena. They form when moist air rises into cold air and the water vapour condenses forming cumulonimbus clouds. There are two types, ordinary and severe.

- Ordinary thunderstorms last about an hour and are typical during the summer.

- Severe thunderstorms are very dangerous as they are capable of producing tennis- ball size hail, strong winds, flash floods, squall lines, strong gust fronts, and microbursts.

    - The squall lines that thunderstorms can produce can cause a rapid build-up of wave conditions which can swamp a boat if precautions are not taken.

    - If a thunderstorm is imminent, and lightening is likely to accompany it, head to shore and seek a safe anchorage or marina.

16.17 Lightening

Lightening is an electric current and for lightening to exist, you first need clouds. During a thunderstorm, particles of ice collide into each other and create friction in the form of an electrical charge. When a cloud fills up with electrical charges, lighter, positively charged particles form at the top of the cloud and heavy charges sink to the bottom of the cloud. When the positive and negative charges grow large enough, a giant spark (lightening) occurs between the two charges.

If positive charges build up on the ground beneath, this can cause a spark that is attracted to the negative charge in the bottom of the cloud. The grounds positive charges centers around anything that "stick up" such as a tree, people, lightening conductor or the mast of a sailboat.

Lightning at Sea

- A lightning storm at sea is a frightening thing to encounter, especially on a sailboat. If a mast is struck, it will generally "fry" all of the electronics on board a vessel such as radio, GPS, radar, chart plotters etc. It is important to carry a hand held VHF and GPS as we discussed for the "abandon ship" bag in the safety equipment chapter. As in the case of thunderstorms, head to shore and seek a safe anchorage or marina as soon as the weather predicts.

16.18 After A Storm

When a storm has passed, there will often be calm weather but it is important to understand that a large and sudden rainfall can cause debris, tree branches and vegetation to flood down rivers and into estuaries which can be a hazard to navigation and a danger to your vessel.

Creeks can rise quite dramatically and the water will become muddy and murky and if someone were to fall overboard without a lifejacket, it might be impossible to see them. The rate of water flow down rivers and creeks will also increase dramatically and navigating upriver is best left until the flood has died down.

Make sure to steer clear of any rapids as the rate of water flow in currents will increase significantly. As with other adverse weather conditions, head to shore and seek a safe anchorage or marina as soon as possible.

16.19 Knowledge Review

1. What sort of information is contained in a marine weather forecast?
2. Name 8 different sources for obtaining a weather forecast.
3. What is the Coriolis Effect?
4. Describe what happens when a front passes through
5. Describe the differences between a warm front and a cold front
6. What is the difference between a sea breeze and a land breeze?
7. What is a katabatic wind?
8. What is an anabatic wind?
9. Describe the Beaufort wind scale, how many “forces“ are there on the scale?
10. What are the 3 basic cloud types?
11. Describe how a hurricane is formed and what the effects are.
12. What is the difference between a tropical depression, tropical storm and a hurricane?
13. Name 3 types of fog
14. What precautions should be taken if you encounter fog?
15. Describe the effects of thunderstorms and lightening
16. What should you be aware of when a storm has passed?

Module 17 SHORT PASSAGES – HEAVY WEATHER, RESTRICTED VISIBILITY & NEGOTIATING HARBOUR ENTRANCES

17.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO GIVE THE STUDENT THE INFORMATION REQUIRED TO PREPARE FOR HEAVY WEATHER TACTICS FOR SHORT PASSAGES AND ACTION IN RESTRICTED VISIBILITY AND NEGOTIATING HARBOUR ENTRANCES.

17.2 Heavy weather preparations, line squalls

Preparations for Heavy Weather

Preparations for heavy weather should be made well in advance of the incoming weather system. It is important to:

- Close all hatches, put washboards and hatch covers in place
- Close seacocks
- Hoist radar reflector
- Secure all loose items on deck and below
- Make sandwiches or easy to prepare food
- Don heavy weather apparel, safety harnesses and lifejackets
- Appoint lookouts as visibility can be significantly reduced
- Plot position accurately, manoeuver away from a lee shore ·
- On sailboats, reduce sail and prepare trysail or heavy weather sails
- Head for a safe haven if heavy weather persists or is likely to continue

Leeshore

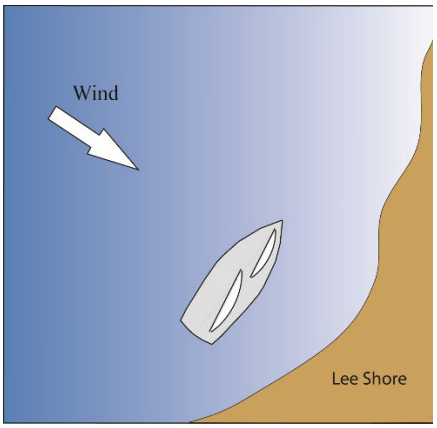


FIGURE 17-1 LEESHORE

- In rough weather there is always the danger of a leeshore on to which the wind is blowing, and the seas breaking.
- A boat will be safer offshore in deeper water.
- Often, what appears to be a safe harbour requires an approach to a leeshore. This can result in large rolling waves at the entrance to the harbour which can cause a boat to "surf" down the waves out of control.
- Under such circumstances it may be wise to stay offshore until the weather calms down or to find an alternative harbour or safe refuge.

Line Squalls

- A line squall during daylight hours is visible as a darkening line across the sky which sometimes contains short bursts of intensive rain and a sudden and dramatic increase in wind speed.
- They are generally short lived but can be severe and sometimes frightening during their short lifespan.
- Preparations for a line squall are the same as for heavy weather and it is always better to err on the side of caution in the event that you encounter one. This is especially important at night time when they may not be as noticeable against a dark sky.

Heavy Weather Tactics

Be prepared in the event of a strong wind warning, and make sure that your vessel is big enough to handle the tides, waves and weather that is associated with this.
Preparations for heavy weather should be undertaken as listed above. However, when heavy weather is approaching it is always best to head for a safe haven if at all possible.
For sailboats, it is possible to "heave to" during a storm which is probably the most comfortable option. This requires the reduction or reefing of both the mainsail and the headsail and the" backing" of the headsail which effectively leaves the boat dead in the water with little forward leeway.

The procedure is to tack leaving the foresail cleated, when the foresail backs, the helm is brought to leeward and secured. The mainsail should be adjusted according to the size of the

foresail. With the foresail backed, this counteracts the forward drive of the mainsail. The boats motion will be steady and gives the opportunity for a break or rest period. In the hove to position, the helm is lashed to leeward and the foresail sheeted to windward. Your sailing instructor will demonstrate this procedure for you.

Sea Anchors

FIGURE 17-2 SEA ANCHOR

Another option for both powerboats and sailboats is the deployment of a sea anchor. This is usually a canvas or web type bag which looks like a small parachute and is deployed off the bow of the boat using the anchor rode to keep the bow into the swell. This is the safest position for small power boats as a heavy beam sea can capsize a boat quite easily. For maximum benefit, a sea anchor should always be deployed with enough rode to reach the crest of the oncoming wave.

When coastal cruising it is important to get regular weather forecasts allowing enough time to reach a safe haven in the event of incoming heavy weather.

Drogues

During strong following seas, the wave action on the stern of a vessel can cause the vessel to constantly "yaw" which will push the boat from side to side. To prevent this, a **drogue** is dragged behind a vessel (attached to the stern) which will act as a brake and assist in maintaining the boats course. It will however reduce the speed of the vessel but will allow for a greater level of stability and comfort.

Drogues: Also see module on boat safety equipment

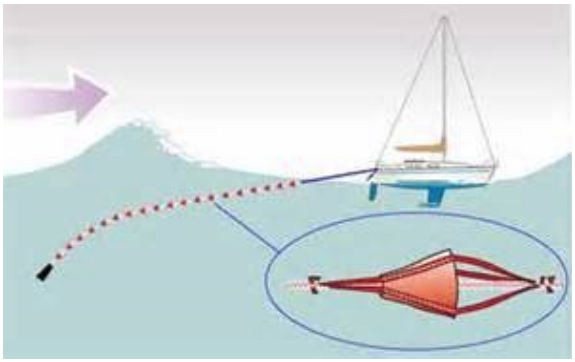


FIGURE 17-3 DROGUE EXAMPLE

FIGURE 17-4 DROGUE

Ice and Ice Accretion

Ice accretion is the process whereby a layer of ice will build up on a vessel when exposed to freezing rain or sea spray or from super cooled fog or cloud droplets. The weight of ice can become quite substantial and must be removed as soon as possible. Failure to do so can result in the vessel becoming top-heavy and likely to turn over in the event of a beam sea. Melting ice packs can flow down rivers during the spring season and become serious hazards to navigation.

FIGURE 17-5 ICE ACCRETION

17.3 Action in Restricted Visibility

Fog

Air reaches its “dew point” when it saturated with water at a certain temperature. When the temperature drops below dew point fog can occur. It usually occurs when the land cools at night and the moisture laden air can drift across coastal regions for several miles offshore. When the sun rises, it usually burns off the fog by raising the dew point. It can also disperse when warm dryer air raises the temperature.

Fog can be very disorientating as visibility can often be reduced to just several yards. It is important to make the following preparations:

- Immediately obtain an accurate position of where you are. The logbook should be updated regularly with positions and courses
- Check your chart and steer a course to keep you clear of any obstructions, navigation hazards, shipping channels or traffic separation schemes.
- Avoid constantly altering course as this makes accurate navigation difficult.
- Monitor your VHF and if in a shipping lane a “securite” should be broadcast giving the vessels current location.
- Note all other vessels in the area.
- Turn on radar and all available electronic navigation equipment.
- Hoist a radar reflector as high as possible

- Slow your boat speed so you can stop quickly in an emergency or alter course as necessary.
- Appoint a lookout to watch and listen for other shipping.
- Have white flares close to hand.
- Don lifejackets and know the location of your life raft and all safety equipment.
- Maintain silence.
- Sound the fog signal with your boats air horn (one long blast every two minutes).
- If close to a marked channel, stay outside the channel but close to the buoy.

17.4 Negotiating a Harbour Entrance

- When approaching any harbour entrance, it is essential to be aware of all other vessels entering and leaving the harbour. Larger vessels may be restricted in their ability to manoeuver or constrained by draught and it is important to know your light, sound and day shapes as covered in the collision regulations. Be aware of all traffic approaching from behind and make sure to stay on the starboard side of the channel.
- Prepare your pilotage plan in advance.
- Have ample crew on deck to assist you if required.
- Have your VHF radio switched on and close at hand.
- Prepare dock lines and fenders for arrival at the dock. It is always a good idea to have your anchor ready.
- In the event of an engine failure should you need to anchor to avoid collision or grounding.
- At night time, make sure your navigation lights are on and working.
- Hoist your radar reflector as high as possible.
- If approaching a leeshore, great care must be taken to control the vessel while entering a harbour entrance due to the possibility of large rolling waves at the entrance. In extreme circumstances such as this or when crossing a sandbar at an

entrance, it is best to deploy a sea anchor off the stern of the boat to slow down the boat and avoid surfing.

17.5 Collision Regulations on Passage

It is important on all voyages to maintain a proper lookout at all times. Make sure your crew have a basic understanding of the collision regulations and if in doubt always call the skipper. Allow sufficient time for collision avoidance if you feel there may be a problem.

Any action to avoid collision should be made in sufficient good time with due regard for good seamanship. Any alteration of course or speed shall be large enough to be readily apparent to another vessel observing visually or by radar. Avoid a succession of small alterations of course and or speed. Make sure to avoid changing course into the path of another vessel.

17.6 Preparing a Short Passage Plan

Reference Materials/Information for Planning

It is essential to all boat skippers and navigators to understand the importance of preparing a passage plan for any voyage they are about to undertake. An appraisal of information must be made before a detailed plan can be drawn up. This includes:

- Charts containing sufficient detail to show navigation marks, known hazards and any other specific information that is appropriate for each part of the intended voyage.

- Where possible, a Reeds Nautical Almanac (or similar) for the appropriate area and current year should be consulted. This will contain a list of lights and navigation marks, tidal information for the ports in the area, current and tidal atlases, traffic separation schemes, list of appropriate radio signals, harbour radio and other useful information.

- A local cruising guide giving information on locations of fuel, fresh water, pump out stations, supermarkets, hospitals and other information as appropriate to the voyage.

- Vessels intending to go beyond 5 miles from any coastline should carry a minimum level of navigational publications and the operating manuals and maintenance instructions for all navigation aids, engines and equipment on board.

Passage Plan Headings for Consideration:

- Date: does the timing coincide with adverse tropical weather systems

- Weather: do I have access to local weather information

- Charts: are current small and large scale charts available for the area.
- Distance: what is the length of total passage and of each leg.
- Boat speed: what is a reasonable average boat speed to expect.
- Passage time: how much time should be allowed for the total / each leg.
- Tidal information: what are the tidal restrictions, direction of flow, strong currents, overfalls, time of high and low water at points of departure and arrival.
- Port information: what do I know about berthing, provisioning, medical care, fuel
- Harbours of refuge: shelter from adverse or changing weather, access or tidal restrictions.
- Navigation marks: buoys and light characteristics and sequence.
- Documents: boat registration papers, radio license (if applicable) insurance, passports for all crew, return tickets (if applicable).
- Watch schedules: how will the watch routine be handled during day / night hours.

Decide What Tactics to Use

In deciding what tactics to use to implement your passage plan, the following factors should be taken into account:

- The number of crew onboard
- The experience and qualifications of the crew
- The reliability and condition of the boats navigation equipment
- Estimated times of arrival at critical points for tidal heights and rates of flow
- Weather conditions especially areas prone to fog
- Daytime or night time passing of danger points
- Traffic conditions especially in busy harbours or thoroughfares

Having considered all of the above, the skipper must decide if any of the conditions introduce an unacceptable hazard to the safety of his vessel and crew or indeed if the passage should

be undertaken given certain prevailing conditions. Consideration should also be given to the requirement of additional deck or engine room personnel if deemed appropriate.

Selecting an Anchorage

Selecting a suitable anchorage is important for both the safety of the vessel and the comfort of its crew. The factors to be taken into consideration are:

- Wind speed and direction to determine the suitability of the anchorage. Winds generate swells which can be most uncomfortable to anchor in.
- Tide and current information will ascertain if there is too much flow to anchor safely
- Navigational access to the anchorage is important in busy shipping areas and during heavy weather.
- Depth of water will determine the amount of rode required, make sure you have sufficient depth under the boat at low tide to prevent grounding.
- Type of holding (sand, shale, rock, turtle grass or mud) will determine what type of anchor to use.
- Number of boats at anchor will determine if there is sufficient room to anchor and swing without risk of collision.

It is always best to arrive at an anchorage in daylight hours to have sufficient time to thoroughly research the best position to anchor in.

Navigation on Short Passages

- On the chart, draw in the ground tracks from start to finish, avoiding dangers by a safe margin, and taking advantage of navigation marks and lights wherever possible. These tracks are not courses to steer; specific tidal work will usually be done just before the passage starts.
- From the distances and the expected average speed of the boat decide how long the passage will take and how much of the passage will be completed within your daily time schedule. Note harbours or anchorages which may suit for overnight stops.
- Circle clearly any hazards on the chart which are not easily noticed.
- Look for headlands or other areas which may have strong tides or overfalls, these may dictate that you pass at a specific time relative to high, or low, water.

- Note any harbours that may be used as harbours of refuge in an emergency. It may not be possible to enter these harbours under all conditions so note carefully any shelter or tidal restrictions these harbours may have.

- If you are using GPS or Loran note the latitude and longitude of waypoints, you intend to use. Check these carefully as it is only too easy to make mistakes when writing them out.

- Check whether the track passes through traffic separation schemes.

- If there is a tidal consideration, such as lock gates at your destination, it may be necessary to work backwards from this consideration in order to decide the time of departure. There is not much point in arriving 20 minutes after the lock gates have shut.

- Check which harbours have fuel and water available. The fuel consideration is of considerable importance to motor yachts. Always plan so that you have a reasonable amount of fuel in reserve and remember that adverse conditions may increase fuel, consumption dramatically. Check whether fuel, water, etc., is available on the dock.

- When deciding how long you will travel each day take into account the stamina and experience of the crew and the sea-worthiness of the boat. Remember that cruising is supposed to be relaxing and enjoyable, not a test of superhuman endurance.

- If a passage is expected to take longer than about 15 or 16 hours, it is advisable to work out a suitable watch schedule.

- Decide the provisioning of basic food and water supplies.

Most important of all try to maintain a flexible approach to the whole plan as conditions may be adverse on the day; trying to complete a passage against difficult conditions can spoil a holiday and put you and your crew under a lot of pressure.

Delegation of Responsibilities to Crew

Boating is team work and requires input from all crew members for the safe and enjoyable running of the vessel.

- Each crew member should be fully aware of the location and uses of all safety equipment on board including but not limited to lifejackets, life rafts, fire extinguishers, flares, ditch bag, VHF radio, horseshoe buoy, throw ring, and lifesling.

- It is important on every vessel that crew understand what their duties will be and that they are sufficiently experienced and trained to undertake such duties.

- Crew should also know the safe operational procedures and location for the heads, stove, heater, engine, generator, tool box and other on board equipment.

17.7 Knowledge Review

This is a practical subject for which we do not consistently include a Knowledge Review. However, due to the nature of the material covered and its importance it has been included

1. What preparations for heavy weather should be made?

2. Understand leeshore, line squalls and heavy weather tactics.

3. Understand what the Beaufort Wind Scale is and general description, wind speed and wave height for each level.

4. Understand what must be done in fog conditions to navigate safely and keep all crew and passengers safe.

5. Understand how to negotiate a harbour entrance.

Module 18 COMPASSES AND MAGNETISM

18.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS GET THE STUDENT TO UNDERSTAND THE MAGNETIC COMPASS, VARIATION AND DEVIATION AND APPLYING ERROR.

18.2 Compass Types and Their Uses

The Magnetic Compass

The magnetic compass comprises a magnetic needle mounted on a pivot and a card that is divided into 360º increments, called degrees, 0º and 360º being the same, also labeled north. Most modern compasses have the needle attached to the card and it operates by the needle pointing to magnetic north whilst the compass card indicates the vessels magnetic direction of travel.

FIGURE 18-1 COMPASS

The vessel's compass is mounted on or parallel to the fore and aft centerline of the vessel.

A compass is used to steer a course, that is, the direction in which the vessel wishes to travel, or to take bearings, which is the direction/bearing of an object for charting purposes.

Lubber Line

A lubber line is located on the fixed part of the compass and is positioned on the fore and aft line of the vessel, to enable accurate reading of a course or bearing. Most compasses have lubber lines etched on the forward and after part of the compass (to indicate reciprocal direction).

Compass Error

Magnetic north and true north are not in the same geographic position, therefore the difference between magnetic north and true north is called compass error. Compass error is therefore the algebraic sum of variation and deviation. Note that there are now three headings for bearings and courses: True, Magnetic and Compass. A bearing or course is useless unless it is followed by (T) or (M), or(C).

18.3 Variation, Deviation and Applying Error

Variation

The direction of True North and Magnetic North are both graphically shown on the chart as two compass cards overlaid on each other, known as a compass rose. Variation is the angular difference between the direction of True North, and the direction of Magnetic North. If the compass points east of True North, variation is named east and vice versa. The variation can be found printed in the center of the compass rose and it also notes the annual change.

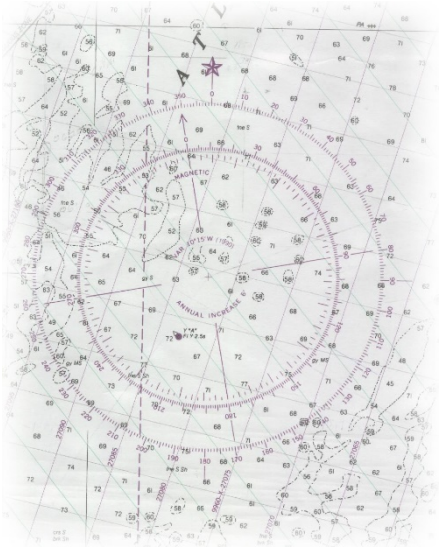


FIGURE 18-2 COMPASS ROSE SHOWN ON CHART

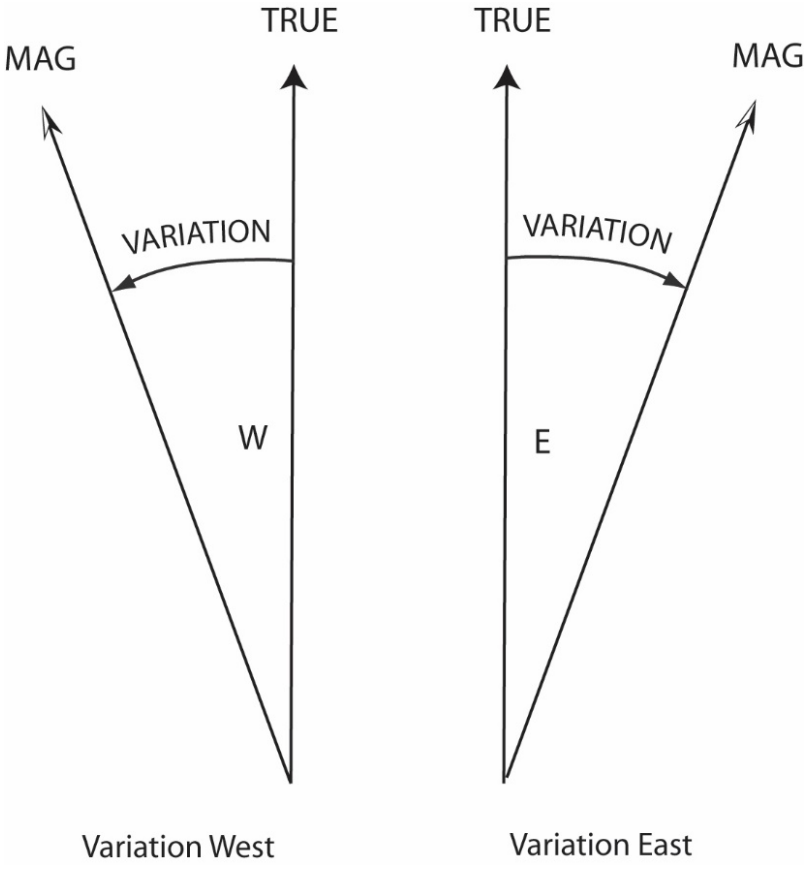


FIGURE 18-3 VARIATION

Deviation

Causes of deviation

- Deviation is caused by ferrous objects (those containing iron) being close to the compass.

- Engines, iron and steel keels, electric motors and cookers can all cause deviation and small portable objects such as pen knives, can cause deviation if they are close enough to the compass.

- Speakers in radios and VHF transceivers contain powerful magnets and if mounted too close to the ship's compass can cause large values of deviation.

- Steering compasses on steel boats are particularly prone to deviation whereas fiberglass and wooden boats are much less susceptible.

- Hand bearing compasses which are designed to be held close to the face can be effected by steel framed spectacles.

Deviation is not static as it changes as the direction of the boat changes and deviation caused by an iron or steel keel may change as the boat heels. Motor boats often have their compass close to a lot of instruments, many of which create magnetic fields.

The earth's magnetic field will cause the compass to point to Magnetic North, however any magnetic effects on a particular vessel will cause the compass to be deflected east or west from Magnetic North. This is called deviation and is also calculated east or west.

A professional Compass Adjuster can usually eliminate most of the deviation by the use of magnets placed strategically around the compass. Not all deviation will be corrected so a compass adjuster will make up a deviation card for selected compass headings.

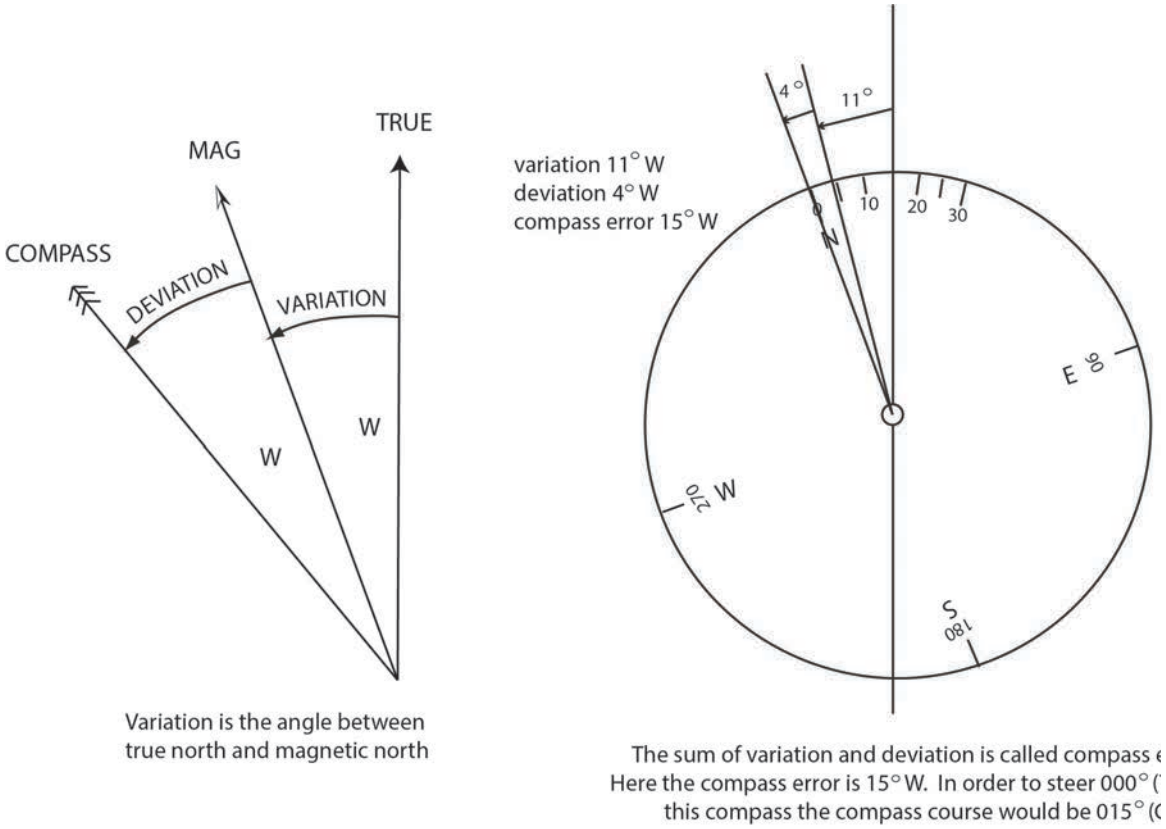


FIGURE 18-4 DEVIATION

When to check for deviation

Deviation should be checked (at least) at the start of any passage, at the beginning of the season and whenever any new equipment has been fitted which might cause deviation. Deviation should also be checked on a new, chartered, or borrowed boat.

Navigation Has Three Compass Bearings:

1. True (T)

The true compass rose and Parallels of Latitude & Meridians of Longitude on the chart all refer to true north as a datum.

2. Magnetic (M)

Takes into account or is affected by Variation only, for example Hand-bearing compass gives readouts in magnetic when used at a location on the vessel which is unaffected by deviation.

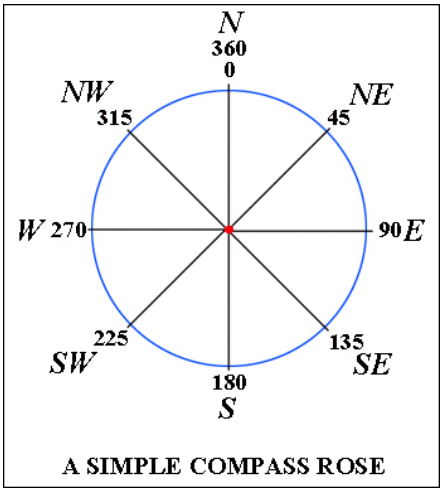


FIGURE 18-5 SIMPLE COMPASS ROSE

3. **Compass (C)**
   Uses magnetic north as its datum and takes into account or is affected by both variation and deviation.

Everything is converted to "True" for plotting on the chart.
Everything is converted to "Compass" for instructions and work on deck.

True North

True North is the North Pole, the point at the top of the globe where all the meridians of longitude meet.

Courses, True, Magnetic

True north - The direction to the geographic North Pole.

Magnetic north - The direction to the 'magnetic' North Pole.

Variation - The angle between the direction of true north and magnetic north.

Deviation - The angle between the direction of magnetic north and the direction towards which the compass actually points. Deviation is caused by metallic influences onboard a vessel, such as a radio or toolbox.

True Course - The angle between a yachts' centerline and the direction of true north.

Magnetic course - The angle between a yacht's centerline and the direction of magnetic north.

Compass course - The course to steer allowing for variation and deviation.

Magnetic North

Magnetic North is not at the same place as True North. The north magnetic pole is situated in the vicinity of Bathurst Island in northern Canada, about 1600 km (about 1000 miles) from the North Pole (and it is constantly moving). This means that from almost everywhere on the earth's surface True North will vary from Magnetic North. The direction of Magnetic North is shown on the compass rose on the chart, as is the annual change.

True Virtue Makes Dull Companions

The corrections for variation and deviation must be carried out in the correct sequence:

- from true to compass = True ~ Magnetic ~ Compass,
- from compass to true = Compass ~ Magnetic ~ True.

The mnemonic **True Virtue Makes Dull Companions** might help in remembering the sequence. If you have any difficulty working compass error problems, use the mnemonic by making boxes as shown. Then fill in the figures you know and the values in the remaining blank space(s) should become obvious.

Applying Variation

In order to apply the correct variation, it is necessary to 'work-up' the up- to- date variation figure. This is done by finding the nearest compass rose on the chart, reading the variation and year and applying the annual increase or decrease. Remember, all work on charts is True, whilst all information used to steer or plot courses is Magnetic.

Therefore, to correct:
True to magnetic add west and subtract east variation (Add on).
Magnetic to true subtract west and add east variation (Subtract).

A good mnemonic is:
"Error west compass best (Add on).
"Error east compass least (Subtract)

True	Var	Mag	Dev	Compass
079°	11ºW	090º	4º E	086º

Magnetic Anomalies

There are certain places in the world where "magnetic anomalies" occur. This is where magnetic magma is encrusted in the earth below the ocean and when you sail over this magma, the compass needle will continually spin around inside the compass. This will only happen for a few miles and will be marked on the nautical chart as an anomaly.

Hand Bearing Compass

A hand bearing compass is used to take the bearings from two different objects and then transform those angles onto a nautical chart. Where the two bearings intersect is your boats position. This subject will be covered thoroughly during the International Bareboat Skipper practical training course

FIGURE 18-6 HAND BEARING COMPASS (IMAGE COURTESY OF WEST MARINE)

18.4 Knowledge Review

1. What is a magnetic compass and how does it work?
2. How many degrees are there on a compass?
3. What is a compass used for?
4. What is variation, deviation, cause of deviation and when to check for it?
5. What is the difference between true north and magnetic north?
6. Understand “applying variation”
7. What is a magnetic anomaly?

Module 19 CHARTS, CHARTWORK & BASIC NAVIGATION

19.1 Key Objectives

THE OBJECTIVES OF THIS MODULE ARE TO FAMILIARISE THE STUDENT WITH CHARTWORK INSTRUMENTS, CHART INFORMATION AND SYMBOLS, LATITUDE AND LONGITUDE, NAVIGATION TECHNIQUES, PLOTTING TECHNIQUES, TIDES, CURRENTS, AND COURSE TO STEER.

The cautious navigator takes every opportunity that presents itself to find his position and plot it on a nautical 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 fixes should be; fog, low visibility and bad weather are some examples when the time between fixes should be reduced.

19.2 Charts

- Charts are essentially maps of sea areas showing coastlines and their prominent features,
- Depths, objects in on and under the water, hazards to navigation, aids to navigation, channels, anchorage areas, harbours, tides, water levels, magnetic variation and information on currents.
- They are intended primarily for use by mariners to assist in route planning, pilotage and navigation
- In addition to charts there are a number of other publications required by the navigator.

FIGURE 19-1 NAUTICAL CHART

19.3 Chart Publications

British Admiralty Charts (BA)

BA charts are published by the Hydrographic Office of the British Ministry of Defence and are available from approved chart agents. BA chart agents will also supply, free of charge the 'Home Waters Catalogue' (NP 109) which is a catalog of BA north European charts from Denmark to Bordeaux on the Atlantic coast of France. NP109 also lists other useful BA publications such as tidal stream atlases, pilot books, etc. for the area covered.

A full catalog of all BA charts called 'Catalogue of Admiralty Charts and other Hydrographic Publications' (NP 131) is also available for viewing at every BA chart agent. Both are published annually.

Canadian Hydrographic Service Charts

The Canadian Hydrographic Service (CHS) charts are published in Ottawa and provide nautical charts for all of Canada's coastlines and large navigable internal lakes, rivers and waterways. With increased commercial shipping, fishing, recreational boating and research vessels the CHS plays an important role in keeping these 946 charts up to date and available to all mariners. The CHS also provides digital charts and nautical publications for the safety of life at sea.

National Oceanic and Atmospheric Administration (NOAA) Charts

U.S. charts are published in Washington, D.C., by the National Oceanic and Atmospheric Administration (NOAA) by the Department of Commerce.

- Nautical Chart Catalog 1 - the Atlantic and Gulf Coasts including Puerto Rico and the Virgin Islands.
- Nautical Chart Catalog 2 - the Pacific Coast including Hawaii, Guam and Samoa Islands.
- Nautical Chart Catalog 3 - Alaska including the Aleutian Islands
- Nautical Chart Catalog 4 - the U.S. Great Lakes and Adjacent waterways.

These catalogs show, in pictorial form, the small craft charts, harbour charts, coast charts, general charts and sailing charts available for the area covered together with their respective chart numbers. Written details are also given of the title and scale of each chart.

Small Craft Charts

1) Charts intended specifically for use aboard small craft, often called 'yachtsmen's charts' are produced by various chart publishers. For example, International Sailing Supply of Punta Gorda (Florida) publish their chart #62 of New York Harbour which is a reproduction of portions of NOAA chart #12327.

2) Yachting charts are generally made to fold into a convenient size and have discarded information which the publishers do not consider of use to the small boat navigator.

3) These charts may also use different colors to indicate land, sea, drying areas and so on. Many of these charts are produced on waterproof and tear proof paper which has obvious advantages but erasing pencil lines can be a problem.

4) Yachting charts often include very useful "chartlets" of harbours and anchorages together with their approaches. (charlets are expanded views of certain sections of the charts). Some may have also have useful information such as pilotage/buoyage notes printed on the reverse side.

5) Be sure to check your marine chart for local hazards that may impede the operation of a vessel.

Suppliers

Charts are available from chart agents and nautical book stores worldwide; most chandlers can also supply a limited number of local charts for the immediate area.

19.4 Chartwork Instruments and Information

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 navigational marks to be easily erased... 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 – **(not recommended)**

FIGURE 19-2 PARALLEL RULES

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

FIGURE 19-3 DIVIDERS

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.

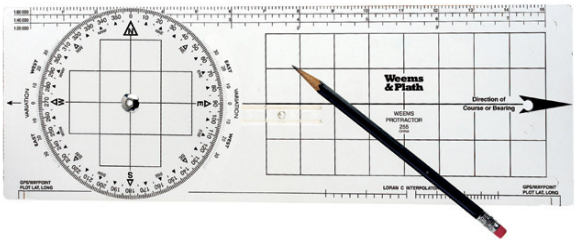


FIGURE 19-4 BRETON PLOTTER

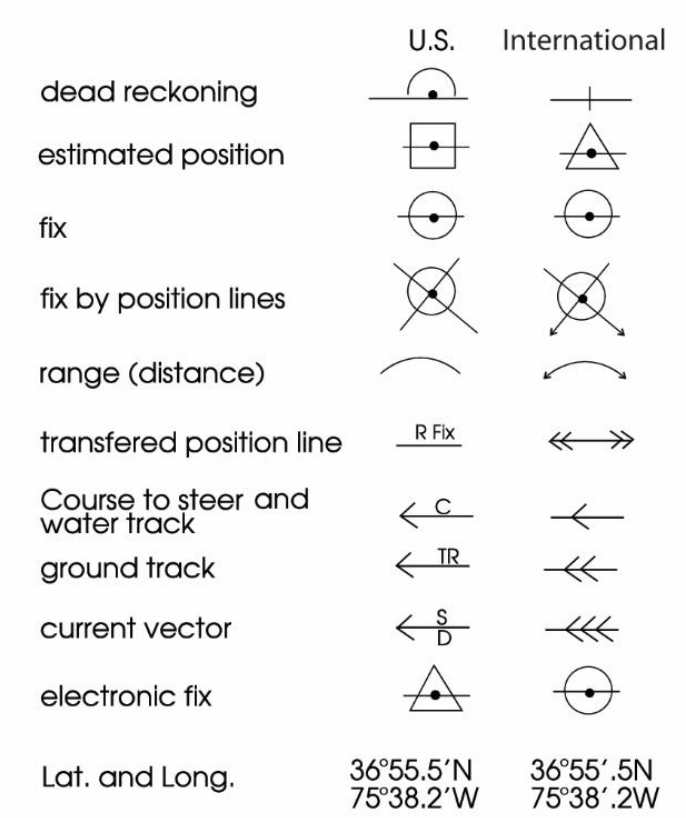
This type of plotter eliminates the need for the compass rose on the chart, can be used on rough surfaces, and on any size vessel. This is the most accurate of plotters having a correction factor of 1º.

Using a chart, parallel rules or plotter/protractor and dividers, the 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 a notebook, pencil sharpener and eraser.

Chart Work Symbols

Symbols used in chart work convey meanings of themselves. Different symbols are used for the U.S. than the rest of the world.



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 harbour 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.

Great care must be taken when moving 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.

Heights and Depths

Soundings (or depths) will be shown in either feet, fathoms or meters, where 1 fathom = 6 feet. In the USA, the standard of measurement will be imperial rather than metric. The measurement will be marked on the title block and on the upper/lower margins, "SOUNDINGS IN FATHOMS" or SOUNDINGS IN FEET" 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"

These will list 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.

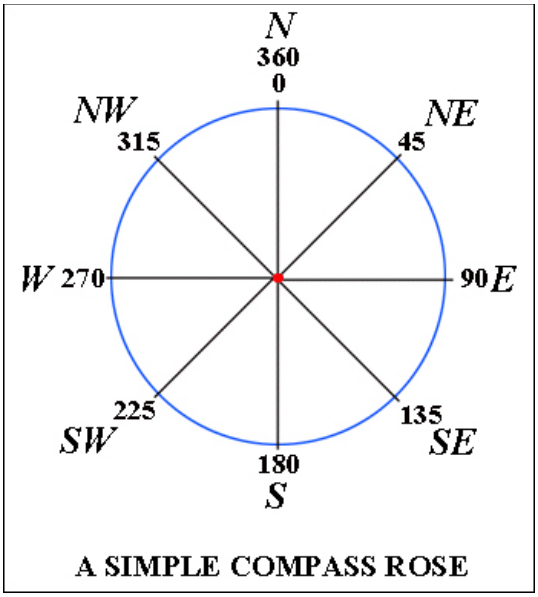


FIGURE 19-5 SIMPLE COMPASS ROSE

North/Compass Rose

True North is always at the top of the chart and South is always at the bottom. This may vary however 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.
(this will be covered in more detail on the practical course).

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.
(more on this later)

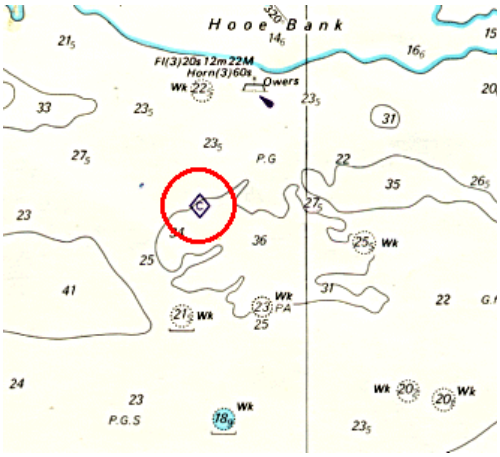


FIGURE 19-6 TIDAL DIAMOND

Chart Symbols and Abbreviations

Chart symbols and abbreviations can be found in booklets issued by various hydrographic offices in the U.K. it is NP 5011 (UK) or Chart No 1(Canada and 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 Vancouver Harbour- Falmouth to Plymouth - English Channel - New York Harbour - Port Everglades.

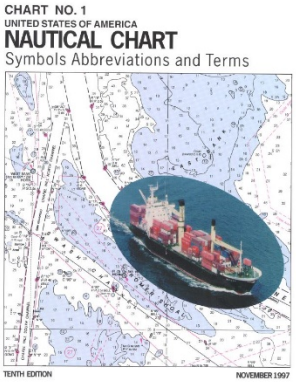


FIGURE 19-7 CHART NO. 1 (U.S.A.)

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

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

Anything blue or white shows the soundings below low water.

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

FIGURE 19-8 CHART INFORMATION EXAMPLE

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

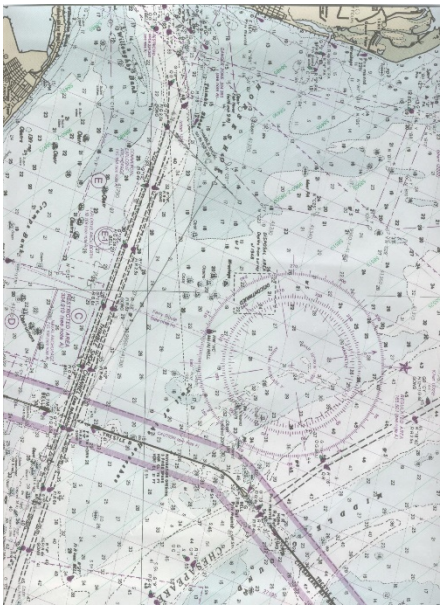


FIGURE 19-9 TRAFFIC SEPARATION SCHEME

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.

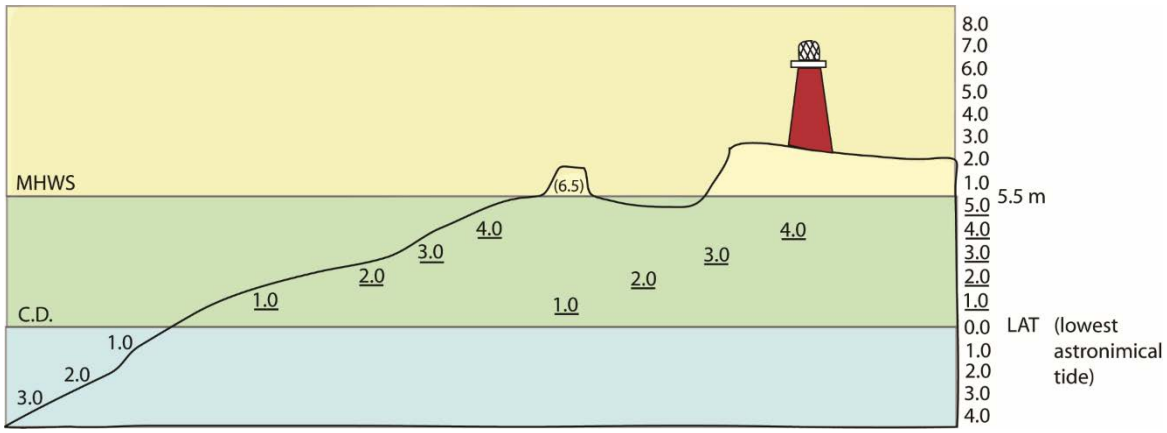


FIGURE 19-10 COLORS & LEVELS

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 90 degrees at the North Pole and 90 degrees at the South Pole.

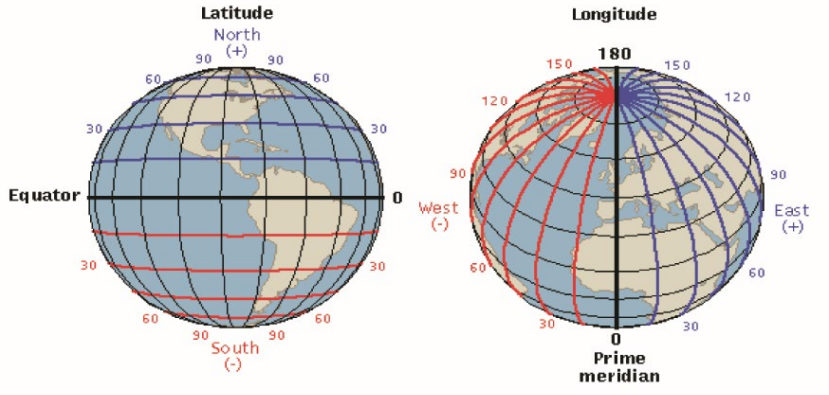


FIGURE 19-11 LATITUDE & LONGITUDE

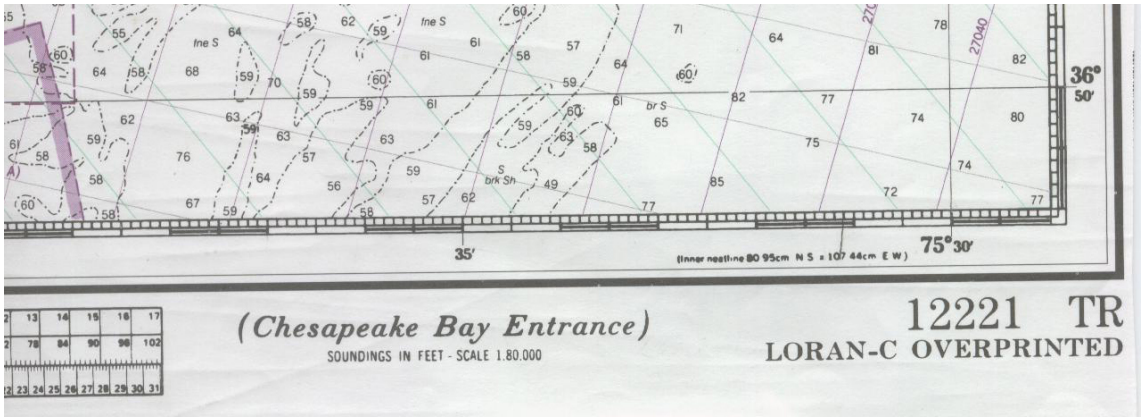
Never use the longitude scale at the top or bottom of charts to measure distance.

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. Positions are given in either "east" or "west" of Greenwich

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

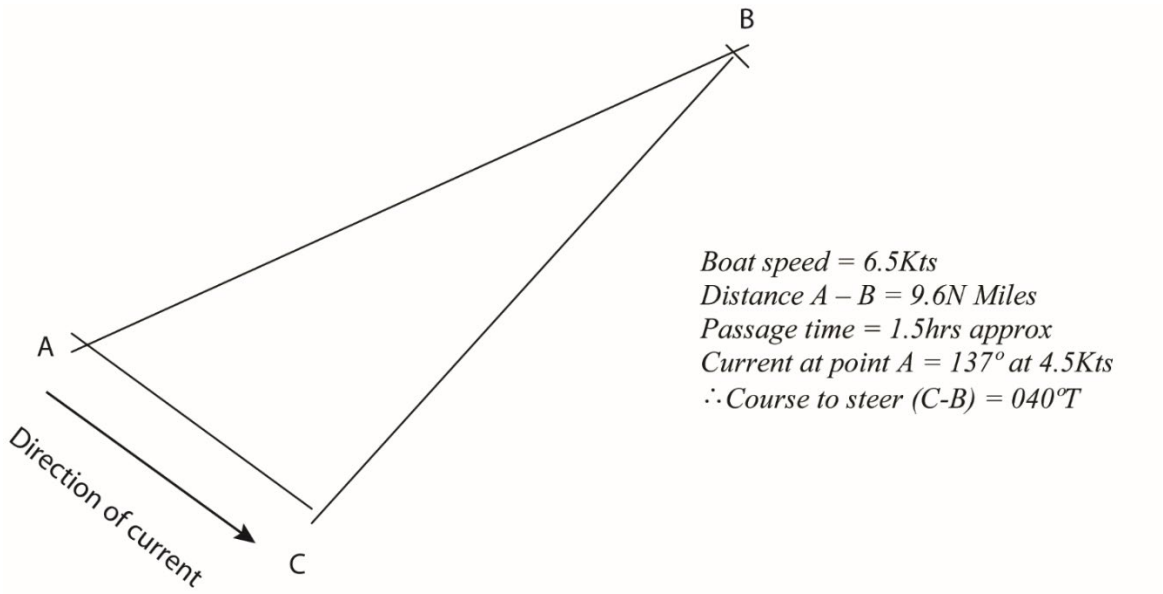


FIGURE 19-12 DETERMINING COURSE TO STEER

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. (more on this later)

Time

Time is always expressed using the 24 hour clock format and not "am/pm". Confusion 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".

FIGURE 19-13 TWENTY FOUR HOUR

Speed

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.

19.5 Terminology / Definitions

Course to Steer (CTS)

The direction to be maintained to a destination point. A course line is drawn on the chart indicating the intended direction of travel; this is the Course to Steer abbreviated to CTS.

Leeway

Leeway is the amount by which the boat is pushed off her intended track by the wind and may be significant, particularly in a sailboat going to windward.

Heading

The heading is the direction in which the vessel is pointing as indicated by the ship's compass. Ideally this should be the same as the course. The heading may be different from the course due to leeway, and due to counteracting tide or current.

Speed (S)

The speed of the boat through the water. This may be different from speed over the ground.

Set (SET)

The direction in which the current or tide is affecting the vessel.

Drift (DFT)

The speed of the current or tide.

Course Over Ground (COG)

The actual direction in which the boat is moving over the sea-bed, i.e. the ground track. This may differ from the course through the water because of the effect of current and leeway.

Speed Over Ground (SOG)

The actual speed of the boat over the ground. This may differ from the speed of the boat through the water because of the effect of current and leeway.

Tides

- The cautious navigator requires a detailed knowledge of tides in order to make safe and comfortable passages.

- 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, sounds and up rivers.

Currents

Currents are the horizontal movements of water from any cause, such as tidal phenomena, prolonged wind activity or river flow. A boat moving 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, its speed and direction of travel over the bottom will change.

Effects of Wind, Tide & Current

Generally, the strongest element affecting a power boat (due to a shallow draft) is wind but close attention will have to be paid to the effect of tide or current on the vessel.

Tides or currents will also have an effect. Pointing upstream will allow greater control but will slow the approach. Conversely, motoring downstream will increase speed over the bottom but may have a detrimental effect on steerageway. Adequate allowances will have to be made once the combination of stream and wind are evaluated.

19.6 Navigational Techniques

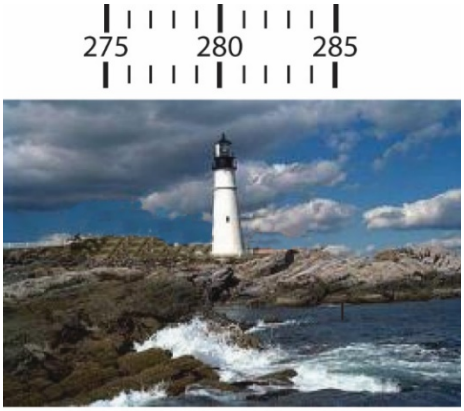
Dead Reckoning Position (DR)

- 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.
- **When "course steered" and "distance traveled" are taken into account, the position arrived at by this method 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.

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 anything 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.



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).

FIGURE 19-14 TAKING A BEARING

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.

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.

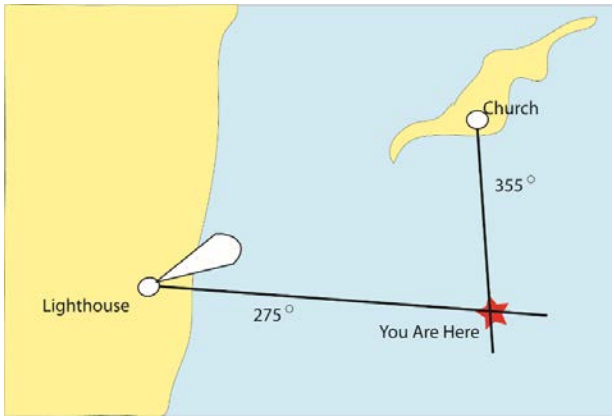


FIGURE 19-15 BASIC FIX

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.

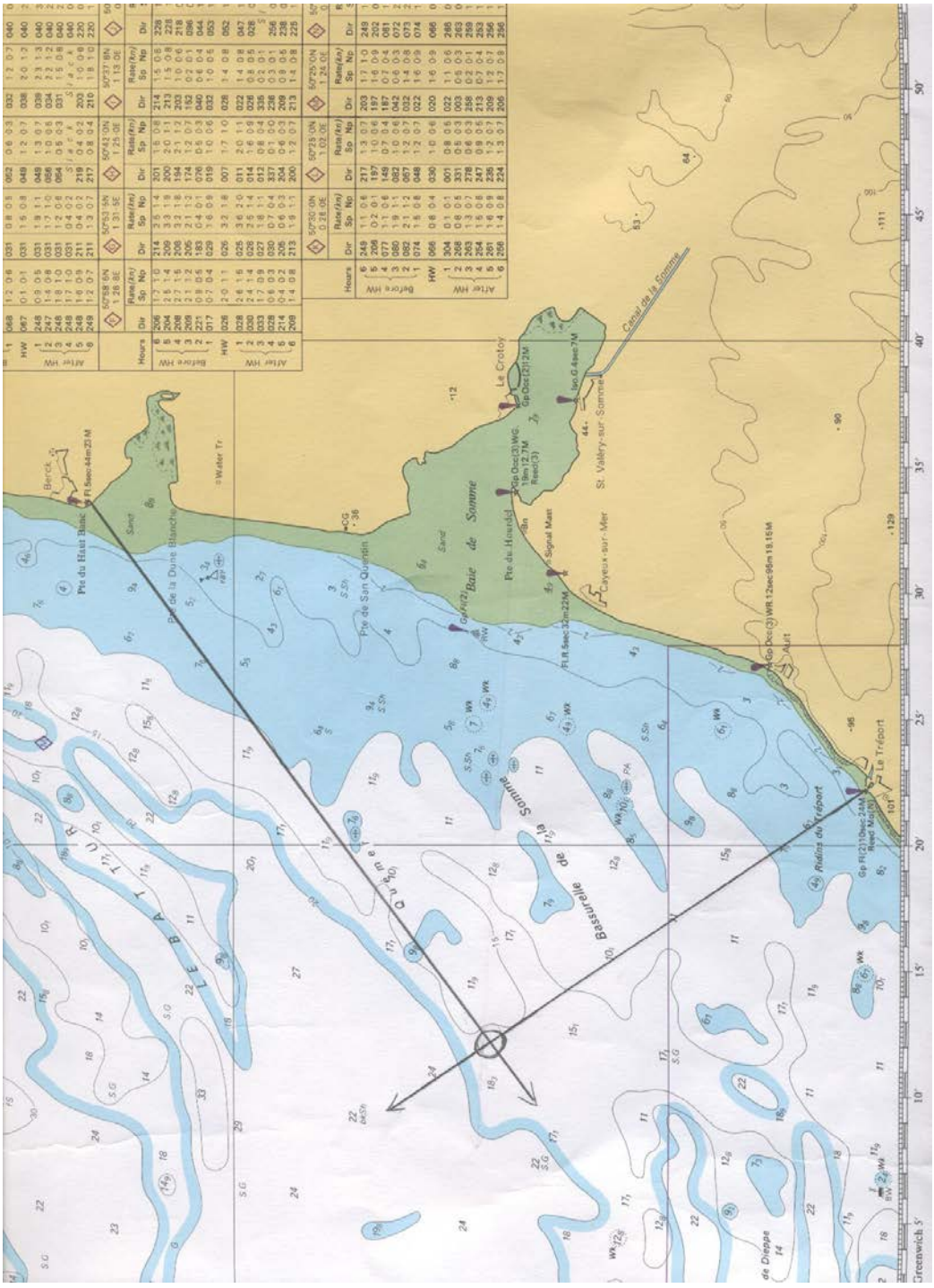


FIGURE 19-16 TWO POINT FIX

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.

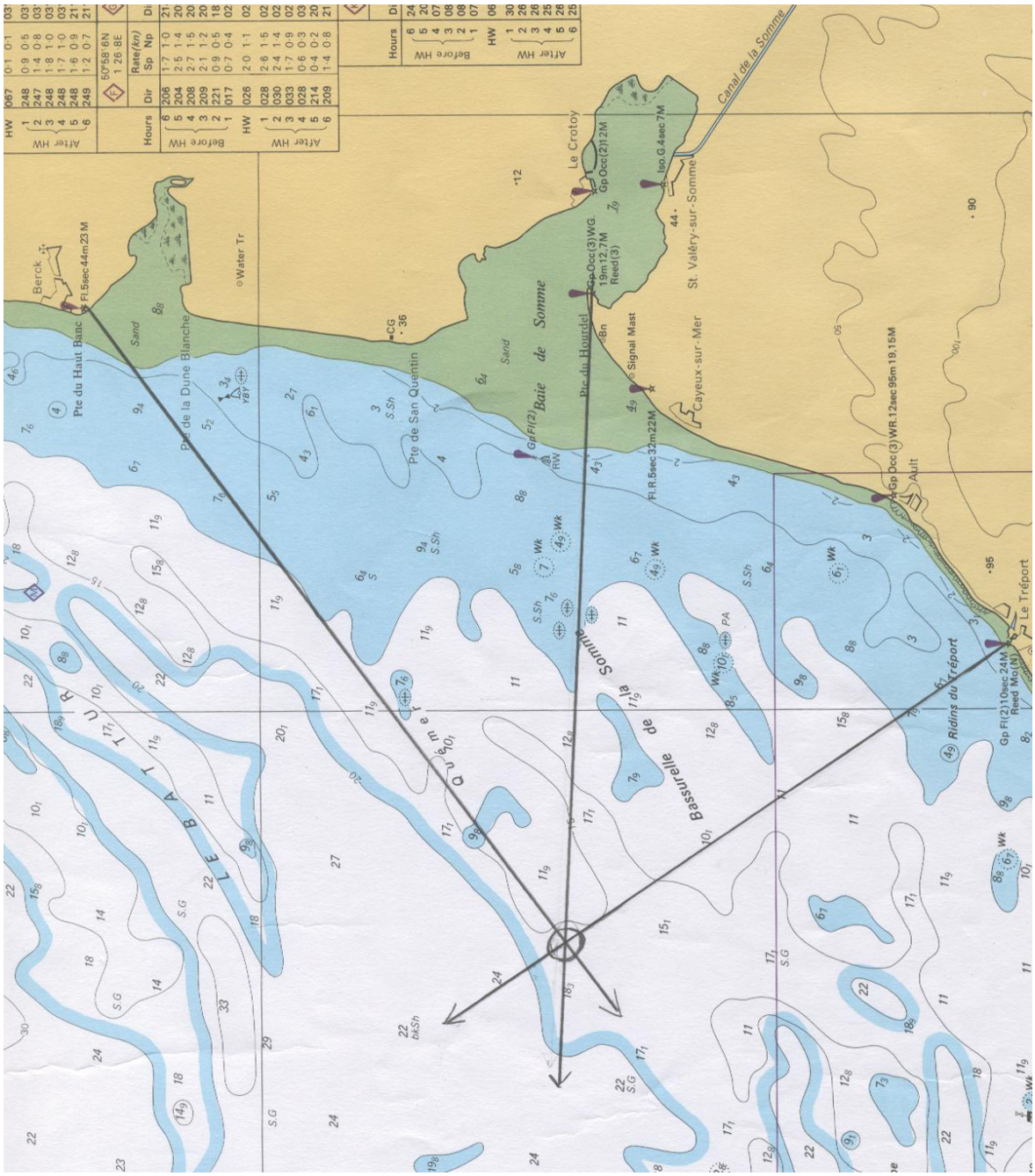


FIGURE 19-17 THREE POINT FIX

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.

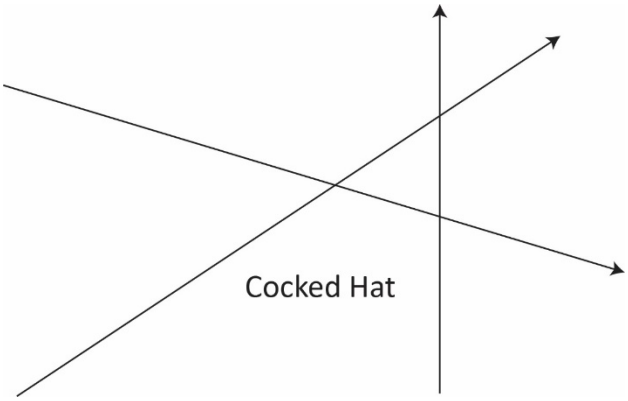


FIGURE 19-18 COCKED HAT

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 or as a vessel continues its movement forward, the LOP will change.

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.

FIGURE 19-19 TAKING BEARING WITH HANDHELD COMPASS

Running Fix

- A running fix is used when only one object for a fix is visible.
- It 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.

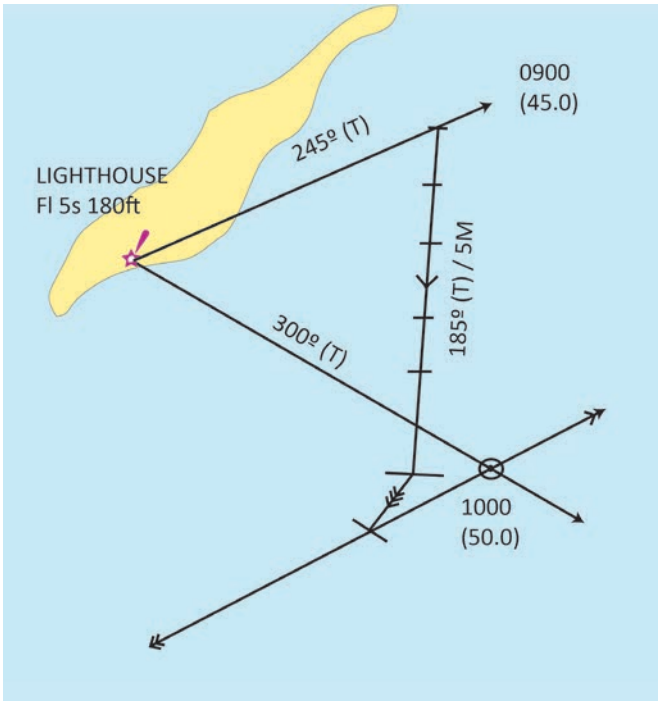
Procedure for a Running Fix

A position fix can be obtained from only one fixed charted object provided that the boat is moving. The principle is as follows:

1. Take a bearing of the object with a hand bearing compass and record the bearing, distance log reading and the time.
2. Maintain as steady a course as is possible, until the bearing to the object has changed significantly.
3. Take a second bearing of the same object and record the bearing, distance log reading, average course steered and the time.

The running fix is then plotted as follows:

1. Plot the first position line through the object.
2. Plot the second position line through the object. (Your position must lie somewhere along this second position line.)
3. From anywhere on the first position line draw a vector representing the boat's course and the distance the boat travelled between the times of the first and second position lines.
4. From the end of the course/distance vector plot a vector representing the current set and drift, if any, for the time involved.
5. From the end of the current vector draw a line parallel to the first position line. (This line is called a 'transferred position' line and should have two arrowheads drawn at each end)
6. The boat's position is where the transferred position line and the second position line intersect.



POSITION AT 1000 FROM A RUNNING FIX

Time	Log	Course (T)	Remarks
0900	45		Lighthouse. 245° (T)
1000	50	185°	Lighthouse 300°(T), current 0900 - 1000 + 215° /1 knt

1. Plot the first position line, 245° (T) to the light house.
2. Plot the second position line, 300° (T) to the light house.
3. From anywhere on the first position line plot the course steered and the distance travelled from 0900 to 1000: 185° (T) / 5 Miles.
4. Plot the current vector: 215° (T) / 1 Mile. (Assumed current for this example)
5. Draw a line through the end of the current vector, parallel to the first position line; this is called the transferred position line. Mark each end with two arrow heads, or write R FIX, beside the transferred position

The boat's position lies where the transferred position line cuts the second position line. Write the time and log reading beside the fix. To avoid clutter only the time and log reading at the time of the position fix would normally be written on the chart.

Other Sources of Position Lines

Transit 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.

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FIGURE 19-21 TRANSIT (AS SEEN FROM BOAT)

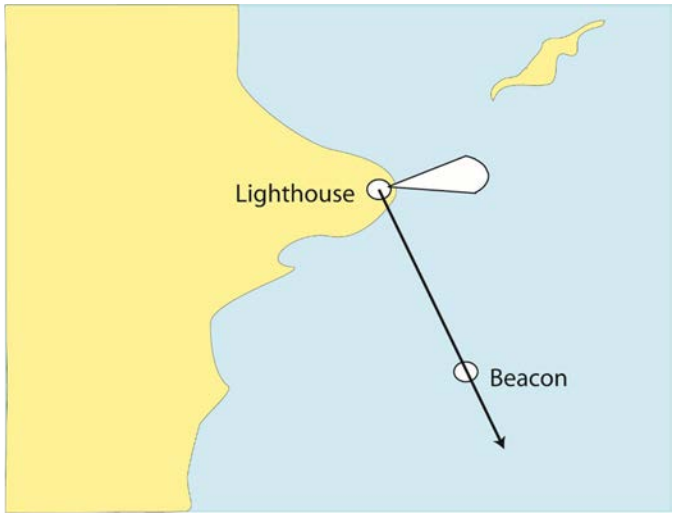


FIGURE 19-21 TRANSIT (AS PLOTTED ON THE CHART)

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.

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 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.

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

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

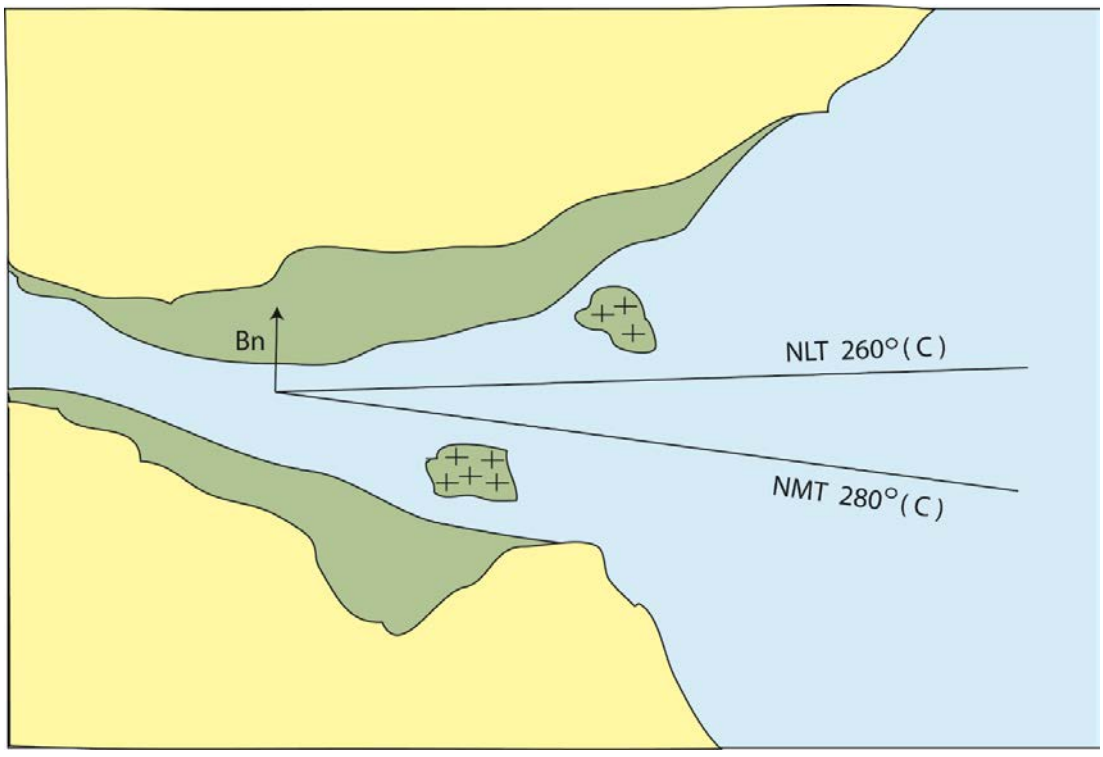


FIGURE 19-22 CLEARING LINE
(NOT LESS THAN 260 DEGREES (C), NOT MORE THAN 280 DEGREES (C)

.

19.7 Estimated Position

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 must be 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.

Depth Contour Navigating

May be used to assist the navigator in determining position by knowing the depth of water under the boat which will coincide with the depth on the chart. Basically the navigator will follow the depth contours of the water and maintain the same depth of water beneath the vessel at all times.

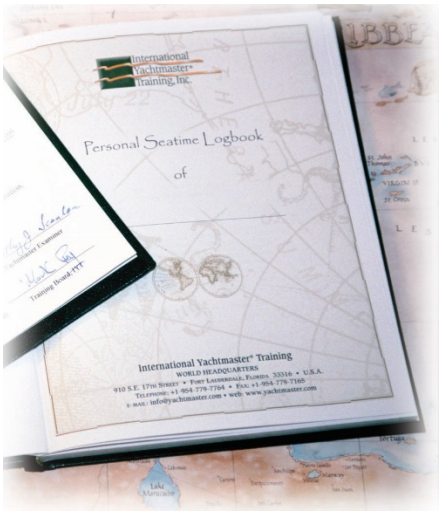
Log Book

There is an established process and format for chart work and for keeping a record of events and navigational information. All information is recorded in the vessels navigation logbook. This logbook makes up the navigational record of the vessel and is the point of reference for working up DR, EP and fixes. It will contain information concerning weather, sea state, engine hours, barometric pressure and also sometimes a narrative of the voyage. Different navigators have different requirements for what is required and will often design their own. It is possible to buy proprietary brands in boating stores, the use of which is a matter of preference. A typical logbook will have at least the following minimum:

FIGURE 19-23 YACHT (SHIP) LOG

- Time
- Log reading
- Course steered
- Barometric pressure
- Wind speed and direction
- Position in Lat. & Long
- Skipper's name
- Helmsman
- Comments
- Skippers name
- Helmsman
- Comments

IYT produces a Maritime & Coastguard Agency (MCA) approved personal seatime logbook which is a record of an individual's career at sea. It lists the names of the vessels they have worked on, ownership, gross tonnage, length overall, port of registry, distances travelled, ports visited, hours on night watch and position on board the vessel (helmsman, mate, skipper etc.) This logbook is available on www.IYTworld.com



19.8 Knowledge Review

1. Who is responsible for producing nautical charts in the U.K., Canada and the U.S.A.?
2. What are “small craft” charts?
3. Name some chart work instruments you would use.
4. Why is the Bretton Plotter the preferred navigational instrument?
5. What are the 3 measurements of depth that you might find on a nautical chart?
6. Name 10 items that a nautical chart contains?
7. What are “special notes, cautions and warnings”?
8. What is a compass rose?
9. What is a tidal diamond?
10. What is listed in “chart symbols and abbreviations”?
11. Describe the difference between large and small scale charts
12. What is the difference between latitude and longitude?
13. On which scale do you measure distance on a nautical chart?
14. Describe what is meant by the 24 hour clock?
15. What is Greenwich England reknowned for ?
16. Describe the following: CTS, leeway, heading, speed, set, draft, smg, sog, tides, currents, DR, EP, 2 point fix, 3 point fix, cocked hat, running fix, transit lines.
17. What is the “yacht log book” and what information is to be logged in?
18. What are tides and currents and how do they affect plotting a course?

Module 20 TIDES & CURRENTS

20.1 Key Objectives

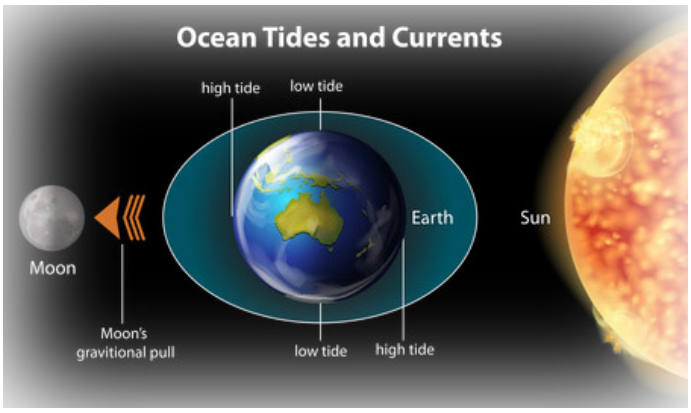
THE OBJECTIVES OF THIS MODULE ARE TO GIVE THE STUDENT AN UNDERSTANDING OF TIDES AND CURRENTS AND THE CAUSES OF THESE. IT ALSO COVERS TIDAL DEFINITIONS, TIDAL HEIGHTS AND DEFINITIONS OF TERMS.

20.2 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, sounds and 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 moon is when the order is sun, moon, earth and full when the order is sun, earth, moon. In both cases, the suns 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.

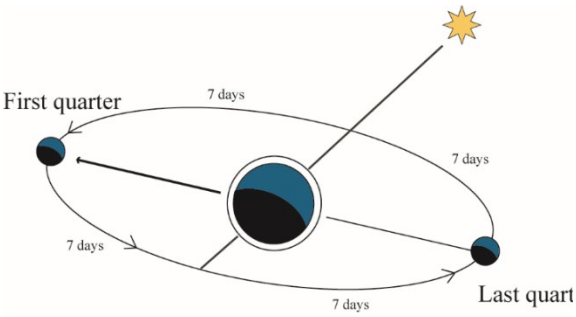


FIGURE 20-1 NEAP TIDES

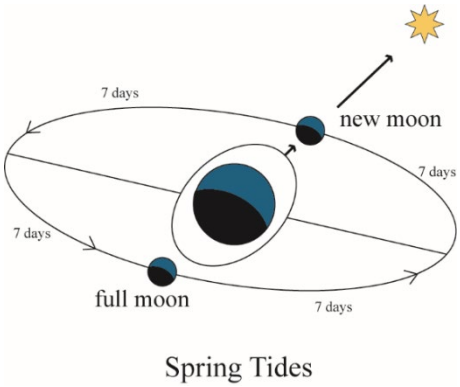


FIGURE 20-2 SPRING TIDES

20.3 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. British Admiralty metric charts use Lowest Astronomical Tide (LAT). American charts commonly use Mean Lower Low Water (MLLW).

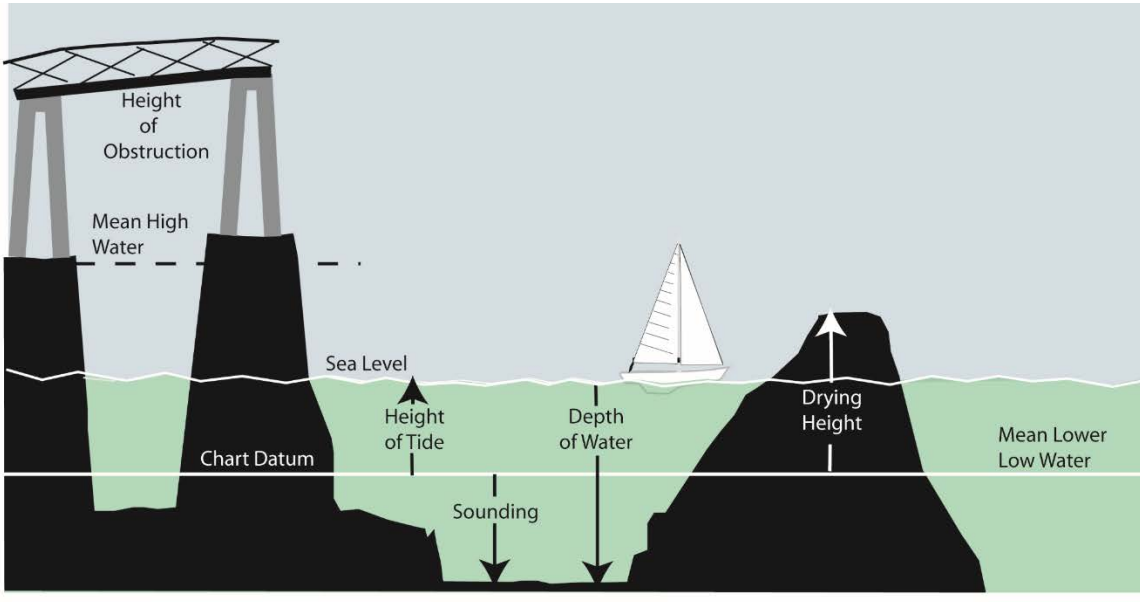


FIGURE 20-3 TIDAL HEIGHT DEFINITIONS

Charted Depth
The distance below chart datum of a feature is 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. 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.

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.

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:

- **the Height of Tide at a specific time,**
  OR
- **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 water 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.**

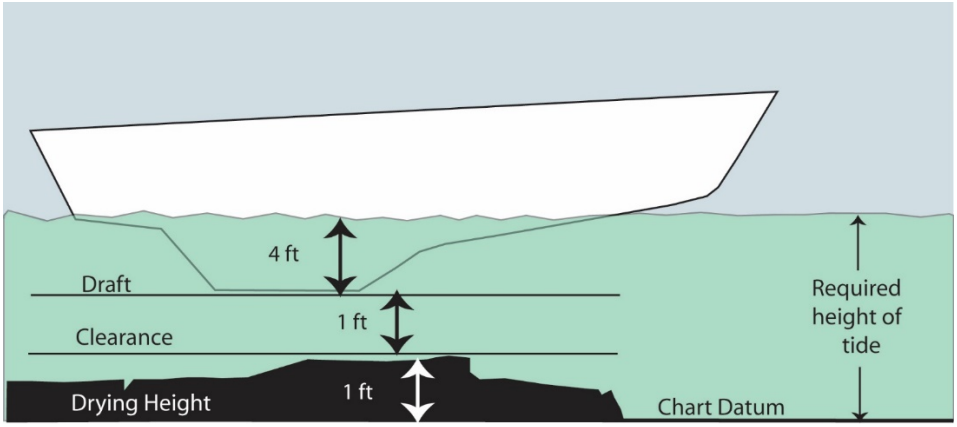


FIGURE 20-4 TIDAL HEIGHT

20.4 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, its 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 - Currents

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 dependent 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

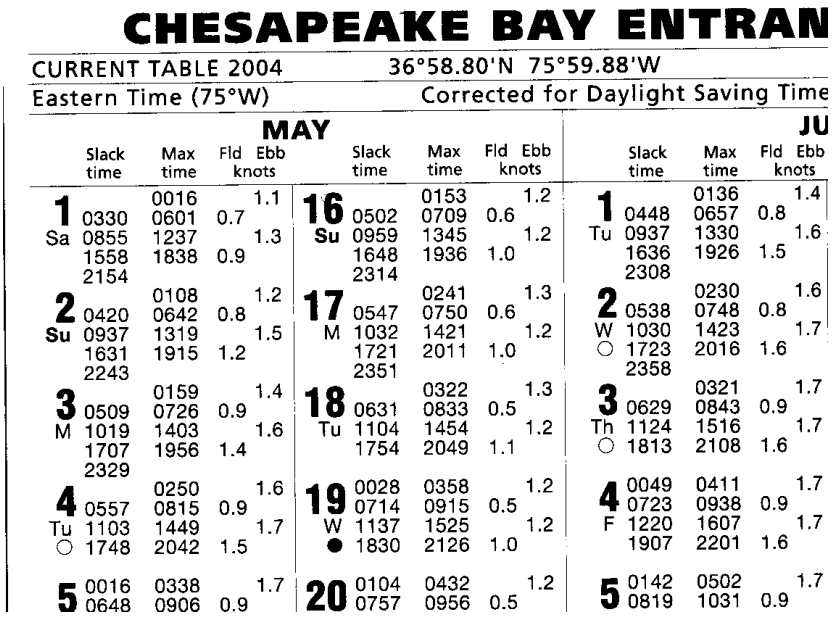
These are published tables containing the data collected by the various organisations. Based on your voyage plan you must obtain information supplied by the U.S. National Ocean Service (NOS), The Canadian Hydrographic Service (CHS), The Australian Hydrographic Service and The National Oceanic and Atmospheric 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		0016		1.1
	0330	0601	0.7	
	0855	1237		1.3
	1558	1838	0.9	
	2154			
2 Su		0108		1.2
	0420	0642	0.8	
	0937	1319		1.5
	1631	1915	1.2	
	2243			
3 M		0159		1.4
	0509	0726	0.9	
	1019	1403		1.6
	1707	1956	1.4	
	2329			
4 Tu ○		0250		1.6
	0557	0815	0.9	
	1103	1449		1.7
	1748	2042	1.5	
5	0016	0338		1.7
	0648	0906	0.9	
16		0153		1.2
	0502	0709	0.6	
Su	0959	1345		1.2
	1648	1936	1.0	
	2314			
17 M		0241		1.3
	0547	0750	0.6	
	1032	1421		1.2
	1721	2011	1.0	
	2351			
18 Tu		0322		1.3
	0631	0833	0.5	
	1104	1454		1.2
	1754	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	
1 Tu		0136		1.4
	0448	0657	0.8	
	0937	1330		1.6
	1636	1926	1.5	
	2308			
2 W ○		0230		1.6
	0538	0748	0.8	
	1030	1423		1.7
	1723	2016	1.6	
	2358			
3 Th ○		0321		1.7
	0629	0843	0.9	
	1124	1516		1.7
	1813	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	

JU

FIGURE 20-5 CURRENT TABLE EXAMPLE

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 is 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.

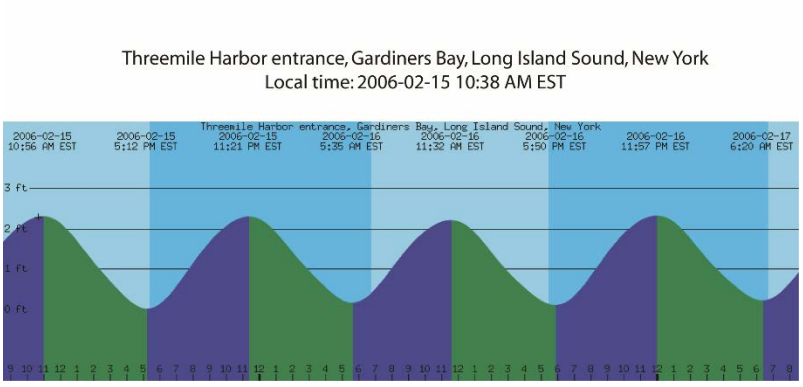


FIGURE 20-6 HARBOUR TIDES EXAMPLE

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 direction 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 02.21, 08.48, 14.56 and 21.03.
- The ebb reaches a maximum speed of 3.8 knots at 05.28 and 3.3 knots at 17.54.
- The flood reaches a maximum speed of 3.1 knots at 11.35 and 3.1 knots at 23.57.

THE RACE, LONG ISLAND SOU

Flood 302°T Ebb 112°T

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.

FIGURE 20-7 CURRENT TABLE EXAMPLE LONG ISLAND SOUND

Tidal Atlas and Tidal Diamonds

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

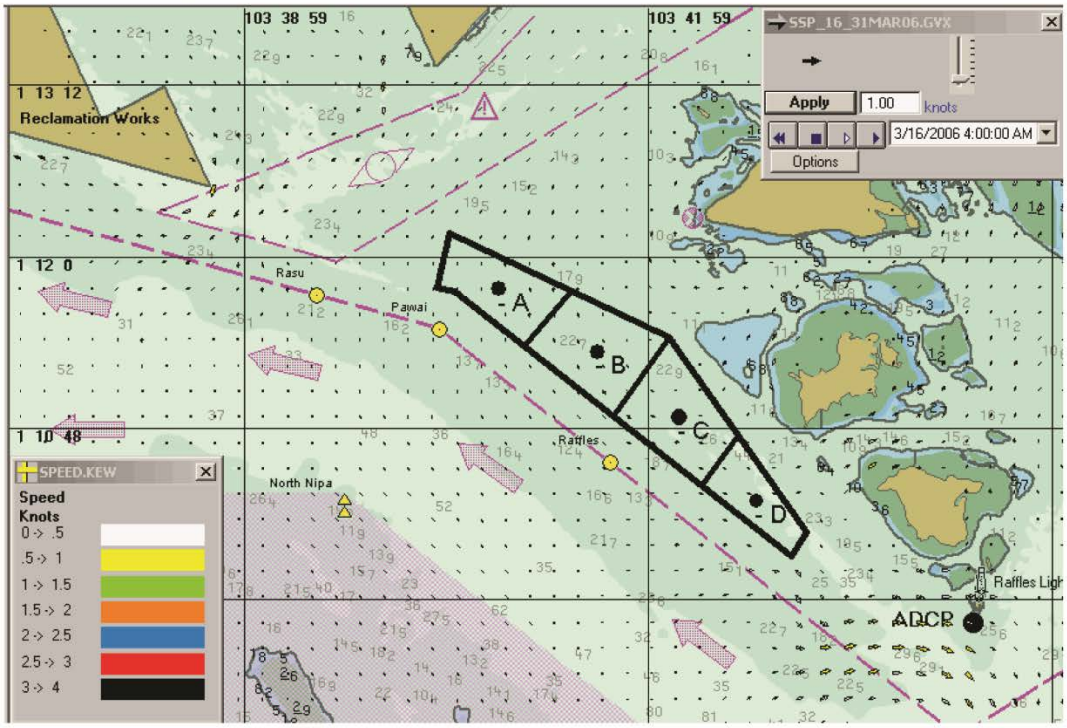
A tidal atlas usually consists of a set of 12 or 13 diagrams, one for each hour of the tidal cycle, for a coastal region. Each diagram uses arrows to indicate the direction of the flow at that time. The speed of the flow may be indicated by numbers on each arrow or by the length of the arrow. Areas of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

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

FIGURE 20-8 DIGITAL TIDAL ATLAS EXAMPLE

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.

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

		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

FIGURE 20-9 TIDAL DIAMOND CHART EXAMPLE

20.5 Knowledge Review

1. What influence does the moon have on tides?

2. Describe: chart datum, charted depth, drying height, duration, height of tide, high water, low water, LAT, MHW, MLLW, spring tides, neap tides, range, primary ports, secondary ports, rule of twelfths.

3. Describe the following terms as they relate to currents: flood stream, ebb stream, slack water, neap and spring rates, current tables, direction, tidal current charts, tidal atlas, tidal diamonds.

Module 21 BUOYAGE

21.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO UNDERSTAND THE IMPORTANCE OF THE INTERNATIONAL BUOYAGE SYSTEM WITH PARTICULAR REFERENCE TO IALA REGIONS A & B AND WHAT THIS MEANS FOR THE NAVIGATOR, & THE USE AND IDENTIFICATION OF CARDINAL MARKS.

The International Association of Lighthouse Authorities (IALA) controls the buoyage system internationally and sets out these rules and regulations.

There are two main systems or regions. So depending on where you are sailing or navigating you must know which system is in use. This is because, unfortunately, the systems are not standardised and, in fact, the systems used in Regions A and Zone B are often opposite.

IALA Region A - covers Europe and most of the world (except as noted in Zone B below)

IALA Region B - covers North and South America, Japan, Korea and the Philippines and the Caribbean.

The IALA system involves the use of two major buoyage systems, Lateral and Cardinal.

- **Lateral marks** indicate the edges of a channel.
- **Cardinal marks** indicate the direction of safe navigation at a dangerous spot.
- **Safe water marks** indicate the deep water and open end of a channel.
- **Special marks** indicate administrative areas, such as speed restrictions or water skiing areas.
- **Isolated danger marks** indicate a hazard to shipping.
- **Emergency Wreck Marking Buoy** is a new buoy introduced in 2006, marking a new wreck. It replaces the double cardinal or lateral marks (IALA Recommendation O-133).

Each type of mark has a distinctive colour, shape and possibly a characteristic light.

21.2 Lateral System (IALA regions A & B)

The lateral system uses coloured buoys and beacons to guide boats through channels and past dangers.

To help ensure safety and to clearly mark out obstacles and hazards that exist both in and under the water, there exists an internationally agreed sets of marks and lights.

Region A (IALA A) covers all of Europe and most of the rest of the world. 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 A, red buoys or marks are on the left hand side of the channel as you enter a port when proceeding in from the sea.

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 harbour (red right returning). These Lateral or Channel Marks define the limits of the navigable water across a channel. It is not wise to attempt to pass between a channel mark and the shore behind unless you have local knowledge of the depth of the water and any hazards in the location.

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 colour and carry the required shape at the top.

FIGURE 21-1 CAN SHAPE MARK

For IALA A:
Port Marks are Red in colour, flash a red light at night and are Can Shaped and indicate the left hand (port) side of the channel.
Starboard Marks are Green in colour, flash a green light at night and are Cone Shaped and indicate the right hand (starboard) side of the channel.

FIGURE 21-2 CONE SHAPE MARK

For IALA B:
Port Marks are Green in colour, flash a green light at night and are Can Shaped and indicate the left hand (port) side of the channel.
Starboard Marks are Red in colour, flash a red light at night and are Cone Shaped and indicate the right hand (starboard) side of the channel.

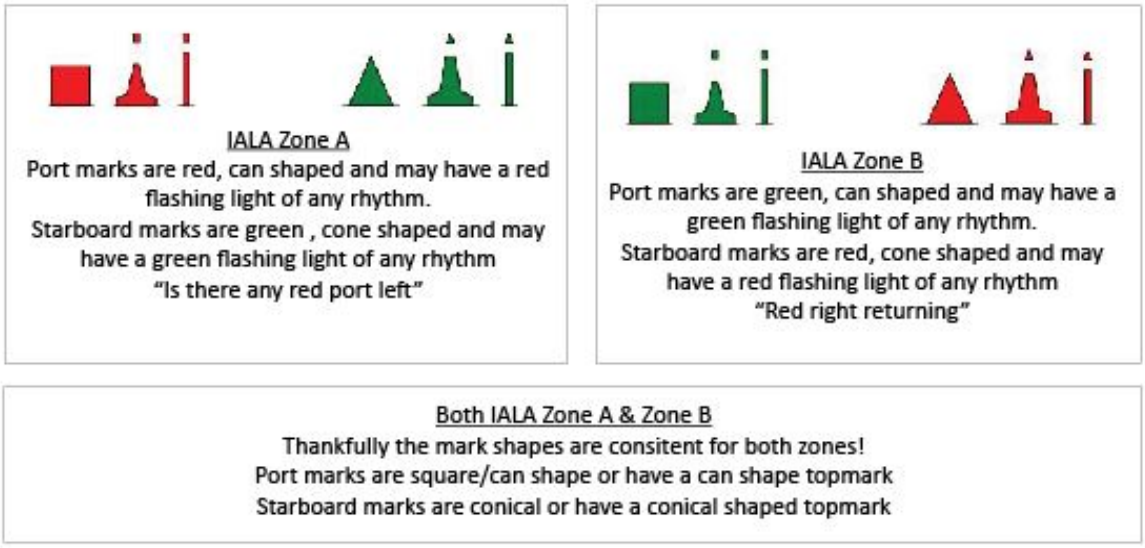


FIGURE 21-3 LATERAL MARKS

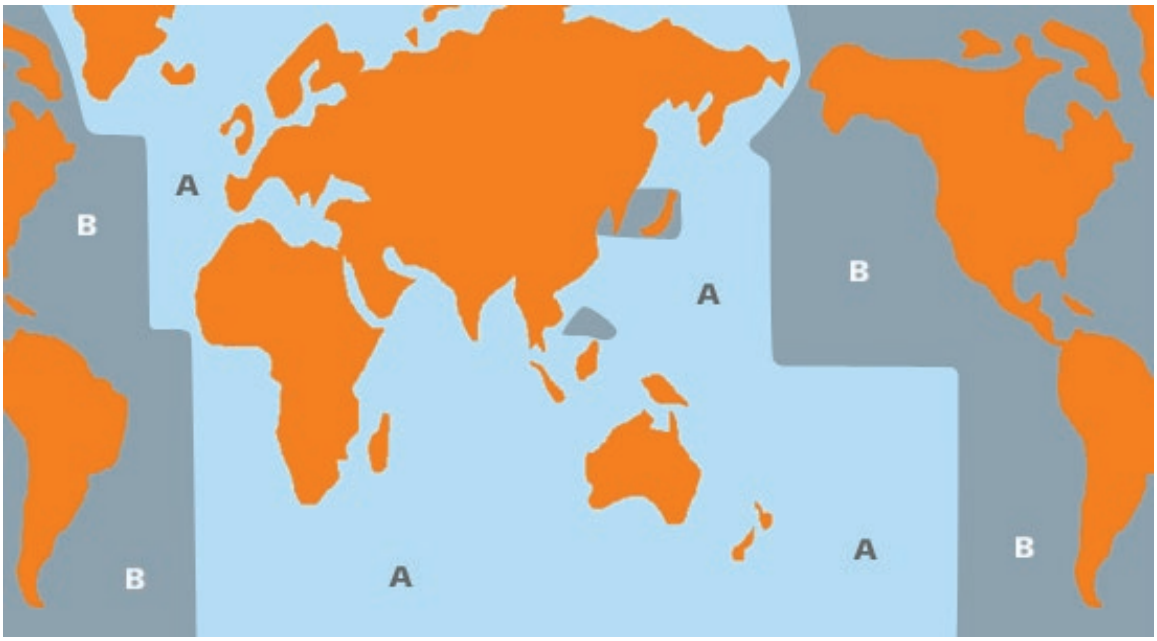
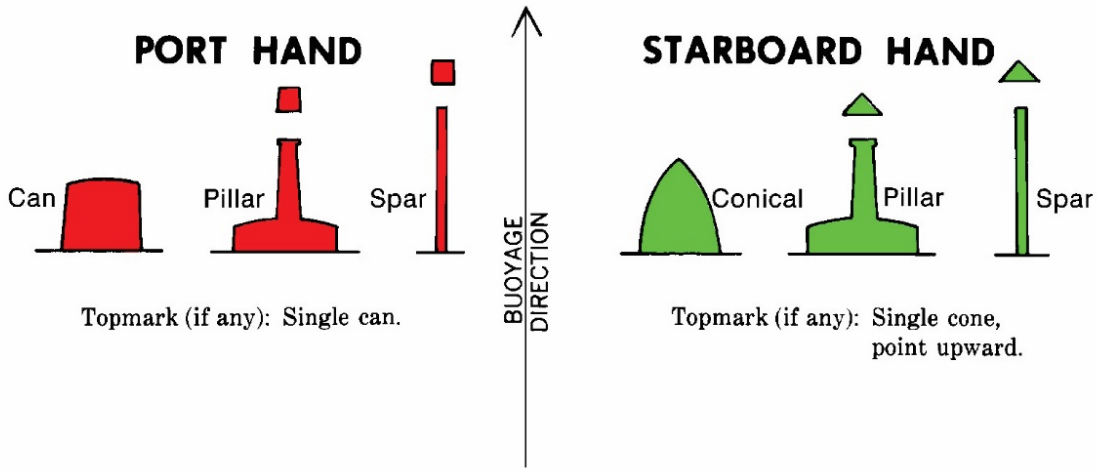


FIGURE 21-4 IALA A AND B

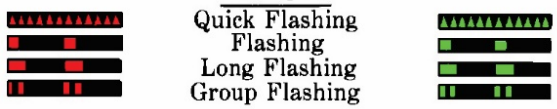
IALA MARITIME BUOYAGE SYSTEM
LATERAL MARKS REGION A



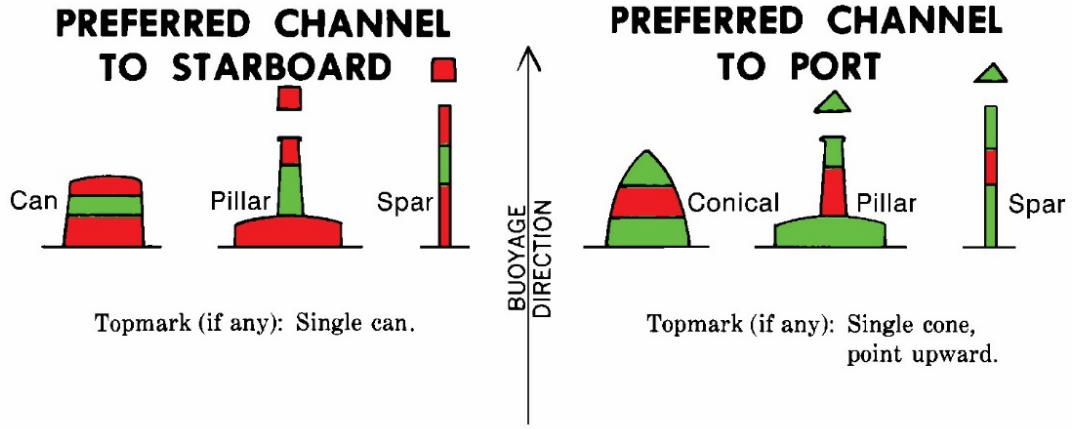
Topmark (if any): Single can.

Topmark (if any): Single cone, point upward.

Lights, when fitted, may have any phase characteristic other than that used for preferred channels.



Examples
Quick Flashing
Flashing
Long Flashing
Group Flashing

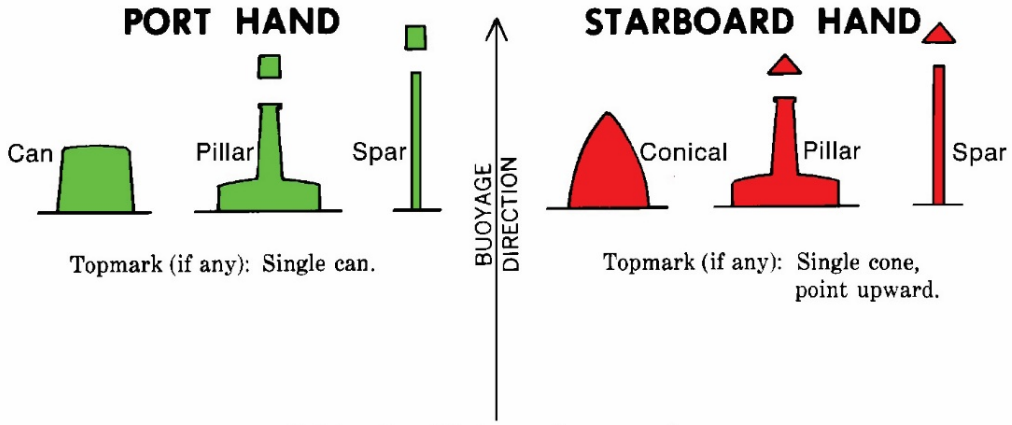


Topmark (if any): Single can.

Topmark (if any): Single cone, point upward.

Lights, when fitted, are composite group flashing Fl (2 + 1).

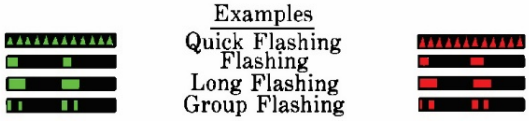
IALA MARITIME BUOYAGE SYSTEM
LATERAL MARKS REGION B

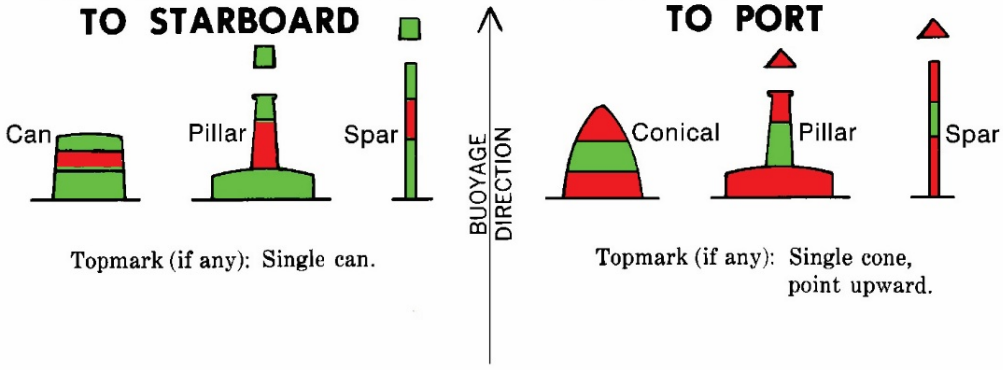


Topmark (if any): Single can.

Topmark (if any): Single cone, point upward.

Lights, when fitted, may have any phase characteristic other than that used for preferred channels.





Topmark (if any): Single can.

Topmark (if any): Single cone, point upward.

Lights, when fitted, are composite group flashing Fl (2+1).

21.3 Marks Common to both IALA Regions A and B

Isolated Danger Mark

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.

The light is WHITE and exhibits 2 quick flashes at intervals of 5 seconds.

FIGURE 21-5 ISOLATED DANGER MARK

Safe Water Mark

Safe Water marks are red and white vertical stripes whereas other striped marks have horizontal stripes.

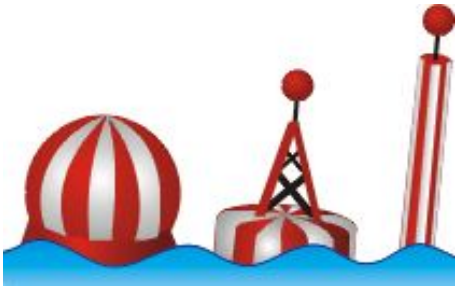


FIGURE 21-6 SAFE WATER MARK

Used to indicate the end/start of a channel, open, deep and safe water lies ahead. It may also be used to indicate the start and end of a buoyed section of a narrow channel, or a line of these buoys can be used to mark a safe route through shallow areas. Sometimes known as a Fairway Buoy, the colour is red and white vertical stripes with a top mark of a red ball.

The light is WHITE and may either flash Morse code "A", occulting, Isophase or long flash every 10 seconds (L Fl 10s) [2].

Special Mark

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 areas, Pipelines, Traffic Separation Schemes, jetties or naval exercise areas.

FIGURE 21-7 SPECIAL MARK

Placed to indicate the boundary of an obstruction, administrative area such as a speed limit, water skiing or mooring area, or to highlight other features such as outfall sewerage pipes. The mark is yellow in colour with a yellow X top-mark.

The light is YELLOW and consists of one quick flash with intervals of 5 seconds.

Wreck Buoy

Used to temporarily indicate a wreck until the wreck is cleared or permanent marks are set up. The colour is blue and yellow indicating that there is a serious danger existing and the mariner must keep clear.

The light is an alternating BLUE AND YELLOW flashing sequence. This may be made even more distinctive when a group of wreck buoys are deployed around a wreck site and the flash characteristics are synchronized to all show the same flash/eclipse cycle at the same time by utilizing an integral timer.

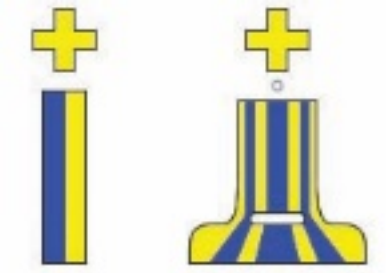


FIGURE 21-8 WRECK BUOY

21.4 Cardinal Buoyage System

Cardinal Marks (rare in U.S. waters) indicate the safe side to pass a hazard. E.g. a North Cardinal Mark indicates that a vessel should pass to the north of the marker. Each Cardinal Mark has a unique pattern, color scheme and is defined by a white flashing light.

Buoys or marks used to indicate the position of a hazard and the direction of safe water/ safety as a cardinal/compass direction relative to the hazard by:

- Indicating that the deepest water is an area on the named side of the mark
- Indicating the safe side on which to pass a danger

Each cardinal mark indicates one of the four compass directions by:

- The direction of its two conical top-marks
  N - both point up,
  S - both point down,
  W - towards each other (Wine glass/Waist shape - W)
  E - away from each other, bases together (Egg shape - E)

- The colour pattern of black and yellow stripes, which follows the orientation of the cones - the black stripe is in the position pointed to by the cones (e.g. at the top for a north cardinal, in the middle for a west cardinal)

- The distinctive WHITE flashing light characteristics, quick or very quick flashes. The pattern indicates the direction of the cardinal point with a number of flashes based on the clock face position which corresponds to the direction of the cardinal point.
  N - continuous flashes
  E - 3 flashes
  S - 6 flashes (plus 1 long flash to help make it easily distinguished from West
  W - 9 flashes

MARK	MARK COLOUR	DIRECTION OF TRIANGLE	LIGHT AND FLASH
North Cardinal	Black over Yellow	Triangle point up	Continuous flash
East Cardinal	Black/Yellow/Black	Triangle 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

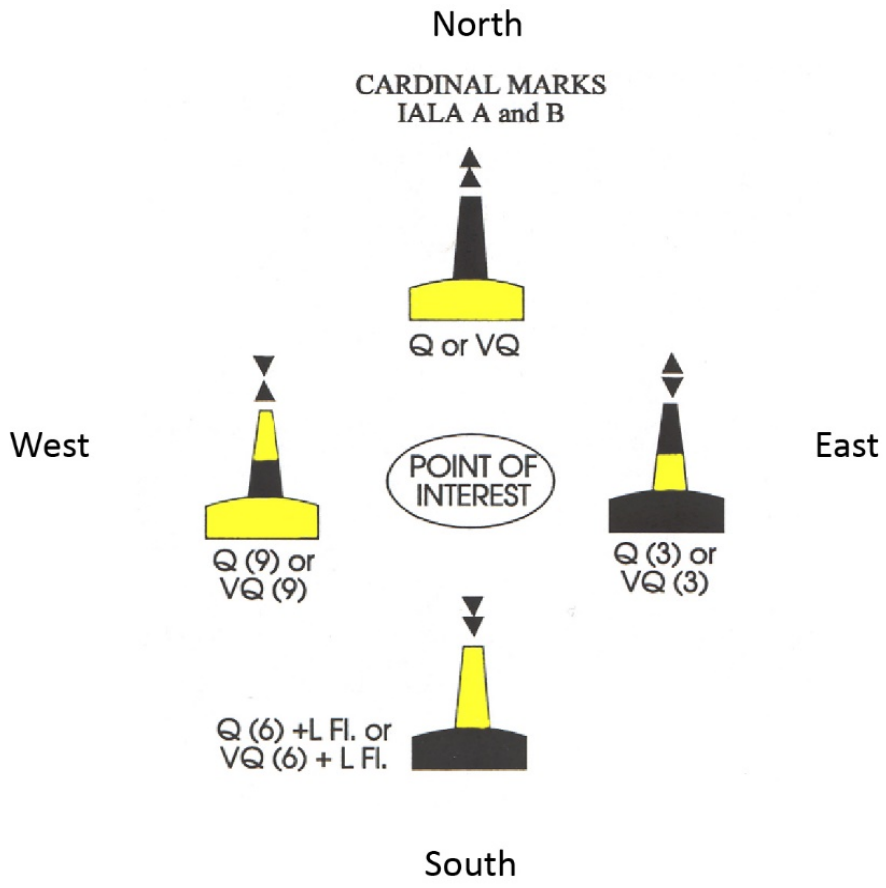


FIGURE 21-9 CARDINAL MARKS IALA A & B

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

21.5 Knowledge Review

1. What does IALA stand for?
2. What countries/regions are covered in IALA regions A & B?
3. What are the fundamental and most important differences between IALA Regions A & B?
4. What is an isolated danger mark, describe its appearance.
5. What is a safe water mark, describe its appearance.
6. What is a special mark, describe its appearance.
7. What is a wreck buoy, describe its appearance.
8. Describe the appearance s of North, South, East and West cardinal marks.
9. What are the flashing sequences for each cardinal mark?
10. On which side of a cardinal mark should you keep clear?

Module 22 COLLISION REGULATIONS

22.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO GET THE STUDENT TO UNDERSTAND THE IMPORTANCE OF THE INTERNATIONAL COLLISION REGULATIONS, LIGHTS, SOUNDS AND SHAPES AND SAFE OPERATION IN RESTRICTED VISIBILITY.

The International Regulations for preventing collisions at sea were agreed upon by a conference of the International Maritime Organization (IMO) and are usually referred to as the "COLREGS". It is not necessary to know all of the Rules off by heart but a thorough knowledge of the COLREGS is essential.

22.2 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.

FIGURE 22-2 POWER DRIVEN VESSEL

FIGURE 22-1 SAILING VESSEL

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.

FIGURE 22-3 VESSEL ENGAGED IN FISHING

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.).

FIGURE 22-4 VESSEL RESTRICTED IN HER ABILITY TO MANEUVER

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.

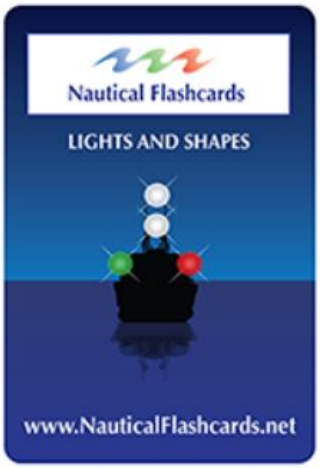
The term **"restricted visibility"** means any condition, in which visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.

FIGURE 22-5 VESSEL CONSTRAINED BY HER DRAUGHT

FIGURE 22-7 VESSEL UNDERWAY

FIGURE 22-6 VESSEL / RESTRICTED VISIBILITY

22.3 COLREGS & What You Need to Know



It is not necessary to know all of the Rules off by heart but a thorough knowledge of the COLREGS is essential, it is totally unacceptable to say "I don't know what it is, or what to do, but I'll look it up in the Almanac". This attitude causes accidents and endangers others as well as yourself. The full text of the COLREGS is readily available from many sources and may be downloaded from various web sources at no cost.

Possibly the most difficult to learn is the section which deals with the lights required by vessels operating under different circumstances at night. Computer programs are available to help but perhaps one of the best ways to learn the COLREGS lights is with a set of playing card sized cards which have various combinations of lights in colour on a black background on one side and the description of the vessel (s) the lights represent printed on the back. These cards are readily available from most marine stores.

These rules must be understood and followed just as automobile drivers follow the rules and signal system when navigating on land road and highway systems.

The 72 COLREGS

The COLREGS consist of 38 rules which are set out in 5 parts, as follows:

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

22.4 Part A, General

Part A defines that the Rules apply to all vessels (regardless of size) on the high seas and to all waters connected to the high seas that are navigable by seagoing vessels.

- The Rules, however, allow appropriate authorities to operate special rules in harbours, rivers, lakes and inland waterways but state that any such special rules should conform as closely as possible to the COLREGS.

- In Europe there is a complete set of regulations for inland waterways, rivers, lakes and canals (CEVNI: Code Europeen Des Voies De Navigation Interieure), while the U.S. has the Inland Navigation Rules which apply on the inland waters of the United States.

The point at which the rules change from International to Inland is marked on U.S. charts by the words 'COLREGS DEMARCATION LINE."

- The Inland Rules apply on U.S. navigable waters inside the demarcation lines and on the U.S. side of the Great Lakes. These waters are called "inland waters" and are formally defined in Rule 3. The Inland Rules also apply to U.S. vessels operating on the Canadian side of the Great Lakes except for those provisions that conflict with Canadian navigation rules for the Great Lakes. The U.S. and Canadian navigation rule drafters worked together to minimize the differences between the two countries' rules and to help ensure that the Great Lakes mariner would have little difficulty transiting from one side to the other.

- Many of the Inland Rules wherever you sail are in fact identical to the International Rules.

22.5 Part B, Steering and Sailing Rules

Section I – Conduct of Vessels in any condition of visibility

Application "Rule 4"
Rules in this section apply to any condition of visibility.

Lookout "Rule 5" (one of the most important of all the rules)
Every vessel shall at all times be responsible for maintaining a proper look-out 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 "Rule 6"
Vessels shall at all times proceed at a safe speed taking into consideration visibility, traffic density, manoeuvrability of the vessel, background lights at night, state of the wind, sea, current, and proximity of navigational hazards.

Risk of Collision "Rule 7"

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.

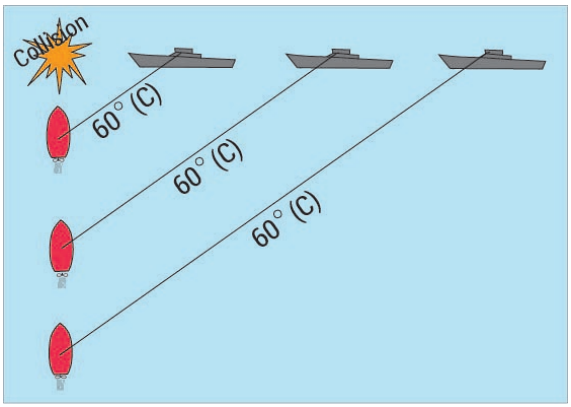


FIGURE 22-8 RISK OF COLLISION - RULE 7

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

Action to Avoid Collision "Rule 8"

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.

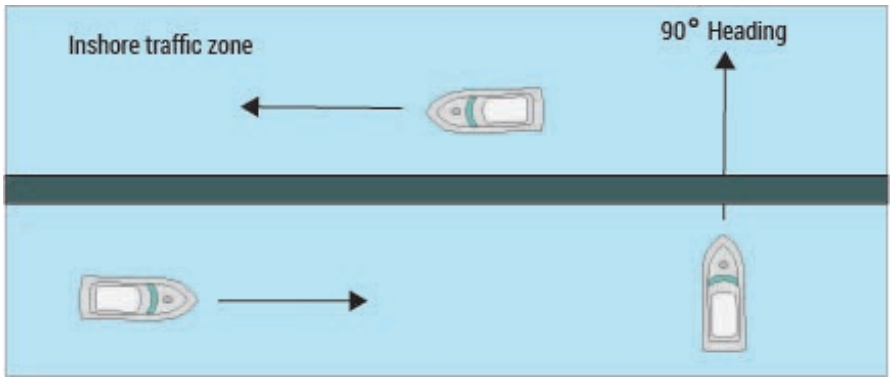
The most important rule for avoiding collision is to **maintain a proper lookout at all times** by watching, listening and all other means possible such as radar or binoculars. It is imperative that when you first encounter another vessel, the question needs to be asked "is there any risk of a collision?". 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.

Narrow Channels "Rule 9"

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.

"Rule 10" - Traffic Separation Schemes (TSS)

Traffic separation schemes have been set up in area where there is a heavy concentration of shipping. They are designed to act in similar fashion to a divided highway by separating the opposing flows.



Use the TSS and always use correct lane, join at shallow angle, cross at 90° heading.
Do not use inshore zone without local knowledge.

FIGURE 22-9 TRAFFIC SEPARATION SCHEMES - RULE 10

Vessels should:

- proceed in the appropriate traffic lane in the general direction of traffic flow for that lane.
- keep clear of a traffic separation line or separation zone.
- normally join or leave a traffic lane at the termination of the lane, but when joining or leaving from either side shall do so at as small an angle to the general direction of traffic flow as practicable.
- avoid crossing traffic lanes but if obliged to do so shall cross on a heading as nearly as practicable at right angles to the general direction of traffic flow.
- vessels of less than 20 meters in length, sailing vessels and vessels engaged in fishing may use the inshore traffic zone.
- A vessel may use an inshore traffic zone when en route to or from a port, offshore installation or structure, pilot station or any other place situated within the inshore traffic zone, or to avoid immediate danger.
- A vessel shall avoid anchoring in a traffic separation scheme or in areas near its terminations.
- A vessel engaged in fishing shall not impede the passage of any vessel following a traffic lane.

Section II – Conduct of vessels in sight of one another

"Rule 11" - Application – Stand on / Give way

Rules in this section apply to vessels in sight of one another. (Which vessel shall "stand-on" and which should "give-way"

'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.

"Rule 12" - Sailing vessels in sight of one another
When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

When each has the wind on a different side, the vessel, which has the wind on the portside shall keep out of the way of the other, a boat on port tack gives way to a boat on starboard tack.

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.

For the purposes of this Rule the windward side shall be deemed to be the side opposite to that on which the mainsail is carried.

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.

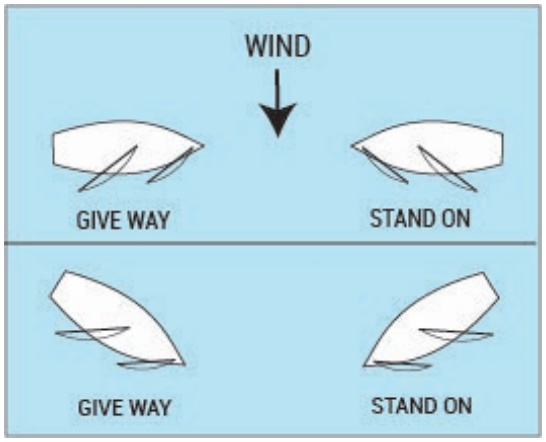


FIGURE 22-10 WIND ON DIFFERENT SIDE – RULE 12

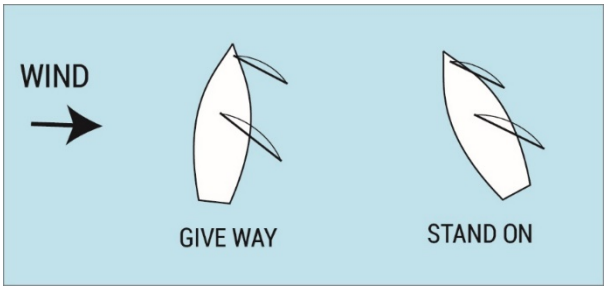


FIGURE 22-11 WIND FROM SAME SIDE - RULE 12

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.

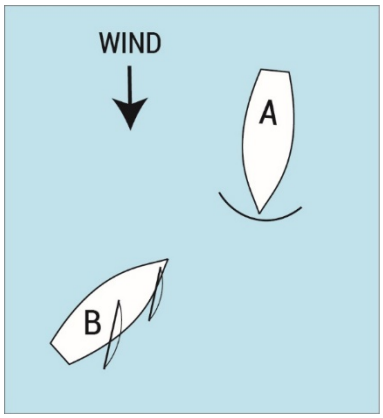


FIGURE 22-12 EXAMPLE DIAGRAM FOR RULE 12

"Rule 13" - Overtaking

Any vessel overtaking any other shall keep out of the way of the vessel being overtaken. A vessel shall be deemed to be overtaking when coming up with another vessel from a direction more than 22.5 degrees abaft her beam, that is, in such a position with reference to the vessel she is overtaking, that at night she would be able to see only the stern-light of that vessel but neither of her sidelights. When a vessel is in any doubt as to whether she is overtaking another, she shall assume that this is the case and act accordingly.

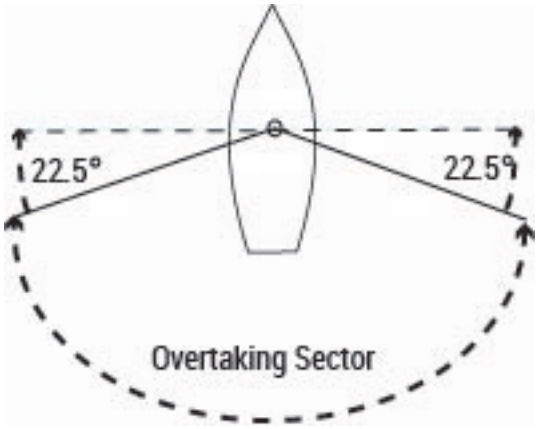


FIGURE 21-13 OVERTAKING SECTOR - RULE 13

Assume overtaking vessel if more than two points abaft the beam, or any doubt. Always keeps clear, until past & clear.

"Rule 14" Power driven vessels meeting head on

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

Both turn to starboard.

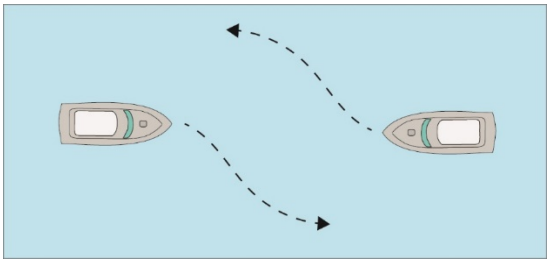


FIGURE 22-14 POWER VESSELS MEET HEAD ON -RULE 14

"Rule 15" 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 should avoid crossing ahead of the other vessel if possible.

Give way to vessel on your starboard side, Stand on for vessel on your port side.

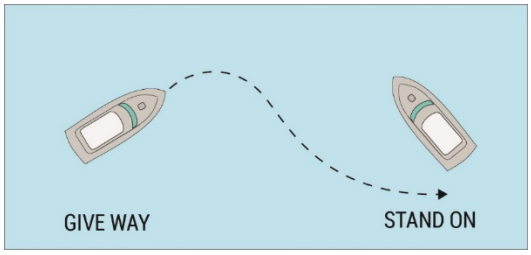


FIGURE 22-15 POWER VESSELS CROSSING – RULE 14

"Rule 16" - Action by give-way vessel

The give - way vessel, is required if possible take early and substantial action to keep well clear.

"Rule 17" – Action by stand-on vessel

The stand on vessel should maintain course and speed.
The stand on vessel may however take action to avoid collision by her manoeuvre 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. If 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.

1. FIRST STEP STAND-ON,
2. MAY ALTER (Not to port for a vessel to port), WHEN DOUBT OF OTHER VESSEL KEEPING CLEAR
3. MUST KEEP CLEAR, WHEN ACTION OF GIVE WAY VESSEL'S ACTION ALONE CANNOT AVOID COLLISION.

"Rule 18" - Responsibilities between Vessels

A power-driven vessel underway shall keep out of the way of:

- a vessel not under command;
- a vessel restricted in her ability to manoeuvre;
- a vessel engaged in fishing;
- a sailing vessel.

A sailing vessel underway shall keep out of the way of:

- a vessel not under command;
- a vessel restricted in her ability to manoeuvre;
- a vessel engaged in fishing.

A vessel engaged in fishing when underway shall, so far as possible, keep out of the way of:

- a vessel not under command;
- a vessel restricted in her ability to manoeuvre.

Any vessel other than a vessel not under command or a vessel restricted in her ability to manoeuvre shall, if the circumstances of the case admit, avoid impeding the safe passage of a vessel constrained by her draft.

"Rule 19" - Conduct of vessels in restricted visibility

This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

- Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility.
- A power-driven vessel shall have her engines ready for immediate maneuver.
- Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility.

A vessel, which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:

- an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;
- an alteration of course towards a vessel abeam or abaft the beam.

Every vessel which hears the fog signal of another vessel forward of her beam (unless it has been determined that risk of collision does not exist) shall:

- reduce speed to minimum
- if necessary take all way off
- navigate with extreme caution until danger of collision is over.

ALWAYS GO AT A SAFE SPEED, ALL VESSELS KEEP CLEAR – THERE IS NO STAND-ON VESSEL IN RESTRICTED VISIBILITY

AVOID ALTERING TOWARDS VESSEL ABEAM OR ABAFT BEAM,

AVOID ALTERING TO PORT FOR VESSEL FORWARD OF BEAM

22.6 Part C, Lights & Shapes

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
- a white light at the stern

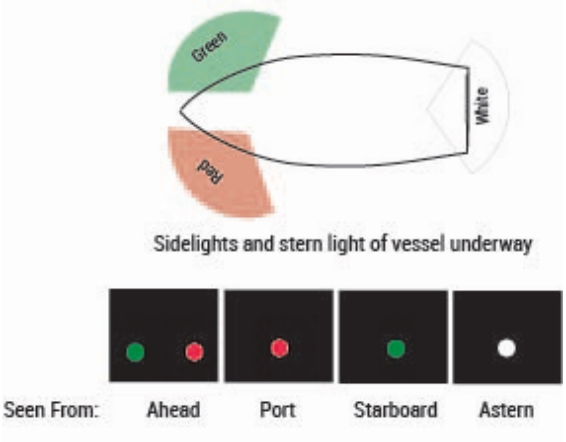


FIGURE 22-16 SIDE & STERN LIGHTS

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.

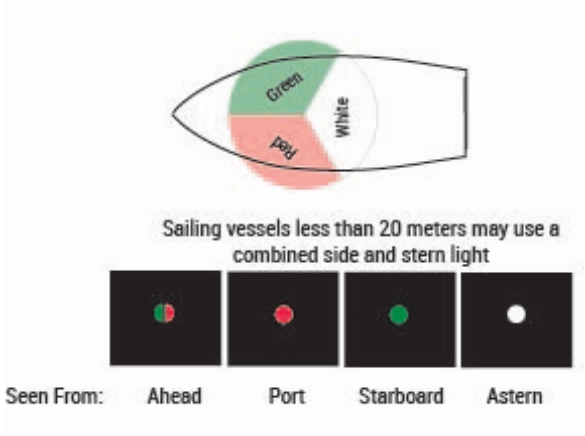


FIGURE 22-17 SIDE & STERN LIGHTS

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.

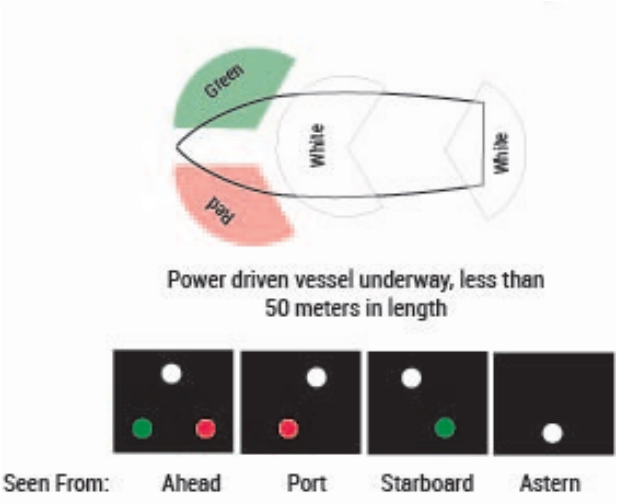


FIGURE 22-18 SIDE & STERN LIGHTS

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.

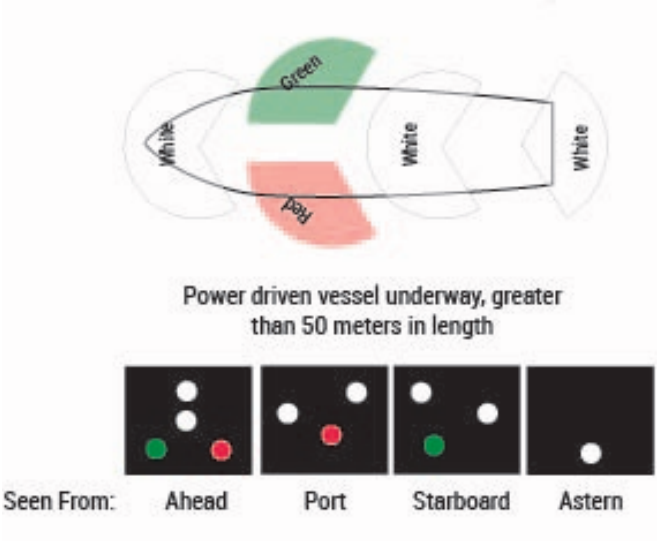


FIGURE 22-19 SIDE & STERN LIGHTS

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 length she shall use available lights to illuminate her deck.

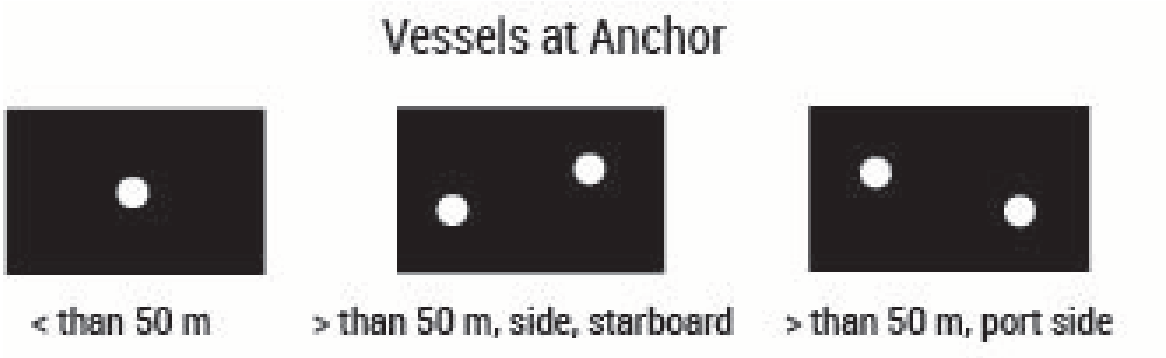
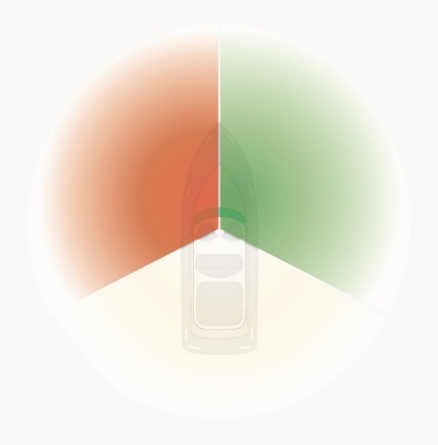


FIGURE 22-20 VESSELS AT ANCHOR LIGHTS

Safe Operation in Restricted Visibility

It is imperative to take great care when operating a vessel at night or during periods of restricted visibility. Remember to proceed at a safe speed.



Reduced visibility

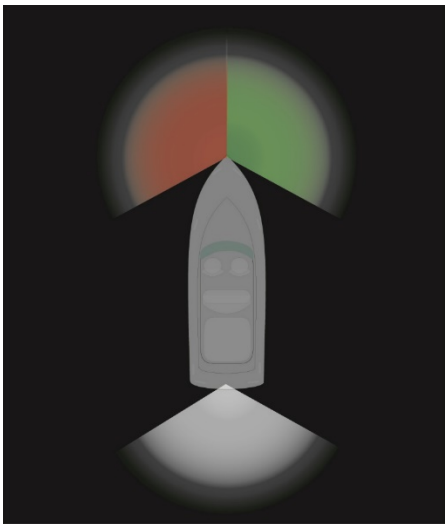
Navigating at Night

The rules for navigating are the same for night and day, however, at night or in restricted visibility you must determine the speed, position and size of other vessels based on their navigation lights.

The following factors require specific navigation lights:

- The size of the vessel
- If it is power or sail
- If it is underway or at anchor

Power vessels over 12 meters must exhibit a forward masthead light, sidelights and a stern light.



Night

FIGURE 22-21 NAVIGATION LIGHTS

Many small boats will have a white light affixed to the top of a light pole placed at the stern. When underway this light acts as a combined masthead and sternlight and must be visible in all directions. Therefore, it must be mounted higher than the boat structure.

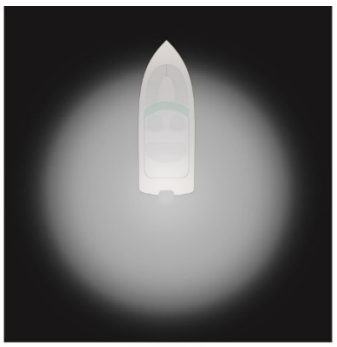


FIGURE 22-22 SMALL BOAT / ONE STERN LIGHT SHOWING ALL AROUND

Day Shapes

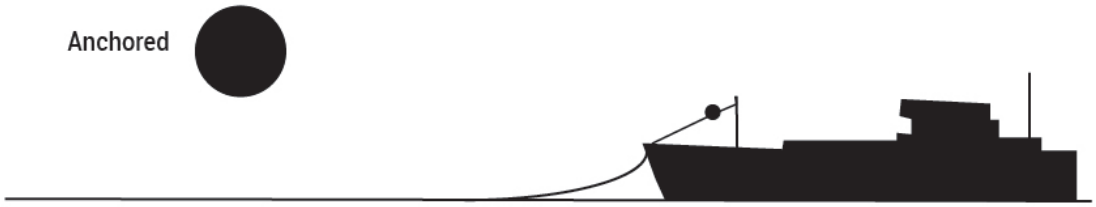


FIGURE 22-26 DAY SHAPE - ANCHORED

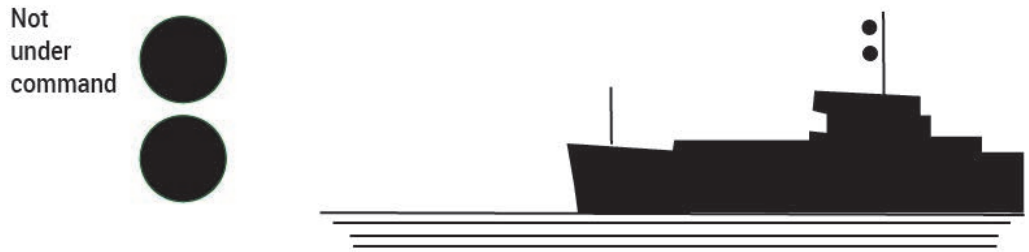


FIGURE 22-25 DAY SHAPE - NOT UNDER COMMAND

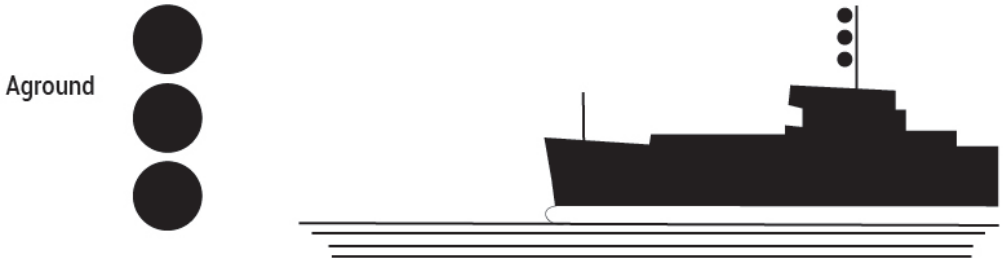


FIGURE 22-24 DAY SHAPE - AGROUND

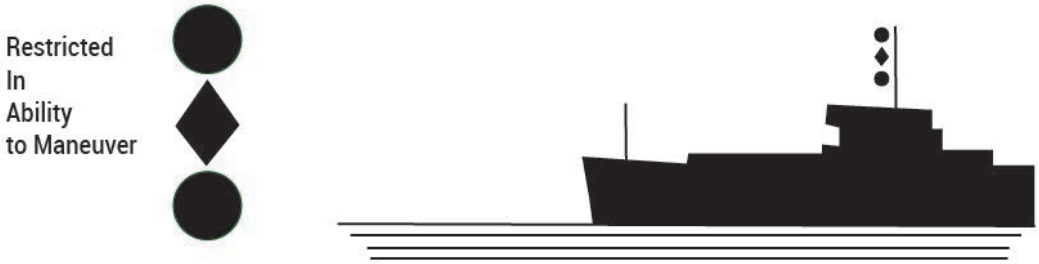


FIGURE 22-23 DAY SHAPES - RESTRICTED IN ABILITY TO MANOEUVRE

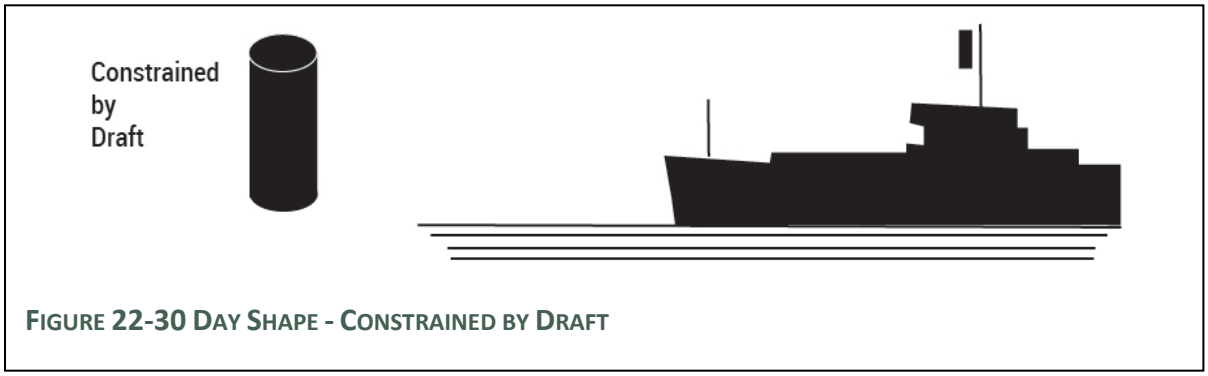


FIGURE 22-30 DAY SHAPE - CONSTRAINED BY DRAFT

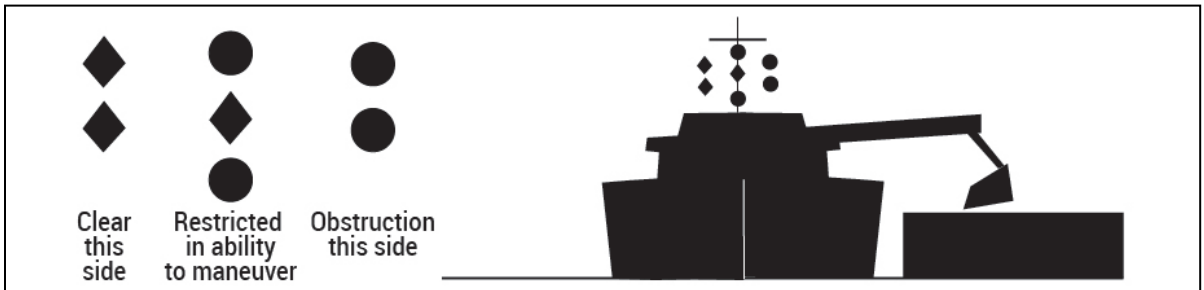


FIGURE 22-29 DAY SHAPES - VARIOUS

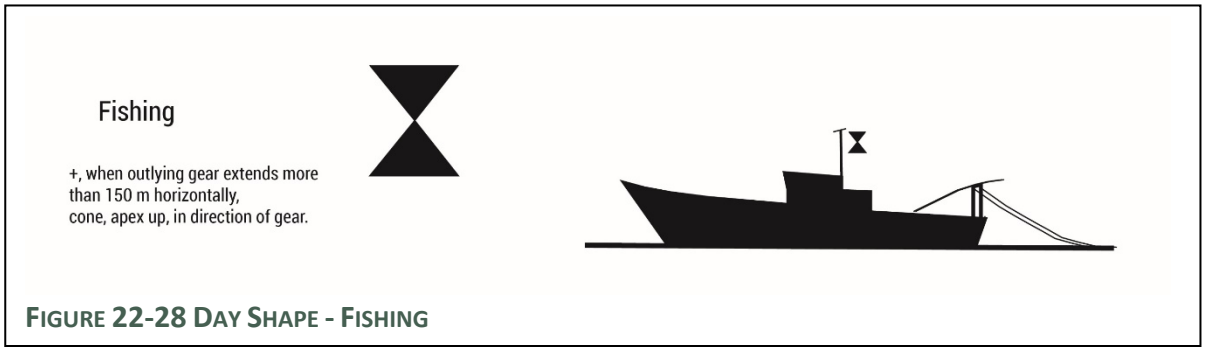


FIGURE 22-28 DAY SHAPE - FISHING

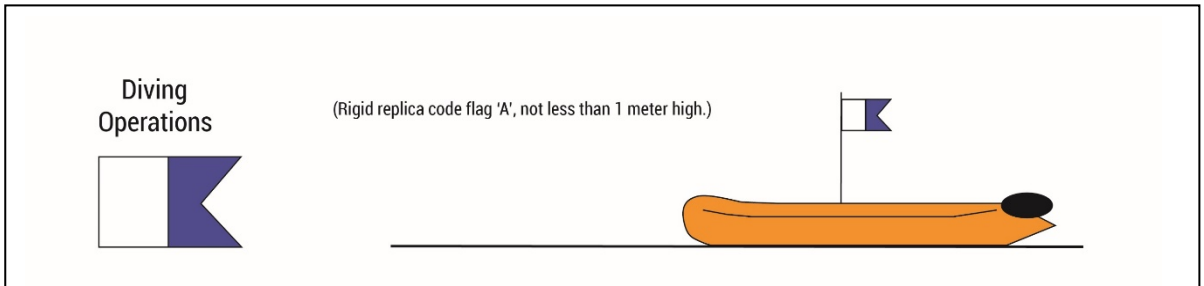


FIGURE 22-27 DAY SHAPE - DIVING OPERATIONS

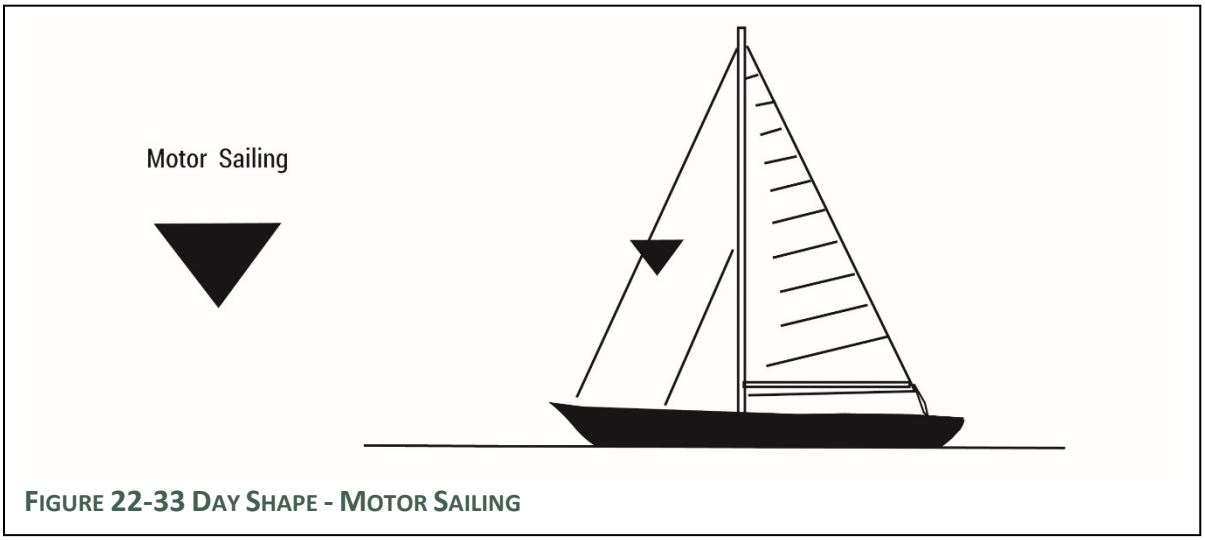


FIGURE 22-33 DAY SHAPE - MOTOR SAILING

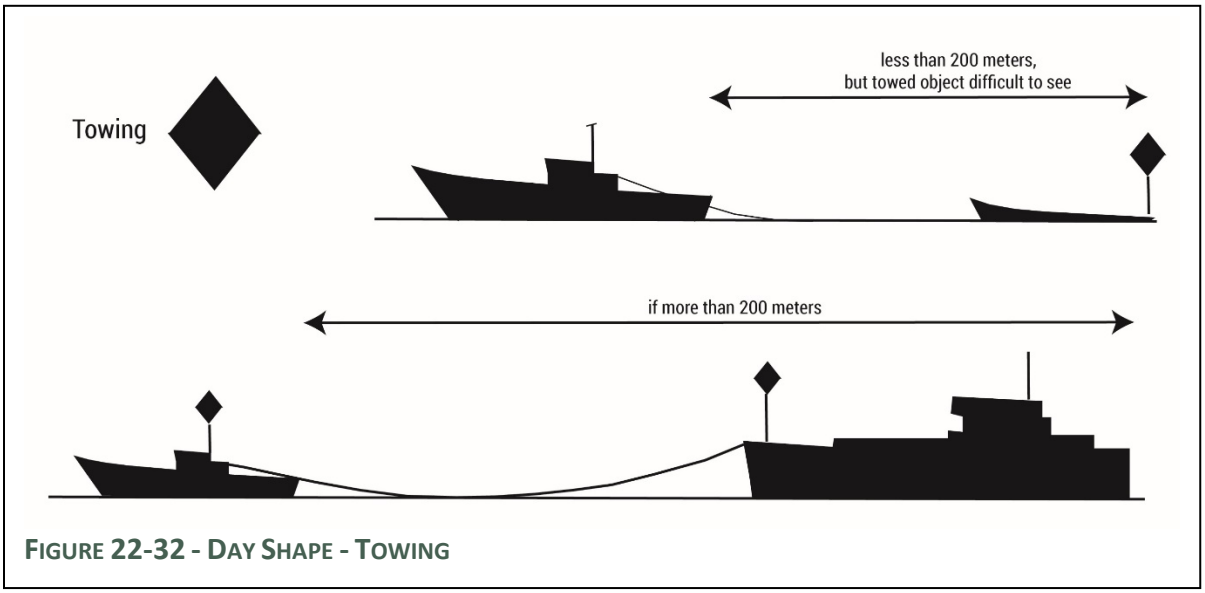


FIGURE 22-32 - DAY SHAPE - TOWING

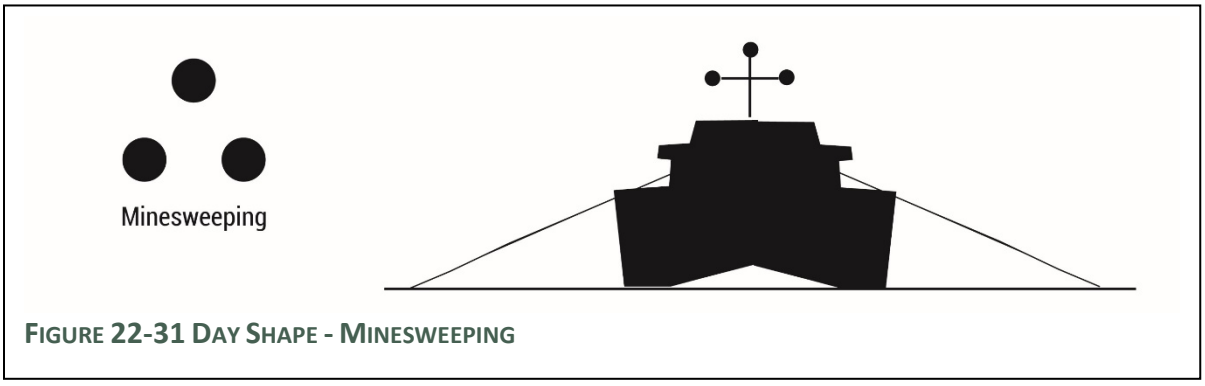
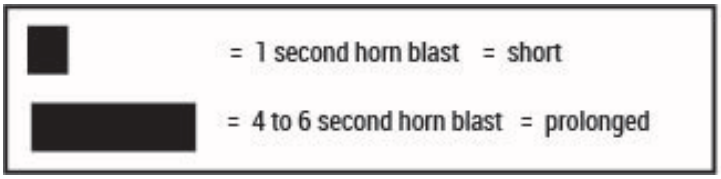


FIGURE 22-31 DAY SHAPE - MINESWEEPING

22.7 Part D, Sounds



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

ALL the different configurations of lights and shapes MUST be learnt by the seafarer in order to be safe at sea. These are just an introduction.

Learning the “Rules” is not easy, it takes lots of time and patience, however it is essential to know everything about the other vessels around you.

The above is an abridged version of the ‘Rules’. The prudent mariner will undertake a full and thorough study the Rules.

22.8 Rule 33 (Equipment for Sound Signals)

A vessel of 12 m or more in length shall be provided with a whistle, a vessel of 20 m or more in length shall be provided with a bell in addition to a whistle, and a vessel of 100 m or more in length shall, in addition, be provided with a gong, the tone and sound of which cannot be

confused with that of the bell. The whistle, bell and gong shall comply with the specifications in Annex III to these Regulations. The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the prescribed signals shall always be possible.

A vessel of less than 12 m in length shall not be obliged to carry the sound signalling appliances prescribed in paragraph (a) of this Rule but if she does not, she shall be provided with some other means of making an efficient sound signal.

22.9 Knowledge Review

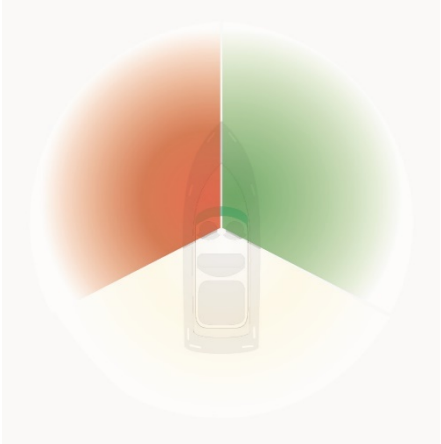
1. Define the following: vessel, power driven vessel, sailing vessel, vessel engaged in fishing, vessel not under command, vessel restricted in ability to maneuver, vessel aground, vessel constrained by draft, vessel not underway.
2. Describe what restricted visibility means
3. What are the COLREGS?
4. What action should you take to avoid collision?
5. What is a traffic separation scheme? how should you cross it?
6. What is the difference between a stand on and a give way vessel?
7. What is the rule when two vessels meet head on?
8. Describe “conduct in restricted visibility”.
9. What color are starboard, port, stern, bow and masthead lights?
10. What shape would a vessel display at anchor, not under command, restricted in ability to maneuver, aground, fishing, constrained by draft, motor sailing.
11. What color and shape is the letter “A” flag ? what does it signify?
12. What sound signal would you give if moving to starboard, port, astern, overtaking and I do not understand your intentions?

Module 23 NAVIGATION LIGHTS

23.1 Key Objectives

THE OBJECTIVE OF THIS MODULE IS TO GET THE STUDENT TO UNDERSTAND THE DIFFERENT LIGHT CONFIGURATIONS REQUIRED ABOARD VESSELS UNDER THE RULES OF THE "INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA" (COLREGS).

Between sunset and sunrise and during any period of reduced visibility (fog or heavy rain) you are required to use navigation lights. If operating a non-powered craft with no fixed navigation lights such as a kayak or rowboat, you must have a watertight flashlight or lantern which emits a white light.



Reduced visibility

Safe Operation in Restricted Visibility

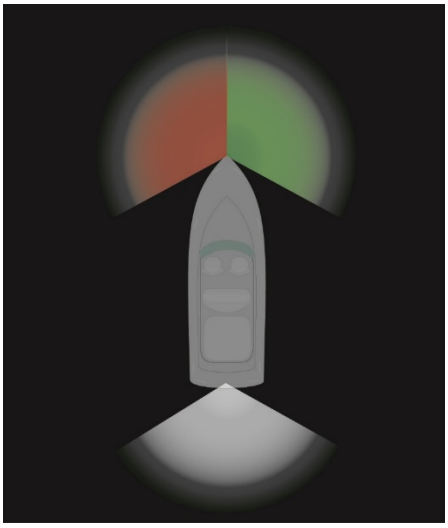
It is imperative to take great care when operating a vessel at night or during periods of restricted visibility. Remember to proceed at a safe speed.

Navigating at Night

The rules for navigating are the same for night and day, however, at night or in restricted visibility you must determine the speed, position and size of other vessels based on their navigation lights.

The following factors require specific navigation lights:

- The size of the vessel
- If it is power or sail
- If it is underway or at anchor



Night

FIGURE 23-1 NAVIGATION LIGHTS

Power vessels over 12 meters must exhibit a forward masthead light, sidelights and a stern light.

Many small boats will have a white light affixed to the top of a light pole placed at the stern. When underway this light acts as a combined masthead and stern light and must be visible in all directions. Therefore, it must be mounted higher than the boat structure.

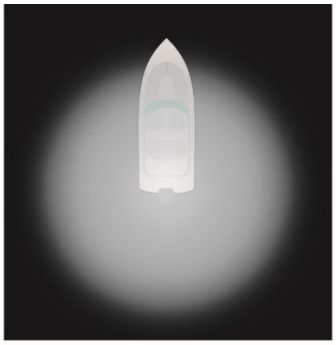


FIGURE 23-2 SMALL BOAT / ONE STERN LIGHT SHOWING ALL AROUND

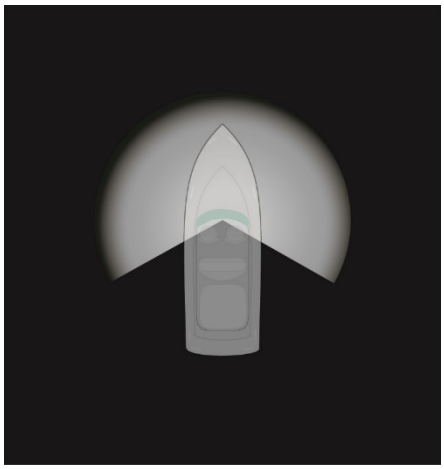


FIGURE 23-5 MASTHEAD LIGHT 225°

- White
- Light covers an arc of 225 degrees from dead ahead to 22.5 degrees abaft the beam on both sides of boat
- Position is fore and aft of the centerline of boat

FIGURE 23-3 MASTHEAD LIGHT 360°

- White
- Light covers an arc of 360 degrees
- Position must be where light is visible from all directions.

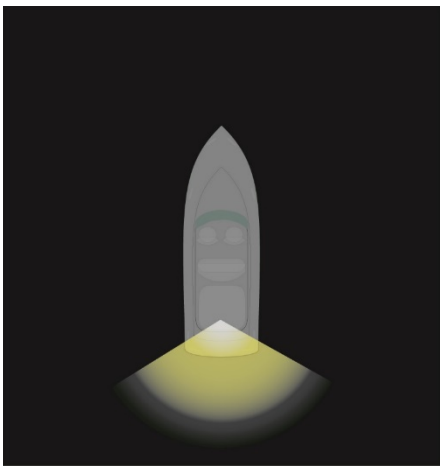


FIGURE 23-4 TOWING LIGHT 135°

- Yellow
- Light covers an arc of 135 degrees
- Position is as close to stern as possible.

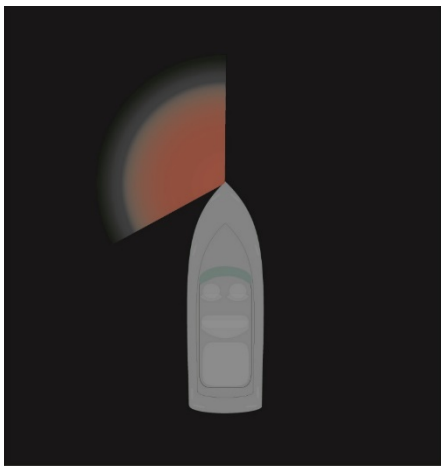


FIGURE 23-7 PORT SIDELIGHT 112.5°

- Red
- Light covers an arc of 112.5 degrees on port side
- Position forward area

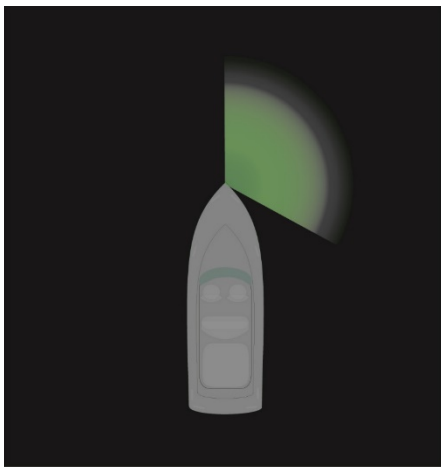


FIGURE 23-6 STARBOARD SIDELIGHT 112.5°

- Green
- Light covers an arc of 112.5 degrees on starboard side
- Position forward area

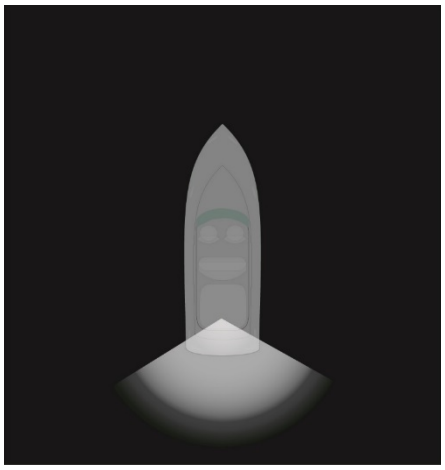


FIGURE 23-8 STERNLIGHT 135°

- White
- Light covers an arc of 135 degrees
- Position as close to stern of boat as possible.

Powerboats under 12M (39’ 4”) Rule 23 (Collision regulations)

Options are depicted below. Note that it is optional to have another masthead light.

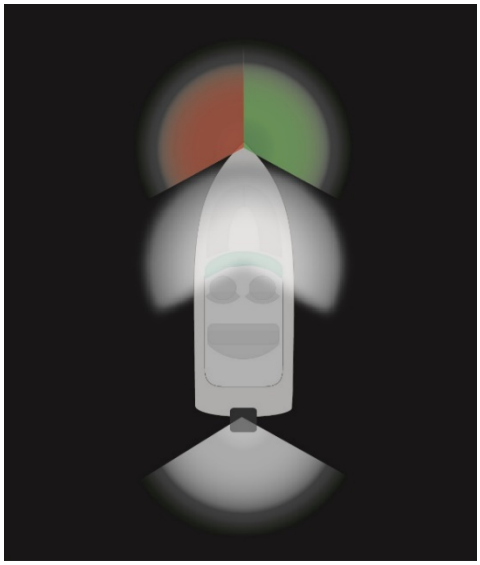


FIGURE 23-10 PBT UNDER 12M OPTION 1

- 1 masthead light
- Sidelights
- 1 sternlight

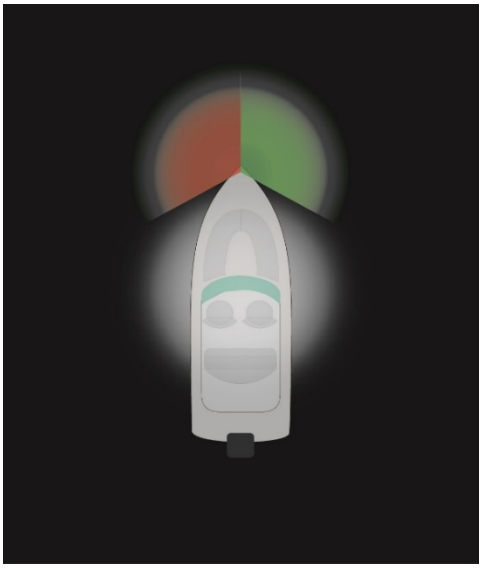


FIGURE 23-9 PBT UNDER 12M OPTION 2

- 1 all-round white light
- Sidelights

Powerboats from 12M (39’ 4”) to under 50M (164’1”) Rule 23
Depicted below. Note that it is optional to have another masthead light.

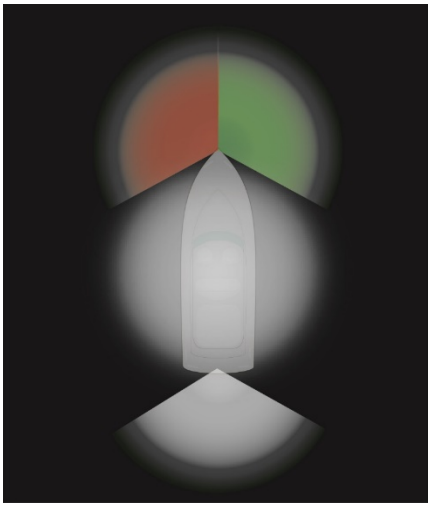


FIGURE 23-11 PBT OVER 12M UP TO 50M

- 1 masthead light
- Sidelights
- 1 sternlight

Sailboats under 7M (23') Rule 25

Options are depicted below.

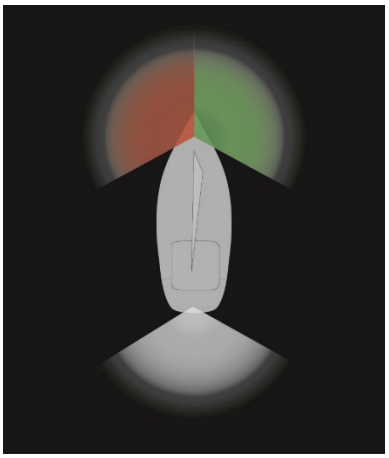


FIGURE 23-14 SBT UNDER 7M OPTION 1

- Sidelights
- 1 sternlight

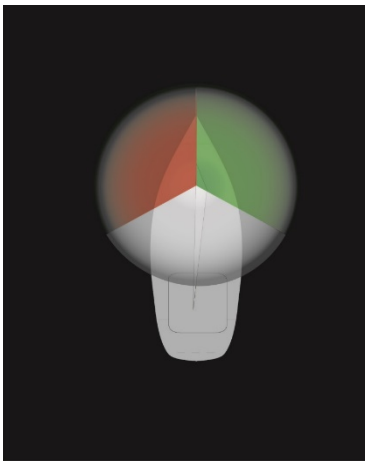


FIGURE 23-13 SBT UNDER 7M OPTION 2

- 1 lantern, combining the sidelights and sternlight above

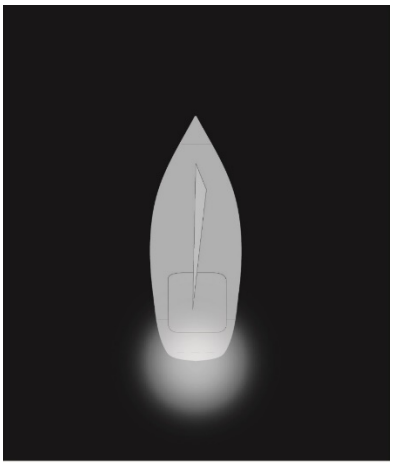


FIGURE 23-12 SBT UNDER 7M OPTION 3

- If options 1 and 2 are not possible you must have a torch or lantern showing a white light to be used far enough in advance to prevent a collision.

Sailboats from 7M (23') to under 20M (65' 7") Rule 25

Options are depicted below.

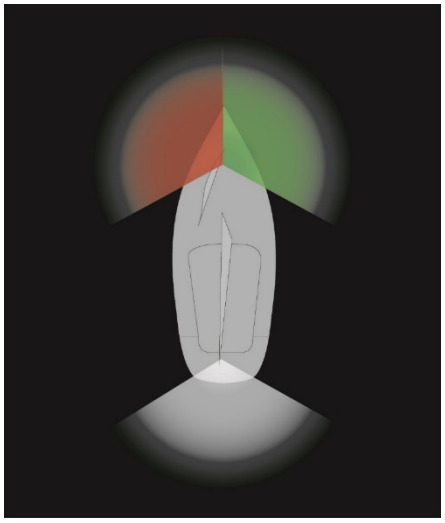


FIGURE 23-15 SBT UP TO 20M OPTION 1

- Sidelights
- 1 sternlight

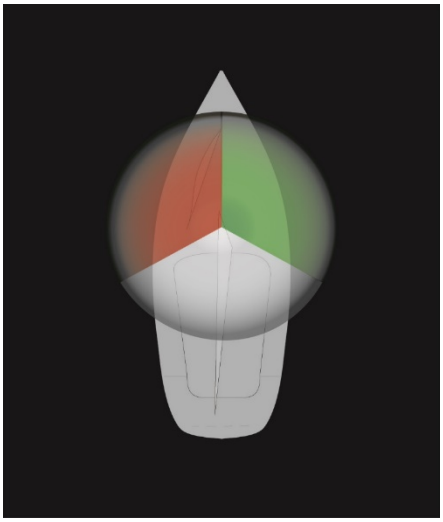


FIGURE 23-16 SBT UP TO 20M OPTION 2

- 1 lantern, combining the sidelights and sternlight above mast

Sailboats 20M (65' 7") and over Rule 25

Options are depicted below.

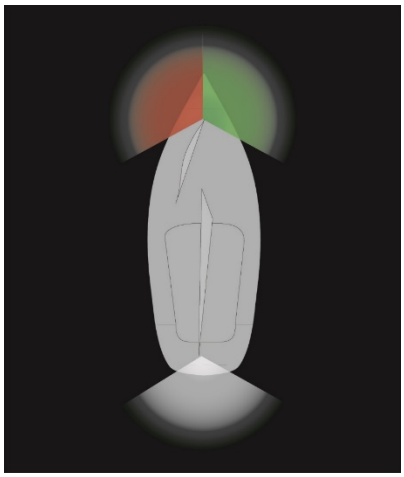


FIGURE 23-17 SBT 20M AND OVER

- Sidelights
- 1 sternlight

Human-Powered Boats Rule 25

Options are depicted below. Note that it is optional to have another masthead light.

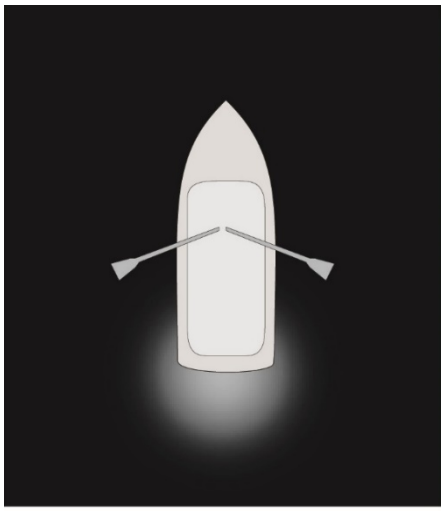


FIGURE 23-19 HUMAN POWER OPTION 1

- 1 lantern showing a white light that must be used far enough in advance to prevent a collision.

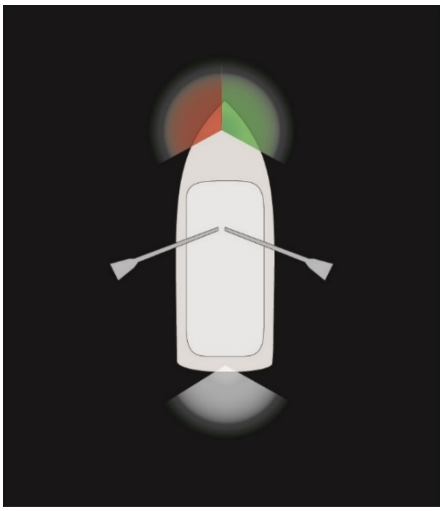


FIGURE 23-18 HUMAN POWER OPTION

- Same lights as listed for sailboats according to length.

Boats at Anchor Rule 30

Options are depicted below. Note that it is optional to have another all-round white light for boats under 7M to under 50M.

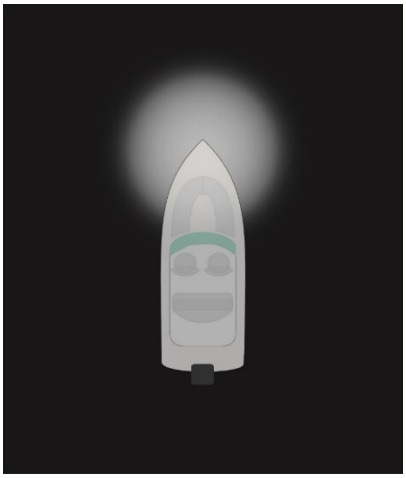


FIGURE 23-20 BOATS AT ANCHOR

If the boat is in or near a narrow channel, fairway or anchorage, or where other boats normally navigate:

Under 7M

- 1 all-round white light *(at night)*
- 1 anchor ball *(during the day)*

From 7M to Under 50M

- 1 all-round white light *(at night)* OR
- 1 anchor ball *(during the day)*

23.2 Knowledge Review

1. What 3 factors determine specific navigation lights?
2. What color is a towing light?
3. What lights must a sailboat display at night when motor-sailing?
4. What lights must a human powered boat display at night?
5. What light must a boat at anchor display?

Module 24 BASIC FIRST AID

24.1 Key Objectives

THIS MODULE OUTLINES THE BASIC KNOWLEDGE REQUIRED TO RECOGNISE HYPOTHERMIA AND OTHER POTENTIAL MEDICAL ISSUES AND BASIC FIRST AID PROCEDURES.

Because first aid and CPR are often updated, IYT encourages schools to reference current material for their particular country.

24.2 Hypothermia and Cold Water Immersion

Hypothermia is a drop in core body temperature caused by prolonged exposure to abnormally low temperatures. Hypothermia sets in when core body temperature drops below 35.0 degrees Celsius.

Causes of hypothermia:

- Immersion in cold water
- Exposure to cold air and wind while in wet clothing
- Prolonged exposure to cold water and air temperatures

24.3 Cold Water Shock

Even more dangerous than hypothermia is cold water shock. This occurs when a person is immediately immersed into water 15° C or below. For three to five minutes after sudden immersion in cold water, a person will gasp for breath and can experience muscle spasms and a rise in heart rate and blood pressure. These spasms and gasping can cause the victim to ingest water and drown. Also, a rise in heart rate and blood pressure can result in a heart attack or stroke.

Cold water can paralyze you instantly making it nearly impossible to put on a lifejacket. Cold water shock can occur any time of year, even in summer, as water temperatures can remain lower than air temperatures.

24.4 Rescuing a Person with Hypothermia

Immediate Action Prior to Rescue Procedure

- Don an approved PFD or lifejacket
- Assess victim's condition – stage of hypothermia
- Identify yourself to victim and ask them to respond
- Assess what items you have onboard that may be used to warm the victim
- Assess your ability to help the victim. For example, how far to shore
- Exhibit a distress signal indicating need for assistance if you believe it is necessary

Rescue Procedure

- Remove the victim from the water as discussed previously
- Dry the victim from head to toe and cover with layers of dry clothing
- Move to shelter below deck if possible
- Attempt to slowly increase victim's body temperature by one or more of the following:
    - Cover head and neck
    - Wrap in dry blankets, towels or clothing
    - Cover with an insulating blanket

Additional points:

- Provide warm liquid but never alcohol or hot stimulants
- Do not rub or massage the victim's body or extremities as this may cause nerve ending damage
- You may use your own body to transfer heat

Surviving Cold Water

In order to increase your survival time in cold water you should do the following:

- Assess the situation:
    - Is everyone wearing a lifejacket?
    - Can you get to shore or to safety?
    - Are there other boaters in the vicinity who can assist?
    - Can you call or signal for help?

- Determine if you are within roughly 50 m from shore and if so swim to shore.

- You should stay where you are if:
    - You are injured
    - There is help close by

- You are more than 50 m from shore

- If you are close to a floating object you should climb onto the object to save energy. However, you should only do so if you are able to get most of your body out of and above the water.

- Immediately signal or call for help if you are able to do so.

The "Huddle" Position

If you and your passengers are exposed to cold water and are not able to swim to shore or a floating object, you should assume the huddle position.

- Place your arms around each other's mid to lower back and pull together so your chests are close to each other's sides
- Intertwine your legs
- Place children in the middle of the huddle
- Keep unnecessary movements to a minimum in order to conserve energy.

FIGURE 24-1 HUDDLE POSITION

Heat Escape Lessening Position (H.E.L.P.)

You can use this position to reduce heat loss from your core body temperature and delay the effects of hypothermia.

- Cross your arms tightly against your chest.
- Draw your knees up and against your chest.
- Keep your head and face out of the water.

FIGURE 24-2 H.E.L.P. POSITION

24.5 Contents of Basic 1st Aid Kit

A comprehensive first-aid manual should be carried as well as a first aid kit designed for the length of voyage and operating area based on your specific needs. At least one member of the crew should have received some first aid training from a recognized training entity.
Basic contents should include a minimum of:

- Sunscreen
- Bandages/gauze pads of various sizes
- Band aids (various)
- Thermometer
- Antiseptic wipes
- Aspirin
- Motion sickness tablets
- Antacid tablets
- Scissors
- Tweezers
- Insect bite relief swabs
- Alcohol prep. pads
- Eyewash/cup and pads
- Calamine lotion
- Ice pack
- Antibiotic cream

24.6 Cuts, Stings and Burns

Cuts

- Clean the wound thoroughly, applying antibiotic cream and a Band –Aid or small dressing, treat minor lacerations.
- In the case of deeper wounds control bleeding by applying pressure and seek immediate medical help.

Bites and Stings

- Bites and stings may be no more than a minor irritation to potent venoms that may be life threatening.
- To treat a mild insect bite, remove the sting by scraping rather than tweezers and apply ice pack or ointment.
- Some bites/stings may induce severe allergic reactions, which may occur within minutes or may be delayed for several hours or days. Again, if in doubt seek immediate medical help.

Burns

- Burns are classified by degrees. First degree being superficial but burns to large areas of the body will need emergency medical help. The severity of burns should not be judged by the amount of pain a victim feels as nerve endings may be destroyed.

- Minor burns over small skin areas may be cooled by the application of cool water (not ice) and soaked bandages or dressings. A dry sterile dressing may be applied after cooling (do not use any kind of grease or butter) cover with a bandage.

- Second-degree burns are deeper; the victim's skin may be blistering or weeping. Immerse affected area in cold water. Proceed as for 1st. degree but do not pierce any blisters or remove any burnt tissue. Do not apply any antiseptic sprays or ointments, keep affected areas above the level of the victim's heart. Look for signs of shock. Call for emergency medical help and follow directions.

- Third degree burns are characterized by white gray or black charring. If the area affected is small treat as second-degree, watch out for shock symptoms, do not give victim fluids or any kind of alcohol, and call for immediate assistance.

24.7 Control of Bleeding

- If possible, identify source of bleeding. External source should be fairly easy. Internal bleeding is hard to identify. You should attempt to minimize or stop the flow.

- To control external bleeding apply direct pressure with sterile cloth or towel until bleeding stops. If a cloth or towel is not available have the injured person apply pressure using their own hand. As a last resort use your own hand taking suitable precautions (gloves, plastic wrap etc.). Wash hands thoroughly after contact with body fluids. Elevate the wound.

FIGURE 24-3 CONTROL BLEEDING

- Internal bleeding may come from several sources, is hard to identify and can be life threatening. Severe internal bleeding will often be accompanied by symptoms of shock (see shock). Advanced medical training and equipment are required for the treatment of severe internal bleeding. Call for help and if you cannot transport the victim to medical help in a short time request helicopter evacuation.

24.8 Shock

- Shock can be described as the collapse of the cardiovascular system. Blood flow slows or stops thus depriving vital organs of oxygen, which may result in death. Even after short deprivation of oxygen rich blood to certain organs, primarily the heart and brain, cells die and cannot be regenerated.

- Shock may be induced by severe blood or fluid loss due to large open wounds or burns as well as internal bleeding. Nervous system damage and poor heart pumping action will also bring on shock symptoms. Signs may include cold, clammy skin, profuse sweating pallid skin color. Advanced stage symptoms include bluish lips, shallow labored gasping/breathing, weak rapid pulse, extreme thirst, nausea and vomiting.

Treatment for shock:

1. Clear and maintain airway. (see unconscious victim)
2. Lay victim on his back and elevate the feet 8 to 12 inches if there are no signs of head, neck or back injury. If victim is having convulsions, seizures or respiratory difficulties do NOT elevate feet. Reassure and comfort.
3. Control bleeding to minimize blood loss.
4. Do not give food or drink, keep victim comfortable and warm using blankets or clothing.
5. Call for medical assistance if symptoms persist.

24.9 Dangers of Heat and Cold

Heat Stroke

Heat stroke is a severe condition which occurs when the body's 'thermostat' stops working properly. The body stops producing perspiration and the lack of cooling can send body temperature so high that brain damage or even death may occur.

The symptoms of heat stroke:

- High body temperatures, up to 106 F, hot, red, dry skin.
- Progressive loss of consciousness, weak, rapid pulse and shallow breathing.

Treatment for heat stroke:

1. Call for immediate medical assistance.
2. Cool the victim by wrapping cool wet sheets around the body and ventilate by hand or electric fan.
3. Be alert for signs of shock.

4. If condition worsens, take further steps to cool the body using ice or icepacks placed at large blood vessel areas of the body such as wrist, ankles, neck, groin or armpits.
5. Continue to monitor the patient, maintain airway and be ready to perform CPR. (see unconscious victim)

24.10 Heart Attacks & Strokes

Heart Attack

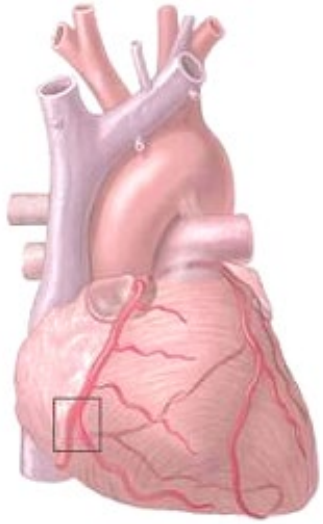


FIGURE 24-4 HEART (BOX REFERS TO FIGURE BELOW WHERE BLOCKAGE HAS OCCURRED)

- A heart attack is caused by one or more vessels feeding blood to the heart becoming clogged. As a result, the heart may stop pumping, (no pulse) causing the victim to stop breathing.
- This is a condition known as Cardiac Arrest and requires CPR (cardiopulmonary resuscitation) immediately. Courses in CPR are readily available through various organizations and it is highly recommended that anyone going to sea should have at the very least, CPR, Rescue Breathing (mouth to mouth) and First Aid training.

FIGURE 24-5 BLOCKAGE IN RIGHT CORONARY ARTERY

- The victim of a heart attack whose heart continues to pump will often show no great signs of illness and may complain of heartburn or indigestion. This kind of attack is difficult to identify but the clock is ticking and urgent action is required.
- Be alert to the possible signs of a heart attack such as the victim complaining of pain in the chest area that may be described as ‘crushing pressure’, ‘fullness’ or ‘squeezing’ behind the breastbone but may radiate to other part of the torso and arms. Sweating, nausea, short or labored breathing are also early warning signs. Pains in the left arm can also be a sign of a heart attack. It has been medically proven that immediately taking aspirin can save a victim’s life.

Stroke

- Strokes are the result of inadequate supply of oxygenated blood to the brain caused by blood clots forming anywhere in the body. The signs of stroke include complete or partial paralysis of the face muscles and/or extremities on one side of the body, varying levels of consciousness, confusion, dizziness, convulsions, headache, visual

and swallowing difficulties. If stroke is suspected: open airway and reassure and comfort victim.

- There is nothing that can be done onboard for a stroke victim to mitigate the outcome, which may range from mild temporary disability to death. Immediate evacuation for medical treatment is necessary.

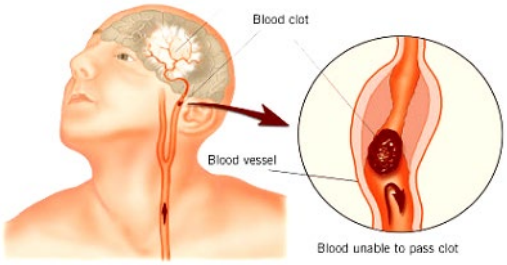


FIGURE 23-6 STROKE

A completely blocked airway however will render the victim speechless, unable to speak, breathe or cough.

Victim may make feeble wheezing sounds and communicate their distress by clutching the throat area.
If possible, send a crewmember for medical assistance and perform 'Heimlich' maneuver.

24.11 ABCs of First Aid Response (Airway – Breathing – Circulation)

Adult Casualty (8 years and older)

When the breathing stops, the heart will soon stop beating.

- 0 – 4 minutes clinical death.
- 4 – 6 minutes brain damage possible
- 6 – 10 minutes brain damage likely
- After 10 minutes irreversible brain damage/biological death

A - Airway
Open the airway using the head tilt / chin lift method. Tilting the head back and lifting the chin will move the tongue away from the back of the throat and allow an open airway.

B - Breathing
Check for breathing by looking at the chest and feeling for air coming from the mouth for up to 10 seconds.
If the person is not breathing, give two slow breaths. When giving two slow breaths:

- Keep the airway open
- Seal the nose shut
- Place your mouth around the person's mouth with a tight seal
- Give two breaths, each lasting two seconds. Make sure the chest rises.
- Use a breathing barrier when possible

C - Circulation

Once two breaths go in, check for signs of circulation by looking for movement, effective breathing, coughing, and appropriate colour of the skin. For the more experienced rescuer, check for the presence of a carotid pulse. Check for circulation for no more than 10 seconds.

Things to consider:

Tip 1 – open the airway with a jaw thrust if a head or spinal injury is suspected. To do this, lift jaw upward using index fingers. Be sure not to move head and neck.

Tip 2 – to prevent disease transmission, use protective equipment. A breathing barrier should be used f you feel any risk.

Tip 3 – if the person is breathing, place them in the recovery position. Take the arm closest to you and lift it above the person's head. Grab their leg and other arm and bring them gently to their side, rolling them over. Once they are on their side, monitor the breathing and keep the airway open and await arrival of emergency personnel.

Tip 4 – if the person begins to vomit, place them in the recover position to prevent choking.

24.12 Unconscious Victim / Not Breathing

If you are in the situation of finding an unconscious person you should:

- Approach the person and try to wake them up by gently tapping them or shaking them and shout to see if the person responds.
- Open the person's airway, check to see if they are breathing, and check to see if there is a heartbeat.
- If the person does not respond have someone call 911, 999, 112 or other emergency number for your location, or make the call yourself if you are the only one around.

Always begin with an ABC check

Following the emergency call open the person's airway

Check to see if the person is breathing

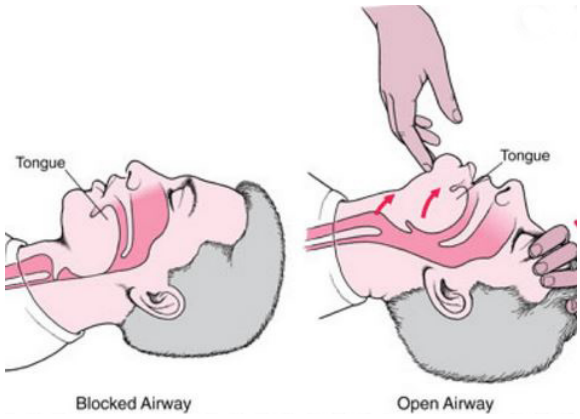
If not breathing, give them 2 slow breaths

Check for signs of blood circulation

If not breathing but have signs of blood circulating (heartbeat) the person needs oxygen. Giving repetitive oxygen is called **"rescue breathing"**. This provides oxygenated blood which can keep the organs alive.

For an adult 8 years and older, 1 breath every 5 seconds. Do this for about 1 minute (12 breaths).

Make sure the chin is the highest point of the face. This ensures an open airway. Make sure the nose is closed to allow air to go into the lungs. Each breath should make the chest rise. The air a person breathes out contains 16% oxygen and 5% carbon dioxide. This means when doing rescue breathing you are still supplying enough oxygen to keep the person alive.



After 12 breaths or 1 minute of rescue breathing, re-check signs of circulation. If the person if still not breathing but has signs of blood circulation, continue rescue breathing sequence.

Continue rescue breathing until:

- Emergency medical personnel arrive and take over – reaching a dock with rescue team or rescue team coming to vessel in marine situation.
- You are too exhausted to continue
- The person begins to breathe or vomit
- The person loses signs of circulation
- The area or location becomes dangerous

Adult CPR – Cardiopulmonary Resuscitation

When breathing stops, the brain begins to die in 4 – 6 minutes. Without immediate CPR, the person has little chance of survival.

If the person is not breathing and has no sign of blood circulating this means the heart has stopped pumping blood through the body. You must initiate adult CPR for cardiac arrest.

You must immediately give the person chest compressions to circulate the blood and give breaths to oxygenate the blood. When you combine chest compressions with breaths you are performing CPR and helping to keep them alive.

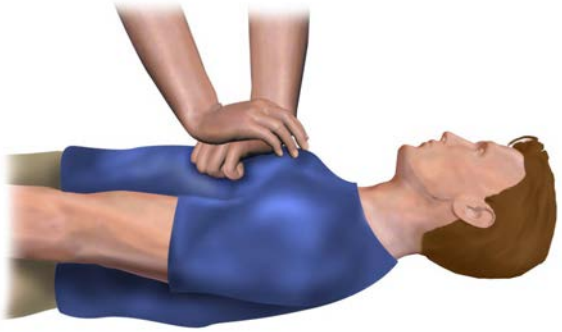
Signs of no blood circulation:

- Unresponsiveness
- No breathing
- No coughing
- No movement
- Bluish colour of the skin
- Absence of a carotid pulse

If you are unsure whether the person has signs of blood circulation, don't delay care. Just begin CPR.

CPR Steps:

- To find hand position, place heel of the and two fingers above bottom of sternum.
- Crawl up the ribs with your fingers and place 2 fingers above the sternum and plant the heel of your hand above the 2 fingers.
    - An alternative way to find the hand position, take the hand and place it in between the chest muscles also known as the lower half of the sternum.



Position Hands Over Sternum

- When giving 15 compressions
    - Keep your arms at a 90° angle to the body.
    - Keep elbows locked
    - Compress sternum 1.5 – 2"
    - Do 15 compressions in 9 seconds (100 compressions per minute)
    - Keep fingers off the chest
- Compressions force the blood out of the heart and circulate it throughout the body.
- Give 2 slow breaths to oxygenate the blood.
- Continue 15 compressions and 2 breaths for 4 cycles.
    - If you feel the ribs break, keep going.
- Once you have completed 4 cycles of 15 compressions and 2 breaths, re-check signs of circulation for no more than 10 seconds.

24.13 Radio for Help

Channel 16 is reserved for Distress, Urgency and Safety messages. Ch 16 is also used as a calling channel. Because every station should keep a continuous watch on Ch 16 it follows

that any station you wish to contact will hear you if you call them on Ch 16. As soon as contact is established you will both change to an appropriate working channel to continue the conversation. The absolute minimum time possible must be spent transmitting on Ch 16, in order to leave Ch 16 clear for its designated purpose.

URGENCY (PAN PAN)

An Urgency message takes precedence and priority over all other radio communications except Distress. It is therefore the second most important message that can be transmitted.

The URGENCY PRIORITY for an Alert and the URGENCY SIGNAL indicates that a VERY URGENT MESSAGE follows concerning the SAFETY of a VESSEL or the SAFETY of a PERSON.

The Urgency Signal consists of the words "PAN-PAN".
The signal shall be said THREE times in an Urgency Call.

The use of the URGENCY PRIORITY for an alert and the use of the URGENCY SIGNAL shall be used only on the authority of the Master or person responsible for the VESSEL.

The Urgency Call Message is normally sent on the distress frequencies. However, the Urgency MESSAGE may be sent on a working frequency in case of a long message or medical message or for a repeat of a message in areas of heavy radio traffic.

Urgency Call Example:

PAN-PAN, PAN-PAN, PAN-PAN,

ALL STATIONS, ALL STATIONS, ALL STATIONS,
THIS IS

"MY BOAT", "MY BOAT", "MY BOAT",

MY BOAT
POSITION - :

NATURE OF URGENCY AND ASSISTANCE REQUIRED,
ANY FURTHER RELEVANT INFORMATION,
OVER.

24.14 Drowning

Do not enter the water to attempt to rescue a drowning person except as a last resort, avoid being a possible second victim! Throw any kind of floating object such as PFD, life ring, floating cushion etc. to assist and buy time so that the most practical and expedient way can be devised for recovery. If the victim is beyond effective throwing range, then row or maneuver to pick up safely.

If all other methods are impractical then enter water wearing a PFD and approach victim from behind. If you can, try to calm them down. Be alert to the possibility of a panicky victim pulling you under!

Remove victim from the water, open airway and check for breathing. Commence rescue breathing if necessary and be prepared to administer abdominal thrusts. If no spinal or head injuries are suspected, turn the victim's head to one side. If no pulse is present administer CPR and continue until medical help arrives. Near-drowning victims should always seek follow up medical care.

24.15 Choking

If you think a child or an adult is choking, ask them "are you choking?". If they nod yes, tell them to "cough it out".

If they are unable to speak or cough, they need your help right away.

If coughing does not work, slap it out.

- Support their upper body with one hand and help them to bend forward
- Use the heel of your hand to give five back blows between the shoulder blades
- Then check to see if there is anything in their mouth
    - If there is, tell to try and pick it out

If back blows do not work, then you should give 5 abdominal thrusts to squeeze it out. To give the abdominal thrusts

- Stand behind them
- Put your arms around them
- Put a fist between tummy button and the bottom of their chest
- Put your lower hand in a fist and grasp your other hand
- Pull sharply inwards and upwards, repeat up to 5 times
- Check their mouth

- If they are continuing to choke call 911, 999, 112 or other emergency number for your location.
- Continue repeating 5 back blows and 5 abdominal thrusts until the blockage clears or help medical professionals arrive.
- If they become unresponsive, open the airway and check their breathing
- If they are not breathing normally, start CPR

So, if someone is choking, remember:

- Cough it out
- Slap it out
- Squeeze it out
- If not cleared, call emergency number for your location (radio for help URGENCY (PAN PAN)
- Keep repeating the cycle
- Start CPR if they become unresponsive

24.16 Seasickness, Heat Stroke, Exhaustion

- Seasickness can lead to heat exhaustion which can be major problem.

- Seasickness is motion sickness that happens only when on the water. The inner ear becomes unbalanced due to the rocking motion of a boat or ship. The part of the brain that controls balance becomes confused because it sees objects that are normally stationary, such as pictures and furniture, suddenly become mobile.

Recognising Symptoms

Seasickness begins with a cold sweat, is followed by an upset stomach with fatigue, and ends in nausea and vomiting.

Treatment

- Stay close to the middle of the vessel as there is less motion than the bow and stern.
- Find a place to sit and relax and take some deep breaths of fresh air.
- Our brain will recognise the stillness and send clues to your inner ear which will regain its balance.
- Eat a bland diet.
- Stay away from alcoholic drinks and stick to water, tea or ginger ale.
- Take ginger capsules or eat ginger cookies as ginger is a natural remedy for nausea.
- Use medication. There are many over the counter remedies available.

24.17 Carbon Monoxide Poisoning

Recognising Symptoms of Carbon Monoxide Poisoning

Poisoning by carbon monoxide is difficult to diagnose. Symptoms are similar to illnesses such as influenza, the onset of a cold or seasickness:

- fatigue
- nausea
- headaches
- dizziness or fainting
- vomiting
- impaired judgment, confusion
- shortness of breath
- changes to seeing and hearing capacities

Treatment of Carbon Monoxide Poisoning

When you suspect carbon monoxide poisoning, immediately taking the following steps can save lives:

- Move the person immediately to fresh air in an open area.
- Open doors and windows, turn off gas appliances and leave the boat if at dock.
- Watch the victim.
- Administer oxygen, if available.

- Call 911 or another local emergency number for immediate medical attention
- If the victim is not breathing, perform rescue breathing or CPR until medical help arrives.
- If at dock, do not re-board the boat until you receive an expert opinion (ex: firefighters)

If you are watching the victim, tell someone else to:

- Shut off all potential sources of carbon monoxide, if possible.
- Correct any ventilation problems.

If the victim does not improve, he/she will need to be taken to the hospital emergency room where he/she will be given oxygen and tests will be conducted to determine if carbon monoxide is the cause of her illness. If underway, radio for help. Carbon monoxide poisoning can be diagnosed by taking a blood sample.

CO2 detector

- If applicable, install a marine grade CO2 detector on your vessel and always make sure that the batteries are working.
- Do not heat the cabin or cook unless in a well ventilated area.
- Do not use heaters or cookers that are not certified for marine use.
- Make sure that engine room blowers are functional at all times.
- Make sure that all ventilators and fans are functional at all times.

24.18 Knowledge Review

1. What is hypothermia? What are the causes?
2. What should, at minimum, a basic first aid kit comprised of?
3. How would you treat cuts, stings and burns?
4. How would you control bleeding?
5. What is shock and what are signs of shock?
6. What is the treatment for shock?
7. What is heat stroke and hypothermia and what is the treatment for each?
8. What is a heart attack and what are some possible signs of heart attack?
9. What is a stroke, what are the signs, and what should you do if stroke is suspected?
10. What actions should you take if there is an unconscious victim who is not breathing?
11. Understand actions to take to aid a drowning victim.
12. Understand actions to aid a choking victim.
13. What causes sea sickness and what is the treatment?
14. What are the symptoms of carbon monoxide poisoning?
15. How would you treat carbon monoxide poisoning?

Module 25 RESPONSIBILITIES OF THE SKIPPER/CAPTAIN

25.1 Key Objectives

THE OBJECTIVES OF THIS MODULE ARE TO GET THE SKIPPER TO UNDERSTAND THE RESPONSIBILITIES THAT COME WITH BEING THE SKIPPER OF A VESSEL.

25.2 Skipper or Captain?

Skipper or Captain, what's the difference?

We are often asked what the difference is between a skipper and a Captain, as the terminology tends to vary in different countries.

- A skipper is generally referred to as someone who is in command of a recreational vessel or "pleasure craft" and is not paid for his services.
- A Captain is generally someone who is in charge of a commercial vessel and is paid for his services including the command of commercial Yachts such as Superyachts.
- In the U.S.A., a Captain is someone who is qualified by the United States Coastguard while a skipper may not have a recognised qualification.

Responsibilities

- The skipper is legally responsible at all times for the operation and safety of the vessel, its crew and its guests, even when asleep or below decks, this is especially important in bad weather or if the boat is in jeopardy.
- The skipper is obligated by law to render assistance to any vessel (or mariner) that is in distress whether from capsizing, fire, swamping, grounding or sinking, as long as the action does not endanger their own crew, passengers or vessel. If rendering assistance, make sure to stay with the vessel and its crew until assistance is no longer required. Be prepared to take on passengers, provide warm clothing, towing assistance or any other help that may be required of you. Alert authorities on shore.
- It is the responsibility of the skipper to cooperate with the Police at all times when out on the water ant to render assistance if so asked.
- It is up to the skipper to make sure that the vessel is in seaworthy condition before it leaves the dock and has all the necessary safety and navigation equipment to undertake the intended voyage.

- The skipper is responsible for operating the boat in a safe and courteous manner and making sure that all guests, crew, passengers and all water users are safe.
- The skipper should be qualified to command the type and size of vessel that he is operating and it is important that the crew and guests are familiar with the skipper's qualifications & experience as he is ultimately responsible for the lives of all souls aboard.
- It is important that the skipper clearly informs each crew member of each of their duties while they are on board. The skipper should have a plan for every eventuality likely to occur on board, and should be able to deal with them in a confident manner.
- The crew are obligated to respond to the skippers' instructions and commands quickly and efficiently.
- The skipper should be aware of any restrictions on the use of motorboats or PWC's in restricted areas or towing in certain areas and should check local regulations before operating a vessel.
- The skipper is obligated to take care of the environment at all times bringing garbage ashore and not anchoring or grounding in environmentally sensitive areas.
- Be cautious around tugs and tows and never pass between them.
- Steer clear of shipping lanes, give way to large vessels or those restricted in ability to maneuver.
- Keep clear of ferries, docked ferries and vessels under tow.
- Avoid pollution at all costs including toxic cleaners, cross contamination of invasive species, oil spills, fuel spills, black water discharge and hull scrapings and sandings.
- Adapt to changing conditions such as wind, weather, visibility and tidal changes.
- Beware of designated waters where boats are prohibited or where special conditions apply.
- Where possible, navigate as a group if a number of small craft are travelling in the same direction.
- The skipper needs to maintain and be aware of all fuel burning devices on board such as heating, cooking or refrigeration, their operation and maintenance and what to do in the event of a fire.

Prior to departure:

The operator of a pleasure craft should inform the persons on board about the following safety points:

- The location of personal flotation devices and/or life jackets;
- The techniques for putting on personal flotation devices and/or life jackets;
- The techniques for putting on personal flotation devices and/or life jackets when in the water
- The importance of wearing personal flotation devices and/or life jackets at all times
- The location of the emergency equipment

- The importance of keeping oneself low, on the centre line, and holding on to a rigid part of the pleasure craft while moving around on board
- The importance of keeping one's hands, arms and legs inside the pleasure craft when approaching or leaving a dock
- The effects of the motion of the pleasure craft, sunlight, waves, wind, sound and alcohol on them
- Their roles in the event of emergencies.

Common Courtesy

- Common courtesy is expected in and around marinas and anchorages. Common sense should dictate the volume of stereos, noise of guests, crew and passengers, especially in the evening hours and overnight.
- Reduce your engine noise where applicable, stay clear of divers, swimmers, kayaks, windsurfers, paddle craft and wildlife.
- Slow down, keep your wake small when passing other vessels, in waterways and close to onshore property.
- Be aware of local hazards and obstructions
- Be aware of your boat handling characteristics and size of your wake.
- Pay attention to all posted speed limits.
- Be aware of wind and tide conditions at all times.
- Slow down in limited or restricted visibility.

25.3 Delegation to Crew

- Depending upon the length of voyage the skipper will likely need to set up a watch system. For a short day trip this is not necessary, as long as there is always someone on the helm steering and another keeping a 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.

25.4 Duty of Care

The skipper of a yacht is required to provide reasonable duty of care for his crew. This includes:

- competent crew to operate the vessel.
- necessary safety equipment such as life raft, flares, fire extinguisher, etc.
- a safe vessel (safe access, lighting, fencing of openings, slippery surfaces, ventilation, necessary warnings)
- a safe system of work (the degree of supervision and enforcement depends on the nature of the work and circumstances)

Duty of care relevant to both visitors and passengers

- Courtesy and common-sense:
- Reduction of engine noise
- Keeping distance from divers below the surface
- Avoiding motor/propeller strikes
- Staying clear of swimmers, paddle craft, wildlife, properties etc.
- Controlling the wake
- Respecting the environment

Actions to be taken after collisions

- Identifying measures to be taken to assist a vessel in distress
- Recognising distress signals as per colregs
- Mechanical breakdowns

25.5 Knowledge Review

1. What is the difference between a skipper and a Captain?
2. Name 8 responsibilities of a skipper
3. Name 5 elements of common courtesy
4. What are crew responsible for?
5. Name some of the components for “Duty of Care”.

TABLE OF FIGURES

GLOSSARY OF TERMS

A

Aback	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 downwind 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 athwartships 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 harbour.
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 leeward.
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.

Dhow	The generic name of a number of traditional sailing vessels with one or more masts with lateen sails used in the Red Sea and Indian Ocean region.
Dinghy	A small sailboat or rowboat.
Displacement	The weight of the boat; therefore the amount of water that it displaces.
Dock	The quay or pontoon where a boat may be tied up OR 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 water's 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 tacking.
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	Top corner of a sail OR 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 rudder 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 formula 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 located 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.
La.	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 members from falling overboard.
Lift	The force that results from air passing by a sail or water past a keel that moves the boat forward and sideways, OR 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	The leading edge of a sail, OR 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	To steer close to the wind, OR 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	The left hand side of the boat when facing forward, OR, a harbour, OR, 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	The design of a boat's masts, standing rigging and sail plan, OR, 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	The direction of the current, OR, 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.
Slab Reefing	See Jiffy reef. A quick reefing system allowing a section of the mainsail to be pulled down and tied to the boom.
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	To alter course so as to cause the bow of the boat to pass through the eye of the wind, OR, 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 rigging to be adjusted.

U

Underway	A boat that is not attached to the ground by either anchor or mooring lines is said to be underway.
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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