Camp Marine Module
Training Course Manual

Canadian Camping Association
Association des camps du Canada

This manual is based on "MED A3 Small Non-Pleasure Vessel Basic Safety Course Study Guide", Third Edition © 2008. and "SVOP Small Vessel Operator Proficiency Course Study Guide", Third Edition © 2009.
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Chapter 1- Introduction

This student manual has been written for the CCA / OCA to accompany the Camp Marine Module. This course will provide you with the knowledge and skills to safely operate small passenger vessels, and deal with emergencies which could arise while operating these vessels.

The material in this course is based on the following operational criteria:

1. Vessels are operating in sheltered waters, or near coastal 2 waters.

2. Vessels are less than 15GT, carrying 12 passengers or less.

3. Operators of the vessel will already have their Pleasure Craft Operator Card and Standard First Aid.

Course Outline

Knowledge or Skill Required	Classroom Hours	Practical Hours
1. Course Introduction	.25	
2. Canada Shipping Act, 2001 and federal regulations	1.5	
3. Safe working practices and safety culture	.5	
4. Vessel construction	.5	
5. Propulsion and Fuel Systems	.5	.5
6. Pollution prevention	.5	
7. Marine weather and marine forecasts	.5	
8. The Canadian buoyage system	.5	
9. Basic Seamanship		.5
10. Maintaining a vessel's stability	.5	
11. Manoeuvering a vessel	.5	1.5-4.0
12. Departure preparation	.5	
13. Safe pilotage and collision prevention	1.5	
14. Dealing with emergency situations	.5	.5
15. Survival and Rescue	1.0	.5
16. Maintenance of skills	.25	
TOTAL- 13 to 15.5 hours	**9.5**	**3.5-6.0**

NOTES:

 A separate 4-hour "Navigation" unit is available (see course syllabus) for those camps required by Transport Canada MTRB to have this knowledge and understanding.

 Time allotment for practical Section 11 varies depending on the number of participants and their skill level. The assumption here is 15 minutes for a skilled trainee to 30 minutes for someone who might require extra practice docking the boat, for example. Therefore, a course with 6 trainees with a reasonable level of skill will require 1.5 hours, and a course with twelve participants with a mix of skilled and unskilled could take 3 to 4 hours.

Safety on the Course

As the course consists of both classroom work and practical exercise, safety rules set out by the instructor must be followed at all times;

- We will be doing practical boat handling exercises- lifejackets or PFD's must be worn at all times when in and around the boat(s).
- We may be handling pyrotechnics which are a fire hazard and must be handled and disposed of with care
- We may be extinguishing live fires- proper clothing must be worn and fire extinguishers used according to the directions of the instructor

Basic nautical terms and definitions

 Abaft: In a direction toward the stern.
 Above: Going upstairs we go above.
 Aft: We go aft towards the stern.
 Ahead: In a direction or position pointing forward of a vessel.
 Aloft: Looking up we look aloft.
 Amidships: That portion of the overall length of a vessel that lies roughly midway between the bow and the stern.
 Astern: In a direction or position pointing behind a vessel.
 Below: Downstairs is called below on board a vessel.
 Bow: The bow of the vessel is the forward end of the craft.
 Draft: The depth of water which a craft requires to float freely.
 Fenders: Devices that cushion the shocks and protect the side of a pleasure craft.
 Forward: We go forward towards the bow of our vessel. When one faces forward they look towards the bow.
 Going aboard: Stepping onto a vessel is referred to as going aboard.
 Port: when one faces forward the port side is on the left.
 Starboard: when one faces forward the starboard side is on the right.
 Stern: The flat back or transom of the boat is called the stern of the vessel.

Chapter 2- Canada Shipping Act 2001 and Regulations

The Canada Shipping Act, 2001, and the regulations made pursuant to regulate the operation of all vessels in Canada. There is also other legislation which applies, such as the Criminal Code, and possibly local regulations. On this course you will learn the requirements of the Act and those regulations pertinent to your job as a camp passenger vessel operator.

To understand how the Act and regulations apply to you, first we need to explain some definitions:

Canada Shipping Act 2001

The *Canada Shipping Act 2001* governs the operation of all vessels in Canadian waters, large or small. Transport Canada regulates small commercial craft safety under its authority. Commercial mariners are affected in four ways:

- First as to the certification of operators.
- Second as to the registration of vessels.
- Third as to the equipment which is required by law to be carried aboard various sizes of vessels.
- Fourth as to the operation of the vessel in accordance with the rules.

CSA 2001 Regulations that could affect operators of small non-pleasure vessels are:

Administrative Monetary Penalties Regulations

Collision Regulations (Rules of the Road)

Fire Detection and Extinguishing Equipment Regulations (Equipment requirements)

Life Saving Equipment Regulations (Equipment requirements)

Marine Personnel Regulations (Personnel certification, training and vessel crewing requirements)

Navigation Safety Regulations (Equipment requirements)

Ship Radio Inspection Fees Regulations

Ship Station (Radio) Regulations, 1999 (Equipment Carriage requirements)

Ship Station (Radio) Technical Regulations, 1999 (Equipment technical requirements)

Shipping Casualties Reporting Regulations (Mandatory Reporting of incidents)

Small Vessel Regulations (Operational requirements)

Vessel Certificates Regulations (Inspection requirements and voyage definitions)

Vessel Registration and Tonnage Regulations

Vessels Registry Fees Tariff

VHF Radiotelephone Practices and Procedures Regulations (Operational requirements)

Vessel Pollution and Dangerous Chemicals Regulations (prohibition of pollutants and reporting)

This is only a partial list of regulations made under the Canada Shipping Act 2001- those that are most pertinent to the operation of vessels under 15 GT.

Transport Canada publishes TP 14070 which provides an informative summary of the regulatory requirements, plus general advice on the safe operation of small vessels.

Transport Canada also publishes TP 1332 which provides the detailed requirements for construction of small vessels- further details are found in Chapter 4.

Consult with your local Transport Canada Marine Safety office for pertinent regulations concerning specific operations.

Operational Definitions

Small Vessel (*Commercial)*: A vessel that is not a fishing vessel (except for those listed earlier under 15 gross tonnage or 12 meters overall length on specified voyages), a passenger vessel or a pleasure craft.

"pleasure craft" means a vessel that is used for pleasure and does not carry passengers,

Passenger Vessel: Passenger vessel means a vessel carrying passengers.

Who is a passenger?

"passenger" means a person carried on a vessel by the owner or operator, other than:

(i) the master, a member of the crew or a person employed or engaged in any capacity on board the vessel on the business of that vessel, or

(ii) a guest on board the vessel, if the vessel is used exclusively for pleasure and the guest is carried on it without remuneration or any object of profit;

(iii) a person carried on a vessel in pursuance of the obligation on the master to carry shipwrecked, distressed or other persons or by reason of any circumstances that neither the master nor the owner could have prevented;

Vessel Operator

Transport Canada Marine Safety considers the Operator to be "one who controls the operation of the vessel in terms of such things as navigation, management, upkeep, maintenance, manning, on board processes and routines, budgets, schedules, fuel supplies and ship's stores."

Master, crew member or a person employed/engaged

The complement of Master and crew members that are required on board to run the vessel. “A person who is employed or engaged in any capacity on board the ship on the business of that vessel” is not a passenger.

Basic Vessel Definitions

The *Canada Shipping Act 2001* defines a vessel as: any ship or boat or any other description of vessel used or designed to be used in navigation.
The International Regulations for preventing Collisions at Sea, 1972 with Canadian Modifications further defines watercraft as:
1 The word *vessel* includes every description of water craft, including non-displacement craft and seaplanes, used or capable of being used as a means of transportation on water.
2 The term *power-driven vessel* means any vessel propelled by machinery.
3 The term *sailing vessel* means any vessel under sail provided that propelling machinery, if fitted, is not being used.
4 The term *vessel engaged in fishing* means any vessel fishing with nets, lines, trawls or other fishing apparatus which restrict manoeuvrability, but does not include a vessel fishing with trolling lines or other fishing apparatus which do not restrict manoeuvrability.
5 The word *seaplane* includes any aircraft designed to manoeuvre on the water.

Registration and Licensing

As the operator of a commercial vessel, it is your responsibility to ensure it is properly licensed or registered.

Registration

In Canada, ship registration is basically a title system for the ownership of vessels. It is similar in nature to title systems applicable to land registry. Registration is mandatory for every ship that exceeds 15 gross tons.

Licensing

Commercial vessels less than or equal to 15 gross tons which are not registered must be licensed. Licensing is an identification system, not a title system, and does not permit registration of mortgages or liens. The Small Commercial Vessel Licensing Program is delivered by Transport Canada offices in Ottawa. Application forms are available from any Ship Registration office, or from the Transport Canada Web Site. Further information may be obtained from Transport Canada’s at 1–877–242–8770.

Operator Responsibility and Obligations

The operator of a commercial vessel is responsible for the lives of those on board. He/She is also responsible for any damage the vessel causes through negligent operation.

Pollution Prevention

The Canada Shipping Act 2001 prohibits the discharge of pollutants:

> 187. No person or vessel shall discharge a prescribed pollutant, except in accordance with the regulations made under this Part

The Vessel Pollution and Dangerous Chemicals Regulations provides the details as to what is a prescribed pollutant, and the conditions under which a pollutant may be discharged. This is more fully discussed in Chapter 6.

Offences and Penalties

Penalties and/or fines for maritime violations can be imposed under the *Canada Shipping Act 2001,* for violations of the Act or any regulations made pursuant to it, *the Contraventions Act* or *the Criminal Code of Canada.* It cannot be too strongly emphasized that all rules falling under these Acts and Regulations must be complied with, and failure to do so can result in conviction with severe penalties.

Any operator who fails to comply with or contravenes any provision of these regulations is guilty of an offence and liable on summary conviction to a fine or to imprisonment. Financial penalties (fines) may also be issued under the administrative monetary penalty provisions of the Act and the *Administrative Monetary Penalties (AMP's) Regulations.* This process is similar to getting a traffic ticket, but the fines may range up to $25,000 for severe offenses such as repeat pollution offenses. The first pollution offense (for example) could result in a fine of $6000. The process and a list of offenses and the applicable fine is found in the AMP's regulations.

Remember that regulations change from time to time. It is the Operator's responsibility to stay up to date and current with changes to maritime laws.

Enforcement of these regulations is carried out by both Transport Canada Marine Safety Branch or Federal, Provincial or Municipal Peace Officers, including any member of any Harbour or River Police Force.

A Peace Officer may order detention of a vessel and may take action by other reasonable and appropriate means at his or her disposal to prevent violation of the *Canada Shipping Act 2001*.

Generally speaking, Transport Canada administers the AMP's provisions of the Act, and prosecutions, whereas police forces tend to use the *Contraventions Act* to issue tickets for offenses such as not carrying a lifejacket, or *Criminal Code* offenses such as impaired operation of a vessel.

Regulations under the Canada Shipping Act 2001

This section highlights those regulations most applicable to operations of small vessels under 15GT.

Small Vessel Regulations

The *Small Vessel Regulations* apply to:

- Pleasure craft.
- A vessel, other than a pleasure craft, that does not exceed 5 tons, gross tonnage, and that does not carry more than 12 passengers.
- A power-driven vessel that does not exceed 15 tons gross tonnage, that does not carry passengers and that is neither a pleasure craft nor a fishing vessel.

The Small Vessel Regulations set out the minimum safety equipment required on board a non-fishing vessel according to vessel length. Length as described in the Small Vessel Regulations is:
- In the case of a registered vessel, the length shown in the Certificate of Registry.
- In the case of a licensed vessel, the length from the fore part of the head of the stem to the after part of the head of the stern post.

Minimum required safety equipment

Safe, responsible operation is the common denominator for safe vessel operation on any waterway. Having all the required safety equipment on board a non-pleasure vessel provides peace of mind to each crewmember in the event something goes wrong. It may also save a life! . Operators may wish to take additional items depending on specific water activities, the area of operation and the time of year.
Always depart for your operation prepared. Safety equipment must be maintained so that it is capable of functioning properly. The *Small Vessel Regulations* describe this activity as "maintenance". All safety items should also be readily accessible and all crew and passengers should be knowledgeable in their location and use. For open vessels, *we* suggest purchasing a rubber container at any hardware store to safely stow all your vessel's safety equipment. Label it "Emergency Safety Equipment".

Careless operation of a vessel

The *Small Vessel Regulations* state no person shall operate a vessel in a careless manner, without due care and attention or without reasonable consideration for other persons.

Noise pollution - Engine noise muffling equipment

Power driven vessels must have engine noise muffling equipment in use at all times when operating within five miles of shore.
Vessels constructed before January 1, 1960, or those that are engaged in an official competition, formal training or final preparation for an official competition are exempt.

Passenger Briefings

The Small Vessel Regulations set out the requirement for passenger briefings on vessels under 15GT carrying 12 or less passengers. This is discussed further in Chapter 12, Departure Preparation.

Marine Personnel Regulations

The Marine Personnel Regulations set out the training and certification requirements for operators and crew of vessels, as well as the number of crew members required to safely operate a vessel.

Section 205 describes the basic safety training for all seafarers.

Familiarization

Everyone who works on board a vessel must be familiarized with the hazards of the vessel and the marine environment, as well as the vessel itself, the safety equipment and the crewmembers duties, especially their role in an emergency.

This is apart from any formal training (such as this course) and must be repeated every time a crewmember or operator begins working on a different vessel, no matter how long they have been sailing.

Marine Emergency Duties Training

Formal training in firefighting and lifesaving, survival and rescue, as applicable to the size of vessel and voyage the vessel is operating on, is mandatory for all crewmembers. This course meets these requirements for your operation.

A standard first aid or marine basic first aid certificate is also required.

Minimum Complement

The regulations describe the minimum complement (number of crew) and their qualifications, required on board any vessel, to carry out the following functions:

1. Keeping a safe watch
2. Dealing with emergencies
3. Abandoning the vessel and assisting passengers
4. Assisting passengers in survival craft.
-

Onboard vessels of less than 15GT or 12 metres in length, carrying 12 or less passengers, determining the minimum complement is a fairly simple process, and generally one person is sufficient to operate the vessel, as long as the person is able to safely navigate the vessel and keep a lookout (needs a clear all round view from the operating position), as well as operate the engine, and deal with the emergencies likely to be encountered by the vessel on the type of voyage it is allowed to operate on.

As long as the vessel is an open boat, or powered by an outboard engine, or less than 5GT, no engineer is required. On board passenger vessels less than 20 metres in length, with an inboard engine of over 75kW (100 HP) the master (operator) may also be the engineer, as long as there is a second person to act as lookout.

Vessel Certificates Regulations

The definitions of the voyage classifications applicable to all regulations are found in the Vessel Certificates regulations:

Near Coastal Class 2

“near coastal voyage, Class 2” means a voyage:

(a) that is not a sheltered waters voyage; and

(b) during which the vessel engaged on the voyage is always:

(i) within 25 nautical miles from shore in waters contiguous to Canada, the United States (except Hawaii) or Saint Pierre and Miquelon, and

(ii) within 100 nautical miles from a place of refuge. (voyage à proximité du littoral, classe 2)

In other words, a vessel on a Near Coastal 2 voyage can go from the US/Mexico border on the west coast, around the northern coast of North America, to the US/Mexico border on the east coast, as long as it remains within 25 miles of shore. A voyage on the Great Lakes is also a Near Coastal 2 voyage, as long as the vessel remains within 25 miles of shore.

Sheltered Waters

"sheltered waters voyage" means a voyage

(a) that is in Canada on a lake, or a river above tidal waters, where a vessel can never be further than one nautical mile from the closest shore;

(b) that is on the waters listed in column 1 of an item of Schedule 1 during the period specified in column 2 of that item.

In other words, if you are on a lake or river less than 2 miles across (so you can't be more than 1 mile from the shore at any point), you are on a sheltered waters voyage; the waters don't have to be listed in the regulations. Being only a half mile from shore on Lake Ontario, for example, would not be classed as a sheltered waters voyage, as you CAN go more than one mile off shore. This makes sense, as even if you are close to shore, you are still fully exposed to the wind and sea conditions of a large body of water.

Or, if you are on any of the waters listed in Schedule 1 of the Vessel Certificates regulations, during the season listed, you are also in sheltered waters. Outside of the operational season these waters would be Near Coastal 2. Here is an example of a sheltered waters area as described in the Schedule:

SHELTERED WATERS VOYAGES

PART 1

ONTARIO

Item	Column 1 Waters	Column 2 Period
1.	The waters of the North Channel in Lake Huron east of a line drawn from Bruce Mines to De Tour Light, Michigan, in the United States and west of a line drawn from Red Rock Point at the east end of Killarney to Cape Smith on Manitoulin Island	Beginning on May 15 and ending on October 15

Rendering assistance and reporting accidents

The operator of a commercial vessel should always watch for signals that indicate distress and need of assistance. If the operator is involved in, or comes across an "on the water accident" (recreational or commercial) he or she has an obligation to stop and offer assistance as described in the *Criminal Code of Canada*.
The *Canada Shipping Act 2001* also requires that the operator shall (in so far as he/she can do so without serious danger to their own vessel and the persons on board) render assistance to every person who is found at sea or in danger of being lost.
Therefore, upon seeing someone who requires assistance due to a distress situation, marine law requires that the operator and crew must do what they can to help. Notwithstanding, mariners are also protected by the *Act* and cannot be held responsible for any assistance they give, providing they have done what any prudent seafarer of their ability would do.

Other Legislation

Other Acts and Codes that could affect small vessel operators of non-pleasure vessels are:
- Canadian Transportation Accident Investigation and Safety Board Act and Regulations
- Marine Liability Act and Regulations
- Canada Labour Code Part II
- Criminal Code of Canada

Marine Mammal Regulations – Fisheries Act

The Federal Department of Fisheries and Oceans is responsible for ensuring the protection and conservation of marine mammals. The *Fisheries Act* prohibits any form of harassment of cetaceans, including repeated attempts to pursue, disperse, and herd whales and any repeated intentional act or negligence resulting in the disruption of their normal behaviour. Individuals who contravene the *Marine Mammal Regulations* are guilty of an offence and liable to a fine not exceeding $500,000 and twenty four (24) months imprisonment (*Fisheries Act sec. 78).*
Harassing whales changes or interferes with their behaviour, forces them away from their habitat at critical times in their annual reproduction and feeding cycles and may cause injury.
Summary of Guidelines as listed in Notice to Mariners Annual Edition - *www.notmar.gc.ca*
• Do not hunt, chase, follow, disperse, drive, herd or encircle whales.
• Avoid any sudden changes of course or speed.
• Avoid heading directly toward a whale.
• If in an area known to be frequented by whales, be on the lookout to avoid collisions.
• Travel parallel to whales.
• The mammals may wish to come closer to you; if they do, do not chase them and be wary of any individual that appears tame. Keep clear of flukes.
• If you are operating a sailing vessel with an auxiliary motor, leave it in idle or turn on the echo sounder to signal your presence. If it is impossible to detour around a whale or a pod of whales, slow down immediately and wait until you are more than 400 metres away before resuming speed.

Local laws and regulations

Harbour authorities have the right to enforce additional regulations governing their own areas. These usually concern permissible speeds, type of watercraft allowed and right-of-way rules. Check with the appropriate police force to see if any apply in the local area.

Chapter 3- Safe Working Practices and Safety Culture

Safety the first priority on board

A small commercial vessel can be a dangerous working environment. But the risk of accidents will be greatly reduced if proper precautions are taken. This chapter outlines some basic guidelines for avoiding accidents on board.

Proper stowage and seamanship

Flammables should be stored in proper containers, away from crew quarters.
Waste synthetic material, rope, nets, lines, garbage bags etc. must not be thrown over the side. Synthetic materials can foul propellers and be a danger to the environment.
Deck gear should always be tied down so it won't come loose in the worst possible conditions.

An untidy deck is sure to cause accidents. Keep decks clear, and stow all ropes in coils.

Make sure that all cabins and living quarters are well ventilated. Exhaust gases from the engine room can be deadly if allowed to build up.
Many fires and explosions are caused by poor ventilation and engine backfire control. This is not an idle statement, but a fact. Gasoline (even just a small cupful) is highly explosive and presents a high degree of hazard, explosion, and/or fire.
Gasoline and propane in a boat's bilge presents serious danger because the fumes, being heavier than air, can gather in bilge. Therefore, it is essential that all inboard gasoline engines and fuel tank compartments are thoroughly ventilated.

Vessel Maintenance

It can hardly be emphasized enough that vessel maintenance is a key component of vessel safety. The checklists provided in Chapter 12 provide a good basis on which to start a maintenance program. Critical items such as engines, bilge pump, navigation lights and safety equipment are the most important to check on a daily or weekly basis. Other items such as hull condition might be once a season, or after some heavy weather, or a grounding, for example.

Hazards in the Workplace

Never jump. On larger vessels, always use the gangway or ladder when boarding or leaving the vessel, on small boats, step carefully into the boat. Don't try to carry heavy objects into the boat- have someone pass them to you.

Never stand in a bight (or loop) of rope or wire. If it tightens suddenly, a serious injury may follow.

Be careful where you put your feet, especially when wires, ropes or nets are moving.

Always check ladders to be sure they are well constructed, secured and maintained.

Watch your head. Don’t stand under a load, or in areas where over-head equipment may swing and cause serious injury.

Never bend your back over the load when lifting heavy weights. Stand with your feet a little apart, and keep your back straight.

Wear proper safety equipment, and clothes suitable to the job.

Always wear work gloves when handling wire rope, or when doing any work with rope where there is a danger of damage to the skin of your hands.

Make sure that hatches and flush decks scuttles are properly covered and the cover secured when they are not in use.

All belts and other moving parts of equipment should have proper guards fitted.

Chapter 4- Vessel Construction

Construction Requirements

In order to ensure a consistent standard of safety, all vessels must be built and maintained as required by the Small Vessel Regulations. These regulations, in Part 7 require that vessels meet the construction requirements that were in effect when the vessel was built, when it was imported into Canada, or when it was converted to commercial use — whichever comes later. The detailed requirements are set out in the Construction Standards for Small Vessels (TP 1332).

The construction requirements are the minimum requirements for safety that must be met by anyone designing or building a vessel for personal use or for sale. Vessel importers must also make sure that the vessels they import meet these same standards.

If your vessel was built, imported, or converted to commercial use:

• on or after April 29, 2010, when the new Small Vessel Regulations came into force, it must meet the non-pleasure craft construction requirements of the Small Vessel Regulations and the 2010 edition of the Construction Standards for Small Vessels (TP 1332).

• before April 29, 2010, it must meet the non-pleasure craft requirements of the 2004 edition of the Construction Standards for Small Vessels (TP 1332), or, as applicable, the alternatives set out for vessels built before April 2005 in the Small Vessel Regulations.

TP 1332 provides requirements in the following areas:

- Hull serial numbers and compliance notices
- Construction requirements including structural strength and watertight integrity
- Protection from falls
- Discharge of sewage
- Navigation lights
- Hull design requirements including recommended maximum safety limits and flotation requirements
- Stability standards
- Ventilation systems for spaces containing sources of gasoline vapour and diesel engine and fuel tank space ventilation
- Battery spaces
- Fuel systems and outboard motor installations
- Electrical systems
- Machinery and exhaust systems
- Bilge pumping arrangements
- Safety systems

Compliance Notices

The construction requirements establish minimum requirements for safety. Anyone building a vessel that is or can be fitted with a propulsion engine or an auxiliary engine or fitted with a fuel-burning appliance, whether for personal use or for sale, must build it to the construction requirements. This is true whether you are building the vessel for

yourself or for someone else. Likewise, vessel importers must verify that the vessels they import meet the same requirements.

The Small Vessel Regulations require the builder or the importer of a vessel for use in Canada to submit a Declaration of Conformity to Transport Canada and attach a compliance notice to the vessel unless:

• it has been built or imported for personal use; or

• it is an open vessel of traditional construction that is not mass produced and can only be fitted with an outboard engine.

From April 29, 2011, a compliance notice must be attached to all new small commercial vessels. The builder, manufacturer, rebuilder or importer of the vessel must also prepare a Declaration of Conformity and give a copy of this declaration to the first owner of the vessel.

Compliance notices are a statement by the builder or importer declaring that the vessel met the construction requirements as they read on the date of construction, manufacture, rebuilding or importation of the vessel. The compliance notice will indicate the vessel model, the builder or importer, the category of construction requirements and the design limitations, such as the ISO (International Organization for Standardization) design category for stability.

There are three vessel categories for compliance notices:

- not more than 6 metres long;
- more than 6 metres long – pleasure craft; and
- more than 6 metres long – non-pleasure vessels.

Vessels not more than 6 m

For vessels that are not more than 6 metres long, the construction requirements are the same for both pleasure craft and non-pleasure vessels.

Compliance notices for vessels not more than 6 metres long will indicate recommended safe limits for maximum capacity in kilograms and number of persons and, if it is designed for an outboard motor, the maximum power.

Vessels more than 6m

For vessels more than 6 metres long, the requirements for pleasure craft and non-pleasure vessels are not the same. Be aware that if you intend to use a vessel that is more than 6 metres long that was built to the pleasure craft requirements, it may have to meet additional construction requirements before you can use it commercially.

Depending on the type and the use of the vessel, these may include such things as a stability assessment, bilge pumping arrangements and additional fire safety equipment. Consider hiring a marine surveyor to see if your boat complies with the non-pleasure vessel requirements and determine any required modifications you must make, if you are not sure. Remember, when you put it in operation, you, as the owner, are responsible for making sure your vessel meets all regulatory requirements.

Maintenance

It is importance to have a maintenance program for your vessel. The following is a list of items which could be included such a program. See also the checklists provided at the end of Chapter 12.

Hull

Inspect and renew as needed. (anti-fouling bottom paint / topside	Frequency
cleaning / waxing)	End of season
Inspect all through-hull fittings and attachments for leaks.	Weekly
Check all through-hull fittings can be moved to closed position.	Week 1
Check all above-deck watertight and through-deck fittings, including cleats, stanchion mounts, hatches, ports, doors, antenna mounts, and the hull to deck seal.	Week 2
Check the cabin interior for water and stains, which could signal a leak and weak materials.	Week 3

Machinery

Change main engine and auxiliary generator oil and filter at the hours of operation interval recommended by the manufacturer or once a year, whichever comes first.	Insert manufacturers recommended intervals, e.g. “Every 300 hours”
Check fluid levels. (oil, water, engine coolant)	Daily
Check the engine(s) for oil or fuel leaks.	Daily
(For gasoline powered vessels) Check the blower works properly and verify that the associated ductwork is free from leaks.	
Check that the bilge pump is operating properly and that the strainer inlet to the bilge pump suction is free from debris. When checking the pump, take care to not discharge a pollutant overboard.	
Tune up gasoline engines every year and replace electrical parts, such as spark plugs, as needed.	Yearly
Inspect and tighten all hoses and drive belts often.	Replace them when they are worn or cracked.
Inspect the starter motor and alternator.	
Maintain painted surfaces and apply a light coating of oil every year to reduce corrosion.	Yearly
Inspect and service transmissions and outdrive units according to manufacturer’s recommendations.	Insert manufacturers recommended intervals
Pressure check outdrive units.	
Check transmission fluids and gear oil for water.	
Change transmission fluids and gear oil from time to time.	
Grease universal joint, gimbal bearing, propeller spline, and unit	

fittings.	
Check bellows and water seals and replace, if needed.	
Check and replace the sacrificial zinc anodes on shafts, props, tabs, and other underwater gear, as well as engine-mounted zincs on the underside of exhaust elbows or risers and on the end caps of heat exchangers to guard against corrosion.	
Clean and service outdrive unit.	

Electrical System

Test all circuits for proper operation.	
Inspect all exposed wiring, fuse/ breaker panels and electrical equipment. Wire insulation should be intact and contacts and connectors should be secure and clean.	
Replace defective parts.	
Secure loose wiring.	
Inspect and test batteries. Batteries should be in approved boxes or trays, well ventilated and securely fastened.	

Other Systems

Inspect and service the fuel tank, filter, fitting, and lines on a regular basis. Keep tanks free of scale, dirt, and water.	
Flush and chlorinate the fresh water system, taking care not to pollute.	
Check all fresh water lines and connections for tightness. Repair and/or replace as needed.	
Check, clean and lubricate mechanical parts of all systems as needed for proper operation. These systems include hydraulic trim systems, air systems, anchoring systems, and bilge pumping and sanitation systems.	
Check safety equipment: lifejackets, flares, fire extinguishers, liferafts, life buoys, bilge pumps, oars, anchors, etc.	
Check radio equipment, EPIRB, antennas, batteries, and backup systems.	
Lubricate winches, blocks, turnbuckles and other mechanical equipment.	

The intervals for each item should be determined by experience, based on your vessel and its operational area, or by manufacturers recommendations.

Bilge Pumps

Bilge pumps are a particularly important piece of equipment which require regular maintenance and inspection, as noted in the maintenance schedule above.

Bilge pumps may be manual or electrically driven, and may be equipped with float switches for automatic operation. Be careful if your boat is equipped with an automatic bilge pump to keep your bilge completely free of pollutants, so that you don't inadvertently pollute!

Items to check:

Daily: check the operation of the pump as part of your pre-departure checklist, or before commencing operations for the day. If there is a back-up pump, follow the same routine as with the main pump, and make sure you test it regularly as well.

Weekly, or at another suitable interval check the following items:

Strainer- Usually the bilge pump suction will be protected by a small strainer, to keep large objects from damaging the pump impeller. Check the strainer to be sure it is not becoming clogged and remove any items from the bilge which may clog the strainer.

Suction and discharge hoses: These may crack over time, and are usually attached to the pump and thru-hull fitting by hose clamps- check these for tightness and inspect the hose for cracks.

Through-hull fittings: Check these for cracks or loosening. As these fittings are usually plastic, they can develop hairline cracks, which could cause the fitting to fail suddenly.

Pump - Listen when the pump is running for smooth operation. A couple of times a year, disassemble the pump and replace any worn or damaged parts such as the impeller. On a manual bilge pump, which are often of the diaphragm design, the cover can be removed and the pump cavity inspected for debris. Replace the cover, and ensure it is fitted properly, and that there are no air leaks by testing the pump after it is reassembled. Ensure the pump is solidly mounted.

Float Switch/Bilge Alarms- Check float switch by lifting it manually and check bilge alarms, if fitted, by following the manufacturers directions.

Chapter 5- Propulsion and Fuel Systems

Small vessel propulsion systems

Outboard Motors

The most popular method of propelling a small vessel through the water is the outboard motor. Most small watercraft have a flat stern or transom to which the motor usually clamps or bolts. Sometimes, special brackets are fitted on the stern for mounting purposes. Outboard motors come in various sizes ranging from 1.8 kW (2.5 HP) up to and beyond 206 kW (275 HP).

Inboard/Outboard Drive Engines

This type of propulsion system has some engine components in and part outside the hull. The engine is inboard, near the vessel's stern while the drive unit (propeller, gear box, etc.) is outboard. The drive unit or lower half is similar in appearance to an outboard.

Inboard Engines

Most large commercial vessels have inboard engines. These engines are fueled by either gas or diesel. The trend these days is more toward diesel engines as the fuel is less dangerous than gas. The engine is usually mounted near the center of the vessel and connected to the propeller by a long shaft.

Jet Drives

These are mechanical propulsion systems that pump large quantities of water through jets at high pressure. Similar to an aircraft jet, the force of the water being ejected propels the vessel through the water. A water jet powered vessel is steered by turning its jet to one side or the other. Jet drives are used on vessels that are routinely operated in shallow water areas and on personal watercraft (jet skis or Seadoos).

Twin engine vessel

Twin engine vessels have two propellers so they are some-what easier to handle. The vessel can turn slowly by adjusting the speed of the motors independently or can turn 360° by going slow ahead on one engine and slow astern on the other. Never attempt this when moving at cruising speed through the water.

Propellers are dangerous

In scuba diving operations or in a man overboard shut off the engine. Engines can accidentally be put into gear and in some cases like with variable pitch, propellers revolve even with the gear shift is in the neutral or “dead stop” position.

Engine Operation

Engine pre-start checks

All manufacturers provide “start-up information” with the owner’s manual. Read the manual first, usually it’s too late after something has gone wrong. Complete an engine pre-start check-list!
First ensure bilges are ventilated. Turn on the fuel, for most outboards pump the bulb in the fuel line until solid resistance is felt. If the cooling system has valves, make sure they are in the running or open position. Sit at the operator’s position and attach the “kill switch lanyard”.

Engine starting safety devices - Kill switch

Outboard engines have mechanical and electrical interlocks which make it virtually impossible to start the engine with the gears engaged or with the throttle wide open.

Many small craft engines (outboards, inboard/outboard, jet drives) are also fitted with electrical “kill switches” that are connected to a lanyard for attachment to the operator.

The “kill switch” immediately stops the engine if the operator is removed from the steering position. If the engine is older it may not have these safety features so be doubly careful, because the operator could be pitched overboard by a sudden start in gear.

Starting the engine

Put the gear shift in neutral, set the throttle to start position, pull out the choke or raise start lever, turn the ignition key all the way to the right.

When the engine fires release the ignition key to the run position, adjust the throttle for a fast idle, and promptly check gauges, particularly for oil pressure, listen for low oil pressure alarm (if fitted).

Listen critically for anything abnormal. In most marine systems, check the exhaust: as soon as the engine is warm, water should start to appear from the exhaust, indicating that the cooling system is working. This may require two or three minutes, but if water does not appear by then better shut down and see what is wrong.

By now the engine should be running smoothly and getting up to operating temperature. The ammeter should show charge, the temperature gauges should be approaching running indication, and oil pressure should be normal. The tachometer shows several hundred rpm (check owner’s manual for exact range). Prepare to get under way.

Shutting down

Follow the owner’s manual advice concerning the recommendations for engine shut down. But in general, when the vessel is properly secured:

- Switch off the engine.
- Tilt an outboard engine up out of the water and in salt water crank it over a few turns to clear the water pump.
- Pump the bilges.
- Make sure the fuel supply valves are closed and all electric switches are off.
- If the vessel has a master switch, make sure it is off.
- Close any seacocks (valves to the sea) on the engine or head (toilet).

- Check all stowage and place securely any coverings you have to keep out the weather.
- Make a last check of fuel valves, electrical switches, and lines.

Fuel safety precautions

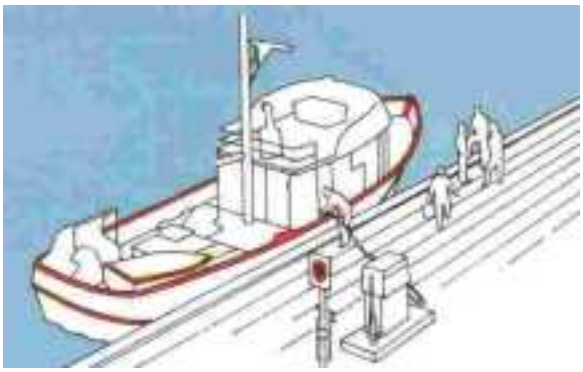
Any enclosed space that contains fuel-burning engine(s), cooking or heating appliances should be well ventilated. In addition to the fire hazard, fuel burning apparatus produce the colourless, odourless gas carbon monoxide. This deadly gas can easily build up undetected below deck. Even at low concentration carbon monoxide can injure or kill those breathing it. If a boat has accommodations and is fitted with an inboard engine, generator or fuel burning appliance, it is recommended to install a carbon monoxide detector in the cabin.
Gasoline vapours are heavier than air and highly explosive, therefore special precautions need to be taken when using gasoline as a marine fuel.

Backfire flame arrester - Carburetor fitted inboard engines

When a gasoline engine runs, there are continuous explosions within its cylinders. Sometimes the fire from these explosions comes out through the carburetor instead of the exhaust system. If this happens and there are gasoline fumes near the engine, an explosion could occur. This is why each gasoline carburetor must have a clean, well secured backfire flame arrester.
An outboard motor does not have a flame arrester. This is because the motor is not inside the boats hull so does not present the same danger as an inboard/outboard or an inboard motor.

Fueling procedures

Follow these procedures, step by step, when refueling. It not only makes good sense, it's the law:



- Moor the boat securely to prevent spillage.
- Shut off all engines.
- Insist that all passengers and crew not involved with the refueling go ashore.
- Extinguish all open flames.
- Do not smoke while refueling.
- Turn off electrical switches and batteries, and refrain from operating electrical devices.
- Close all windows, portholes, hatches and cabin doors.
- Ground nozzle against filler pipe.
- Do not overfill tank to prevent overflow, clean up any spillage.
- Check for fuel vapour odours.

After filling the tank, open portholes and hatches and air out the boat. Turn the exhaust blower on for at least four minutes and then sniff for fumes! Note: A blower should be used every time before starting the engine, not only when refuelling.

Portable tanks

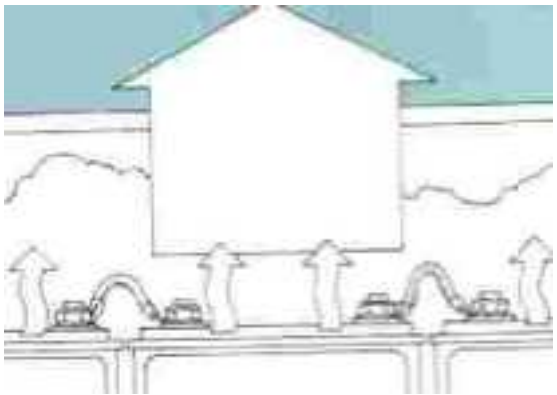
These should always be taken ashore for filling. If any gas spills it will not be in the boat, and any vapours from refueling will not collect in the boat either. Make sure all portable tanks are well secured on board after refuelling.

Marine Batteries

Marine batteries should be well secured and maintained in a well ventilated area that is easily accessible. The battery should be stored in a box made for corrosive material. (Purchased battery box usually made of plastic.)

Hydrogen Gas

Lead Acid batteries, the most common in marine applications, give off explosive hydrogen gas when being charged. Never locate batteries in accommodation areas. Hydrogen gas is lighter than air, so place your battery boxes in a well ventilated area so the gas can float free.



Chapter 6- Pollution Prevention

The *Canada Shipping Act, 2001* prohibits discharge of pollutant substances, under section 187 to ensure the protection of our aquatic environment. Operators should know that it is an offence to put oil, garbage or other pollutants into the water, either accidentally or with willful intent and not report it immediately to the Coast Guard or other local authorities.

Oil and Chemicals

The Vessel Pollution and Dangerous Chemicals Regulations consolidate a number of previous regulations and cover sewage, oil and chemical pollution, air pollution and the discharge of garbage from vessels, and also make mandatory the reporting of spills.

These regulations define a pollutant:

4. For the purposes of sections 187 and 189 of the Act, the following substances

are prescribed pollutants:

(a) oil and any oily mixture;

(b) garbage; and

(c) organotin compounds that act as biocides. (used in anti-fouling paint for example)

Exceptions to this prohibition are as follows:

5. For the purposes of section 187 of the Act… substances may be discharged, if:

(a) the discharge or emission is necessary for the purpose of saving lives, securing the safety of a vessel or preventing the immediate loss of a vessel;

(b) the discharge or emission occurs as a result of an accident of navigation in which a vessel or its equipment is damaged, unless the accident occurs as a result of an action that is outside the ordinary practice of seafarers;

(c) the discharge is a minimal and unavoidable leakage of oil that occurs as a result of the operation of an underwater machinery component;

(d) the discharge is an accidental loss of a synthetic fishing net and all reasonable precautions were taken to prevent the loss;

(e) the discharge is a discharge of garbage that results from damage to a vessel or its equipment, and all reasonable precautions were taken

> (i) before the occurrence of the damage to prevent and minimize the discharge, and
>
> (ii) after the occurrence of the damage to minimize the discharge; or

(f) the emission involves pollution of the air and results from damage to a vessel or its equipment, and all reasonable precautions were taken

(i) before the occurrence of the damage to prevent and minimize the emission, and

(ii) after the occurrence of the damage to minimize the emission.

Reporting

132. (1) The master of a vessel in waters under Canadian jurisdiction must report any discharge or anticipated discharge from the vessel if the discharge or anticipated discharge is

(a) prohibited by section 187 of the Act or by these Regulations; or

(b) authorized by paragraph 5(a), (b), (d) or (e) [above].

As you can see, if you discharge a pollutant as a result of a collision, or going aground for example, it is not an offence under the act. The exception referred to in (c) allows for minimal leakage from oil filled stern tubes on larger vessels, and does not have to be reported, but is not really applicable to small vessel operations.

However even if the discharge is legal, you are still responsible for reporting it and for cleaning it up, no matter what the cause, as noted in paragraph (b) above

132. (3) The master must make the report

(a) as soon as a discharge occurs or is anticipated; or

(b) as soon as feasible after a discharge occurs or is anticipated, if the master is unable to make the report under paragraph (a) because he or she is involved in activities relating to

(i) saving lives,

(ii) securing the vessel's safety or preventing its immediate loss,

(iii) preventing or mitigating damage to the vessel or its equipment, or

(iv) preventing or mitigating damage to the environment.

So, the report must be made as soon as possible, by the operator of the vessel, unless they are busy with the safety of the vessel or cleaning up the spill. However, the operator must certainly report the spill to the owner, or their supervisor, immediately, so that all resources possible may be bought to bear on the spill.

132 (4) If the authorized representative of a Canadian vessel, or the owner of any other vessel, is not on board the vessel and has knowledge that a report has not been made in accordance with paragraph (3)(a), the authorized representative or owner must make the report immediately.

Therefore, if the operator has not reported the spill, their supervisor must do so, by providing the following information.

132 (5) Every report must… include the following information:

(a) the identity of every vessel involved;

(b) the date, time and location of the discharge or the estimated date, time and location of the anticipated discharge;

(c) the nature of the discharge or anticipated discharge, including the type and estimated quantity of pollutant involved; and

(d) in the case of a discharge, a description of the assistance and salvage measures employed.

How To Make A Pollution Report

Detailed reporting requirements are found in *TP 9834E- Guidelines for Reporting Incidents Involving Dangerous Goods, Harmful Substances and/or Marine Pollutants.*

A pollution report should be transmitted in the following manner:

1. When an incident occurs involving a vessel in waters under Canadian jurisdiction, the report shall be made with the highest possible priority and using the quickest means available to a marine safety inspector; this can be made by phone to the nearest Transport Canada Marine Safety Office. This number can be found on the Transport Canada website at: https://www.tc.gc.ca/eng/regions.htm.

   There are also pollution reporting numbers at Transport Canada which may be used to report pollution from your or another vessel:

NEWFOUNDLAND AND LABRADOR

1-800-563-9089

P.E.I., NOVA SCOTIA, NEW BRUNSWICK

1-800-565-1633

QUEBEC

1-800-363-4735

ONTARIO, MANITOBA,

SASKATCHEWAN, ALBERTA,

NORTHWEST TERRITORIES, NUNAVUT

1-800-265-0237

BRITISH COLUMBIA, YUKON

1-800-889-8852

2. When the vessel is in a radio telecommunications area that is covered by Canadian Coast Guard Marine Communications and Traffic Services, the report should, where expedient, be routed through that system to a marine communications and traffic services officer;

3. The content of the report is set out in TP9834, appendix A2 Standard Reporting Format and Procedures; This standard report is designed for large vessels, so each item is not necessarily relevant. Typically for a small vessel the report would include the following information:

a. Type of Report- Marine Pollution Incident
b. Vessel- Name or license number
c. Time of incident
d. Type and quantity of pollutant discharged
e. Any defects or damage to the vessel
f. Position (use lat and long or a land reference, or address for example if alongside)
g. Course and speed (only if relevant)
h. Where you departed from and when
i. Where you are going and when you expect to arrive
j. Your intended route (only if relevant)
k. What radio station you will be listening on (if applicable)
l. Description of vessel- size, type and draft (if relevant)
m. Number of persons on board
n. Any other relevant information- actions taken, other vessels assisting etc.

Sewage

95. A person or vessel must not discharge sewage or sewage sludge except in accordance with section 96 or in the circumstances set out in section 5 that apply in respect of the discharge.

86. (1) Subject to subsections (3) and

(4), the authorized representative of a vessel in Section I waters or Section II waters that has a toilet must ensure that the vessel is fitted with a holding tank or a marine sanitation device.

Basically this means that any onboard toilets must be approved as a Marine Sanitation Device and have a holding tank.

Greywater

Greywater refers to domestic water other than sewage, such as shower and sink drains- there really isn't any greywater on a small boat, however, operators should be aware of the legal aspects in any case.

131.1

(3) This section does not apply in respect of a release of greywater that:

(a) is necessary for the purpose of saving lives, securing the safety of a vessel or preventing the immediate loss of a vessel; or

(b) occurs as a result of an accident of navigation in which a vessel or its equipment is damaged, unless the accident occurs as a result of an action that is outside the ordinary practice of seafarers.

(4) The authorized representative of a vessel must ensure that any release of greywater by or from the vessel into the water does not result in the deposit of solids in the water or leave a sheen on the water.

So discharge of greywater is not prohibited, but a careful operator will avoid discharging anything into the water. In addition, operators should verify with local authorities the rules applying to both sewage and grey water (sink and shower) before working on new waterways, as there are numerous local regulations which may impact the vessel.

Garbage

Garbage is solid matter, as opposed to all the other pollutants which are either liquids, or air emissions. The regulations define garbage as:

" all kinds of victual, domestic and operational waste that is generated during the normal operation of a vessel and that is likely to be disposed of continuously or periodically, and includes plastics, dunnage, lining and packing materials, galley wastes and refuse such as paper products, rags, glass, metal, bottles, crockery, incinerator ash and cargo residues.

However, it does not include fresh fish, fresh fish parts, oil, oily mixtures, noxious liquid substances, liquid substances [listed as pollutants by IMO] 1, marine pollutants, sewage or sewage sludge."

Basically the discharge of all garbage into Canadian waters is prohibited. Cargo residues and other garbage may be discharged in certain areas, but none of these apply to the operations of the vessels to which this course applies.

Anti-Pollution tips

- Keep the boat's bilge clean, don't pump oily water overboard.
- Use bilge sorbents in place of detergents. (Kitty litter works well)
- Observe local and federal sewage regulations.- portable toilets are no longer legal
- Bring garbage ashore, don't litter.
- Use detergents sparingly, even biodegradable detergents- to avoid putting phosphates.
- When fuelling, don't top off tanks, clean up any spilled fuel.
- Follow the fuelling procedures as described in Chapter 5
- Use only paints approved for marine use.
- Avoid shoreline erosion, watch the wake and propeller wash.

The easiest way to stay out of trouble, and protect the environment?

DON'T PUT **ANYTHING** IN THE WATER!

Chapter 7- Marine Weather and Forecasts

Important factors

Weather is an all important factor when considering a work day on the water. There are few things worse than being out in a small open vessel when an approaching storm hits with a torrential downpour. It is not only extremely uncomfortable, but potentially hazardous.
In Canada weather systems usually travel from west to east. Get in the habit of glancing to the west fairly frequently:

- Are the clouds changing in color or shape?
- Are they getting darker?
- Are they higher and larger than they were?
- Are they getting closer?

If they are, a storm may be building and if the clouds are higher and darker, the more violent it might be.

Marine forecasts

Always check weather forecast information before making the decision to head out, so as not to put the vessel and crew on board at risk. Marine forecasts cover areas of open water, such as Georgian Bay, and include visibility and sea state forecasts. For inland areas, standard weather forecasts should be consulted.

In areas of VHF coverage, Marine forecasts are available by radio.

Marine forecasts can be heard or found in/on:

- VHF Channel 21B and 83B (Atlantic and Great Lakes)
- VHF Channel 21B and WX1, WX2, WX3, (Pacific Coast)
- Meteorological Environment Service's Weatheradio broadcasts across Canada.

Marine forecasts are also available via:
The Marine Weather Services Bulletin, obtained by calling the nearest Environment Canada weather office, or
on the web at http://weather.gc.ca/marine/index_e.html

- Regular weather forecasts are available on:
- Regular AM and FM radio weather forecasts
- Weather Television
- On the web at:

http://weather.gc.ca/, or
http://www.theweathernetwork.com/

Another useful source of information is the NOAA weather radar at:

http://radar.weather.gov/radar.php?product=N0R&rid=cle&loop=yes

This link is useful in the Great Lakes area where a radar picture is shown of approaching weather systems. This is useful especially for short term forecasting and warning of approaching thunderstorms.

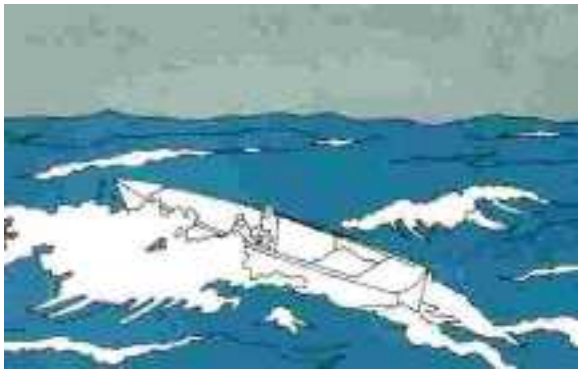
The above link takes you to the Cleveland radar and you can view a number of radars in border areas to view any area in the Great Lakes.

Weather Warnings

Strong Wind Warning

This warning is issued when sustained wind speeds are expected in the range of 20 to 33 knots. Wave heights can reach 2 to 3 metres in open coastal waters. Responsible operator's action:

- Everyone on board don P.F.D.'s
- Reduce speed.
- Proceed with caution to nearest safe harbour.
- Keep everyone seated and as low as possible in your boat.
- Secure all loose gear.
- Approach large waves at 45 degree angle.



Gale Warning

This warning is issued when sustained wind speeds are expected in the range of 34 to 47 knots inclusive. Wave heights can reach 6 to 9 metres in open coastal waters. Responsible operator's action: proceed to the nearest safe harbour or shore.

Storm Warning

This warning is issued when sustained wind speeds are expected in the range of 48 to 63 knots. Wave heights can reach 9 to 16 metres in open coastal waters. Small vessels could be lost in these conditions, stay ashore!

Hurricane Force Warning

This warning is issued when sustained wind speeds are 64 knots or over. Wave heights can reach over 16 metres in open coastal waters.

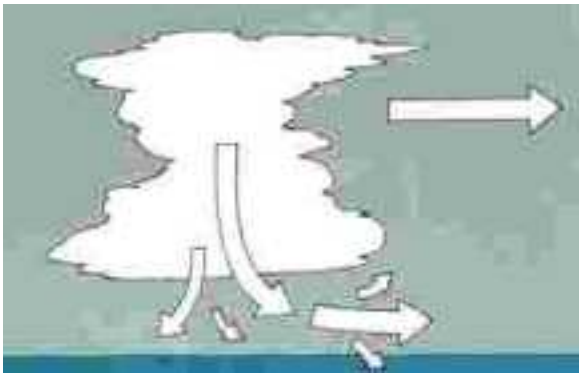
Wind shift and the Barometer

Rapid changes in air pressure cause strong winds. Keep an eye on the barometer; if it is falling it usually means bad weather. Generally the faster the barometric pressure drops the stronger the winds will be.

Changes in air pressure indicate a change in weather. Again, the faster the drop in pressure, the faster the change is likely to come. When a “front” passes, which is simply the border between cool and warm air masses, a wind shift is usually associated with the passage. Be prepared then for a shift in wind direction as well as other changes in weather. For example, what was a safe anchorage with the wind off the land, may suddenly become unsafe if the wind shifts direction as well as increasing speed, causing an unsafe sea state and potentially putting the vessel ashore if the anchor drags or the anchor cable breaks. Sudden increases of wind and changes of direction may also lead to a vessel taking on water and potentially capsizing if the operator is unprepared.

Thunderstorms and severe weather conditions

The strongest winds in a thunderstorm usually precede the storm centre itself, in a zone up to three miles long. Gusts up to 50 knots can be expected in this zone. The winds blow downwards from the cloud, and they are especially dangerous for small vessels.



The heaviest rain occurs directly under the thunder cloud, leading to poor visibility. Heavy rain lasts from five to 15 minutes. Thunderstorms normally last less than one hour.

Waterspouts may occur during a thunderstorm. A waterspout is a funnel of cloud reaching from the base of the thunderstorm cloud to the water, that may suck up water in to the air. It usually lasts less than 15 minutes. Although immature waterspouts may be small, they can

become extremely violent without warning.

Fog, rain and snow reduce visibility and create hazardous navigation situations at sea. The major hazard is reduced visibility. Vessels should proceed with caution, hoist the radar reflector, listen for fog signals carefully and monitor radar if fitted. Heavy rain will obsure radar as well as visual observation.

What to do in bad weather

If you run low on fuel in bad weather, consider anchoring if the water is shallow. Anchoring will keep the bow into the weather and is often safer than running down wind with the weather.
If the water is too deep, put out a warp or a sea anchor. A warp is a long line that the vessel can trail in a loop from the bow. It will help to keep the bow into the weather. They can be purchased commercially or can be made from a bucket, an ice chest or a tool box attached to a mooring line.
If the operator is unable to make port or a safe anchorage, keep the bow into the weather or the waves at 30º to 40º off the bow. Be attentive to changing conditions and slow down in bad weather so as to avoid losing control of the craft.

Weather’s effect on loading a boat

Different weather - different loads, different operation:

On windy or rough days

a. Wait for better conditions if there is any doubt about your ability to complete the trip safely
b. don't load as much into the boat (passengers and gear) as on calm days.
c. Load cargo and passengers as low as possible
d. Avoid excessive speed to avoid damage to the vessel and cargo and taking on water

Chapter 8- The Canadian Buoyage System

Aids to Navigation are invaluable guides to mariners that help determine position, vessel's course, warn against dangers or obstructions on the water and advise the operator of the location of the best or preferred route. The Canadian Coast Guard maintains this system. Complete details of the system are available in more detail from Canadian Coast Guard offices across the country.
Aids to Navigation include lateral channel markers, cardinal buoys, special buoys and isolated danger buoys as well as lighthouses and beacons. They are all external to the vessel (not part of the vessel's navigation equipment).
Aids to Navigation assist an operator to travel from one port to another safely on the water when used in conjunction with a nautical chart. This is why as discussed in Chapter 2, it is illegal to tie a boat up to a navigation buoy.

There are two systems of buoys used in Canada- the Lateral System and the Cardinal System, as well as special purpose buoys.
Lateral buoys are arranged to mark a channel, indicating to the vessel operator whether they should be left on the port or starboard (left or right) side of the vessel, with special buoys to mark fairways (usually marking the entrance to harbours) and places where the channel splits. Shore based lights, such as pier lights marking a harbour entrance, and day beacons, use the same colour convention as buoys.
Cardinal buoys are related to compass direction and indicate where there is safe water in relation to the buoy, that is to the north, south, east or west, with an isolated danger buoy which is placed on a hazard and indicates safe water to any side.
Special purpose buoys mark swimming areas, hazards such as dams etc.

Lateral buoys

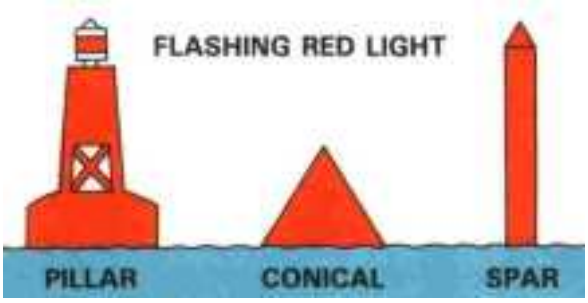
A simple rule to help operators understand how to use lateral markers is to remember the simple phrase red, right, returning. In other words when returning to port from seaward, keep red markers (these could be buoys or beacons or shore based lights) to the right or on the starboard side.

What does returning from seaward mean?

It would be quite clear if you were returning from the ocean to a port, but in some circumstances returning from seaward can be a little confusing. The terms upstream and downstream come into use now. If you are proceeding upstream (or up a river from seaward) on a navigable river then red markers are passed on your starboard side (right side) and green markers on your port (left side).

Starboard hand buoy:

 Marks the starboard (right) side of a channel or the location of a danger and must be kept on the starboard (right) side of a non-pleasure craft when proceeding in the up stream direction.



 Is coloured red.
 Displays identification letter(s) and even number(s)
 If it carries a topmark, the topmark is a single red cone, point upward
 If the buoy carries a light, the light is red and is flashing (Fl) 4 second or quick flashing (Q) 1 second. Most buoys use the standard flash or 4 seconds. In a long buoyed channel, quick flashing buoys are often used to mark places where an alteration of course is required- this makes them easier to distinguish from the other buoys at night.
If the buoy does not carry a light, it has a pointed top.

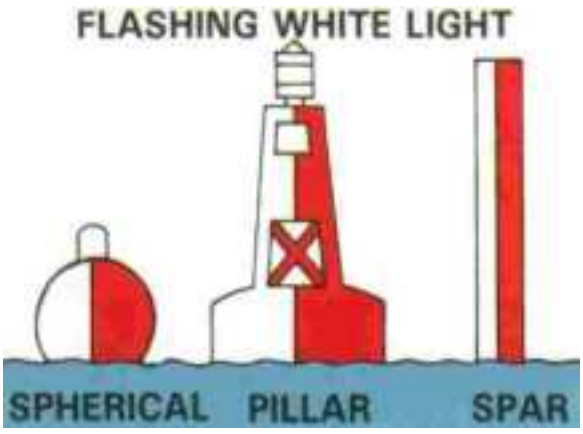
Port hand buoy

 Marks the port (left) side of a channel or the location of a danger and must be kept on the port (left) side of a non-pleasure craft when proceeding in the up stream direction.
 Is coloured green, displays identification letter(s) and odd number(s).
 If it carries a topmark, the topmark is a single green cylinder.

 If the buoy carries a light, the light is green and is flashing (Fl) 4 second or quick flashing (Q) 1 second. Most buoys use the standard flash or 4 seconds. In a long buoyed channel, quick flashing buoys are often used to mark places where an alteration of course is required- this makes them easier to distinguish from the other buoys at night.
If the buoy does not carry a light, it has a flat top.
Port and starboard hand buoys or lateral buoys are shown on charts with their colour indicated. Never pass too close to a buoy as it is possible to get fouled in its mooring. The buoy could also be out of position from the indicated location on the chart exposing the boater to a possible danger.

Fairway buoys

Fairway buoys mark the entrance to a harbour. They have red and white vertical stripes and mark the center of navigable fairways and channels. When marking the middle of a channel it should be kept on the vessel's port (left) side.
These may or may not have lights. If they are lighted the light is white and flashes the letter A in the Morse code. The signal is a short flash followed by a prolonged flash, a pause and then the flash is repeated.



Bifurcation marker (mid channel markers)

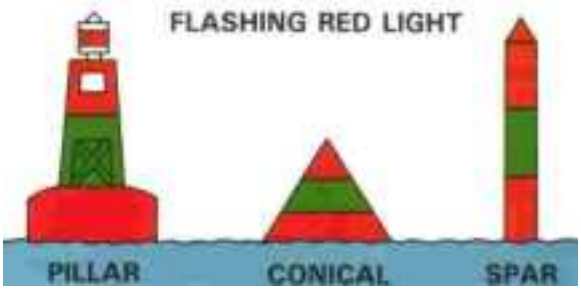
These markers indicate where a channel divides into a preferred and secondary channel. They might be buoys or day markers. If a buoy, and the preferred is to port (to the left) the buoy

will be a red conical buoy with a green horizontal band. It must be left to starboard unless the secondary channel is preferred.

If the preferred channel is to starboard the buoy would be a green can buoy with a red horizontal band and would be left to port to follow the preferred channel to the right. The secondary channel would be to the left.

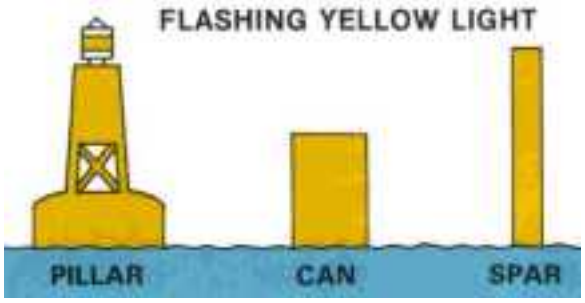
If the preferred channel is to port, the buoy would be red with a green band and red light. An unlighted buoy would have a point on top.

If lighted the colour of the light is the same colour as the colour of the top band (i.e. red on the conical buoy and green on the can buoy).



Cautionary buoys

Mark an area where mariners are to be warned of dangers such as firing ranges, racing courses, seaplane bases, underwater structures or areas where no safe through channel exists and of traffic separations. They are also used to mark designated anchorages for large vessels in certain areas such as the St. Lawrence Seaway.
It is coloured yellow and displays identifications letter(s). If it carries a topmark, the topmark is a single yellow X shape, and if it carries a light, the light is yellow and is flashing (Fl) 4s. One flash every 4 seconds.



Day Beacons

Day Beacons are triangular or square boards mounted on supports that often mark minor channels, or obstructions such as bridge abutments or piers- any place where it is impractical to place a buoy. Their shapes and colours have the same meaning as those of the buoys in the lateral buoyage system. They are usually not lighted and their shape and colour determine which side they are to be passed on.

A starboard hand day beacon marks the starboard (right) side of a channel or the location of a danger during daylight hours. It must be kept on the starboard (right) side of a pleasure craft when proceeding upstream. It is a red coloured triangle centered on a white background with a red reflecting boarder. These day beacons may display an even number made of white reflecting material.

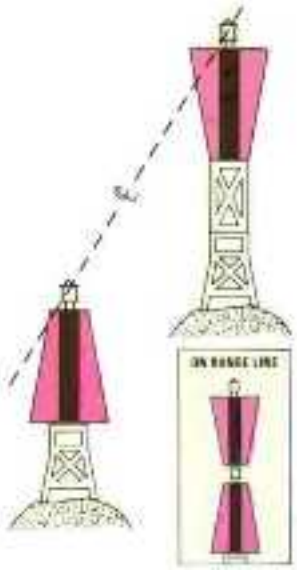
A port hand day beacon marks the port (left) side of a channel or the location of a danger during daylight hours and must be kept on the port (left) side of a pleasure craft when proceeding upstream. It is a black or green coloured square centered on a white background with a green reflecting border. These day beacons may display an odd number made of white reflecting material.

Junction right. Marks a point where the channel divides and may be passed on either side. If the preferred channel is the one the boater wishes to transit, this daybeacon should be kept on the starboard (right) side of a craft when proceeding upstream.

Junction left. Marks a point where the channel divides and may be passed on either side. If the preferred channel is the one the boater wishes to transit, this daybeacon should be kept to the port (left) side of a craft when proceeding up-stream.

Ranges

A range consists of two or more fixed navigation marks situated some distance apart and at different elevations. A range provides a leading line for mariners when both marks are in line, the operator is on the recommend navigation track. A range is usually marked with a daybeacon on each tower as well as a light so that the range may be used day or night.

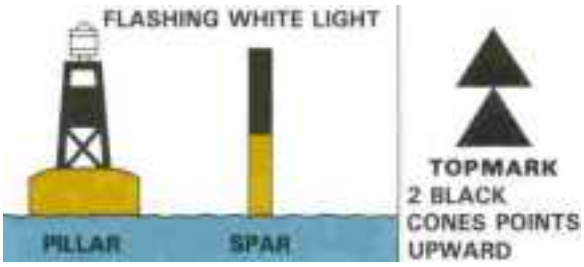


Cardinal buoys

Cardinal buoys are yellow and black in colour and show where the deepest water or safer water is around an obstacle. The North, East, South and West cardinal buoys are distinguished by the colour pattern and by their top marks.

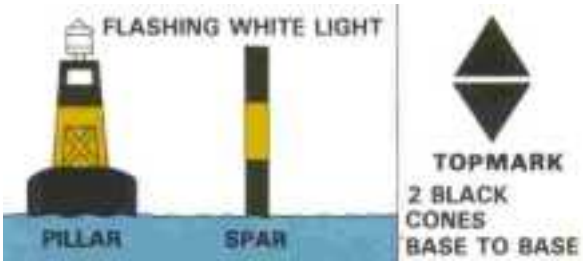
North Cardinal Buoy

is black on top and yellow on the bottom. The buoy is placed so that the safest water exists to the north of it. If the buoy carries a light, the light is white and is a quick flashing (Q) 1 s or very quick flashing (VQ) 0.5 s light. If the buoy does not carry a light, it is normally spar shaped. If the buoy carries a top mark, the top mark is two black cones, one above the other, points upwards.



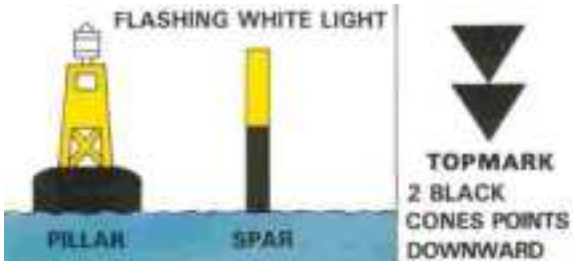
East Cardinal Buoy

is black with a yellow band. The buoy is placed so that the safest water exists to the east of it. If the buoy carries a light, the light is white and is a group quick flashing three Q(3) 10 s or a group very quick flashing three VQ(3) 5 s light. If the buoy does not carry a light, it is normally spar shaped. If the buoy carries a top mark, the top mark is two black cones, one above the other, base to base.

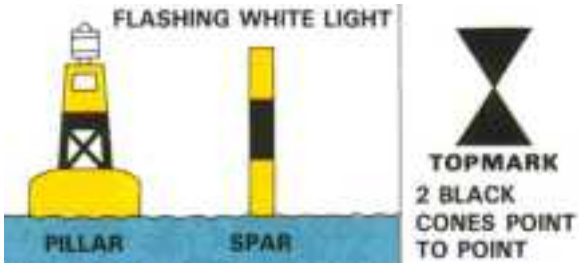


South Cardinal Buoy

is yellow on top and black on the bottom. The buoy is placed so that the safest water exists to the south of it. If the buoy carries a light, the light is white and is a group quick flashing six plus long flash (Q(6) + LFI) 15 s light or group very quick flashing six plus long flash (VQ(6) + LFI) 10 s light. If the buoy does not carry a light, it is normally spar shaped. If the buoy carries a top mark, the top mark is two black cones, one above the other, points downward.



West Cardinal Buoy



is yellow with a black band. The buoy is placed so that the safest water exists to the west of it. If the buoy carries a light, the light is white and is a group quick flashing nine Q(9) 15 s light or a group very quick flashing nine VQ(9) 10 s light. If the buoy does not carry a light it is normally spar shaped. If the buoy carries a top mark, the top mark is two black cones, one above the other, point to point.

Isolated danger buoy

An isolated danger buoy is moored on, or above an isolated danger that has navigable water all around it. It is black with one red horizontal band, has two black spherical top-marks and if it carries a light it is white.

There are very few of these buoys in use in Canada.

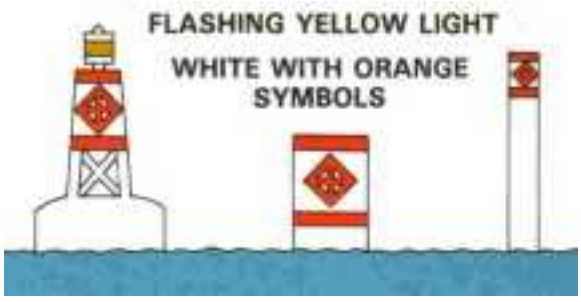
Special purpose buoys

The following examples are cylindrical buoys that all have a special meaning. They indicate such things as:

- Speed requirements.
- Caution areas i.e.: rapids ahead.
- Swimming locations.
- Information i.e.: name of a marina, keep out areas.

These buoys are quite common on inland waters, especially to mark dams and swimming areas.

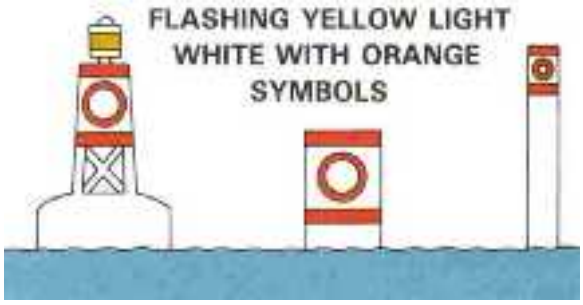
Keep out buoy



Marks an area where vessels are prohibited. It is coloured white, and has an orange diamond containing an orange cross on two opposite sides and two orange horizontal bands, one above and one below the diamond symbols. If it carries a light, the light is yellow and is a flashing (FL) 4s light.

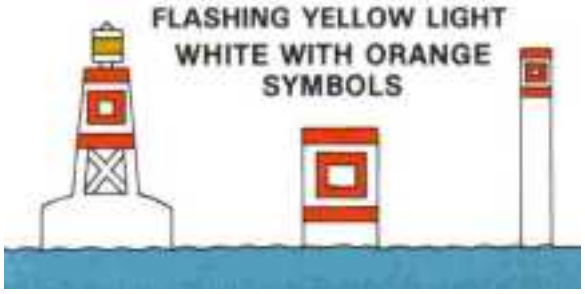
Control buoy

Marks an area where vessels are restricted. It is coloured white, has an orange, open faced circle on two opposite sides and two horizontal orange bands, one above and one below the circles. A black figure or symbol inside the orange circles indicates the nature of the restriction in effect. If it has a light, the light is yellow and is a flashing (Fl) 4s.



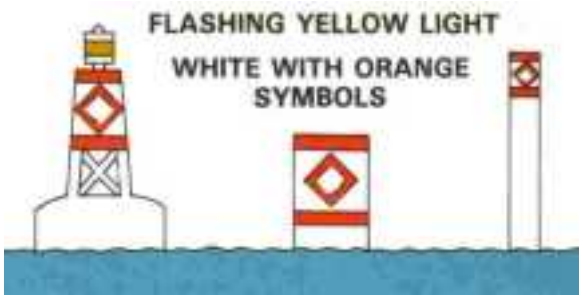
Information buoy

Is a buoy that displays by means of words or symbols, information of interest to the mariner. It is coloured white, has an orange, open-faced square symbol on two opposite sides and two orange horizontal bands, one above and one below the square symbols. If it has a light, the light is yellow and is a flashing (Fl) 4s.



Hazard buoy

Is a buoy that marks random hazards such as rocks and shoals. It is coloured white, has an orange diamond on two sides and two orange horizontal bands, one above and one below the diamond symbols. If it has a light, the light is yellow and is a flashing (Fl) 4s.



Swimming buoy

Marks the perimeter of a swimming area. Is coloured white and if it has a light, the light is yellow and is a flashing (Fl) 4s light.

Diving buoy

Described within the *Private Buoy Regulations*, this flag marks an area where scuba or other such diving activity is in progress. It is coloured white, displays a red flag not less than 50 centimeters square with a white diagonal stripe extending from the tip of the hoist to the bottom of the fly. If it carries a light, the light is yellow and is a flashing (Fl 4s). Give this buoy and flag a wide berth.

Posted command or warning signs

These signs are posted ashore and indicate special instructions such as:
- No wake zone.
- No anchorage area
- Speed limit zone.
- Low head dam hazard.
- Power line hazard.
- Pipe line hazard.

Pilotage

This chapter has shown you the basics of the Canadian Buoyage System. The system has been designed so that once you understand the meanings of the buoys and marks, you can follow a channel safely. Using man-made and natural marks to navigate your vessel, as opposed to using navigational instruments, such as compass and radar, to mark a position on a chart, is known as pilotage- this is what you do every day, even if you didn't realize it before.

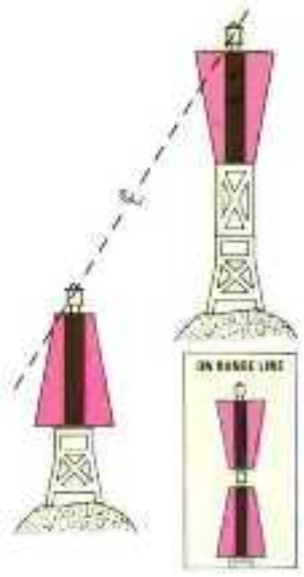
Pilotage techniques are suitable for small open boats because there is no plate to put a chart, and a single operator needs to keep a proper lookout as well as operate the vessel, monitor the engine and other equipment as well as monitor the passengers- there is no time for formal "navigation".

Using the buoyage system

A buoy is known as an "aid to navigation" meaning that a prudent mariner will not rely on buoys alone for navigation.

If you are using the same buoys on a day to day basis, you should be able to tell by the local landmarks if the buoy is on position, and marking the danger is it supposed to, or not.

By looking at local landmarks not only will you be aware if the buoys are on position, you can use landmarks to position your vessel as well.



Using ranges and landmarks

As shown earlier in the chapter, important channels are marked by ranges- as long as the two lights or daymarks are lined up, as shown in the square, your vessel is on the course line.

The same principle can be used with natural, or other man made landmarks – such as the ends of islands, points of land, prominent rocks, cottages, lighthouses, etc.

Natural ranges can be used to mark a safe course, or to mark an alteration of course, or a "danger angle"- a line you want to stay outside of, for example, to avoid a shallow or rocky area.

This chartlet shows how both man made and natural ranges can be used to navigate a small craft channel.

1. When entering the channel from offshore, a safe approach is marked by a set of man made ranges = the front range light is on Runaway Island and the rear range light is on Snug Island, marked by symbols, and the course they mark shown as a dotted line.
2. You can see that the green line on the chart marked 001-002 is a range formed when the left hand edge of Cracroft Rock lines up with the lighthouse or range tower at 001.
3. If you wanted to go to Peachy Island, but want to avoid the rock (marked +) south of Cracroft Rk, you know that you can alter course safely towards Peachey Island, once these two objects line up.
4. If you alter course at the correct point- that is the range you are following (Snug Island and Runaway Island is still lined up, and you cross the range marked 001-002, you can check your compass once you are lined up on Peachy Island, and follow that course to your destination.
5. If you are going further, you follow the same process- following buoys, ranges and natural landmarks, using your compass also if desired as a check- to any further destination.

When following a regular route, becoming familiar with that route, and the hazards to be avoided along it, is simply a matter of practice- going out with someone who knows the route, and the marks along it, and taking along a digital camera and notebook is a good way to learn your route. If a small craft or other nautical chart is available, this is helpful, but it is not necessary, and in many cases will not be available, so learning the route from another experienced person is the only option.

Learning the route you will be following to the camp is one of the most important parts of your job. It needs to be learned in daylight, darkness, as well is any reduced visibility conditions you may be working in.

Chapter 9- Basic Seamanship

Seamanship skills

There is perhaps no better measure of a sailor's worth than his/her skill in seamanship. This is as true today as it was a thousand years ago. To be less than skilled in seamanship may be costly when the safety a life and your boat depends upon a few knots.
Seamanship includes handling and working all kinds of line and rope into knots, splices, bends, hitches and securing lines to deck fittings. All line handling can be at times be dangerous and to become proficient in this skill requires practice.

Ropes, lines, knots and splices

In the days of sail, a vessel's crew worked a great deal of line. Out of this era, a widely diversified catalogue of knots and splices has emerged. The art of "marlinspike" seamanship or rope-work has become highly developed and still today, sailors strive to outdo each other in devising useful knots and splices with the many synthetic fiber materials available.
Unless marlinspike seamanship becomes a hobby, the small vessel operator is unlikely to require more than five knots. You can get by without knowledge of splicing, but it is very satisfying to be able to complete a mooring line with a finished eye splice. A cared for vessel reflects the competence of the operator. A small vessel requires a minimum of lines but they should be of appropriate material, properly finished, secured, and stowed.

Fiber Line

Before working, always inspect the rope you will be using whether it is a lifeline, or stage rope. Check for damage, and make sure it is right for the job. Your life may depend on it. Know the safe working load of the rope, and don't exceed the limit. Abrasion will weaken a rope. Wrap and tie chafing gear around the line where rubbing occurs.
Avoid sudden strains or jerks which can snap a line. Never load a kinked rope or pull it through a block. Never "fold" a rope or bend it sharply, or the fibres will be weakened.
Do not expose rope to oil, gasoline, paint or other chemicals. These can cause severe damage, especially to natural fibre rope.

Synthetic Rope

There are many different types of synthetic rope:
 Nylon ropes are very strong and elastic. They can withstand shock loads that would break other fibres, but if they do break, the “snapback” can be dangerous. They resist weather and abrasion.
 Dacron is second to nylon in elasticity, and it withstands abrasion very well. It will stretch only half as much as nylon un-der heavy loads.
 Polyester ropes are slightly less strong than nylon or dacron, but they resist sun-light better.
 Polypropylene ropes are the lightest kind of synthetic rope. They are reasonably strong, but deteriorate with sunlight. They should not be used with lifesaving devices.
 Polyethylene ropes are not quite as strong as polypropylene ropes, but they float, which is an advantage for some jobs.
 Blends of nylon, dacron, polypropylene and new fibres such as kevlar, mylar, and spectron have the advantages of all these different fibres. Blended fibre ropes are being used more frequently, especially for rigging trawl nets.

Construction and sizes

Most lines are built up of three strands, which are laid together, with a twist called the lay, to form the complete rope. Also common in marine use are woven or braided ropes.

Five basic knots

A knot is a series of turns and hitches in a line that holds by friction. The knots below are ideal for small vessel use and are well proven for their holding power.

Figure of eight

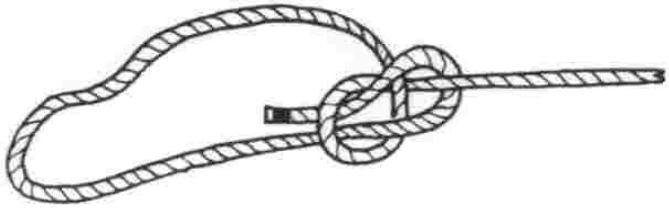
A stopper knot, used to stop the end of a line temporarily or to enlarge the diameter so the line will not run through a block on deck.

Reef Knot

A very reliable joining knot, originally used to reef a sail. It is suited to all light lines of the same diameter.

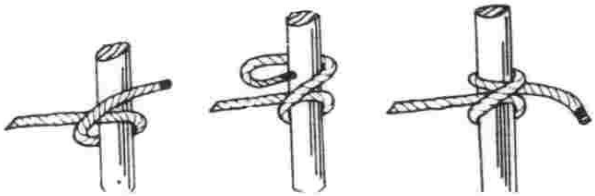
Bowline

The bowline is one of the most widely used knots. It is the knot to use when a secure loop is required.



Clove hitch

The clove hitch is useful to secure to a spar, rail, or railing.



Belaying a line to a cleat

Consists of initially making a turn around a wooden or metal fitting with two projecting horns with a line, then putting on figure of eight turns. A cleat provides a speedy and secure means of belaying (making fast without knots). The holding friction is developed between the turns of line placed on the cleat.

Securing to a dock

The vessel is known to be secured when at anchor, made fast to a mooring, or to a wharf or pier. No matter whether a vessel is to be secured for a day, a week, or a year, the operator's peace of mind is enhanced if he/she is adequately assured the vessel will not break away or be damaged due to the weather.
A wide variety of conditions are encountered across Canada that affect a secure vessel including changing water levels caused daily by ocean tides or seasonally by fluctuations of lakes and rivers. In addition exposure to prevailing winds and storms and possible freeze ups.

Fenders

Sometimes inaccurately called bumpers, these devices are used as a cushion between a dock and a vessel. It helps to prevent damage and scrapes to the hull when manoeuvring alongside or if another vessel wishes to raft (come alongside one another).

Anchors and Anchoring

Anchoring is the method of securing a vessel for a comparatively short period of time, when docks, wharves, or moorings are not available. For example, a deep sea ship may anchor in a harbour while waiting for a pilot or a berth. A small vessel would drop the hook when the crew works, fishes, or rests overnight. Anchoring a small vessel is also a safety option to consider in the following conditions:

- The crew is lost in fog.
- Experiencing engine difficulties.
- When the vessel is disabled.
- When severe weather threatens.

Anchoring can be either a routine or an emergency procedure. An operator may consider an anchor a heavy waste of time and space, but if it proves to be the only means of saving the owner's investment from pounding to pieces on the shore, it will be worth its cost and trouble.

Moorings

A mooring is a semi-permanent anchor installation which remains in place when the vessel leaves. It is usually installed in quiet waters at or in a harbour. A mooring consists of an anchor of one sort or another, a suitable length of line, cable, or chain, and a float to hold one end of the line at the surface.

Small vessel anchors

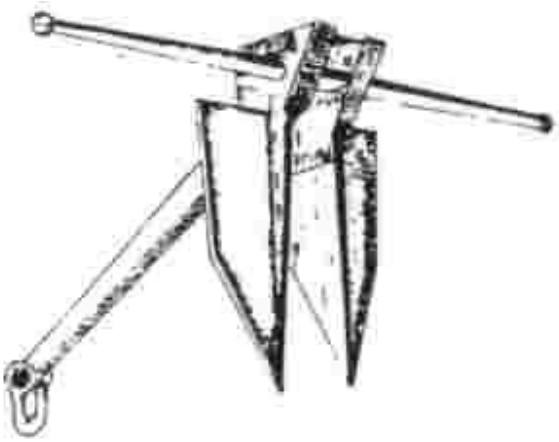
A small vessel anchor should be light in weight, have good digging power and be easy to stow (store). These features are all found in the brand name modern anchors, with a wide range of styles and weights. They are constructed of comparatively light metal and are strong in tension. Check manufacturer's specific holding power data sheets to determine what size and weight anchor is best suited to a vessel. This information is available at marine retailers. An anchor holds by digging into the bottom rather than just lying there as a dead weight. Selection should therefore be influenced by the anchor's ability to embed itself in mud, sand, or gravel or to penetrate weeds. Weight of the anchor is not the only factor that influences good holding power. To properly set the anchor, a crewmember must release a considerable length of rode to develop a pull almost parallel to the bottom. The ratio of length of rode to water depth is called scope.

To ensure adequate setting, a scope of 5 or 6 to 1 (5 or 6 is the length of anchor line and 1 the depth of water) or more is necessary. Setting and holding power will be further improved if, in addition to large scope, a length of chain is attached to the anchor. This overcomes the buoyancy of the rode at the anchor, providing a pull parallel to the sea/lake floor, and has the further advantage of withstanding chafe on the bottom. Where tides exist, the changing heights of water must be taken into consideration when determining scope. In calm sheltered water, for short periods of time, a scope of 3 to 1 may be used.

Types of vessel anchors

The two most common small boat anchors, are the Danforth and Plow anchors. Both are relatively lightweight and perform well in a variety of conditions. Your boat may be equipped with other anchors. You need to test your anchor in actual conditions to know if it is suitable for your vessel or not.

Danforth



Plough

Chapter 10- Vessel Stability

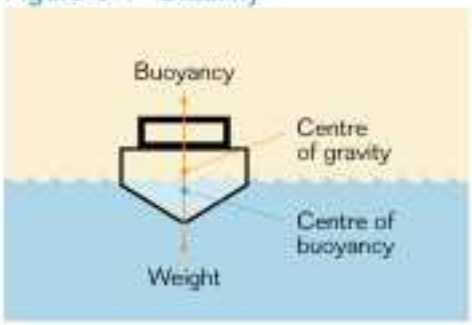
Stability is too important to leave to intuition. Stability is a fundamental aspect of a vessel's safety, but often it is not really understood. With terms like GZ, GM, righting lever and heeling moment, it's no wonder the science of stability seems complicated. In the end, it all comes down to whether your vessel will come back to the vertical position after being listed out by the force of the waves or wind.

The *Canada Shipping Act 2001* requires the owner and the master to ensure that the vessel is seaworthy including having adequate stability, both before setting out and for the duration of the voyage. While most small vessel operators have a feel for their boats, this is generally based on operating in less than the most extreme conditions the vessel may encounter. How then can you show that the vessel has an adequate level of stability?

Basic Principles of Stability

The centre of gravity (G) is the point at which the whole weight of the vessel can be said to act vertically downward. As a general rule, a lower centre of gravity means a more stable vessel. The centre of buoyancy is the point at which the underwater volume of the vessel acts upward. These two force must always be in balance, and in normal circumstances result in an upright vessel.

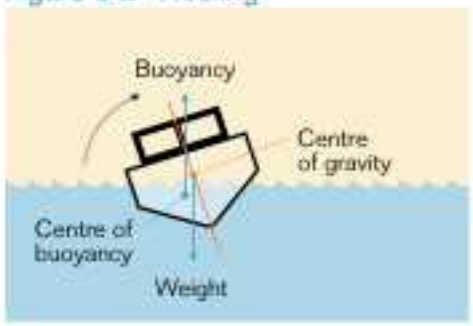
Figure 8-1 Stability



With no heel the downward force of gravity is equal and opposite the upward force of buoyancy.

When the vessel heels (leans to one side) from the force of wind or waves, the centre of buoyancy, because the underwater volume is now greater on one side, tries to push the vessel back to its upright position- this effect is called the "righting lever". The lower the centre of gravity, the longer is this "lever" and the more easily the boat can upright itself.

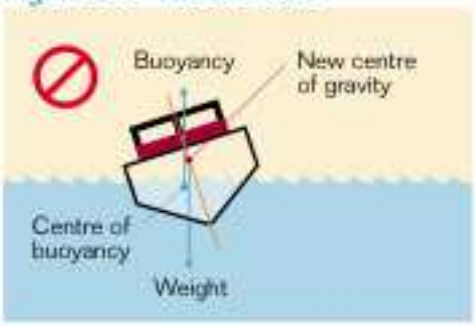
Figure 8-2 Heeling



Buoyancy and gravity bring the boat upright.

The centre of gravity changes, depending on how weight is distributed in the vessel. For example, a heavy load placed high on deck will produce a higher centre of gravity and less stability than a load stored below deck. In a small open boat, the same effect is produced by people standing up. The most obvious example of this is someone standing up in a canoe- the loss of stability is easily felt.

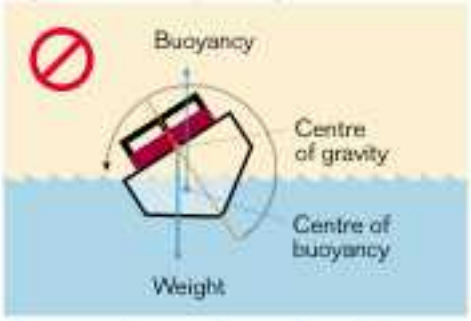
Figure 8-3 Added Load



Weight added above the centre of gravity reduces the righting ability of the vessel.

If a vessel is built, modified or loaded incorrectly, with too high a centre of gravity it becomes "top heavy." If it lists or heels to one side, due to the force of wind or waves, the "lever" produced by the upward force at the centre of buoyance may be too short, and not have sufficient force to bring the vessel upright, resulting in capsizing.

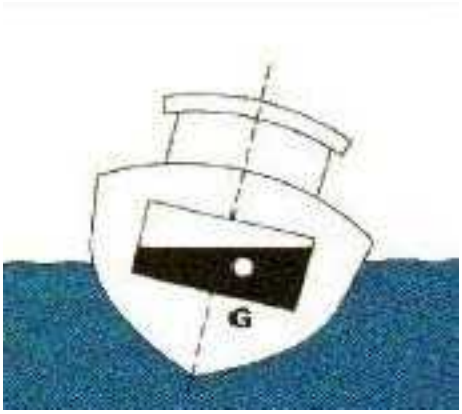
Figure 8-4 Capsizing



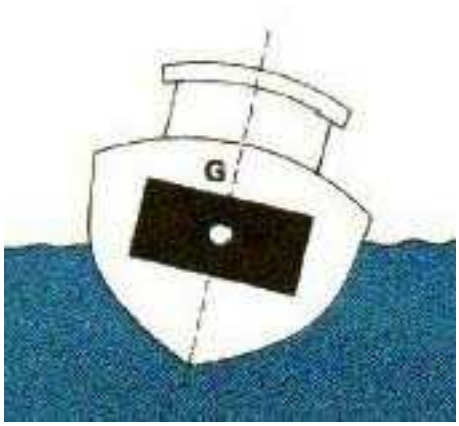
Centre of gravity located too high will cause the boat to capsize.

Free Surface Effect

If any liquids are free to flow around the vessel, this can have the same effect as having too high a centre of gravity. This "free surface" effect increases the danger of capsizing. When a vessel with partially filled spaces heels over, the contents of the spaces will shift. The centre of gravity moves over to the side, making the vessel less stable. The larger the tank, the greater the effect.



When a vessel with full tanks heels over, the contents of the tank do not shift. The tank's centre of gravity does not change, so it does not affect the vessel's stability. To avoid this free surface effect, try to have as few partially filled tanks and compartments as possible.

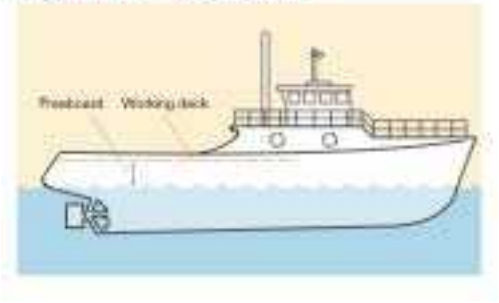


You cannot always avoid partly filled spaces. By dividing a tank into two equal parts with a baffle, the free surface effect is greatly reduced. In fish holds, using boards to divide compartments will also be beneficial.

In small open boats, tanks are generally small; e.g. portable fuel tanks, so free surface effect is generally not an issue, however, if a significant amount of water is taken on board in rough weather, it can have a significant effect. This can be prevented by adjusting the vessel's speed to weather conditions to avoid taking on water, and by pumping the bilges if any water is taken on board.

Freeboard

Figure 8-5 Freeboard



Freeboard is the distance between the water and the watertight deck of your vessel, or the gunwale (upper edge of the hull) if it's an open boat without scuppers.

Lack of freeboard can cause two problems:

1. Loss of stability: If the deck edge goes under water when the vessel heels, its stability, that is the righting lever mentioned earlier, will decrease rapidly and the danger of capsizing will increase. An overloaded vessel's freeboard will be smaller and the deck edge or gunwale may go under water with even a slight heel.

2. Down-flooding: If the freeboard is low and the vessel has openings to the interior that are too close to the water, or the gunwale of an open boat is too close to the water, the vessel may take on water even with a slight heel, and either capsize or simply sink due to the weight of water taken on board.

You need a safe freeboard height, so take care not to overload your vessel.

Warning Signs of Instability

During a voyage, your vessel's handling changes. For example:

- it seems sluggish, rolls more or rolls more slowly,
- Your vessel is listing to port or starboard or,
- is trimmed more than usual by the bow or stern.
- There is less freeboard than you would expect normally.
- If you have automatic bilge pumps,they are working more frequently than usual.

If so, check tanks and interior spaces for flooding.

If you load your boat, and notice that it rolls more slowly than normal, this is a good indication that the centre of gravity is too high, and you should remove or rearrange what you have loaded until it feels "normal" again.

Precautions

Of all accident types, founders and capsizes caused by a loss of stability are the most likely to lead to death on the water. Many of these accidents can be avoided. A well-designed vessel will resist capsizing or foundering in severe conditions if it is operated properly. Keep these rules in mind:

- Be aware of outside forces: wind, waves and water depth. Always check the weather forecast before setting out and avoid rough weather conditions.
- Don't overload your vessel. Be aware of the amount of weight added to your vessel and available freeboard. Place people and cargo evenly.
- Make sure that all cargo, tools and equipment are well secured during the entire voyage. It is a lot safer and simpler to remove well-prepared lashings after a successful voyage, than to try to add lashings in poor weather while a vessel is rolling and pitching.
- Store cargo as low in the boat as possible.
- Reduce both the amount of liquids that are able to move and the area in which they can slosh back and forth by using smaller tanks, because partly-filled water and fuel tanks can make your vessel unstable.
- Prevent water from getting into your vessel by keeping hatches, doors and windows closed, as much as you can, when underway.
- Regular maintenance of seals and fastening devices will help to ensure watertightness.

- Vessel loading vehicle– vessel stability within design features.
Photograph courtesy Munson Marine

- Remove water as quickly as possible. Scuppers and drains must meet design standards and be kept in good working order.
- Do not perform operations such as lifting or towing unless the stability of your vessel has been assessed under these conditions.
- Adjust course, speed, or both if you can, to reduce the vessel's rolling motion.
- Avoid sharp turns or turns at high speed.
- Consult a marine professional before making changes, because modifications to your vessel may affect its stability. Have the stability information revised to reflect any changes you make to the vessel.

Vessel loading vehicle– vessel stability not within design features. *Photograph courtesy Munson Marine*

Chapter 11- Manoeuvering a Vessel

Un-docking, Transit, Docking

Leaving the dock

Techniques vary according to vessel size, propulsion system (outboard, single screw, twin screw) and the way in which the vessel lies at the float or dock. Other factors include traffic, currents, wind, and perhaps most significant - manoeuvring space. When there is no wind, or the wind is blowing off the dock or from ahead, you simply need to push the boat off the dock, then pull away slowly, and turn the boat in the desired direction once clear of the dock-watch your stern to be sure you don't hit the dock.

If a strong wind is blowing on the dock the following procedure should be used:

- Turn the wheel so as to turn the bow of the boat toward the wharf.
- Leave one line attached to a cleat on the wharf.
- Engage in ahead (forward) at low speed and keep a fender near the bow
- The stern will be drawn clear
- When clear, let go spring line and go astern (reverse) to clear wharf

Once clear of the wharf

1 Get the fenders inboard and stow the lines.
2 Check vessel speed so that the wash will cause no harm to other docked craft.
3 Once clear of the harbour and controlled speed zones bring the throttle up to cruising speed, as shown on the tachometer or speedometer.

Operating in good visibility

In fair weather and with no sea conditions there is the opportunity for all crew except the skipper and the lookout to relax. The Operator at the (helm) wheel, has things to do including sharing look-out duties, continually searching:

- The area ahead.
- Watching particularly the danger zone (dead ahead to two points abaft the starboard beam).
- Occasionally looking completely around the horizon including listening for marine signals.

Control speed

It is important for all operators to adjust the vessel's speed as required and proceed at a safe speed as noted in the Collision Regulations. That will require slowing down in bad weather to avoid losing control that could increase the risk of causing injuries or loss of life to persons on board.

Operators must be aware that a vessel traveling at high speed requires one to be more attentive because he/she has less time to react to changing conditions. Also, as the vessel's speed increases so does the stopping distance required if there is an emergency.

Important considerations while transiting

1. After a meeting or crossing situation the wash of the other vessel must be negotiated. Large craft may have no trouble but small fast craft should:
- Take off speed and alter course so as to meet the waves either head on or take them broad on the bow, at about 45°.
- Reduced speed gives the vessel an opportunity to ride the waves rather than dive into them.

2. On a compass course, check compass frequently.
3. When steering for a leading mark ahead, line it up with a mark on the deck directly ahead of the steering position and check frequently.
4. An operator's steering ability is apparent in the wake of the vessel. It should be straight.
5. Watch the gauges and/or listen for audible alarm, checking every few minutes for oil pressure and cooling water temperature. Both of these are extremely important. Loss of oil pressure means trouble, probably a burned bearing. Loss of cooling leads quickly to a seized engine: the components expand because of abnormal heat and seize up.
6. Outboard operators should form a habit of glancing astern on a routine basis. Unusual quantities of steam suggest lack of cooling water. The pump may have failed or something may be blocking the cooling water intake effectively shutting off the water flow.

Overtaking

Try not to run parallel to the wake of the other vessel, the stern will swing uncontrollably from side to side. Therefore, cut across the wake on at the first opportunity and get it over. If the weather is less than favourable the handling of the craft becomes a matter of experience. Don't pound (bow pounding into waves*)* unnecessarily or take sheets of spray aboard by driving the vessel at high speed into the seas. Take off speed and if necessary run a zig-zag course to take the waves broad on the bow.

Vessel's turning circle

It is wise to become familiar with your vessel's turning circle. Ask yourself, "How long does it take to get into a turn and how long to come completely around 180°?" If operating a fast craft, take turns cautiously, at reduced speed, until comfortable operating the vessel.

Responding to a breakdown

In the event of a breakdown, the Operator should be aware of the following actions to take in response to breakdowns:

- Alter the speed of the craft as appropriate to the circumstances.
- Anchor the craft if required.
- Investigate the problem.
- Correct the problem if possible.
- Use or exhibit signals to indicate distress and need of assistance if necessary.

The best prevention against breakdowns is to maintain equipment on a regular basis so that it is functioning properly at all times.

Docking

As with leaving a dock, circumstances vary and no complete set of manoeuvring rules can be described or simulated to bring your craft alongside. In general, vessels are more manoeuvrable when headed into the wind, or current, than when running down wind. If the operator has an option in approaching a wharf, run into the current or wind. Alternatively, it may be possible to take advantage of these forces to carry the hull sideways into the available space. Approach technique:

- Fenders out.
- Approach dock slowly and at slight angle to bow.
- Appraise the situation and advise the crew of docking plans so they can prepare lines and fenders.
- Test reversing mechanism before attempting to dock. Do not rely fully upon reverse, it may fail or the engine may stall just when you need it most.
- Do not let anyone on board try to stop a crash with their hands or feet.
- Have a boat hook (pole with hook on one end) ready.

Shutting down

Follow the owner's manual advice concerning the recommendations for engine shut down. But in general, when the vessel is properly secured:

- Switch off the engine.
- Tilt an outboard engine up out of the water and in salt water crank it over a few turns to clear the water pump.
- Pump the bilges.
- Make sure the fuel supply valves are closed and all electric switches are off.
- If the vessel has a master switch, make sure it is off.
- Close any seacocks (valves to the sea) on the the engine or head (toilet).
- Check all stowage and place securely any coverings you have to keep out the weather.
- Make a last check of fuel valves, electrical switches, and lines.

Anchoring

A good anchorage

A good anchorage has a soft bottom of mud, sand, or gravel. No ordinary anchor can be expected to hold on a rocky bottom, unless by chance it catches in a crevice or hooks under a boulder or log. However if this happens it may present a problem in breaking free.

Lowering and setting an anchor

First, make sure the bitter end (end without the anchor) is made fast to a strong cleat on the fore deck. Also securely fasten the outboard end of the anchor line to the anchor. Double check all knots. If using shackles, be sure the pins are secure.

Check that the rode is free to run out and not tangled in the crewmember's feet. Marks on the rode at one fathom (6 feet) or metre intervals are useful. With little or no way on the vessel:

1. Remove the anchor from its chocks (securing fasteners) and lower, don't throw, it over the side. In a small boat this can be done from the cockpit, aft. Aboard a larger boat one crewmember may want to stand on the forward deck, but watch footing.
2. Lower away, hand over hand, until bottom is reached and note how much rode has been paid out.
3. With the anchor on bottom, run the engine slow astern (reverse), paying out rode until the desired scope, say 5 to 1 is achieved.
4. Now secure the rode on a cleat. Feel the anchor dragging and then starting to dig.
5. When it is properly set it will hold the vessel against the slow astern movement of the engine.
6. Stop the engine and adjust the rode to the desired scope.

Riding at anchor

The scope required for secure anchoring depends on the holding ground and the weather. In heavy weather an anchor watch should be organized. A crewmember should stay awake and make certain the anchor is not *dragging*. If there is any suggestion of *chafe* (fraying) at the *chocks* (bow line leads), put some *serving* (chafing material) around the area. In tidal water do not forget during the initial setting to allow for rising and falling water levels and for the different directions of the tidal current which will cause the boat to swing on the anchor.

Weighing and stowing the anchor

The anchor is *aweigh* when it is clear of the bottom. To weigh anchor, haul in on the rode, bitter end remaining secured, flaking (neatly aligning) the wet line on the deck, until the rode leads vertically. The vessel is now right over the anchor. Now break it out with a steady upward pull. Bring the anchor aboard carefully so as not to damage the paint on the hull or deck. If the anchor is covered with mud or sand, wash it by dipping it up and down.
As soon as it is aboard, stow it securely in its chocks or locker. This is important because an insecure anchor can be a hazard when the vessel rolls. It is advisable to allow the rode to dry before stowing it to prevent mildew. If it is to be left on deck, lash (tie) it down. Should it go over the side it may foul (tangle) the propeller.
If the anchor will not break out by hand, belay (secure) the rode and apply ahead (forward) power. In coastal waters, the tide rising against the rode may break the anchor free.

Sharing the waterways

The operator of any vessel shall take the following actions with respect to sharing waterways activities:
- Stay well clear of swimmers.
- Adjust the speed of the craft so that the wake or wash disturbance generated by the passage of the vessel will avoid injuring other persons, reduce erosion of the shoreline and damage to shore front properties.
- Avoid creating a wake when passing ongoing worksites near shore lines, docks, floats, or wetlands.

 Avoid creating a wake near vessels being towed, at anchor, grounded, wrecks, dredges, rowboats or canoes.
- *Wake* is the disturbed column of water around and behind a moving craft that is set into motion by the passage of that vessel.
- *Wash* is the loose or broken water left behind a craft as it moves along and includes the water thrown aft by the propeller and is most noticeable/of concern when the vessel starts from a stopped position in the water.
 Follow the *Collision Regulations*.
 Use courtesy and common sense on the water so as not to create a hazard, a threat, an irritant to others, the environment or to wildlife.

Practical Exercises

Chapter 12- Departure Preparation

Planning the Trip

Planning every trip is important, even if you do the same run every day- weather changes, details of the voyage may change, and things change on the boat- is there enough fuel today? Has the daily and weekly maintenance been done? Before planning any trip, it is important to ensure that you are starting out with a vessel that is safety maintained.

Importance of Maintenance & Checklists

As a well maintained vessel is important to a safe trip, how do you know, before leaving, that necessary maintenance has been done? Checklists are a simple way to verify this. They should be completed, signed and dated, and filed in a readily accessible place where they can be checked by vessel operators. In many cases it is the vessel operator who does the maintenance- but not always, so completing and filing checklists covering maintenance, pre and post trip duties, etc. is important.

Sample checklists for the following purposes can be found at the end of this chapter:

Fuel Consumption

Check the fuel - Is there sufficient on board for the voyage? Practice the one third rule:
- Use no more than one third of the fuel for the trip out.
- One third for the return.
- One third reserve.

Local hazards

As a responsible Operator, before heading out, check local water hazards that may impede the operation of the craft that could increase the risk of causing injuries or loss of life to crew on board. These hazard can include:
- Low-head dams.
- Rapids.
- Sudden winds.
- Tides.
- Currents.
- White water.
- Overhead cables.
- Underwater cables.
- Bridges.
- Rapid build up of high wave conditions.

Weather Forecasts

Check your marine weather forecast, or other local forecast before making your trip; you may need to alter your plans based on the forecast.

Departure Notice

Before departure notify your supervisor and provide the information required to render assistance during the trip if necessary.
When the voyage is over, be sure to let that person know that everyone is back safe.
At a minimum, the following information should be provided:

- Name or licence/registration number of the vessel.
- VHF channel you will be on if radio equipped, or cell phone number.
- Description of the trip: time of departure, time of return, proposed route.
- Number of persons on board.
- Any other pertinent information- e.g. persons with disabilities on board.

Quick Reference Checklists

Checklists are now commonly used throughout the commercial marine industry to assist in the decision making process as well as alleviate the possibility of forgetting a step in any activity on board. They also provide documentary evidence of having completed the work in question, which can be useful in the event of an incident.

A series of Quick Reference Checklists are available at the end of this chapter. These examples were developed for larger vessels in some cases, but give an idea of the types of activities which might be included. You can use these samples as template to develop your own checklists:

- Daily Maintenance Checklist
- Weekly Maintenance Checklist
- Engine Start Checklist
- Pre-departure Checklist
- Post Voyage Checklist

Pre-departure briefings

Crew briefing

Even a simple open boat with one or two crewmembers requires a briefing before departure- this can simply take the form of a discussion between the operator, the supervisor ashore and any crewmembers about the plans for the day- how many trips? How many passengers? Any special cargo? What is the weather forecast? Any changes to the normal routine? Any passengers with special needs? The list could go on for even a very small vessel- the important thing to remember is no two trips are never alike, and complacency brought about by thinking that this trip is going to be just like all the others, or complacency in any area of safety is a major cause of accidents. If any crew are new to the vessel, they need to be familiarized with their duties and the safety requirements of the job.

Passenger Safety Briefings

The *Lifesaving Equipment Regulations* and the *Small Vessel Regulations* require Safety Briefings on all Canadian passenger vessels. Safety Briefings are intended to provide passengers with information they will require in the event of an emergency. They are to be given in either or both official language as required, prior to the vessel leaving any place where passengers embark.

Also, regulations require that there be lifejackets for everyone on board. In lieu of carriage of lifejackets, all persons may wear a PFD at all times when in the boat.
As this course deals with the operation of mainly small open boats, it is important to ensure that passengers have their lifejackets or PFD's donned properly before entering the boat, as there is no time to put them on as there would be on a larger vessel. Therefore, the briefing should be given on the dock, or some other safe place, and should include:

- The importance of wearing personal flotation devices and/or lifejackets at all times in any waterway activities.
- How to correctly don the lifejacket or PFD.
- That passengers should be dressed appropriately for the trip. Emphasize that it is colder over the water than on land, and that moving air, both from the wind, and from the speed of the boat, also has a chilling effect on the body. Having warm clothing on also helps keep the person warm if they go into the water, and their lifejacket has enough buoyancy to support them and their clothing.

Before entering the boat the operator should check that each passenger's lifejacket or PFD is donned correctly, according to the manufacturer's instructions.

Once passengers have boarded the boat, the following items should be covered:

- The location of the emergency kit.
- The importance of keeping oneself low, on the center line, and holding on to a rigid part of the craft while moving around on board
- The importance of keeping one's hands, arms and legs inside the recreational craft when approaching or leaving a dock.
- The effects of the craft's motion, sunlight, waves, wind and sound on them.
- Instructions on what to do if it is necessary to abandon the vessel, or if someone goes overboard.

Lifejackets & PFD's

A lifejacket is intended to help save your life in the event you should become involved in an accident and find yourself in the water. A lifejacket is designed to keep an unconscious person afloat face up in the water. A PFD will not.

When carrying out the passenger safety briefing the following points should be kept in mind:

- Try out the lifejacket or PFD. Put it on and familiarize your-self with the tie strap arrangement.
- Lifejackets are reversible, but it is important that when using the keyhole style that

the waist straps be tied around the body and not around the lifejacket. This allows the jacket to pivot away from the body and give the desired, inclined backward, floating position.

- If you have to swim while wearing a lifejacket use a back or side-stroke.

Donning of Lifejackets

Figure 1: Put your head through the keyhole in the lifejacket.
Figure 2: Tie the neck straps in a bow.
Figure 3: Take the two waist straps, cross the straps behind your back, then tie off the ends in a bow at your waist. Do not tie the straps across the front of the lifejacket.

Care of Lifejackets & PFD's

The responsibility for maintaining a lifejacket in good condition rests with the operator and owner of the vessel. To ensure this, the following points should be noted:

- Do not abuse it by using it for any other purpose such as a seat cushion, boat fender or kneeling pad.
- When dry, stow in an easily accessible location, preferably somewhere on or above the main deck or close to an exit if possible.
- When wet, hang up to dry in the open air in a ventilated area, do not dry it in front of a radiator or other source of direct heat.
- Do not use harsh detergents or cleaning fluids to clean dirty lifejackets. Never dry clean.

Daily Maintenance Checklist

Daily Maintenance Checklist	Check
1. Hull Condition.	
2. Fuel levels	
Oil levels.	
3. Radios - reception and transmission:	
Test on a working frequency.	
Inspect antenna mounts/wires.	
4. Bilge Pump:	
Float switch clear and operable.	
Pump screen/filter clear.	
5. Navigation and search lights operating.	
6. Kill switches:	
Inspect lanyards manually and test.	
7. Engines running:	
Listen to engine for any odd sounds.	
8. Fuses and wiring:	
Check for wear.	
9. Safety equipment:	
On board, dry and well secured.	
10. Operator Console - Secure.	
11. Steering System:	
Lock to lock.	
Inspect lines.	
12. Throttle and cables:	
Move freely.	
Check shift indent.	
Neutral lock.	

Completed by:
Signature:
Date:

Weekly Maintenance Checklist

Weekly Maintenance Checklist	Check
1. Check that all additional equipment is operable, dry and secure.	
2. Inspect hull and all hull attachments.	
3. Batteries and connections:	
Fluid level.	
Inspect all connections, coat with Vaseline or non-conductive grease.	
Inspect battery box secured.	
4. Check all wiring jackets.	
5. Antennas:	
Check all coaxial cables for chafing.	
Check antenna mounts.	
6. Check all radios and mounts.	
7. Check engine transom bolts.	
8. Bilge pump manual test.	
9. Steering system, check all hardware.	
10. Towing assembly:	
Welds and fasteners.	
11. Fuel system:	
Lines, filters, connections.	
12. Zinc anodes.	
When to change.	
13. All major grounds:	
Corrosion.	
14. Check all grease points.	
15. Lubricate all linkages.	

Completed by:
Signature:
Date:

Engine Start Checklist

Engine Start Checklist	Check
1. Checks:	
Ensure engine(s) are down.	
Make sure fuel lines are on.	
Make sure oil lines are on.	
2. Pre-start:	
Engage cold start.	
Ensure throttles in neutral lift lever 1/3.	
3. Ignition:	
Engage primer.	
Push key in and turn.	
4. Start:	
Turn engine over for maximum 10 seconds.	
No start, wait 30 seconds.	
Try again for 10 seconds.	
If the engine is flooding and won't start, wait 30 seconds	
Put cold start up.	
Don't use primer.	
Turn over for 10 seconds.	
5. Warm-up:	
Warm up engine for 3 min @ 1200-1500 RPM.	
Warm up may be minimized in urgent cases.	
6. Check:	
Water output.	
Engine temperature.	
Engine sound.	
Steering(lock to lock).	
Engine idle should be 800 RPM in gear and 1100 RPM in neutral.	

Completed by:
Signature:
Date:

Pre-departure Checklist

Pre-departure Checklist	Check
1. Departure planning. Include:	
Destination.	
Estimated time of arrival (ETA).	
Days activities.	
Weather forecast/sea conditions and local hazards.	
Prepare a Sailing Plan.	
2. Check for loose gear, secure as required.	
3. Load extra gear as required for mission.	
4. All crew and passengers don appropriate PFDs and safety gear.	
5. Driver, attach ignition key kill switch lanyard.	
6. Electrical system energized. Navigation lights on for reduced visibility or night operations. Alarms on and tested. Engine(s) started. Check gauges.	
7. Turn on radio, and have chart ready when necessary	
8. Test steering. Test engine controls ahead and astern	
9. Cast off when ready	
10. Secure fenders, mooring lines, etc.	

Completed by:
Signature:
Date:

Post Voyage Checklist

Post Voyage Checklist	Check
1. Advise contact person that the boat is secured.	
2. Complete appropriate logs.	
3. Check that lines are properly secured.	
4. Do a thorough inspection for any snags (problems or repairs to be done).	
5. Bail or pump out any water.	
6. Refuel power boat, check oil.	
7. Clean, service and restow any used recreational or fishing equipment.	
8. Shut off power, cover boat.	

Completed by:
Signature:
Date:

Chapter 13- Safe Pilotage and Collision Prevention

Collision Regulations

Commonly known as the Rules of the Road, the vessel driving rules on Canada's waterways are correctly known as the International Regulations for the Prevention of Collisions at Sea, 1972 with Canadian Modifications[1]. A complete set of the Collision Regulations can be purchased at your local marine book store, borrowed from the library, or downloaded from Transport Canada's website on the Internet. The following rules in the manual have been simplified and condensed for training purposes.

Application

These rules apply to every vessel no matter how large or small, including pleasure craft, operating in Canadian waters.

Describing vessel movement through the water

Two definitions of moving a vessel through the water are important to understand before applying the rules. They are:

- Underway - describes a vessel that is not made fast (tied up) to shore, at anchor or aground.
- Making way - describes a vessel moving through the water, ahead or astern, by mechanical propulsion.

Even if you are at anchor, you are required by the rules to keep a proper lookout for other vessels, display the proper lights, and sound the proper signals in restricted visibility.

Obey the rules - Rules 1 and 2

Rules 1 and 2 state that the Collision Regulations must be followed unless specific circumstances may make it necessary to depart from the rules. The rules apply to all vessels upon the high seas and in all waters connected therewith. As operator, you must obey these regulations.

Types of vessel Rule 3

The word "vessel" includes every description of water craft, including non-displacement craft (i.e. hovercraft and hydrofoils, as described earlier) and seaplanes, used or capable of being used as a means of transportation on water. This also includes rowboats (and canoes etc.) and any other type of vessel no matter how small.

Power driven vessel:

Any vessel propelled by machinery.

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[1] A complete set of the Collision Regulations can be purchased at your local marine book store, borrowed from the library, or downloaded from Transport Canada's website on the Internet.

Fishing vessel:

Any vessel with fishing apparatus which restricts maneuverability. This includes trawlers and other fishing vessels fishing with nets. It does not include trolling (fishing with lines while the vessel in moving through the water) or angling. If you are out fishing with a fishing rod, you are not a fishing vessel; even if stopped and drifting, the rules still apply to you, and you must keep a proper lookout, and maneuver and light your vessel as required by the rules.

Seaplane:

Any aircraft designed to maneuver on the water. When on the water seaplanes are required to maneuver as if they are a power driven vessel. However, for practical purposes this would only be if they are taxiing from their wharf or mooring to their takeoff area or from their landing area to the wharf. When a seaplane is in the process of taking off or landing, they are unable to maneuver as required by the rules and must be avoided.

Rule 18 provides however that "A seaplane on the water shall, in general, keep well clear of all vessels and avoid impeding their navigation."

Sailing vessel:

Any vessel under sail provided that propelling machinery, if fitted, is not being used. As sailing vessels are less maneuverable than power driven vessels they have certain privileges as described in Rule 18.

Terminology, who has the right of way?

Stand on or Give way. These two important terms are the basic "right of way" statements that are used to describe when one vessel has the right of way (stand-on) and when the other vessel must yield (give way) to the stand-on vessel.
The stand on vessel is one that, if risk of collision exists, must maintain its course and speed under the rules. The give way vessel takes avoiding action if risk of collision exists.

The action to be taken in specific situations by each of these vessels is described in Sections 2, conduct of vessels in sight of one another (Rules 11 to 18) and Section 3, conduct of vessels in restricted visibility (Rule 19).

Lookout and safe speed - Rules 5 and 6

Rule 5- Lookout

For operators, one of the most important rules is to maintain a watch on all activities going on around you. The principle cause of accidents on the water is failure to keep a lookout. The *Collision Regulations* state the operator shall at all times maintain a proper lookout by sight and hearing as well as any other available means appropriate to the situation. (See Rule 7)

Rule 6 –Safe Speed

Just as with cars on the road, excessive speed (as well as not keeping a proper lookout) can cause collisions. This rule requires operators to travel at a safe speed, however, unlike on a highway, these rules don't provide a fixed definition of safe speed.[2]

Safe speed is a speed at which proper and effective action could be taken to avoid collision. Many factors govern safe speed, including:

1. The state of visibility
2. The traffic density including concentrations of fishing vessels or any other vessels
3. The state of the wind
4. Sea and current conditions
5. The proximity of navigational hazards

Risk of collision - Rule 7

All operators shall use all available equipment and means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists.

For example, if you have a radar, you should use it where it would give you better information that a visual lookout, i.e. at night or in restricted visibility. Or, if you have a VHF radio, it should be on and adjusted to the appropriate channel so you can hear what other vessels in the area are doing; this is important if you are operating in an area where there is lots of large vessel traffic.

Action to avoid collision - Rule 8

Any action an operator takes to avoid collision shall be positive, and made in ample time to avoid collision. Changes in course and/or speed shall be large enough to be readily noticed by the stand-on vessel.

This is to avoid confusion on the part of the other vessel; many collisions have been caused by avoiding action being "too little, too late", causing the either the stand on or give way vessel to take inappropriate action at the last minute.The rule also states that you should slow down, stop the engines or go astern if necessary to avoid collision or to provide time to assess the situation.

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[2] The Vessel Operation Restrictions Regulations (used to be called the Boating Restriction Regulations) however, do provide for fixed speed limits in many lakes and other waters, as well as other operational restrictions. A copy of these regulations can be downloaded from the internet. The most reliable way to obtain the most up to date copy of any regulations is to Google the name of the regulations, and download it from the Justice Canada website.

Vessel Operation Restriction Regulations **- Lois du Canada**

laws-lois.justice.gc.ca/eng/**regulations**/sor-2008-120 (example search result)

Local harbour regulations also may provide speed limits. It is your responsibility as an operator to be aware of all regulations affecting your vessel.

Special rules and signals in narrow channels - Rule 9

Just as on the road, you are required to keep to starboard (right hand side) of a narrow channel.

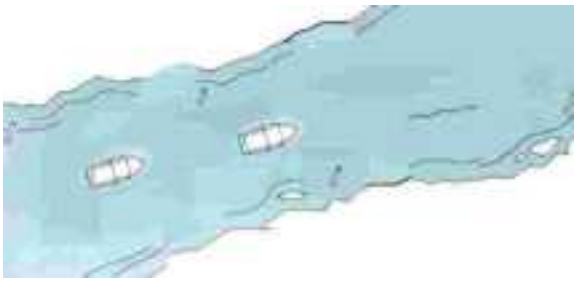
Upper Lakes Group's CANADIAN TRANSFER transiting narrow channel, small vessels can-not impede her passage. - *Courtesy Dick Lund*

Most of rule 9 deals with small vessels and how they must be navigated in relation to large vessels which can only navigate within the channel, such as the one below. If you are less than 20 meters long or under sail, don't impede the passage of vessels which can safely navigate only within a narrow channel

If you meet this vessel, it will not alter for you! That's because it can't, and Rule 9 provides for this.

While this may be obvious in the photo above, the same may apply in your situation in a less obvious manner; for example a large powered yacht with a draft of 6 feet navigating a buoyed channel amongst some islands may have to stay in the centre, while a Boston Whaler with a draft of 1 foot which is able to navigate outside the channel must do so.

Fishing in a narrow channel? Leave room for large vessels! Don't get in the way.
Do not cross ahead of another vessel in a narrow channel.



In a narrow channel where the slower vessel ahead must allow room for your vessel to pass, the overtaking vessel may pass to port or starboard only if you have the slower vessel's agreement. Use whistle signals if necessary Rule 34 or communicate by VHF.

As the operator, of the vessel which wishes to pass, if you hear the vessel ahead sound five blasts on her sound signaling device, you must slow down and wait until the other vessel agrees that it is safe to pass! (See also Rule 34).

Operating in a current or stream

In Canadian waters of a narrow channel or fair-way where there is a current or tidal stream and two power-driven vessels are meeting each other from opposite directions in a risk of collision the following rules apply:
1. The vessel proceeding with the current or tidal stream shall be the stand-on vessel and that operator shall decide which side of the channel to transit his/her vessel. Use whistle signals if necessary Rule 34, or communicate by VHF.
2. The vessel proceeding against the current or tidal stream shall keep out of the way of the vessel proceeding with the current or tidal stream and shall hold position if necessary to permit safe passing.
3. The vessel proceeding against the current or tidal stream shall promptly reply to the signal referred to in 1 (above) with the same signal if that operator in agreement, or with the sound signal prescribed in Rule 34 if in doubt (five short blasts on the whistle).

No Anchoring

Any vessel shall avoid anchoring in narrow channels.[3]

[3] Be aware of No Anchorage signs in your area as well; many of these mark underwater power or phone cables, or even pipelines in certain areas. In areas where there are inhabited islands, underwater cables are common and can result in electric shock if you damage the cable and then try to retrieve the anchor. If you think you may have snagged your anchor, untie the anchor from your boat and leave it on the bottom; use a fender or other floating object to buoy the line for later retrieval. (See also Chapter 9)

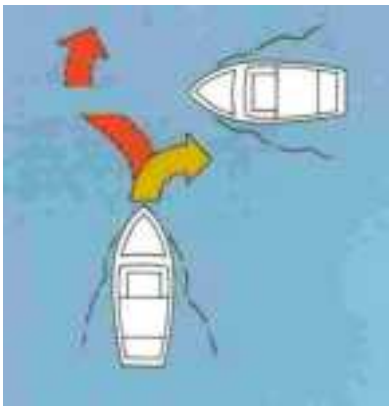
Overtaking - Rule 13

A vessel is overtaking another when it is coming up with another vessel, from a direction more than 22.5° abaft the beam.
The overtaking vessel shall take early and substantial action to keep clear of the vessel being overtaken.
In other words the slower vessel has the right of way, and the faster vessel is the give way vessel. This is consistent with Rule 9, the difference being in a narrow channel, the slower vessel must agree to the passing.

Meeting head on - Rule 14

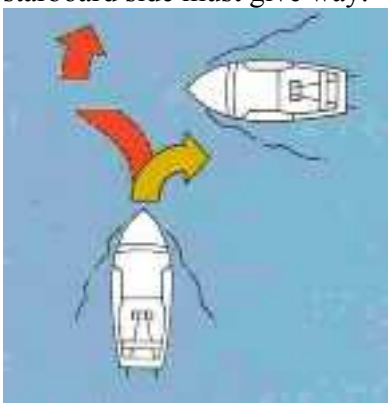
If two power driven vessels meet head on, both must give way by altering course to starboard.
If a power driven vessel meets a vessel engaged in fishing head on, the power driven vessel must give way. The fishing vessel should maintain course and speed.
If a sailing vessel meets a power vessel head on, the power driven vessel must give way. The power vessel should alter course and/or speed. The sailing vessel should maintain course and speed.
If a sailing vessel meets a vessel engaged in fishing head on, the sailing vessel must give way. The fishing vessel should maintain course and speed.

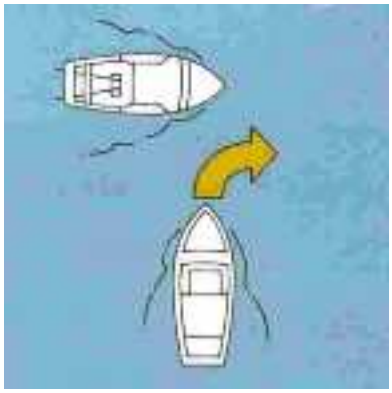
Crossing the path of another vessel - Rule 15



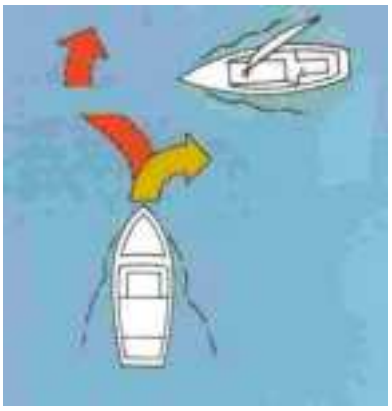
A power driven vessel approaching another power driven vessel on its starboard side and crossing them so as to involve risk of collision, shall take early and substantial action to keep clear and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.

A fishing vessel approaching another fishing vessel on its starboard side must give way.





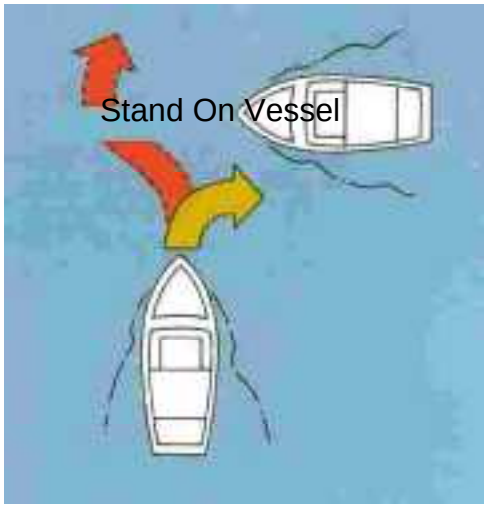
A power driven vessel approaching a vessel engaged in fishing on either port or starboard side must give way.



A power driven vessel approaching a sailing vessel on either port or starboard side must give way.

Action of the give way vessel - Rule 16

If you are the give way vessel, the operator is responsible to take early and substantial action to keep clear.



Action by the stand on vessel - Rule 17

If you are the stand on vessel, there are three stages in a potential collision situation:

1.You are initially responsible to maintain your course and speed. This is so as not to confuse the situation for the vessel which is required to give way.

2. If the give way vessel fails to take avoiding action, you may take the necessary avoiding action.

3. If the give way vessel continues to take no action and you find that collision cannot be avoided by the action of the give way vessel, you may take such action as will best aid to avoid a collision.

If you are the stand on vessel and take action in a crossing situation you shall, if possible, not alter to port for a vessel on your own port side.

Rule 17 does not relieve the give way vessel of its responsibilities. (So if the stand on vessel alters course for example, the give way vessel must still stay out of the way- stopping is a good option in such a situation.)

Responsibilities between vessels - Rule 18

Rule 18 provides a “hierarchy” of vessel types based on their ability to manouever- the least maneuverable vessels having precedence:

1. Power driven craft shall take early and substantial action to keep well clear of a vessel engaged in fishing or a sailing vessel.

2. In turn, a sailing vessel shall take early and substantial action to keep well clear of a vessel engaged in fishing.
3. Under Rule 18 and Rule 27, a vessel shall also take early and substantial action to keep well clear of a vessel restricted in her ability to manoeuver, such as a vessels engaged in diving operations that exhibit the International “Code Flag A” or the “Diver’s Flag”.

The head on situation covered by Rule 14 for vessels of the same type provides a good example of how Rule 18 works:

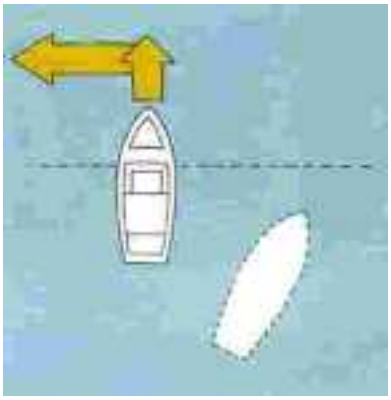
1. If a power driven vessel meets a vessel engaged in fishing head on, the power driven vessel must give way. The fishing vessel should maintain course and speed.
2. If a sailing vessel meets a power vessel head on, the power driven vessel must give way. The power vessel should alter course and/or speed. The sailing vessel should maintain course and speed.
3. If a sailing vessel meets a vessel engaged in fishing head on, the sailing vessel must give way. The fishing vessel should maintain course and speed.

Conduct of vessels in restricted visibility - Rule 19

Every vessel shall proceed at a safe speed depending on the visibility conditions. Operators should obviously slow down in fog, mist, snow or heavy rainstorms and shall at all times maintain an active watch in all conditions. Make a full appraisal of traffic conditions to determine if the risk of collision exists. (Rules 5 & 7).
The operator of a vessel not in sight of other vessels in or near an area of restricted visibility shall:

- □ Proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility.
- □ Sound the fog signal and turn on navigation lights.
- □ Proceed with extreme caution.
- □ Be prepared to stop.

If fitted with radar the operator must utilize it and all other electronic devices in restricted visibility.

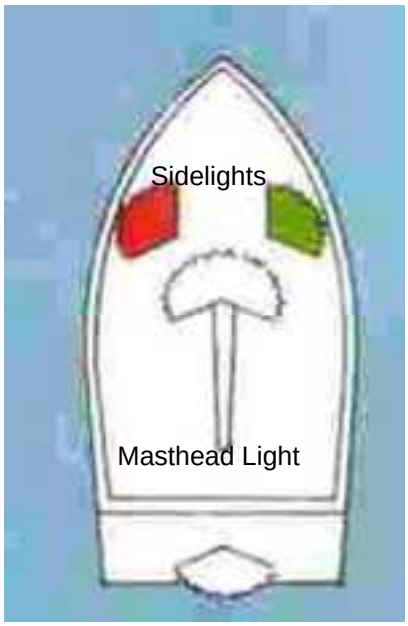


If you hear the fog horn of another vessel abeam or behind of beam, avoid turning toward the vessel. If you hear the fog horn of another vessel apparently forward of your beam, reduce your speed to minimum needed to keep on course.

If you detect a vessel forward by radar, avoid altering to port, except in cases of overtaking.

Application Lights and Shapes - Rule 20

Navigation lights are required under the *Collision Regulations* if a vessel operates at night (sunset to sunrise) or in restricted visibility. If the vessel is fitted with navigation lights, they must work and be properly located in accordance with the collision regulations.



Navigation lights tell other vessel operators not only where you are, but what you are doing. Using these lights and signals properly is an important part of safe navigation.

Navigation light definitions - Rule 21

Sidelights mean a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of the horizon of 112.5 degrees. They are installed so the light is from right ahead to 22.5 degrees abaft the beam on its respective side.

A masthead light means a white light placed over the fore and aft center line of a vessel showing an unbroken light over an arc of the horizon of 225 degrees. It is installed so the light is from right ahead to 22.5 degrees abaft the beam on either side.

These angles of visibility correspond to the angles which mark the change from crossing to overtaking, or meeting head-on to crossing. If you can see both red and green you are meeting head on and both vessels (assuming rule 18 does not apply) must take action- If you can see either red or green you are crossing, and if you can see only a sternlight you are overtaking.

A sternlight means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135 degrees. It is installed to show the light 67.5 degrees from right aft on each side of the vessel. The dual sternlights, i.e. one plus a spare, shown in the illustration are a requirement on commercial vessels over 15m in length as a safety precaution.

Towing light: A yellow light having the same characteristics as the "sternlight". Used on tugs.

An all-round light means a light showing an unbroken light over an arc of the horizon of 360 degrees.

All round white light above acts as both a combined stern light/masthead light for vessels less than 12 metres and also as an anchor light.

Visibility of navigation lights - Rule 22

For vessels of less than 12 metres in length:
- a masthead light, 2 miles
- a sidelight, 1 mile
- a sternlight, 2 miles
- a towing light, 2 miles
- a white, red, green or yellow all-round light, 2 miles

Navigation lights on small power vessel - Rule 23

Power driven vessels less than 20 meters long, when underway, must show lights configured in one of the three following options:
1 Sidelights (red on the port side, green on the starboard), a masthead white light showing from right ahead to 22.5 degrees abaft the beam on either side and a stern (white) light.

2 A combined lantern showing port and starboard light in addition to the masthead and stern light.

3 A combined lantern plus an all round white light at the masthead.

An air cushion vessel when operating in the non-displacement mode shall, in addition to the lights pre-scribed in paragraph 1 of this Rule, exhibit an all-round flashing yellow light.

Motor vessels less than 7 metres in length whose maximum speed does not exceed 7 knots (10km/h) in lieu of the lights above, may exhibit an all round white light.

Towing and Pushing-International - Rule 24

A power-driven vessel when towing shall exhibit:
- Instead of the light prescribed for a power driven vessel in Rule 23, two masthead lights in a vertical line
- Sidelights
- A sternlight
- A towing light in a vertical line above the sternlight

When a pushing vessel and a vessel being pushed ahead are rigidly connected in a composite unit they shall be regarded as a power driven vessel and exhibit the lights prescribed in Rule 23.

A power driven vessel when pushing ahead or towing alongside, except in the case of a composite unit, shall exhibit:
- Instead of the light prescribed for a power driven vessel, two masthead lights in a vertical line
- Sidelights
- A sternlight

Where from any sufficient cause it is impracticable for a vessel or object being towed to exhibit the lights or shapes prescribed, all possible measures shall be taken to light the vessel or object towed or at least to indicate the presence of such vessel or object.
Where from any sufficient cause it is impracticable for a vessel not normally engaged in towing operations to display the lights prescribed on page 95, such a vessel shall not be required to exhibit those lights when engaged in towing another vessel in distress or otherwise in need of assistance.
All possible measures shall be taken to indicate the nature of the relationship between the towing vessel and the vessel being towed as authorized by Rule 36, in particular by illuminating the towline.

A utility vessel designed for pushing. *Photograph courtesy Munson Marine*

Towing and pushing lights - Canadian Modifications

Within Canadian waters or fishing zones, where it is impracticable for a barge being towed to comply with the prescribed lights in Rule 24, the barge shall exhibit the lights prescribed in the bullets below:

- Every barge shall carry one all round white light at each end of the barge.
- Where two or more barges are grouped together, the group may be lighted as a single barge.
- A barge being pushed ahead shall carry, instead of the all round white lights, white lights that show an unbroken light over an arc of the horizon of 225 degrees and are fixed so as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the barge.
- In the waters of the Great Lakes Basin, a power driven vessel, when pushing ahead or towing alongside, shall exhibit two towing lights in a vertical line instead of a stern light.
- In the waters of the Great Lakes Basin, a special flashing light shall be exhibited at the forward end of a vessel or vessels being pushed ahead, in addition to the lights prescribed lights in Rule 24.

Rule 25 – Sailing Vessels and Vessels Under Oars

Sailing Vessels

A sailing vessel underway shall exhibit sidelights and a sternlight, but no masthead light. This way you can tell them from a powerboat at night. In a sailing vessel of less than 20 metres in length these lights may be combined in one

lantern carried at or near the top of the mast where it can best be seen.

OPTIONAL: A sailing vessel underway may, in addition to the lights above, exhibit at or near the top of the mast, where they can best be seen, two all-round lights in a vertical line, the upper being red and the lower green. This makes it easier to identify the sailboat at night, as sidelights are not always easy to see.

Sailing Vessels under 7m and Vessels Under Oars

Both these vessels may exhibit the lights for a sailing vessel, but if not, she shall have ready at hand an electric torch (flashlight) or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision. These boats may simply exhibit one all round white light as this would meet this requirement.

Vessels not under Command or Restricted in their Ability to Manoeuvre - Rule 27

The term "vessel not under command" means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel. One example might be a vessel which has lost her engines and is unable to anchor because of weather or depth of water.

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.

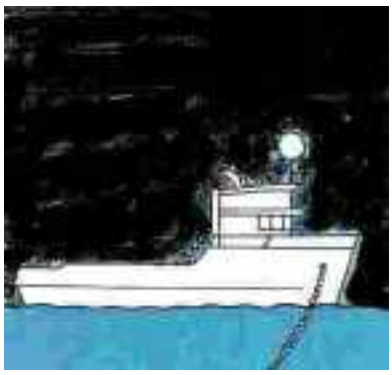
You would most likely sea these lights or shapes displayed by a vessel engaged in a towing operation such as severely restricts the manoeuvering ability of the tug.

A vessel not under command shall exhibit:
- Two all-round red lights in a vertical line where they can best be seen,
- Two balls or similar shapes in a vertical line where they can best be seen,
- When making way through the water, in addition to the lights prescribed in this paragraph, sidelights and a stern-light.

A vessel restricted in her ability to maneuver shall exhibit:
 Three all-round lights in a vertical line where they can best be seen. The highest and lowest of these lights shall be red and the middle light shall be white.
 Three shapes in a vertical line where they can best be seen. The highest and lowest of these shapes shall be balls and the middle one a diamond.
 When making way through the water, a masthead light or lights, sidelights and a sternlight, in addition to the lights prescribed previously.
 When at anchor, in addition to the lights or shapes pre-scribed above, the light, lights or shape prescribed in Rule 30.

Anchored Vessels and Vessels Aground - Rule 30

Lights for a vessel at anchor
A vessel at anchor less than 50 meters in length shall exhibit, from sunset to sunrise, in the fore part, an all round white light (Rules 20 & 30).
Often the anchor light will be amidships (center) on board smaller craft.



All round white light above acts as both a combined stern light/masthead light for vessels less than 12 metres and also as an anchor light.

Sound and light signals - Rule 32

Definition: A whistle - any sound apparatus that can make loud blasts. On small vessels this will likely be an electric horn, but on small vessels with no electric power or place to safely put a horn, a portable (aerosol) air horn is an effective signaling device.

A short blast: 1 second duration.
A prolonged (long) blast: 4 to 6 seconds duration.

Sound signaling equipment - Rule 33

Vessels 12m to 100 m in length are to carry a whistle and a bell.
Vessels under 12 m in length shall carry sound signaling appliances or some other means of making an efficient sound signal.

Manoeuvering and warning signals - Rule 34

These signals are to be made only when vessels are in sight of one another. This is to save confusion with the fog signals in Rule 35.

I am altering my course to starboard - one short blast.
I am altering my course to port - two short blasts.
My engines are going astern - three short blasts.
The above sound signals may also be supplemented by a one second flash on all round white light.
One flash - I am altering my course to starboard.
Two flashes - I am altering my course to port.
Three flashes - My engines are going astern.

These signals are normally only used by large vessels in narrow channels where they pass much more closely than normal, and the risk of collision is great if one vessel is unsure of the intentions of the other. In normal circumstances, with small vessels in open water, sound signals may only serve to confuse the situation if it is not clear for which other vessel the signals are intended. If you are operating a vessel, and are required to give way to another vessel, early and substantial action makes your intentions clear to the other vessel(s) and avoids the need for unnecessary signaling.

Overtaking

In sight and overtaking another vessel in a narrow channel or fairway.

I intend to overtake you on your starboard side: two long and one short

I intend to overtake you on your port side: two long and two short

The vessel being overtaken if in agreement sounds: one long, one short, one long, one short (Morse Code meaning affirmative).

While allowed for in the rules, this signal is almost never used. Again it is mainly for large vessels in narrow channels where overtaking poses a substantial risk of collision, and overtaking is inevitably agreed to (or not) over the radio. If you are overtaking another vessel only do so where you can give a wide berth and be sure that it is safe to do so; if there is any doubt, and the vessel cannot be contacted, you will just have to wait until you reach an area where passing is safe, just as you would in a car on a two lane road. Naturally this should be done at slow speed so that your wake does not disturb the other vessel.

Emergency and warning signal

An operator in doubt as to another vessel's intentions or insufficient action as a give way vessel shall sound at "least five (5) short and rapid blasts" with or without a flashing light. This is the most commonly used signal by large vessels in harbours or narrow channels, when small vessels put themselves in danger by doing the things they are not supposed to do as per Rule 9. You will likely hear it repeated until the other vessel takes action. **If you hear 5 short blasts, look around and be prepared to take immediate action, as your vessel may be in danger.**

Nearing a bend in a river

If nearing a bend in a river or channel where an approaching vessel might be obscured - one long blast.

Sound signals in restricted visibility - Rule 35

The following signals are used by different vessel types:

Power driven vessel making way	Being propelled through the water by machinery - one prolonged blast every two minutes.
Power driven vessel under way	Not made fast to shore, at anchor or aground: two prolonged blasts every two minutes.
Special vessels	Vessels under sail, fishing, towing, constrained by draught, restricted and not under command: one prolonged followed by two short every two minutes.
Vessels at anchor	Vessels less than 100 metres shall ring a bell rapidly for about five seconds at one minute intervals.
Vessels aground	Same signal as a vessel at anchor except strike three district strokes before and after the rapid ringing.

Signals to attract attention - Rule 36

If it is necessary to attract the attention of another vessel:

- Make any light or sound signal other than authorized signals.
- Direct beam of searchlight in direction of danger.
- Avoid using strobe lights.
- Avoid lights that can be confused with navigation lights.

Radar reflectors - Rule 40

If a vessel is less than 20 metres in length, or is primarily constructed of non-metallic materials, it shall be equipped with a passive radar reflector when operating in high shipping traffic areas, and at night or during restrictive visibility.

The radar reflector will allow vessels and ships equipped with radar to better detect small boats and reduce the risk of collision. The radar reflector should be mounted or suspended at a height of not less than 4 metres above the water if practicable.

Exemptions? Yes there are two:

1. A radar reflector is not required if the craft is operated in limited traffic conditions, during daylight hours, in favorable environmental conditions and where in the operator's opinion compliance is not essential for the safety of the craft.

2. A radar reflector is not required if the size of the craft is small and the operation is away from radar navigation making compliance impracticable.

Two types of radar reflector

In other words, most of the boats to which this course applies do not need a radar reflector, but if you find yourself operating a small vessel at any time where there is a risk of collision with larger vessels, a radar reflector is an important safety aid.

Blue Flashing Light - Rule 45

Any government vessel or any vessel that is owned or operated by a harbour, river, county or municipal police force may exhibit as an identification signal a blue flashing light when the vessel,

(i) is providing assistance in any waters to any vessel or other craft, aircraft or person that is threatened by grave and imminent danger and requires immediate assistance, or

(ii) is engaged in law enforcement duties in Canadian waters.

Any vessel operated by the Canadian Coast Guard Auxiliary may exhibit a blue flashing light as an identification signal when the vessel participates, at the request of the Canadian Coast Guard, in search and rescue operations.

Chapter 14- Emergency Situations

Collision

In a collision with the other vessel the operator's obligation is to stay and assist the other vessel if it is in danger. If the operator's own vessel is in danger of the course the first obligation is to ensure the safety of life of your passengers and crew, and deal with the possible consequences of the collision which could include:

- Flooding or capsizing
- Fire
- Pollution
- Injury

Dealing with injuries is not part of this course, but it should be remembered that injured persons should be dealt with first, so long as the vessel itself is safe.

Respond to hull leaks or flooding

Operators should be aware of the following actions to take in response to a hull leak or flooding:

- Inform passengers of the situation.
- Report the situation to your supervisor or other responsible person ashore.
- Locate the source of the hull leak or the flooding.
- Ask passengers to move carefully away from the area of the leak to allow crew access and raise the hole as high as possible.
- Stop the leakage or the source of flooding if possible.
- Remove accumulations of water in the bilge, hold or other compartment by using either hand-held bailers, manual pumps or bilge pumping systems.
- If all efforts fail, use or exhibit signals to indicate distress.
- If vessel remains afloat, keep passengers onboard, otherwise, make sure all group together in the water and follow procedures set out in Chapter 15.

Most small vessels will have sufficient flotation to remain on the surface even if full of water, so stay with the vessel.

Capsizing a small vessel

Should it happen, it is usually best to stay with the vessel. A capsized hull is easier to see than a person in the water and if the water is cold the chances of reaching shore are limited. Distances are hard to judge from the waters surface and the nearest beach might be a lot further off than first thought.

- To increase the chances of survival, try to climb onto the upturned boat to reduce hypothermia.
- Try to attract attention to your situation.
- Keep passengers together, hanging on to boat if not everyone can get on top of it.

Swamping, sinking and grounding

Take the following actions in response to a small vessel that capsizes, a small vessel that swamps, a small vessel that sinks or a small vessel that runs aground:

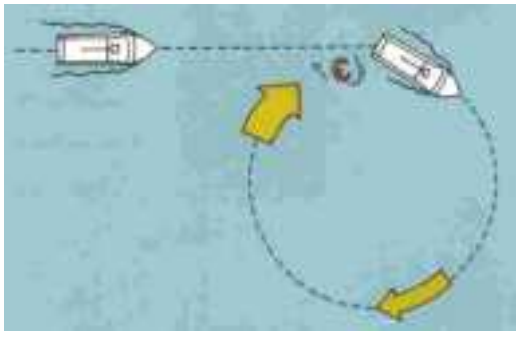
- Don personal flotation devices or lifejackets.
- Stay with the craft when appropriate.
- Account for crewmembers previously on board.
- Use or exhibit signals to indicate distress and need of assistance if necessary.

If the vessel runs aground, first stop the engine and raise or tilt it upward to take the propeller out of the water.

- Check the hull for leaks- if the leak is severe, stay where you are.
- If the hull is OK, try to push off with a paddle or oar.
- Shift passengers, crew or cargo so as to lighten the part of the vessel that is aground.
- If this does not succeed, call for assistance and get the passengers into another boat to lighten the vessel.
- If necessary, try to get another operator to help by towing the grounded vessel off the shoal.
- In tidal waters, wait for the next high water.

Man Overboard

Man Overboard, what to do! Seventy five to eighty percent of loss of life on the water occurs to crewmembers who were not wearing PFDs or lifejackets. These accidents frequently occur due to small vessels capsizing or a crewmember falling overboard. If someone falls overboard do the following:



- Anyone can shout “MAN OVERBOARD Port Side” or “MAN OVERBOARD Starboard Side”
- The operator should immediately reduce speed, and put the rudder over to turn the boat toward the side where the person fell overboard.
- Throw the person a life ring if you have one, or a fender or other buoyant object, or lifejacket if they are not wearing one.
- Have another crewmember, or passenger if you are the only crewmember, point and keep pointing to the person in the water as you turn the vessel.

- The Operator will approach the person from downwind or into the waves, to keep the boat from drifting over the person when stopped.
- When alongside, the Operator will stop the engine and other crewmembers or passengers can assist the person aboard.
- To retrieve a crewmember from the water use buoyant heaving lines, life buoys and a re-boarding device- an example is shown to the right.

Practice rescue procedures

Any operator should practice rescue procedures so that all crewmembers on board are familiar with:

- The safety equipment and use of safety equipment.
- Tasks to be completed to recover a person overboard.
- The handling characteristics of the vessel itself.

Fire

There is a limited number of fire hazards in a small open boat, however the presence of gasoline as fuel can pose a significant fire hazard, so all small power driven vessels must carry a fire extinguisher and the operator must know how to use it effectively.

Types and classes of fire

The fire classification scheme used by the Canadian authorities for regulation purposes is an international marine standard. Fires are classed according to fuel and the most effective extinguishing agents.

Class A fires: Fires involving combustible materials, which can be extinguished by the use of water or water solutions.

Class B fires: Fires involving flammable or combustible liquids, flammable gases, greases and similar products.

Class C fires: Fires involving energized electrical equipment or appliances.

The fire most likely to happen in a small boat is a Class B fire, from the boat's fuel as noted above.

The most effective piece of equipment to use on a class B fire is a dry chemical extinguisher.

Fire extinguishers

Fire extinguishers should be easily reached, and all crew should know where they are and how they are used. In a small open boat, the extinguisher should be beside the operating position, so that you don't have to pass a fire to get to the extinguisher, and so that you have instant access to it. A fire involving gasoline will spread very quickly once it starts.

They must be approved by one of the following organizations and be secured in approved brackets. Approved extinguishers include those certified by: the Board of Steamship Inspection (Transport Canada), the Underwriters Laboratories of Canada, the United

States Coast Guard or British Board of Trade (Marine Use) as outlined in the *Small Vessel Regulations* and *Small Fishing Vessels Regulations* fire extinguisher equipment standards.

Classes of fire extinguishers

Every portable fire extinguisher is classified in two ways, with one or more letters and with a numeral. The letter or letters indicate the classes of fire(s) on which the extinguisher may be used. The letters correspond exactly to the classes of fire mentioned above. The numbers before the letter rate the extinguisher's relative effectiveness against a fire. Therefore, a 10A extinguisher will put out a larger fire than a 5A extinguisher.

Types of Extinguishers commonly found on small vessels

ABC Dry Chemical - These stored pressure extinguishers are suitable for use on combustible Class A, B or C type fires. This is what your boat will be equipped with. It is effective on all three classes of fire.

Response to a fire on board

Use of the dry chemical extinguisher will be covered in the practical part of this course, but operators should be aware of the correct procedures for dealing with a fire.
When faced with the prospect of having to face a fire the following safety rules should always be considered:

- First and foremost, on discovering a fire regardless of its size, raise the alarm before attacking the fire. In the case of an engine fire on a small open boat, this would simply be to inform the passengers that you have a fire. If there is another crewmember, one can raise an alarm by radio while the other deals with the fire. If alone, shut down the engine first, and shut off the fuel to the engine or disconnect the fuel hose from a portable tank and move the tank away from the fire if possible.
- Never pass the fire to get an extinguisher.
- Always test your extinguisher first to ensure that it is operational. (Simply pull the pin and squeeze the handles for a second to be sure that you are getting powder.)
- Always keep low in the boat to protect yourself from heat and smoke.
- Holding the extinguisher upright, depress trigger on top and direct flow of agent in a sweeping motion at base of flames with discharge hose held firmly. Think of the word "PASS" to remember how to operate a fire extinguisher. Pull, Aim, Squeeze and Sweep.
- Never turn your back on a fire even when it is out.
- Beware of flashback situations- the metal of the engine block for example stays hot and could re-ignite the fire.
- As soon as possible arrange assistance to remove passengers from the vessel and get them ashore in case the situation worsens- e.g. due to weather, or the fire re-igniting.
- Even if the fire was very small, report the use of a portable extinguisher to your supervisor and do not return it to its station.

Inspections and Maintenance

Check your fire extinguishers monthly:
 Is the pressure okay? (Should be in the "OK" zone of the guage- about 100 psi)
 Check the nozzle. Often insects build nests in them on board vessels. Is there any sign of powder in the nozzle?

Is the pin missing, or does the extinguisher appear to have been used?

Dry chemical extinguishers should be turned it end for end every few trips. Is the chemical packed? If so, shake it to loosen it or hit its bottom with the palm of your hand.

If in doubt about any of this, have the extinguisher replaced with a spare and send it for servicing.

Did you initial the inspection tag if all ok?

Pollution

In case of accidental pollution, immediately report the spill to your supervisor. Most spills occur during refueling, so there should be a ready supply of absorbent material with which to clean up the spill- kitty litter works well on docks and in the boat. Absorbent cloth-like pads are effective if any fuel gets into the water.

Do not try to use dish soap or detergents to disperse the spill- this is illegal and may cause more damage to the environment than the spill itself.

Engine Failure

The most serious consequences of engine failure is the loss of maneuverability of the boat. Once you have no power you cannot keep the boat's head into the seas, and she may turn broadside to the wind and waves, resulting in capsizing. The boat is also subject to wind and current and may drift into a dangerous situation.

In this situation, try to anchor the boat if the water is shallow enough, or stream some rope from the bow to help keep it into the seas and slow the drift of the boat.

Then, let other vessels or your supervisor know of the situation, and what you are trying to do, before trying to find out the cause of the failure on your own. Then if assistance is needed it will be a lot quicker getting there.

Towing

Whether you need a tow or are required to assist another vessel, the following points should be kept in mind.
1. If at all possible, remove passengers to another vessel.

2. Discuss situation with the operator of the other boat and consider the following safety issues:

- Nature of problem.
- Number of Persons on board (POB) and if OK.
- Overall condition of vessel to be towed.
- Lines/obstructions in water.
- Strength of towing fittings on vessel to be towed and your own.
- Maximum hull speed of towed vessel.
- Everyone don PFD if not already worn.

3. The Operator should brief the crew and on intended procedures:

- Type of approach alongside distressed vessel.
- Passing tow line. (Use a buoyant line if possible)
- Emergency breakaway. (Keep a knife handy in case it is necessary to cut the tow line)
- Keep personnel clear of the tow line and off the bow of the vessel being towed
- Use moderate or slow speed- try to keep the towline from becoming taut- to prevent the line from breaking. A broken line can snap very quickly and cause serious injury.
- Keep one person in the boat being towed to steer.

Reporting

Mandatory reporting of incidents is covered in Chapter 2. If the incident is minor this would conclude dealing with the emergency, assuming the vessel does not need any outside assistance.

Should the operator not be able to fully deal with the emergency, outside assistance and abandoning the vessel will need to be considered.

Mustering

Mustering procedures

Mustering refers to gathering crew and passengers at their designated emergency stations. In a small open boat of course, there would be no formal muster, however the purpose of the muster is to account for everyone, inform them of the situation, and organize passengers and crew to deal with the emergency. Dealing with passengers is covered in Chapter 15

Abandoning the vessel

If all efforts fail to save the vessel and it must be abandoned, only the Captain/Operator or person in charge may give the order. The spoken signal for getting everyone off the vessel is “Abandon Ship”.

In the case of a small open boat, with no life raft or boat, this will result in the passengers and crew being in the water- how to deal with this situation is covered in Chapter 15.

Distress Call

At this point, if the operator has not already requested assistance, a distress call should be made. If you have already contacted your supervisor for assistance from another company vessel you will need to update them on the situation.

If you are unsure whether or not assistance is on the way a distress call needs to be made. This may be done over the radio or by using any of the recognized distress signals as described in Chapter 15.

Practical

On the practical part of this course you will use a dry chemical extinguisher to put out a small fire. (If local fire conditions permit.)

Chapter 15- Survival and Rescue

If you need assistance, any of these recognized distress signals may be used to attract attention. If you see any of these signal, you are required to assist, so long as it does not put your own vessel or crew in danger, as discussed in Chapter 2.

Marine SAR Co-ordination on Coastal and Great Lake waterways

When you place a distress call, the situation is managed, and Search and Rescue resources dispatched by Canada's Department of National Defence.

DND maintains Search and Rescue Co-ordination Centres (RCC) in Victoria B.C., Trenton ON, Halifax N.S. At the centres, both DND and Canadian Coast Guard trained personnel co-ordinate Search and Rescue (SAR) operations involving ships, pleasure craft and aircraft on the Canada's coastal waters.

Search and Rescue on Inland Waters

Other than on the Great Lakes, Search and Rescue on the local inland waterways does not totally rely on voluntary responses by "vessels of convenience" (boat in the right area at the right time).

Marine SAR responsibility for land locked waters is a civil responsibility, often under the jurisdiction of the local Fire Department. However, we strongly suggest the Operator confirms the following with your local rescue officials:

- Who is responsible for water rescue services in the area?
- Is VHF Channel 16 monitored in the area?
- What emergency number should be called?
- What resources are available?

Distress signals

1. A gun or other explosive signal fired at intervals of about a minute.

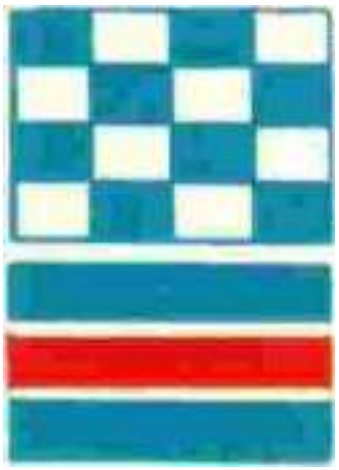
2. A continuous sounding with any fog-signaling apparatus.

3. Rockets or shells, throwing red stars fired one at a time at short intervals.

4. A signal made by any signaling method consisting of the group (SOS) in the Morse Code.

5. A signal sent by radiotelephony consisting of the spoken word MAYDAY.

6. The International Code Signal of distress indicated by the flags N and C.



7. A signal consisting of a square flag, shape or anything resembling a square shape having above or below it a ball or anything resembling a ball.

8. Flames on the vessel.

9. A rocket parachute flare or hand flare showing a red light.

10. A smoke signal giving off orange colored smoke.

11. Distress Dye Marker.

12. Slowly and repeatedly raising and lowering arms out-stretched to each side.

13. A piece of orange canvas with either a black square and circle or the symbol appropriate.

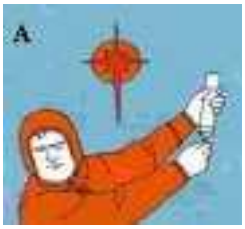
Flares

Pyrotechnic distress signals (flares), must be carried on board all non-pleasure vessels. Flares must be approved by *Department of Transport, Canada* as described in the *Small Vessel Regulations, Equipment Standards*. Marine flares are specialty emergency firework devices designed to signal for help. There are four types of a*pproved pyrotechnics A, B, C and D*. These pyrotechnics are to be used only in time of distress! There are severe penalties for firing flares when no emergency exists. Flares should be stored in a cool, dry location and in a watertight container that is always readily accessible to the crew.

Flares have a shelf life and do eventually expire. Unfortunately, most manufactures have chosen to label flares with the date of manufacture, not the expiry. Flares are only valid for four years from the date of manufacture. To dispose of expired flares, contact the nearest law enforcement agency, Coast Guard or fire department.

Type A Parachute Flare

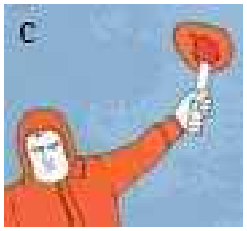
Easily observed from surface or air. Possibly 2-3 second delay after pulling fire pin. Illuminates for at least 40 seconds and rises to a height of 230 metres. Best used to attract attention from vessels and aircraft, at night or in the daytime.



Type B Multi-Star

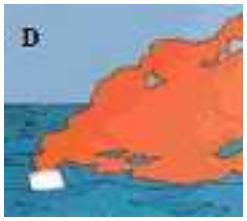
Easily observed from surface or air. Illuminates 4 to 5 seconds. Some Type B Flare project only one star at a time. When using this type make sure you have at least twice the number of cartridges in order to comply with the regulations. Stars should be fired in groups of two with a delay of not more than 15 seconds between them. **You may see this signal from a pleasure craft- Type B flares are not legal on non-pleasure vessels.**

Type C Hand held



Limited surface visibility. Best for pin-pointing location during an air search; will illuminate for at least 1 minute. Avoid looking directly at flare while burning; hold it well clear of the boat and down wind. Best used and observed during an air search at night- especially to allow an aircraft or vessel to home in on your position.

Type D Buoyant smoke float



Smoke flares produce a bright orange smoke. They are a day distress signal only. Burns for 3 minutes. Always position smoke flare down wind. Best used and observed during an air search in daylight- especially to allow an aircraft or vessel to home in on your position.

Marine VHF Radio

If your are in an area of VHF coverage, and you need to use the radio for a distress call, the following procedures should be followed:

Frequencies to Be Used

The first transmission of the distress call and message by a vessel should be on the Marine VHF Radio distress, calling and answering frequency of Channel 16 or by initiating an auto-matic “ALERT” on Channel 70-DSC. If no response is heard on either of these frequencies, the use of any other available frequency in an effort to obtain assistance is permitted.

The Distress Call

The distress call will only be sent on the authority of the Operator or person in command of the vessel.

The distress call should comprise the following:

- The distress signal MAYDAY spoken three times.
- The words THIS IS.
- The name of the vessel in distress spoken three times.

 Particulars of vessel's position; (Position: Latitude 49 52 North, Longitude 064 35 West- or a description such as "two miles west of Snug Island")

 Nature of distress and kind of assistance required (that is, what has happened).

 The number of persons on board and injuries (if applicable).

 Any other information that might facilitate rescue.

Digital Selective Calling (DSC) equipped marine VHF radios

Many marine VHF's now come with DSC. The basic concept of the Digital Selective Calling equipped VHF radios is that Search and Rescue authorities ashore, as well as vessels in the immediate vicinity of the ship (or persons) in distress, will be rapidly alerted to a distress incident ensuring that a coordinated search and rescue operation will begin with a minimum of delay.

When activated by the operator a digital distress message is transmitted complete with vessel identity, time, nature of distress and position (if DSC unit is connected to a navigation receiver).

If your vessel is not equipped with a GPS for example, and you are on a small inland lake, you may get a quicker response from local "vessels of opportunity" by using channel 16, if you have time to do so.

Read the owner's manual, for instructions for the use of your VHF radio's DSC functions.

Cell Phones

There is a great marine feature available through many providers of cellular phone coverage. If a cellular phone is on board the vessel assistance can be contacted by dialing *16. This call in most areas will connect the operator directly to the nearest Marine Emergency Centre (memory hint - Channel 16 VHF is the distress and calling frequency). The Canadian Coast Guard do not recommend equipping a vessel with a cellular telephone as an alternative to carrying a marine VHF radio. The advantage to using a radio as opposed to a cell phone is that any vessel with a radio can hear and possibly respond more quickly than resources being dispatched from RCC.

The Effects of Cold Water

The ability to work an extended day on the water will be affected if the crewmembers are cold. Don't be fooled by warm days ashore. In the Canadian climate, once you leave port and start working on the water, the surrounding air temperature will drop quickly. Staying warm will not only make the difference between a very happy or very unhappy crew, it could save your life.

The Four Stages of immersion in water

There are many recent studies accepted by Transport Canada concerning the dangers of working within the marine environment and cold water immersion. Today it is medically recognized that there are four stages of immersion in which death can oc-cur. These are:

1. Cold shock (kills within 3-5 minutes after immersion).

2. Swimming failure (kills within 30 minutes after immersion).

3. Hypothermia (kills after 30 minutes of immersion).

4. Post rescue collapse (kills at the point of rescue or up to several hours afterward).

The dangers associated with the Four Stages of immersion

The dangers associated with the Four Stages cannot be underestimated. Death can be linked with each of the above stages. Respectively these are:

1. Drowning, heart (circulatory) and respiratory problems.

2. Impaired physical performance leading to inability to self-help, swimming failure and drowning.

3. Deep body cooling leading to hypothermia and drowning.

4. Collapse of arterial blood pressure leading to cardiac arrest.

Historical cold water immersion training

Up until the late 90's, the problems associated with Stages 1-2 and 4 have largely been considered of academic interest only. However, it is now recognized that stages 1, 2 and 4 can have a profound influence on survival probability as the water temperature falls and the sea state worsens.

Historically, there has been a preoccupation with hypothermia. This has been reflected in the predictive survival curves based on the time to reach hypothermia. Thus, excellent teaching and training programs, standards and equipment have been developed aimed at reducing this

The initial responses (Stage 1) peak in water below15ºC. Swimming failure (Stage 2) occurs much sooner in cold water than in warm water, even with good swimmers. As a consequence, individuals tend to grossly overestimate their swimming capability in cold water. It has now been proven that a person's swimming ability in warm water bears no relationship to that in cold water. This is a little known, but fundamental factor in the cause of death.

From all the combined research on cold water accidents and scientific research, it is now reported that sudden immersion in cold water, (i.e. below 15°C) is very dangerous. It should be avoided if at all possible. Furthermore, a conscious decision to swim (and rescue oneself) or stay floating still in the water should not be taken lightly without assessing the pros and cons.

Currently within Canada, there are hundreds of thousands of mariners and passengers being transported for business or pleasure on coastal waters, inland waterways, lakes and rivers. Depending on the local climate, transportation may occur throughout the year or be limited to when the passage is ice free. Irrespective, for a large portion of the year, particularly the winter, spring, and early summer, the water is cold.

Describing the Four Stages of immersion in water

Stage 1 - Cold Shock

On initial immersion, there is a large gasp for air followed by a four-fold increase in one's breathing rate, i.e. severe hyperventilation. This on its own can cause small muscle spasms and drowning. Along with this, there is a massive increase in heart rate and blood pressure. These latter cardiac responses may cause death, particularly in older, less healthy people. These effects last for the first two to three minutes, just at the critical stage of ship abandonment.

Stage 2 - Short-term immersion or swimming failure

Death at this stage, between three and thirty minutes after immersion, appears to affect those who try to swim. It is also known that even good swimmers may be unable to swim for more than a few minutes in very cold water. For example, "A good swimmer aged 20 recently disappeared within 5 minutes while he was trying to swim 50 yards from an overturned dinghy in calm water of a reservoir at 10ºC to 11ºC." The cause was thought to be due to the respiratory and cardiovascular responses already started in the initial immersion. An alternative theory was that the cold water contact with the nose and mouth induced the "diving response". This causes breathing to stop, a slowing of the heart rate and even cardiac arrest.

Stage 3 - Hypothermia

After thirty minutes or more of immersion, death may occur from hypothermia. The reason for this is that water has a specific heat 1000 times that of air and a thermal conductivity of about 25 times that of air. Thus, when a body is immersed in water below body temperature (37ºC), it will inevitably cool to hypothermic levels at a rate dependent on:

• Temperature differential.

• Clothing insulation.

• Rate of agitation of the water.

• Body heat production produced by shivering and exercise.

• Ratio of body mass to surface area.

• Body fat thickness.

• State of physical fitness.

• Diet prior to immersion.

• Physical behavior and body posture in the water.

As the core body temperature falls, the mariner will lapse into unconsciousness. Death may occur in two ways – drowning through incapacitation and cardiac arrest. If the core body temperature continues to fall, death occurs on average from cardiac arrest somewhere below a body core temperature of 24ºC. Death from drowning will occur in a lightly dressed individual even wearing a lifejacket, approximately one hour after

immersion in water at 5ºC, or two hours in water at 10ºC, or in six hours or less at 15ºC. The above survival predictions are made from experimental data and case histories from shipwrecks.

Symptoms and Treatment of Hypothermia

The following are signs and symptoms of cold water immersion. They represent the impact on the mental and muscle functions of persons exposed to hypothermia as it progresses:

Mild Hypothermia

Mild Hypothermia is characterized by Shivering and slurred speech, but the patient is conscious

Patients may lack co-ordination, be irrational, confused or sleepy.

Mild hypothermia is treated by allowing the patient to warm themselves- wrap them in warm blankets, or anything else you might have to help retain body heat. If you have anything warm to give them to drink you may do so as long as it is not caffeine or alcohol.

If you can get the patient indoors, them you may remove wet clothing and replace it with dry clothing or warm blankets.

Keep the patient company and monitor the situation.

Get medical advice as soon as possible.

Deep Hypothermia

Deep Hypothermia is characterized by irregular or absent pulse or respiration, lack of shivering and loss of consciousness at final stage.

A patient suffering from deep hypothermia cannot warm themselves so must be actively warmed. The best method is to get the patient to as warm a place as possible, wrap them in blankets to retain heat, and use the body heat of another person to warm them by body contact. The other person should wear light clothing, so they do not become hypothermic, and both patient and helper should be closely monitored. Change the person providing the body heat when possible to prevent having another hypothermic victim to deal with. As with mild hypothermia, if you can get them to a warm place indoors, then wet clothing can be removed and replaced with dry clothing, and warming continued.

It is important to warm the core of any hypothermic victim before the extremities. If the extremities are warmed (e.g. by rubbing the arms and legs) this will cause cold blood to circulate to the core, possibly causing cardiac arrest.

Do not give alcohol to hypothermic victims, mild or deep, and do not use alcohol to give a feeling of warmth in any situation. Alcohol dilates the blood vessels and increases heat loss from the body.

Do not give caffeine to a hypothermic victim as the heart is in a weakened condition, so extra stimulants could produce cardiac arrest.

Stage 4 – Post-rescue collapse

Up to twenty percent of immersion deaths occur during extraction from the water, or within hours after rescue.This is generally due to cardiac arrest in certain situations where the person being rescued suffers from being lifted from the supportive water environment, into the field of gravity, while in a weakened state. The blood tends to flow to the feet, and in some cases the heart cannot compensate, and cardiac arrest results. Taking the person from the water in a horizontal position and keeping their feet elevated while in a rescue boat helps prevent this from happening.

What to do in the water

When in the water this is what you can do to help stay alive and increase your chance of being rescued.

H.E.L.P. position

If a mariner falls into cold water, conserve energy by not exerting oneself and do not try to swim to shore. Do not discard any clothes (except for heavy rubber deck boots) for the trapped air will provide flotation and offers some insulation against the cold. While wearing personal flotation devices or lifejackets, some positions can help a crewmember survive longer when immersed in cold water.

If alone, climb onto a nearby floating object to get as much of the body out of or above the water, otherwise adopt a *Heat Escape Lessening Position* (H.E.L.P.) by crossing arms tightly against the chest and by drawing the knees up close to the chest.

Huddle Position

If in a group, *huddle* with other crewmembers by getting the sides of everyone's chest close together with arms around mid to lower back and legs intertwined. This helps conserve heat and makes an easier target for rescuers to see.

Should you swim?

If you find yourself in the water, the best option is to stay on top of an overturned boat, or a swamped boat, so you can get out of the water as far as possible, and to make it easier to locate you and your passengers.

However, there may be occasions where is becomes necessary to swim.

When you should not swim

If you are far from shore, and not wearing a lifejacket.

If your position is known, so that there is a reasonable chance of being rescued if you stay where you are.

When you may consider swimming

If you are wearing a lifejacket.

If you are reasonably close to a safe refuge- somewhere you can get out of the water.

If you cannot get out of the water where you are- e.g. on top of an overturned boat

When you should swim.

If your position is unknown- e.g. you were not able to get off a distress message.

If you are reasonably close to a safe refuge.

You are wearing a lifejacket.

This decision must be taken by the operator, and be adhered to by the whole group. The most important consideration is keeping everyone together for the following reasons:

- Warmth
- Ease of location
- Moral support
- Ability to assist weaker survivors.

Any swimming should be done in one or two groups, by chain swimming, using a resting stroke such as the side stroke. This is practiced in the practical part of the course. Chain swimming using a resting stroke conserves energy- energy not used for swimming is used by the body to keep warm- and keeps everyone together.

If you decide not to swim, use the huddle position in one or more groups, for the same reasons as noted above.

Passenger Control

While a small open boat with less than 12 passengers is not the same situation as a sinking cruise ship, passenger control is an issue in any case. While you may be used to boats and the water, this environment may be completely unfamiliar to your passengers.

In this situation, passengers need leadership and reassurance from you. Be calm, and keep the passengers informed. They will be able to hear everything you say over the radio, and will be able to see everything that is going on. If you perform your duties in a calm and competent manner, your passengers will be a lot more co-operative.

If you do not appear to be in control of the situation, passengers may decide to save themselves, or engage in other behavior that is counter-productive to your situation.

To do this-

- Speak with confidence and authority
- Be assertive, but not confrontational
- Speak slowly and clearly, ensuring that everyone can hear
- Give passengers the information that you have, but if you don't know, don't guess
- Practice emergency situations on a regular basis, so you can carry out your duties with confidence

It is also important to:

- Keep families together- e.g. in the water, or if being picked up by another boat
- Make use of passengers who may have special skills, such as another person trained in first aid
- Keep an eye on passengers- look for people who may be panicky, or could become disruptive. Find something useful for them to do if possible, and speak directly with them to find out if anything is troubling them, if they are confused or perhaps didn't hear what you have said to the other passengers.
- Be aware of passenger who may have special needs- e.g. English is not their first language, people with disabilities or the very young or elderly who may be more susceptible to cold water immersion.
- Remember- It is important to give a good passenger safety briefing, answer any questions passengers may have at that time, and ensure that you know how you are going to look after any passengers with special needs, before they get in the boat.

Practical

On the practical portion of this course you will learn to:

- Don a lifejacket or PFD and enter the water correctly
- Use the HELP and Huddle positions when in the water
- Swim individually and in a chain while wearing a lifejacket or PFD
- Use a hand flare

Chapter 16- Maintenance of Skills

On larger vessels, the Fire and Boat Drill regulations require monthly drills on non-passenger vessels, and drills every week, or two weeks on passenger vessels, depending on the voyage. These regulations do not apply to your vessels, but the principles are the same:

The purpose of drills is to:

- Practice using the equipment- fire extinguishers, life jackets etc.
- Inspect equipment- each time equipment is used in a drill it is tested and inspected.
- Pre-plan for real emergencies- working out how you are going to respond to a given scenario in advance means you don't have to think about it in an emergency
- Improve your performance- each time a drill is held, a post drill discussion helps you decide how to improve your response the next time- more practice might be needed in a certain area, procedures may be changed or updated, or equipment repaired, replaced, or an improved piece of equipment purchased.

Also, in your situation, response to an emergency will involve shore staff as well as the boat operators, and probably other resources such as local emergency services. Any time you have a drill this is an opportunity to test your communications both within the camp and outside. Emergency organizations also need to practice what they do, so why not plan a joint exercise with one or more of these organizations?

Make sure you plan a different scenario each time you have a drill or exercise, each time you do something different you have to rethink your plan, use different equipment and people, and have an opportunity to try new ideas- no two emergencies are ever the same, so make sure your drills aren't either.

Besides making sure your organization is prepared to deal with an emergency, it also increases your personal confidence- this course just provides you with the basics- to use the skills you've learned today takes practice.

Chapter 17 -Navigation

This chapter covers basic navigation of a small boat where basic piloting skills, as discussed in Chapter 8, are not sufficient to ensure a safe trip. This could be because your operational area takes you out of sight of land, you are required to operate in fog or other type of reduced visibility, your operational area is not marked with buoys or other easily used visual landmarks, etc.

So, when your eyes alone are not sufficient to tell you where you are and what direction you are going in, instruments and the knowledge and skill to use them, are required. This is the difference between pilotage, and navigation; pilotage involves learning landmarks and following them, much as you would drive your car to work every day; navigation involves laying out your route on a chart (whether paper or electronic), periodically plotting your position in relation to that route, and adjusting your course accordingly, until your either reach your destination, or you arrive back into an area where your pilotage skills can be used again. Of course your trip may combine pilotage and navigation.

In this chapter we will cover the basic principles of navigation and the use of four basic tools you need to navigate a boat.

The two essential tools are

- the magnetic compass, and
- nautical charts. Charts may be paper or electronic. Related publications such as tide tables (if you are in salt water) and sailing directions provide additional information.

Two additional tools which make navigation more convenient are

- radar, which provides information on other vessels around you and can be used for positioning information related to the land around you, especially in darkness or poor visibility, and

GPS, short for Global Positioning System, which tells you where you in terms of latitude and longitude are as well as providing course and speed information.

> GPS positions, Radar information and electronic charts can all be displayed on the same display, as well as passage plan (route) information; when operating a small boat this is likely to be the preferred method of navigation, as opposed to paper charts, simply because the operator can still maintain a proper lookout, steer the vessel, and navigate, without being distracted by manually taking bearings etc. and manually plotting them on a paper chart.

Basic Navigation Principles

Passage Plan

Navigation, like any trip, starts with a plan; that is, you need to mark the route – for example between the dock where you are picking up passengers and the camp. Normally, as discussed in chapter 8, you are following a regular route, which will be already marked on your paper or electronic chart. Navigation simply involves periodically determining where you are in relation to your planned route, marking that position on the chart, and correcting your course and/or speed as necessary to remain on track and safely reach your final destination.

Lines of position (LOP)

LOP are the basic elements in navigation, no matter what the positioning method. For example, using the chart to the right, if you are approaching land from the southwest and see that the range light on Snug Island is in line with the range light on Walton Island, you know that you are somewhere on the dotted line already shown on the chart. A bearing on another identifiable object or two objects in transit will provide a another LOP and where the two lines cross is your position.

Different sources for lines of position can be combined to give your position, also known as a "fix". For example, your radar is commonly used to measure your distance off land- if you measured your distance off Walton Island at two miles, you would know that you are somewhere on a circular line of position, two miles from the island. If you did this when the two range lights in our first example were in line, your position would be on the dotted line, two miles from Walton Island.

Once you plot your position on the chart you can compare it to the track you are following and adjust your course accordingly, as you may have gone off course due to wind, current, poor steering, or any number of reasons. It is also important to note the time of each position, so that you can check your speed; if your position shows you further along the track than you expected, or not as far, again you may be affected by wind, current, or a navigation error.

Relative bearings

A relative bearing is measured from 000º at the vessel's head (bow) in a clockwise direction to the target sighted. Small vessel radar commonly gives relative bearings to

targets. These bearings must be changed to True before being plotted on a chart. To do so, the operator must know the true course of the vessel.

For example, if the Operator is steering a true course of 050º when a bearing is taken on a distant light house. The bearing is 065º relative. To find the true bearing of the light house the operator must add the course steered to the relative bearing. Therefore, (050º + 065º) = 115º. If the result through addition of the course and relative bearing is more than 360º, then subtract 360º.

Pelorus

A pelorus is basically a protractor with sights which may be used to measure horizontal angles, relative bearings and determine compass bearings. Since the instrument is unaffected by magnetic influences it may be used from any location aboard from which a line of sight can be made. The caution to be observed when using the pelorus is that the instrument must be accurately aligned with or be parallel to the centerline of the vessel whenever it is set up for making an observation.

Determining position

The objective of navigation is the accurate determination of the vessel's position. The ability to determine position quickly and precisely under a variety of weather and sea conditions is the primary goal of navigation.

Observed Position

The name Observed Position is given to any position obtained from observations of terrestrial objects (charted fixed objects ashore) or from any electronic navigation instrument such as radar or GPS.

Departure Position

Before leaving harbour, or visual sight of a shoreline, it is necessary that the position of the vessel be determined from terrestrial observations, or GPS, in order to obtain a reliable Observed Position from which the original course may be set and plotted. This is known as the Departure Position.

Distance, speed and time

The basic distance speed and time equation can be used for planing purposes of course as shown in the three following examples:

The formula used to solve for distance, speed or time when any of the variables are known is: 60D = ST where:
D = the distance in nautical miles,
S = the speed in knots,
T = the time in minutes
60 is a multiplier to allow us to use minutes rather than decimal hours.

When a navigator is using the equation, the distance should be expressed to the nearest 0.1 nautical mile, the time should be determined to the nearest minute and the speed should be expressed to the nearest 0.1 knot.

For example, a vessel is running at a speed of 17 knots. How far will it travel in 35 minutes?

Solution: 60D = ST
60 X D = 17 X 35
D = (17 X 35) ÷ 60
D = 9.9 nautical miles

If it takes a vessel 35 minutes to travel 14 miles, what is its speed?

Solution: 60D = ST
60 X 14 = S X 35
S = (60 X 14) ÷ 35
S = 24 knots

If it is 18 miles to the wharf and the vessel will cruise at 12 knots, how long will it take to transit before docking?

Solution: 60D = ST
60 X 18 = 12 X T
T = (60 X 18) ÷ 12
T = 90 minutes, or 1 hour 30 minutes

And of course, the same equation can be used to calculate your speed between two fixes, and the simplest way to do this is to take two fixes six minutes apart and measure the distance between them; now you can do it in your head:

If you travel 1.0 miles in 6 minutes how far will you travel in an hour? Simple multiply your answer by 10; so you are doing 10 knots. If you know that your boat is supposed to be making about that speed given your engine rpm, then you are more certain that your position is not in error, or that you are not being affected by some unknown current.

Dead Reckoning (DR)

In modern navigation, a Dead Reckoning (DR) position is one that has been worked up from the last Observed Position, making no allowance for current and/or leeway (drift caused by the wind). In the past, when there was no electronic navigation, and ships could not always fix their position when out of sight of land, the DR position was plotted on the chart, to indicate where the vessel should be. Once a position was able to be obtained, it was compared with the DR position; any difference between the two gave an indication of the wind and/or current or other factors affecting the vessels course and speed.

Estimated Position (EP)

Once the wind/current is determined the operator can then apply this to the DR position. This position is known as the Estimated Position (EP). An Estimated Position is the most reliable position obtainable when direct observations are not available.

DR and estimated positions are not used much on a formal basis in modern navigation, but the principle of comparing where you think you should be with where you actually are is important to understand and use; the six minute check, for example, being a “quick and dirty” use of this principle.

Charts and Publications

Canadian nautical charts

Mariners shall have on board the most recent editions of largest scale nautical charts for the area to be navigated. The Canadian Hydrographic Service (CHS) is the agency responsible in Canada for survey, management and publication of nautical charts. CHS authorized dealers are located across the country.

Nautical charts are graphic representations depicting water areas, including the depths, underwater hazards, traffic routes, aids to navigation and adjacent coastal areas. Charts are intended primarily for the use of professional mariners and boaters alike to assist with navigation. Nautical charts should be used in conjunction with other required marine publications and documents to find information concerning:

- The depths of the water.
- The nature of the seabed.
- Hazardous currents.
- Magnetic variation.
- Anchorage areas.
- Harbours.
- Water level and tides.
- Geographical place names.
- Descriptions of physical characteristics of the area.
- Facilities offered in ports.
- Aids to navigation such as buoys and lights

Anatomy of a nautical chart

As seen above, nautical charts contain a tremendous amount of maritime information that is published to aid the mariner to safely navigate his/her vessel. Much of this information is contained in the Title Block and elsewhere around the border of the chart. The edition number and date appear in the lower left-hand margin. Immediately following these figures will be the date of the latest revised printing.

To make chart reading easier, quicker and more accurate, a standardized system of abbreviations and symbols is used. Knowledge of the symbols and abbreviations is a must. The meaning of all these symbols is given in Chart No. 1, a document published by the Canadian Hydrographic service that can be obtained where charts are sold.

Chart scale

The scale of charts is commonly stated as a ratio, i.e. 1:60,000 or 1:25,000. A scale stated as 1:60,000 means that one unit of length on the chart represents 60,000 units of length on the surface of the earth. Therefore a chart scale of 1:60,000 covers a larger surface area and will have less detail than a chart of 1:25,000.

The smaller the scale of the chart the greater the geographic area that can be shown on given size chart paper. It is common to use a small scale for charts of large areas showing only major features with little detail. As the scale becomes larger, the area covered on the

same sheet must decrease but the detail shown will increase. Therefore, charts where greater detail is desired, such as harbour charts, or harbour approaches will commonly be to scales as 1:25,000 or 1:12,000 or larger.

For example, the chart of the entire Lake Ontario, Chart L2000, is to a scale of 1:400,000. Chart L2000 is known in the industry as a small scale chart. Chart 2062, "Oshawa to Toronto" is to a scale of 1:72,000 (a relatively larger scale) while the chart "Toronto Harbour and Approaches", chart 2065, is to a scale of 1:12,000 (a large scale chart). The important issue to observe is that as the scale gets larger, the amount of detail shown on the chart increases.

Projection

A chart is a graphic representation of a portion of the surface of the earth. As the earth is a sphere, some distortions occurs when the curved surface is applied to the flat projection of the chart paper. Operators using Canadian charts will mainly encounter charts produced by Mercator projection, where lines of longitude appear parallel.

Datum

Datum is a reference level from which depths and heights shown on the chart are measured. In coastal waters where there are tides, two datum references will be given. One datum for soundings reduced to lowest normal tides and the datum for heights based on higher high water, large tides.

On inland waters where there is no tide, one datum level is used for both soundings and heights. On Lake Ontario charts, datum is when the gauging station at Kingston, Ontario, reads 74.0 m (242.8 ft.). Actual current water levels can be obtained from the DFO website, phone gauges and other local sources of information- you could even create your own gauge at your dock if you have any critical depth areas on your route.

The Title Block of the charts indicates whether depths are measured in fathoms, feet, or metres. A scale bar at the bottom of the chart is sometimes provided to facilitate conversion of the different units. All new charts released by CHS are metric, therefore depths and heights are detailed in metres.

Compass rose

Everything we have talked about so far assumes that north refers to true north; that is, north as related to the geographic north pole. Since small boats use magnetic compasses, which point to magnetic north, every chart has at least one compass rose printed on it. The outer ring of the rose shows true direction. The inner ring of the rose shows magnetic direction. The angle, in degrees, between the True and the Magnetic North direction is known as

variation and is noted on the rose with its annual rate of change. How to use this information is discussed in the section on the magnetic compass.

Latitude and Longitude

On a chart, locations are usually determined through the use of a grid system using latitude and longitude. Latitude is measured along the right and left "margins" of the chart. Longitude is measured along the top and bottom "header/footer" of the chart.

Latitude is measured from 0 degrees at the equator to 90 degrees at either the North or South Pole. Therefore, latitude is referred to as being north or south to indicate in which hemisphere the mariner is working. Longitude is measured from 0 degrees at Greenwich, England, East and West to 180 degrees. Degrees, like hours, are further divided into minutes and seconds- 60 minutes to a degree and 60 second to the minute. Seconds are no longer commonly used, so the scale used usually appears in degrees and decimal minutes- written, for example, as 43º 36.3' (43 degrees, 36 decimal 3 minutes).

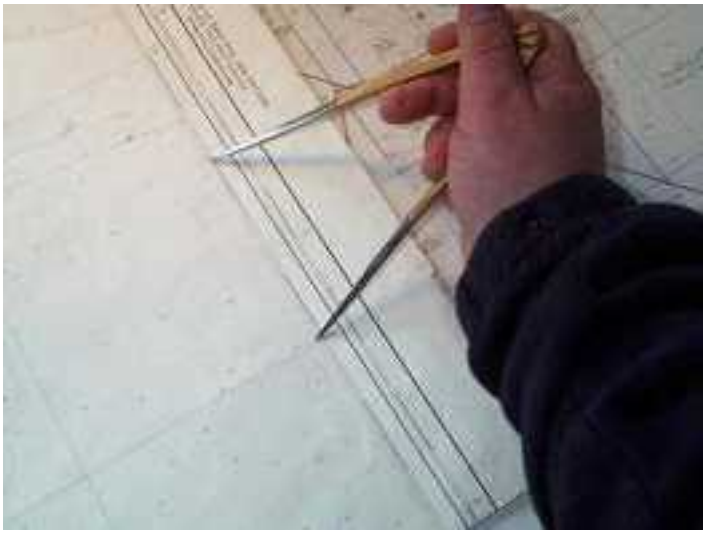
Therefore, any point on the globe can be located by using its latitude and longitude, for example 45º 35.5' N 83º 42.8' W. This is how a GPS will display your position.

Chartwork tools

Here we will discuss the basic tools, assuming a paper chart is being used. Electronic charts have all the same features as paper charts, but how they are displayed and used is a function of the software you have purchased to display the charts; the owner's manual should be consulted as with any electronic product.

Measuring distance

Distance is always measured using navigation dividers on the latitude scale (side margins). Due to distortion of scale in producing the chart projection, scale is true and reliable within a narrow band of latitudes. Therefore, always use the latitude scale immediately to the east or west of the area which you are plotting. (The smaller the scale, therefore the more degrees of latitude covered by the chart, the more this matters. On large scale charts likely to be used by small vessels this is of little consequence.)



One minute of latitude equals one nautical mile. Use dividers (see photograph) to measure distances. Long distances are stepped off. For instance, 26 miles could be stepped off in 5 steps of 5 miles, plus 1 step of 1 mile.

Measuring bearings and courses

Bearings are measured with a set of parallel rules (see photo). Bearings and courses are plotted as true on the chart. Therefore, the outer circle of the compass rose is used.

To lay off a course line, set the parallel ruler (see photograph) on the compass rose so that one edge of the ruler is aligned through the centre of the rose and the desired course on the outer circle.

To determine a bearing, say between two objects, set the parallel ruler so that one edge passes through both objects. Then "walk" the parallel ruler to the compass rose so that one edge of the ruler passes through the centre of the rose. Read the bearing from the outer circle. When reading a bearing from the compass rose, be careful to know the sense of the bearing. That is, is the bearing from A to B or B to A. This is the normal procedure for laying off course lines as well.

A pair of compasses is also useful for laying off distances from a given object or point of land- the intersection of two circles of distance will give your position just as would the intersection of two bearing lines.

Canadian Tide and Current Tables

Tide tables provide predicted times of high and low waters associated with the vertical movement of the sea tide in Canada's coastal waters. These tables are necessary for obtaining the depth of water under the keel of a boat or over a shoal, for anchoring, docking or for establishing the appropriate times for beaching a boat.

Current tables provide predicted times for slack water and the times and velocities of maximum current associated with the horizontal movement of the tide. These tables are available in separate volumes based on geographical coastal zones of the country through Canadian Hydrographic Service dealers. Tide and current information for local areas can also sometimes be obtained on public radio or television or in daily newspapers.

Canadian Sailing Directions

Sailing directions provide information on land features, hazards, port facilities etc. for the Great Lakes and coastal areas of Canada, as well as certain popular inland areas. These are of more use for planning longer voyages, but can also be of use locally as they also provide photos of prominent features to assist the navigator in identifying landmarks.

The Magnetic Compass

The magnetic compass is used to provide directional information to the boat operator.

A magnetic compass has primary magnets that are located on the reverse side of the compass card. These serve to assist the compass in seeking magnetic north. Secondary magnets are located in the compass base or binnacle. These can be adjusted to reduce error between the magnetic heading and the actual compass heading observed on board.

Fluid is used in the compass bowl to dampen vibration and oscillation of the card and expansion bellows are located in the lower section of the fluid container to allow for changes in the volume of fluid due to expansion and contraction as the temperature changes.

Check your owner's manual for instructions on how to adjust the magnets in your compass and how to top up the fluid if necessary.

The Operator should know its principles of operation and always remember that it seeks Magnetic North, not True North. However, charts are drawn in relation to true north, so we will learn how to convert between the two.

There are two factors which cause a difference between north as shown by your compass (referred to as compass north, or compass heading) and true north- variation and deviation.

Variation

Variation is the error in compass reading due to the geographic and magnetic poles not being in the same place. This error is the angle between True North and Magnetic North as shown on the compass rose on the chart. Variation is dependent upon the geographic location and is stated as being either east or west. Since the magnetic pole is constantly shifting, variation in any locality will change over time. The rate of change is shown on the compass rose and variation should be corrected to the current year before being applied to any navigational plot. Variation does not change with the vessel's heading.

Deviation

Ferrous (iron and steel) materials or electronic equipment on board a vessel can set up magnetic fields that will affect the magnetic compass. The effect is to deflect the compass from magnetic north. The error produced is known as deviation. Deviation is the angle, in degrees, between Magnetic North and Compass North. The error is always either east or west and will change with the vessel's heading.

Correcting for deviation and variation

The operator steers the vessel by compass and plots the position on the chart using true bearings. Therefore, the operator must be able to move from one type of bearing to the other rapidly and accurately. The steps involved in going from a compass reading to a true reading are:

Compass
Deviation
Magnetic
Variation
True

(A memory aid often used to help recall the steps is: Can Dead Men Vote Twice)

When correcting a compass course to true, Easterly errors are added while Westerly errors are subtracted. (A memory aid for this is **C**ompass **AD**d **E**ast to get **T**rue- spells CADET)

Example: Covert a compass course of 180º to a true course. Variation in the area is 20º E and the deviation is 5º west.

Compass- 180º
Deviation- -5ºW
Magnetic- 175
Variation- +20º E
True- 195º

Plotted true chart course reverted to compass course

When the operator plots a course on a chart the value will be a true course. This true course must now be converted to a compass reading in order to steer the vessel. The steps involved are as follows:

True
Variation
Magnetic
Deviation
Compass

Example: Convert a True course of 200º to a compass course. Variation in the area is 20º E and the deviation is 3º west.

True- 200º
Variation- 20º E
Magnetic- 180º
Deviation- 3º W
Compass- 183º

Finding compass deviation – Deviation Card

The easiest way to correct your compass for deviation, called "swinging the compass" is to hire a professional TCMS certified compass adjustor who will spend a morning on your boat. For most small vessel operators, however, you can swing your own compass with sufficient accuracy for most uses.

Step 1: On a chart, find two objects that line up directly north magnetic, such as a pair of radio towers. Steer toward the objects and keep them directly in line while checking your compass. If it doesn't read 000 degrees or north, it needs to be adjusted.

Step 2: Most compasses have a pair of compass adjusting screws marked N-S and E-W. Turn the N-S screw until the compass reads directly north, and then turn the boat south, keeping the same objects in line while you again adjust the screw to remove half the southerly error. Turn north once more and remove half the error again, which should give you a good N-S adjustment.

To correct the compass for east-west error, repeat the procedure with a pair of objects aligned in those directions. To complete the process, use other known objects to check the deviation every 20 degrees to 30 degrees around the entire compass and make a deviation card that shows the error on each course.

A simple deviation card for a small boat might look like this:

Magnetic	Deviation	Compass
000	6W	002
045	3W	046
090	0	090
135	3E	134
180	6E	178
225	3E	222
270	0	270
315	3W	318

Make copies of the deviation card and laminate one in plastic so you can leave it at the helm to check in all conditions.

In the illustration to the right, a magnetic compass is mounted above an auto-pilot system.

The casing is aluminum to prevent deviation. However there is also a wire to the autopilot unit which may cause a magnetic field, as may the unit itself. Also the steel chain just ahead of the compass will cause deviation. So can a large knife on the operator's belt or other ferrous objects- a toolbox full of tools set beside the steering console for example.

So, when you are creating your deviation card, and when operating the boat first eliminate any moveable sources of magnetism- that is, loose ferrous objects, and make note of whether electronic equipment in the vicinity is on or off- turning equipment on and off while watching the magnetic compass will tell you whether or not the equipment is affecting the compass. If it does you should have two deviation cards- one with the equipment on and one with it off. It may be more convenient, however, to relocate either the equipment or the compass to a better position.

Marine Radar

Radar is an aid to navigation. Vessel navigation using radar in limited visibility depends on the Operator's experience and training with radar operations. It also depends on the Operator's knowledge of the local operating area and is not a substitute for an alert visual lookout.

Basic principle

Radar radiates radio waves from its antenna (also called the scanner) to create an image that can give direction and distance to an object. Nearby objects (contacts) reflect the radio waves back and appear on the radar indicator (display) as images (echoes). The radar scanner transmits a beam with a horizontal beamwidth of 2 to 6 degrees, depending on the length of your scanner. The antenna rotates mechanically, taking a few seconds for each rotation, and "paints" a picture on the display, which is refreshed with each rotation.

Advantages: Advantage of radar include:

- Use at night and during low visibility conditions.
- Ability to obtain a fix by distance of two or more charted objects or range and bearing.
- Assistance in preventing collisions.

Disadvantages:

- Mechanical and electrical/electronic failure.
- Minimum and maximum range limitations.
- Paying too much attention to the radar can distract the operator from keeping a good visual lookout

Safety- Antenna Placement

It is extremely important to place the radar scanner high enough in the boat so that passengers and crew are not exposed to the electromagnetic radiation emitted by the scanner. Radar scanners, unlike radio antennae which are omnidirectional, emit a directional beam. Check the specifications of your scanner, but generally radar scanners have a vertical beamwidth of 35 degrees above and below the horizontal, so if you have an existing installation this should be checked and new installations should be planned with this in mind.

If for any reason, a person is required to work near the scanner the radar should be locked out and tagged to prevent someone accidentally turning it on.

Placing the scanner as high as practical will also give you a better picture- you will be able to pick up objects in the water (such as buoys) more easily and you will be less subject to sea clutter. Sea clutter is the reflections of nearby waves on the screen, which tends to mask nearby targets- this can be controlled, but good antenna placement will help.

The scanner should also be placed where objects on the boat such as a mast, house or exhausts will not cause blind spots on the radar display.

Reading and interpreting the radar display

Interpreting the information presented on the radar display takes training and practice. The display screen displays a bright straight radial line (sweep trace) extending outward from the centre of the display. It represents the radar beam rotating with the antenna. In turn, images are displayed on the display as patches of light (echoes).

The centre of the radar display represents the position of the vessel. The display provides relative bearings of a target and presents a map like representation of the waterway around the vessel. The direction of the target is represented by the direction of its echo from the centre and the target's range is represented by its distance from the centre.

Main Controls

Since all radars work on similar principles, they tend to have common controls, so that the operator can adjust the display to provide the best image.

Brightness

As with a computer monitor, the brightness control adjusts the overall brightness of the screen. It is important to keep the brightness as low as possible when using the radar at night so that it does not interfere with night vision.

Gain

Gain controls the strength of the return echo- gain should be adjusted to give targets that are clear but not too bright- excessive gain will "smear" the picture, resulting in further inaccuracy in bearings, and possibly causing objects near to each other to appear as one object on the screen.

Sea Clutter

As mentioned earlier, reflections of nearby waves on the display "clutter up" the centre of the screen. Too much clutter can mask small targets such as buoys or small boats; the sea clutter control reduces the gain in a small area around the centre of the screen only. It should be adjusted to show a small amount of clutter, so you know you haven't set the gain so low as to eliminate genuine targets. Watch the targets of objects such as buoys on the screen as you approach them to make sure they remain visible as they approach the centre of the screen.

Range

The range control determines the "scale" of your radar display, that is the distance from the centre to the outside of the screen. This can normally be adjusted from approx. half a nautical mile to 24 miles or higher. The range should be adjusted by the operator, based on conditions, and what the radar is being used for at the moment. For example, 12 mile range will give good advance warning of an approaching ship, but will not provide a good image of a buoy you are trying to approach that's only a half mile away- 3 to 6 mile range would be more practical in that situation.

Bearing cursor

This is an electronic line on the screen which is used to take bearings from the vessel to other vessels or objects.

Range rings

Most radars have fixed range rings which can be turned on and off as required, and a variable range ring (or 2) which can be adjusted to measure distance.

Orientation

Most radars can be adjusted to provide either a North Up display, which matches the orientation of your charts, or Head Up, where the top of the screen is always oriented to match the vessel's heading. In most small boats there is no gyro-compass or other heading information for the radar to use, so they are generally used in the Head Up mode.

Use of Radar for positioning

Radar is extremely useful for obtaining a position in a small boat due to the convenience of measuring distance and bearings; the magnetic compass is not generally equipped to take bearings, and most small boats do not have a pelorus.

Radar ranges and bearing can be measured and transferred to a paper chart. The radar image can also be overlaid on an electronic chart.

Identification of landmarks

When using radar for navigation is important to understand which landmarks are the most suitable for obtaining accurate ranges and bearings.

Since radar works with the reflected electromagnetic radiation, as discussed earlier, steep land features such as cliffs will provide a good echo and an accurate range when measured by radar. Swampy areas or low shores such as sand beaches do not create a good echo, so it is difficult to take an accurate range or bearing.

When taking a bearing by radar it should be remembered that, especially with smaller scanners (e.g. 24" scanners commonly seen on small boats), the horizontal beamwidth can be up to 6 degrees- this limits the accuracy of bearings as what appears as, for example, a point of land on the chart will appear as a smear on the radar screen. To make bearing as accurate as possible you should estimate the centre of the echo, and use nearby objects so that any error is not magnified by distance. Radar ranges are much more accurate than bearings. Therefore it is preferable to use objects on the beam; any error in

bearing will result in an error along the track which is not so critical as an error across the track. The range to the object, which is much more accurate, will provide the most accurate indication of cross-track error.

Collision Avoidance

Radar watch: It important for the Operator to keep in mind Rule 5 of the Collision Regulations while navigating the vessel.

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

In plain language, radar qualifies as part of the *"all available means"* required by law for a proper lookout- so if you have it, use it.

In using the radar for collision avoidance there are four stages in any potential collision situation; determining whether or not there is a risk of collision, taking avoiding action if required, monitoring the situation until the other vessel is past and clear, and resuming your course.

Determining Risk of Collision

The first step in determining risk of collision is identification of targets- keeping a good lookout both visually and by radar will allow you to identify targets as early as possible, giving you time to assess the situation.

The second step is to take a bearing of the target, and record it manually, or mark the target on the screen, either electronically or manually (grease pencil).

The third step is to watch the target as it “moves” on the screen. If the bearing is not changing, or changing very slowly; in other words the target is moving toward the centre of the screen, a risk of collision exists.

If it is not clear what the other vessel is doing, slow down to give yourself time to further assess the situation.

Taking Avoiding Action if Necessary

As per the collision regulations, if you are the give way vessel, you must take action. Whatever action you take, take it early and make sure that it is substantial enough to be noticed by the other vessel. Avoid making a number of small alterations of course as this will not be readily apparent to the other vessel; they make think you are not taking action and take some conflicting action of their own- many large ship collisions have been caused by this type of situation.

When considering avoiding action, make sure you consider other vessels and navigation hazards in the area and make sure your action doesn’t take you into a hazardous area, or create a new risk of collision with another vessel.

If you are the stand on vessel, you must monitor the other vessel to determine that they are doing what they are supposed to do. If this is not the case, then you must take

whatever action is best to avoid a collision. Often the safest thing to do is stop your boat in this situation.

Monitor the Other Vessel

Once you have taken action, continue to mark, or note mentally, what the target is doing now. If your action was substantial enough, the target should now be moving so as to pass the centre of the screen at a comfortable distance- continue to monitor the movement of the target until the risk of collision no longer exists.

You also need to keep an eye on your own position during this time; since this is an unplanned change to your voyage be sure you don't put your own vessel in danger from rocks, or other vessels which may now pose a threat.

Resume Your Course

Once the risk of collision no longer exists, resume your course. You will probably have to adjust your heading to get you back on to your planned track, so check your position and adjust your course accordingly.

Radar Training

In order to become really proficient with radar, it's wise to enroll in a hands on course. If you are not required by Transport Canada to be a licensed radar operator and don't wish to attend a course in person, there are software packages available for home study.

Additional features: Modern digital radars can be linked to a GPS receiver so critical navigation information can be overplayed onto the radar display, giving the Operator a clearer picture of the land formations close at hand.

Radar also "talks" or "handshakes" to electronic chart plotters, which results in the echoes being overplayed onto a chart if selected by the Operator.

GPS (Global Positioning System)

The Global Positioning System is a satellite-based radio navigation system provided by the US Department of Defense. It permits users with suitable receivers to establish their position, speed and time on land, sea or in the air, at any time of the day or night and in any weather condition. The System is accurate to within 30 metres, which is equal to or better than any other radio navigation system available today. GPS receiver can obtain a position fix anywhere in the world.

You can see that 30 metre accuracy might be fine in the open lake, but may not be accurate enough close to shore. If you only use your GPS offshore this is sufficient for safe navigation, but if you want to use it in closer proximity to hazards, a Differential GPS unit can be purchased, as discussed below.

Differential GPS

Differential GPS is a method of increasing the accuracy of positions derived from GPS receivers. With DGPS receivers, position accuracy is improved, going from 30 metres to better than 10 metres. Canadian Coast Guard (CCG) reference stations correct most of the errors in the GPS signal and transmit these corrections to anyone within the CCG or USCG coverage area who is equipped with a DGPS receiver.
If the receiver on board is designed and equipped for differential corrections, then it will apply the Coast Guard corrections to the observed position making its position much more accurate.
A GPS receiver can be upgraded to receive DGPS signals only if it has been designed as "DGPS ready." This is a useful option for those who do not need the more accurate technology immediately, but think they will in the near future. If you require 10 metre accuracy right now, you can also purchase a DGPS receiver initially.
Caution: While many GPS receivers are advertised as differential "ready", this does not necessarily mean that the differential receiver is already built into the unit. The unit requires an additional receiver module along with a low frequency antenna.

Installation and maintenance

To take full advantage of this service, users should ensure that they have high quality GPS/DGPS receiver equipment which is properly installed in accordance with the manufacturers' instructions.

Obstruction error

The GPS/DGPS signal could be reflected from the surfaces of nearby obstructions. It that happens, the signal may reach the receiver antenna indirectly and positional accuracy may be degraded. This is especially true with handheld GPS units.
Obstructions can include other vessels, mountains, trees ashore and even parts of your own vessel. Indeed, if one stands too close to the antenna, he or she could become the obstruction. Remember, for GPS/DGPS to work the receiver must have clear visibility of the full sky.

Datum error

In addition to the vertical datum discussed earlier, each chart also has a horizontal datum.

Be sure your GPS units "datum" is set to match that of the charts you are using. Check the information block on your chart to see which surveying datum was used when the chart was created. Most charts now use WGS 83. If you do not do this, your GPS position, while accurate in terms of latitude and longitude, may not be accurate in relation to the chart itself; it is where you are in relation to the rocks around you that is important, rather than your absolute position on the earth.

Double Checking

Although its operation is very simple, as with any piece of electronic equipment, the GPS needs to be checked regularly by some other means of positioning.

Each trip, you should compare the position given by the GPS with that given by the radar or other means- if there are discrepancies they need to be corrected. The simplest thing to

do is check the position of the boat when it is at the dock, since its position is then known with the greatest accuracy.

Practical Exercises

In addition to the knowledge items covered in this chapter, he syllabus for the navigation module requires the student to demonstrate the following abilities:

- to plot a position on the nautical chart
- basic nautical chart reading, course and position plotting
- the use of nautical publications (List of Lights, Canadian Tide and Current Tables, Notices to Mariners)

The practical portion of the navigation module is 1 ½ hours in duration. Practical exercises using a paper chart, dividers and parallel rules, or electronic equivalent, to demonstrate the following navigation skills, as appropriate to the location of the camp:

The exercise should be designed to use charts of the operational area normally used by the boat operators, and should consist of a simple passage, marked on the chart by the student, with exercises in positioning, using publications, and conversion of compass bearings.

Suggested skills to be included in the exercise, which should be repeated as time allows to reinforce learning, are:

1. Chart reading
    a. Get basic information from the chart; scale, units of measure, datum, magnetic variation, hazards and warnings, edition date, correction status.
    b. Understand information and chart symbols used for navigation- depths, depth contours, lights and buoys and their characteristics, land and water features and other chart symbols
2. Laying off courses
    a. Laying off a course, given the true bearing
    b. Laying off a course to pass a given distance off land or a hazard
3. Position Plotting
    a. Plot a position given latitude and longitude
    b. Plot a position given two bearings
    c. Plot a position given a radar range and bearing
4. Conversion
    a. Convert true courses laid off above to compass courses to steer.
    b. Convert compass bearings to true bearings to plot on the chart
5. Measuring/Calculation
    a. Measure distances on the chart (course legs, radar ranges) using dividers and the latitude scale.
    b. Calculate ETA’s for course alterations, trip duration etc.
6. Use of publications
    a. Use publications to look up information relevant to the operational area of the camp
    b. Use publications to calculate times and heights of tides, where applicable