Canadian Coast Guard Auxiliary

Search & Rescue Crew Manual

This manual was written in cooperation by the Canadian Coast Guard Auxiliary, Pacific Region and the Canadian Coast Guard Marine SAR Programs, Pacific Region.

Published by The Canadian Coast Guard Auxiliary - Pacific Region, 2002, 2006, 2011.

Original Design and Layout by **Vivencia Resources Group**.
Original Front and Back Cover by **Hot House Marketing & Design**.

Revised Version, Design and Layout by **GRIZZLY Communications & Design / B&E Printing** – Sept-Iles - Quebec – 2006, 2011.

This book is a compilation of common practices used in due regard to safety by the Canadian Coast Guard Auxiliary and the Canadian Coast Guard.

While every precaution has been taken to ensure this information is correct, neither the Coast Guard or the Coast Guard Auxiliary, nor any of the authors shall have any liability to any person or entity with respect to injury, loss of life or damage caused or alleged to be caused by the instructions contained in this book.

Photo Credits:

Ryan Woodward: Pages 7, 29, 35, 36, 39, 56, 57 (right), 132, 163, 212 (left), 219 (bottom), 221, 224 (bottom), 226 (bottom), 228, 229, 230, 233 (bottom left), 235, back cover (center).

Boomer: Pages 18 (left), 22, 55, 181, 183, 186 (left), 187 (top right), 191, 222 (top left), 223.

Zodiac Hurricane Technologies: Page 114 (bottom).

C-Tow: Page 233.

ISBN 0-9730217-0-5

Original Edition 2002
Printed by Queen's Printers
Victoria, BC
Canada

Revised in 2006
Printed by B&E Printing
Sept-Iles, QC
Canada

Third Edition 2011
Printed by Queen's Printers
Victoria, BC
Canada

SEARCH AND RESCUE CREW MANUAL
CONTENTS

Introduction

This manual is dedicated to the volunteers of the Canadian Coast Guard Auxiliary who give their time and effort to protect Canadians on our National waters by ensuring safety at sea.

AQUAE NUMQUAM ILLOS MERGENT
The waters will never take them

"I took another look at the chart and realized that things were pretty bad. Not only was Raphael 160 miles away from me but he was also to windward in atrocious conditions. But I had to go, I knew that. It was that simple. The decision had been made for me a long time ago by a tradition of the sea. When someone is in trouble you help."

An excerpt from "Close to the Wind," when, during the 1996 Vendé Globe single hand around the world race, Pete Goss turned his vessel around into hurricane force winds and went back to save Frenchman Raphael Dinelli.

Introduction

Contents

Letter from the President

Dear CCGA Member:

Welcome to the Canadian Coast Guard Auxiliary.

This manual has been designed to provide you with all the necessary core information which, when combined with classroom teaching and on the water practice, will give you the tools you need to be an effective crewmember on a CCGA rescue boat. The time frame for this training, although flexible, is projected at one year. It is the intention of this course to have all members training to the same minimum proficiency throughout the organization. Members moving between communities will be confident that they will possess the required skills wherever they volunteer for duty.

I would like to thank all the dedicated Coast Guard Auxiliary volunteers and Canadian Coast Guard employees who over the years have contributed to the training programs that have preceded this one. Their work was essential in the development of this program. I would also like to recognize the hard work of the many Coast Guard Auxiliary volunteers who helped put this manual together as well as Project Leader Tyler Brand. Many thanks are also due to John Palliser, Superintendent, Canadian Coast Guard for his support to this project from start to finish, and former Coast Guard Auxiliary Training Director John Thomas, whose tenacity made this project a reality.

This manual is a prime example of the excellent work that comes from the partnership between the Canadian Coast Guard and the Coast Guard Auxiliary. Together, we will continue to build a strong team dedicated to saving lives at sea.

Randy Strandt
President, CCGA - Pacific

Table of Abbreviations

AMVER	Automated Mutual Assistance Vessel Rescue System
CASARA	Canadian Air Search and Rescue Association
CCG	Canadian Coast Guard
CCGA	Canadian Coast Guard Auxiliary
CISF	Critical Incident Stress Foundation
CISM	Critical Incident Stress Management
CSA	Canada Shipping Act
DFO	Department of Fisheries and Oceans
DND	Department of National Defence
GMDSS	Global Maritime Distress and Safety System
GSAR	Ground Search and Rescue Association
IAMSAR	International Air and Marine Search and Rescue Manual (volumes I-III)
ICAO	International Civil Aviation Organisation
IMO	International Maritime Organisation
JRCC	Joint Rescue Co-ordination Centre
MCTS	Marine Communications and Traffic Services
MOB	Man Overboard
MRSC	Maritime Rescue Sub Centre
MMSI	Maritime Mobile Service Identification
NSM	National Search and Rescue Manual
NVG	Night Vision Goggles
OBS	Office of Boating Safety
OSC	On Scene Co-ordinator
PIW	Person in Water
RIC	Radio Information Circular
RROC	Restricted Radio Operators Certificate
RSER	Rescue, Safety and Environmental Response
S/V	Sailing Vessel
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite Aid Tracking
SART	Search and Rescue Radar Transponder
SFVR	Small Fishing Vessel Regulations
SITREP	Situation Report
SKAD	Survival Kit Air Droppable
SLDMB	Self Locating Datum Marker Buoy
SMC	Search and Rescue Mission Co-ordinator
SOLAS	Safety of Life at Sea
SOP	Standard Operating Procedures
SRR	Search and Rescue Region
SRS	Search and Rescue Sub-Region
SRU	Search and Rescue Unit
SVR	Small Vessel Regulations
VHF	Very High Frequency (Radio)
VTS	Vessel Traffic System

This manual was developed by the volunteers of the Canadian Coast Guard Auxiliary in partnership with the Canadian Coast Guard and the Joint Rescue Co-ordination Centre Victoria. Only through the devotionand extraordinary effort of over fifty CCGA and CCG team members did this manual come to exist. The base of expertise available in the ranks of the CCGA makes a product of this calibre possible for minimal amounts in funds and time.

The Development team

Project Leader: Tyler Brand
CCGA - P Training Directors: John Thomas & Brian Cameron
Special thanks to Ric Tolonen

CCGA Team

Rick Allart
Donna Beesley
Michelle Blaksic
Rick Callandar
Glenn Driscoll
Malcolm Dunderdale
Duff Dwyer
Bruce Falkins
Ron Gieck
John Hallier
Barry Hastings
Noel Hay
Frank Hudson
Harvey Humchitt
Mike Janicki
Kyu-Chang Jo
David Lamb
Marc Legacy
Don Limoges
Peter Naysmyth

Dean Polvi
Daniel Robinson
Dan Savage
John Urquhart
George Walker
Meg Walker
Tully & Christy Waisman
Stanley Warlow
Ryan Woodward
Jay Young

CCGA National Office
Kathy Needham
François Vézina

CCG/DFO Team
Marine SAR
Clay Evans
Melanie Fugard
Alison Keighan
Bryan Pennell
Kevin Tomsett
Canadian Hydrographics
IRB Pacific 2001 Crew
Wayne Bamford
Jeff Nemrava
John Palliser
Neil Peete
Mark Proulx
Mike Stacey

Office of Boating Safety
Colin Michael
Kevin Monahan

Corporations
442 Squadron
VRG designs and publishing services
Shawn O'Keefe (Designer)
Carswell Industries
Department of National Defence
Hot House Marketing

Volunteers Saving Lives at Sea

Welcome to the Canadian Coast Guard Auxiliary

This manual has a distinct purpose: it provides the key concepts that are primary to becoming a safe, effective, and efficient crewmember on-board a Canadian Coast Guard Auxiliary vessel. This manual also provides the basic knowledge required for a new crewmember to meet the challenges of becoming a mariner.

Canadian waters are cold and unforgiving. Each year the northern oceans will claim the lives of expert mariners who have made no mistakes and taken no reckless actions. Any experienced sailor has, at one time or another, survived a storm or been surprised by the sea. They know that every calm day on the ocean is a gift.

Mariners thrive in the state of seamanship where they are on the waters, travelling on a vessel. This is a fragile state, one that lies only a breath away from a desperate fight for survival. Young sailors often speak of mastering their environment. Old sailors know how ridiculous an idea that is. Imagine standing on the nose of a giant and declaring yourself as the master. The key to existing on the oceans is the diligent regard for safety, and the constant habit of preparation. These must combine with a respect for the overwhelming strength of the ocean.

The Canadian Coast Guard Auxiliary does more than just work under the umbrella of the Coast Guard. Individual units and vessels respond where there is no Coast Guard vessel to back them up or ensure their safety. Alone, they face the same elements and perform the same rescue as Canada's professional rescue crews. The Canadian Coast Guard Auxiliary is tasked by joint rescue co-ordination centres to respond to 25% of calls for help on Canadian waters. The service that these vessels provide is a vital part of the Canadian search and rescue system and the risks that they face are real.

What makes this manual different?

This manual is only one part of a competency based training program that ensures a top level of performance that will become universal onboard all Coast Guard Auxiliary vessels. Each crewmember is evaluated against a performance standard that describes the skills and knowledge necessary to function as a well-trained member of a CCGA rescue crew. This manual was written around those standards and delivers a straightforward, step by step approach to achieving the skills along with a breakdown of positions and approaches.

The greatest challenges for a trainer is not just to come up with safer methods and techniques for vessel crews but to come up with techniques that are used. To be used in practice a technique must be:

- ➜ Easy to remember
- ➜ Easy to use
- ➜ Fast and efficient
- ➜ Intuitive to the user

These tools are designed to be used and we hope that the pages of this book will end up tattered and worn from constant reference.

Auxiliary crews operate in a team work environment

How to use this manual

This manual has a few features that identify different aspects of crewmembers' responsibilities:

Assessment and Approach: Stop Assess and Plan (SAP)

This manual uses the new **Stop Assess and Plan** (**SAP**) protocol to reduce the risk of injuries and accidents on the rescue scene. When the team is confronted with various situations the SAP sections of this manual provide a step-by-step approach for assessment and planning that SAR trained coxswains and captains will use to detail the scene and assign duties to the crew before commencing action.

Commands and Signals

Each chapter includes a list of common commands and signals used by the Canadian Coast Guard and the Coast Guard Auxiliary Coxswains during all operations. These sections encourage the crews to pre-determine and practice their language prior to the operations. The commands and signals sections enable the new crewmember to become familiar with the terms and their meanings. Scripted examples give the reader a live example to put the terminology in context as well as to understand the responses and procedures connected to these commands.

ON WATCH, *Positions and Duties*

This symbol signals to the reader that the section outlines the primary duties of the crewmember. The section will describe and define the performance of a task and give examples.

When a rescue vessel transits to an area, sets up and prepares for a mission and then commences a search or rescue action plan, the crew must perform some common tasks that are universal to all CCGA vessels. This manual will specifically define the roles of the captain/coxswain and each crewmember in reference to the mission of the vessel. These position sections will help a captain or coxswain assign duties and responsibilities to his/her crew as well as enable the crew to understand their role in the mission without a lengthy explanation. As the vessel transits to the scene or navigates, normally certain roles and responsibilities are designated for the safe operation of the vessel. One crew will be on radio watch and one on navigation monitor, and each will know their responsibilities.

Each job on the vessel is described in detail allowing the new crewmember to anticipate the actions that will be needed.

Warning Symbol

This symbol indicates a critical safety warning or procedure.

Live examples

Every section has real life examples, scripted scenarios and actual Vessel Log excerpts from experienced rescue crews. The new crewmember and experienced member will all benefit from seeing how other vessels and units approach these fundamental duties.

Canadian Coast Guard Auxiliary

The Canadian Coast Guard Auxiliary (CCGA) volunteer organisation was formed in 1978 in partnership with the Canadian Coast Guard (CCG) to provide support to a national volunteer rescue service. The Auxiliary does assist the Coast Guard in the delivery of search and rescue (SAR), operational, and accident prevention services. The tradition of vessels responding to distress situations is part of the fabric and, in many cases, the law for most maritime nations.

In Canada, the participation of volunteers in marine rescue pre-dates Confederation. A loose network of unpaid rescue agents reported incidents and organized searches for overdue vessels.

By the nineteen seventies, it became clear that a formal volunteer network was needed to provide a more effective response to marine incidents and implement a wider safety net for mariners.

Mission Statement

The Canadian Coast Guard Auxiliary (CCGA) is a non-profit organisation dedicated to search and rescue (SAR) and safe boating activities.

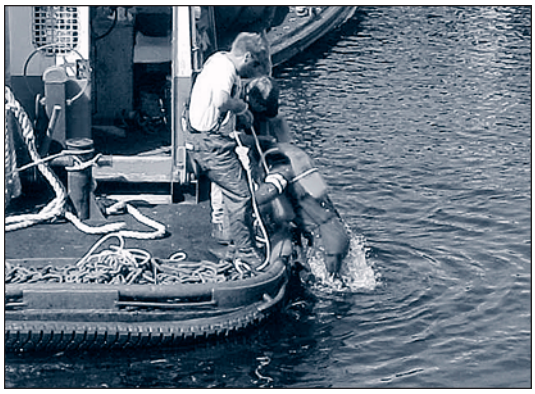
Our mission is to provide a permanent day and night search and rescue service to cover marine requirements in Canada and prevent the loss of life and injury.

To fulfill this mission, our objectives are to:

- Save 100% of lives at risk;
- Reduce the number and severity of SAR incidents;
- Promote marine safety;
- Support the Canadian Coast Guard;
- Provide a humanitarian service;
- Maintain the highest professional standards;
- Promote dedication and pride of membership.

Marine SAR

The Canadian Coast Guard Auxiliary is a major player in Canada's national search and rescue (SAR) response network. Annually, the Auxiliary responds to approximately 25% of calls of nearly 7,000 marine SAR incidents. This translates into more than 200 lives saved each year.



The territory covered by the CCGA is vast. Canada's area of responsibility stretches over 5.3 million square kilometres, bordering some of the most rugged coastline in the world. In addition, the CCGA is also present on many of Canada's major inland waterways. Its units are especially concentrated within those high risk areas where the requirements are greatest. In a SAR system, it is essential that a sufficient number of rescue boats be available to provide the best coverage so that they may go immediately to the scene of an accident. Reaction has to be fast – lives depend on it.

Organization

The organizational structure of the CCGA is a testament to its humanitarian ideals and its grassroots strengths.

In Canada, six Canadian Coast Guard Auxiliaries are federally incorporated as non-profit associations.

- CCGA National Inc.
- CCGA Pacific Inc.
- CCGA Central & Arctic Inc.
- CCGA Quebec Inc.

- CCGA Maritimes Inc.
- CCGA Newfoundland & Labrador Inc.

Each association has a legal entity separate from that of the Government of Canada.

The Presidents of each of the five regional associations are members of the CCGA National Council, chaired by an elected Chief Executive Officer. The National Council oversees the administrative and business requirements that concern every region.

In seaside villages, marinas and ports across Canada, auxiliarists are organized into units that handle missions in their vicinity. Each unit is led by an elected unit leader. A group of units combines to make up a zone led by a director.

Volunteers

The Auxiliary is made up of close to 5,000 dedicated volunteers. The members are primarily pleasure craft operators and commercial fishermen who use their own vessels or community owned vessels for safe boating education and SAR-related activities.

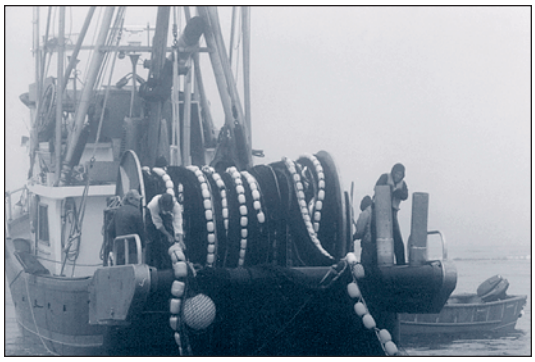
All CCGA members are dedicated to saving and protecting lives in distress. In addition to their everyday jobs, auxiliarists are ready to exchange leisure, comfort and sleep for cold, wet and fatigue in a range of situations that will test their skills, strength and nerve.

When taking part in authorized SAR activities, they are compensated only for the cost of their fuel and little else save a thank-you from the victims or their families for their tireless efforts.

Fleet

Currently, the CCGA fleet includes over 1,500 vessels with a combined asset value of over 215 million dollars. Vessels are either privately owned, community owned or loaned by the Canadian Coast Guard to the Auxiliary.

All vessels must meet strict standards in order to become part of the Auxiliary fleet. Members are responsible for keeping their boats maintained. In addition, they are required to equip them with specialised



Many fishing vessels are members

search and rescue gear, which can run into the thousands of dollars.

Training

Once a person has become a member of the Auxiliary, they participate in an on-going training regime including SAR operations and SAR prevention activities to enhance their capabilities in the delivery of the program.

Running Costs

The CCGA is very cost conscious and aims to make maximum funds available for operational needs. The terms and conditions which establish the conduct of activities of the CCGA are identified in a Contribution Agreement drawn up between the Auxiliary and the Canadian Coast Guard.

Because auxiliarists are only reimbursed for out of pocket expenses when tasked to a SAR mission, the Government of Canada receives the equivalent of $30 in services from the CCGA for every dollar actually spent. In other words, CCGA members save Canadian taxpayers millions by providing services at a fraction of the cost of maintaining the same number of Coast Guard units at the ready.

Call Out

Because of the effective organizational structure of the CCGA, the Canadian Coast Guard is able to keep up-to-date information on active auxiliarists and can match almost instantly a distress call to the nearest CCGA unit.

Most of the calls come from one of three Canadian Joint Rescue Coordination Centres known as JRCCs or one of two Marine Rescue Sub-Centres or MRSCs. These centres are responsible for the planning, co-ordination, conduct and control of SAR operations.

Their job is to direct the closest and most appropriate search and rescue resources to a distress call. These centres, staffed by SAR co-ordinators from the

Canadian Military and the Canadian Coast Guard, are on full alert 24 hours a day, seven days a week, year round.

National Statistics

The CCGA currently has close to 4,200 members and 1,200 enrolled vessels. In 2009, CCGA units responded to 1,750 SAR taskings and participated in 2,200 training exercises. Auxiliarists were also present at 160 boat shows, exhibitions and displays to support the Safe Boating Program.

The Auxiliary has shown an enduring and valuable commitment to SAR. Each year, the CCGA contributes to saving a significant number of those whose lives are at risk in marine incidents in Canada.

Since the CCGA was founded in 1978, its members have been credited with participation in 52,000 missions and saving 5,000 lives. Another 5,000 people are helped each year in non-distress marine incidents and millions of dollars of property are saved.

The CCGA is committed to the Government of Canada to provide search and rescue services. It is a hugely intensive operation requiring a large number of vessels, crewmembers and equipment.

International

The Canadian Coast Guard Auxiliary has been recognized as one of the best, safest and most cost effective volunteer marine rescue organizations in the world, with numerous national and international awards to its credit.

The CCGA also plays an integral role in the worldwide SAR community. The CCGA has signed a Memorandum of Agreement with the United States Coast Guard Auxiliary to promote joint efforts in search and rescue initiatives. The CCGA is also an active and contributing partner to the International Lifeboat Institution.

The Future

With the growing importance of safe boating education programs, the importance of private funding continues to increase.

The Auxiliary receives donations from the public and private corporations to support their activities. Since it is a non-profit association, donations are tax-deductible.

CCGA Offices

National Office

Canadian Coast Guard Auxiliary (CCGA) - National

Toll free: **1 866 MAYDAY2 / 629-3292**
Telephone: (819) 557-0541
Fax: (819) 557-0541
Internet: http://www.ccga-gcac.org

Regional Offices

Canadian Coast Guard Auxiliary (CCGA) - Pacific
25 Huron Street, Victoria,
British Columbia, V8V 4V9
Telephone: (250) 480-2798
Fax: (250) 480-2742
Internet: http://www.ccga-pacific.org

Canadian Coast Guard Auxiliary (CCGA) - Central & Arctic
577 Kingston Road, Suite 206
Toronto, Ontario, M4E 1R3
Telephone: (416) 463-7283
Toll free: **1 866 429-7283**
Fax: (416) 463-7285
Toll free: **1 866 392-7285**
Internet: http://www.ccga-ca.ca

Canadian Coast Guard Auxiliary (CCGA) - Quebec
17 Prince Street,
Sorel, Quebec, J3P 4J4
Telephone: (450) 746-4385
Fax: (450) 746-4386
Internet: http://www.gcac-q.ca

Canadian Coast Guard Auxiliary (CCGA) - Maritimes
P.O. Box 9640, Commercial Service Center,
Halifax, Nova Scotia, B3K 5S4
Telephone: (902) 475-1842
Fax: (902) 479-3222
Internet: http://www.ccga-m.ca

Canadian Coast Guard Auxiliary (CCGA) - Newfoundland & Labrador
P.O. Box 938, Station C, St. John's,
Newfoundland & Labrador, A1C 5M3
Telephone: (709) 772-4428
Fax: (709) 772-4109
Internet: http://www.ccga-nl.ca

The Canadian National SAR System

The primary goal of the national SAR Program is to save lives at risk throughout Canada. The program involves federal departments, volunteers, provinces, territories and municipalities, working together to provide this essential service.

You are part of a larger system. The Canadian Coast Guard Auxiliary (CCGA) Search and Rescue Unit (SRU) responds and acts in co-operation with the Canadian Search and Rescue System. In order for that system to function each SRU must work together with the Joint Rescue Centres and Surface Co-ordinators (on scene). As soon as one unit decides to act independently then the system starts to fail.

As stated in the National Search and Rescue Manual, the National SAR objective is:

To prevent the loss of life and injury through search and rescue alerting, responding and aiding activities which use public and private resources, including where possible and directly related thereto; reasonable efforts to minimise damage to or loss of property; and by ensuring appropriate priority to aviation and marine safety and prevention measures focused on owners and operators most commonly involved in SAR incidents.

The National SAR Program is delivered two ways:

1. **SAR Operations** - detection, search, rescue and incident co-ordination;
2. **SAR Prevention** - public education programs and the enforcement of safety regulations that are designed to minimise the loss of life and decrease the number of SAR incidents.

The Minister of National Defence is the lead minister responsible for co-ordinating the response to air and marine search and rescue (SAR) incidents in Canada. The Department of National Defence (DND) co-ordinates SAR through the country's three Joint Rescue Co-ordination Centres (JRCCs). These Centres are named after the cities where they are located: **Victoria**, **Trenton**, and **Halifax**.

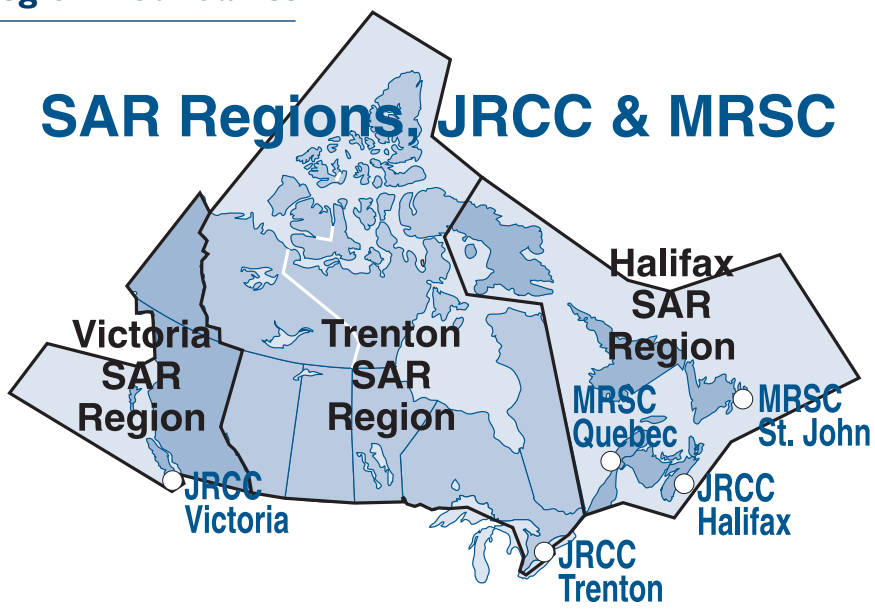
The Joint Rescue Co-ordination Centres are staffed by DND and Coast Guard (CG) personnel who co-ordinate both air and marine incident response. The three JRCCs manage the federal search and rescue responsibilities for all of Canadian Waters and a substantial area of the Arctic, Pacific and Atlantic Ocean, extending approximately 800 nautical miles past the international boundaries.

The Joint Rescue Coordination Centre Responsibilities

- ➜ Co-ordination and termination of all SAR operations, associated with air and marine emergencies;
- ➜ Providing assistance to civil agencies, such as police forces and the local ambulance and fire services.

The Joint Rescue Co-ordination Centre (JRCC) is responsible for receiving and responding to information about an actual or suspected search and rescue incident. Maritime and Aeronautical Co-ordinators are on duty at JRCC twenty-four hours a day, seven days a week. Once JRCC has been alerted to a marine or air incident by any source, SAR Co-ordinators evaluate the information and activate the appropriate SAR response. JRCC utilises both government and non-government resources in responding to SAR incidents.

SAR Region Boundaries



Under the terms and provisions of the 2001 **Canada Shipping Act.** Section 131:

Answering distress signal

131. (1) Subject to this section, the master of a vessel in Canadian waters and every qualified person who is the master of a vessel in any waters, on receiving a signal from any source that a person, a vessel or an aircraft is in distress, shall proceed with all speed to render assistance and shall, if possible, inform the persons in distress or the sender of the signal.

Distress signal – no assistance

(2) If the master is unable or, in the special circumstances of the case, considers it unreasonable or unnecessary to proceed to the assistance of a person, a vessel or an aircraft in distress, the master is not required to proceed to their assistance and is to enter the reason in the official log book of the vessel.

Considerations for Volunteers

Risk

Much like volunteer fire department members, CCGA members can find themselves in harms way. One should consider this duty an honour yet consider it carefully. Any mariner that goes to sea experiences risk and especially those that endeavour to go out and assist mariners that are already in trouble. You should discuss your choice with your family before making a commitment to serve as a SAR crewmember.

Long Term Physical Effects

The physical forces affecting the crew onboard rescue vessels are not yet fully understood and in certain circumstances could result in long term after effects. These vessels can experience moderate to high impacts and the crews can be required to carry out heavy physical work. Fast Rescue Craft may not provide protection from the outside environment and can expose crew to extreme environmental conditions such as high wind chills prolonged excessive motion and vibration.

CCGA members must consider their fitness and health when volunteering for duty. If you are questioning your own strength and stamina then it may be wise to investigate exactly what may be required of you, to volunteer for duty on a vessel before you take the pager.

1

Search and Rescue Unit (SRU) Performance

"An effective team, a fit vessel and working equipment all come together to create an effective search and rescue unit. The most important component being the team."

The first chapter defines and describes the roles and expectations of the vessel and her crew. Here the actions and strategies used by the experts are described as well as some secrets to survival and success.

In order for you and your future crew to survive and perform in extreme conditions you must make the decision to devote your time and energy to becoming not just a mariner but a mariner who can overcome adversity and assist other mariners in distress. This is not an easy task and only the most dedicated are able to join the crew of an auxiliary rescue vessel. Those that take this task lightly will endanger their own lives along with the lives of their crew.

Search and Rescue Unit Performance

Contents

May Day This is the Responder

February 1st, 1989 (excerpt taken from the "Victoria Times-Colonist")

"**May Day, May Day**, this is the Rescue Vessel **Responder**"

Weather for Victoria Waterfront: Minus 11 Degrees Celsius, snow showers, Winds NE at 20 Gusting 26 knots, Freezing spray Conditions and six-foot breaking seas. Sea smoke and snow showers reducing visibility to near zero.

Two Radio Technicians were stranded on the Chatham Islands due to extreme weather conditions. At 1700 Oak Bay Sea Rescue vessel "**Responder**" was tasked by Victoria Joint Rescue Co-ordination Centre to assess the conditions and attempt the recovery if safe to do so. At 1830, with radar blacked out by snow and all visual references lost in the blizzard the Responder struck a reef. The crew issued a distress and abandoned the vessel as it sank. The three frozen crewmembers swam through the surf and pulled themselves onto a rock only a few feet above the crashing seas. When the spray landed on their floater suits it froze instantly until they were encased in inches of ice.

The coxswain had a head injury and was barely lucid. Bruce Cafferky, one of the crew, chipped the ice away from his pockets and reached into his vest to pull out his flashlight and flares; only two of the six flares worked. Using the last flare to signal for help, the red burning flicker reached the bridge of the **Evco Buccaneer**, a passing tugboat.

The crew of Victoria Coast Guard Auxiliary Unit 35 (a five metre rigid hull inflatable) knew that they would not survive the 4 mile transit to the islands so they enlisted the help of the Victoria Pilot vessel to tow their Zodiac to the scene. At 2022 (almost two hours after the sinking) Coxswain Denis Nyren and crew Alek Bill climbed into the iced up Zodiac and crashed through the six foot breaking sea to attempt to save their friends on the rocks. They managed to retrieve the crew from the rocks and got them on board the Evco Buccaneer for treatment. They all fully recovered.

In a following interview, Bruce Cafferky commented:
"The funny thing about this predicament was that, although I was huddled on a rock freezing to death in the middle of an ice storm, I could look across the channel into the living room of my friend and could see him watching television. I was so close to safety yet so far away."

1.0 Introduction to SRU Performance

The crew of the Responder went out into conditions that exceeded the capabilities of the vessel and the crew. Her crew became stranded and fought for survival in the freezing spray. Subsequently, other rescue crews were compelled to go out and retrieve them. Although no lives were lost, the Responder's crew made some crucial mistakes. New auxiliary members should be asking themselves some questions:

- ➜ How can I avoid this situation?
- ➜ How can I, as a crewmember, effect the decisions made during an incident?
- ➜ How can I reduce the risk?

SRU Vessel and Training

As a Canadian Coast Guard Auxiliary vessel speeds towards the scene of an accident, a number of systems must be functioning in order for that vessel to arrive safely, assess the scene, and resolve the incident. The most important system is the crew system. It is the cumulative thoughts, efforts and concerns that create more than the sum of the individual aspects. A Search and Rescue Unit (SRU) can perform 95% of SAR tasks without a team that works together, without a leader that communicates and encourages excellence and without all the minds on board focused on the mission. Sometimes vessels and crews can function for years without all these things. Yet, an SRU will occasionally face challenges that overwhelm the most experienced mariner. These incidents will put the vessel in extreme danger and the crew's lives in imminent peril. The only way for the SRU to survive and prevail in these conditions is through the joint thought and planned effort of the entire crew.

A leader can only lead a crew out of danger after his or her leadership has developed and grown with the team.

The moment your vessel is steaming along with one crewmember resigned, rebellious, or malicious, the vessel is in danger. It is up to you, the crewmember, to consciously decide to overcome natural responses to conflict and disagreement. Today's rescue vessels are complex, fast moving, and require the utmost vigilance to perform safely.

Take advantage of a fresh start. Now that you are a new member of the Canadian Coast Guard Auxiliary you have an opportunity to focus on your strengths and strive to meet the demands of a new role. You will have the opportunity to help people out from the lips of inconvenience and occasionally snatch them from the jaws of death. In order for you to be a part of a highly effective rescue team you must bring some basic elements to the vessel, as described below. These qualities are never bestowed on you, they are a state of constant learning and effort. With some they will exist only while on board the vessel, but it is on the vessel that matters.

Individual contributions to the team

The qualities that make a mariner able to survive and overcome:

Commitment:

Each crewmember must be committed to the vessel and her crew. One must recognize that only through co-operation, communication, and extraordinary effort is the vessel able to function and perform in the conditions that it may face. Each crewmember must occasionally support the team through plans and actions with which they do not agree. The support and effort must be 100% even in these cases.

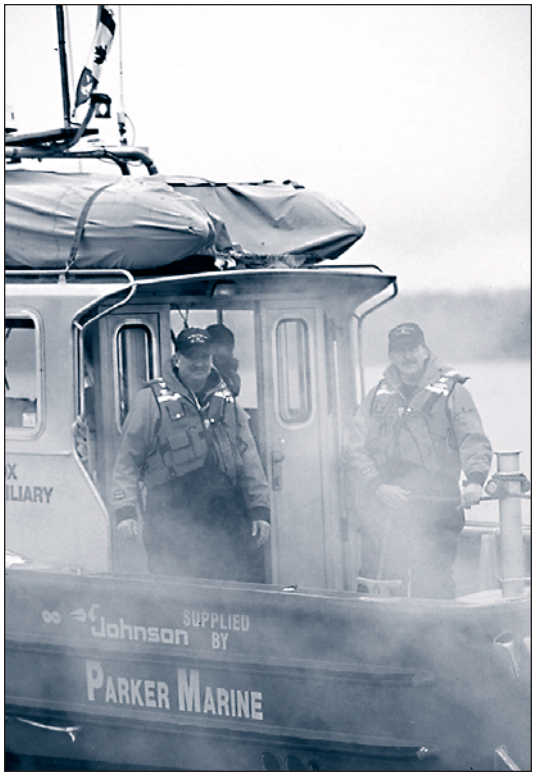
Diligence:

When a crewmember steps on-board a vessel his or her habits and personality change to those of a mariner. Mariners are obsessed with order and routine; they clean, organize and inspect the vessel and her gear constantly. Mariners always have one eye on their mate and one eye on their task, ready to jump to assistance in the event of an accident or mishap. A mariner watches the ocean ahead for those tiny dots that become vessels in minutes. A mariner thinks ahead towards the next move anticipating the needs of the vessel and the crew.

Integrity:

Integrity means honesty and transparency. Each team member communicates their thoughts and concerns freely and openly. The leader must maintain an encouraging environment for this open communication. Your crewmates know when you are not feeling well or are worried. The confines of a vessel require that each person is honest and trustworthy. Effective team

members do what they say they will do, and admit what they are not able to do. Integrity allows the vessel to prosper from her crew's strengths rather than being crippled by their weaknesses.



Unit 60 Comox SRU Team

Compassion:

Canadian Coast Guard Auxiliary vessels only exist because their members recognise the hardship and risks of being on the water. The Rescue Crews know that everyone faces the same risk and at any time we all could be overwhelmed and thrown into distress. Sharing the same state allows us to care and respond when someone is in need of help. In a sense, by coming to aid of other mariners we are making the waters safer for ourselves.

Commitment, Diligence, Integrity and Compassion; these are the traits that allow your vessel to survive through the extreme conditions and unexpected challenges that are characteristic of the business of Search and Rescue.

1.1 Team Performance

The team must think of itself as a group working in perfect harmony toward a common goal. Each crewmember must remain focused on that goal while overcoming personal and team obstacles.

Rescue Team Priorities

The priorities of an effective rescue crew are simple. They are ranked like this:

1 Safety of the Crew
2 Safety of the Auxiliary vessel
3 Safety of the people in need of assistance

You can not put yourself or your vessel in unwarranted risk in any circumstances.

Effective Leadership

Malicious Obedience: the Silent Killer

Have you ever worked for a controlling manager who needs to change all your decisions and constantly corrects you on small, seemingly irrelevant details? If so, how did you react when he or she did this? What was your coping strategy? When faced with this common dilemma, most people stop trying to make decisions on their own and wait for the next detailed instruction. They follow the directions to the letter regardless of whether it is the right action or even a safe action. At this point all personal stake in the success of the tasks and pride in the outcome disappear. We become maliciously obedient when we state "If this guy knows everything then why should I tell him that the water in this bay is only six feet deep?" Malicious obedience is a passive aggressive state that can slow down productivity in an office or kill a rescue crew.

Two factors encourage malicious obedience. The first is a coxswain or captain that is unable to communicate their expectations, thereby getting frustrated and taking over or micromanaging every action on the vessel. The second is a crewmember who forgets the consequences of this brand of mental resignation and lets his/her attention drift to the conflict and not the vessel's mission.

Vessel operating at peak performance requires an efficient team to maintain safety & overall performance

It takes all the minds on the vessel focused on safety and success before a rescue vessel is functioning well. With small teams, an autocratic leader-

ship style can be dangerous. Each person must feel involved in the decisions and have a stake in the solutions. A coxswain who states "don't think, just do it" will be conning a vessel that is being watched by one mind only: his. This is a crippled resource with a limited response capability.

Challenge on Deck

An alternative to malicious obedience is the challenge. Challenges at the wrong time and for the wrong reasons can prove equally dangerous, but a trusted and experienced crewmember that offers a strong challenge can prevent a catastrophe. As a crewmember you should feel as though you are able to ask questions and make a challenge if you perceive a real danger. Yet a crewmember that repeatedly challenges the coxswain/captain on issues such as efficiency and protocol can be damaging to the team. You should only challenge a coxswain when you perceive a real danger in a developing situation or in the consequences of an order. If the situation is not urgent, then asking questions and making respectful suggestions can be an important dynamic of a healthy team.

Some basic leadership qualities help an individual function in and/or lead a team:

- ⇛ Personal commitment to the team members
- ⇛ Ability to see past conflict and support all team members
- ⇛ Honesty and assertiveness offered at the right times
- ⇛ Clear and consistent communication
- ⇛ Acceptance of input and thoughtful responses
- ⇛ Effective use of short term strategies as needed
- ⇛ Capable of fostering a balance between authority and assertiveness
- ⇛ Ability to stay alert

Know your Limitations

These are other very important factors. You yourself may have the knowledge required for a task, but your boat may not be adequate for the task. For example, you may be an expert in cardiopulmonary resuscitation (CPR), but if your boat does not have enough deck space to perform CPR properly (assuming that you are the only unit present), you cannot help. Alternatively, you may have a large, powerful vessel fully equipped for towing, yet you will be useless again if the water is not deep enough to allow you to reach a grounded vessel.

The same applies to your crew, you may be a very competent and experienced mariner. Once again, search and rescue is a team effort. You cannot expect to do well on any search and rescue mission if you act alone as a unit or alone as an individual. Always remember that many tasks must be performed during a search and rescue mission. If, in a SAR crew, only one person is capable of performing all the tasks, that person will certainly get overwhelmed at some point. If you are an expert in CPR, to use the same example, and also happen to be the only team member capable of piloting your boat, you will have a problem if you happen to be called upon for a cardiac emergency. It is good practice to have some redundancy in the areas of expertise of every crewmember. In other words, at least two persons in your unit should be able to perform any important tasks.

Commitment to Training

Your level of training is very important, since it will determine what you can do to help in a search and rescue mission. The reason for this is obvious: emergency situations are usually not the best place to learn new skills. It is important to know how to perform the necessary tasks, since time is of the essence. In addition, lack of knowledge in an emergency situation can put someone at risk. If you become part of the emergency, you are not helping anybody. When someone (the On-Scene Co-ordinator or the Co-ordinator of the Joint Rescue Co-ordination Centre, for example) gives a unit a specific task, it is essential for that unit to determine whether or not they have the level of knowledge required to carry out the task safely and efficiently. The following questions may help you to assess your ability to perform a task:

- ➜ Do I know exactly what is expected from me?
- ➜ Do I know how to do what is expected of me?
- ➜ Do I know how to deal with any conditions that I may encounter during this task (waves, wind, darkness, currents, injured persons, etc.)?

Do I know exactly what is expected from me?

Do I know how to do what is expected of me?

Do I know how to deal with any conditions that I may encounter during this task (waves, wind, darkness, currents, injured persons, etc.)?

1.1.1 Command Structure

A small vessel's command structure is fairly simple. The captain, a.k.a. Master (for small vessels the title is coxswain) is responsible for the actions, and state of the vessel. He or she is also responsible for the safety and welfare of everyone on-board his or her vessel as well as anyone on-board another vessel that has accepted the assistance of, or is under tow from the rescue vessel. For reasons of safety and welfare of a vessel, each crewmember must follow the instructions/orders of the captain/coxswain unless that crewmember perceives the order will result in the injury or death of a crewmember.

If you are not ON WATCH then your vessel is in danger.

1.2 On Watch

This manual offers the knowledge and key concepts necessary for training to be ON WATCH. Being ON WATCH is many different things:

- You are ON WATCH when you are responsibly monitoring your assigned taskings along with the safety of the vessel.
- You are ON WATCH when the captain or coxswain can be assured that all aspects of the vessel that are under your control are being monitored and maintained.
- You are ON WATCH when all of the assigned duties and tasks are performed diligently.
- You are ON WATCH when you are alert and vigilantly looking out for unexpected objects, vessels, or targets.
- You are ON WATCH when the captain knows that emergencies and mishaps will be handled and reported competently.

If you are not **ON WATCH** then your vessel is in danger.

1.3 Vessel Positions

Each crewmember shall be familiar with the areas of responsibility on the vessel during the different operations. Like an actor studying the many parts during a play, you should be ready to assume all the positions of the crew. During a challenging and potentially dangerous incident, an effective leader will be able to assign you to the role in which you show the most strength, thus ensuring a problem free mission. Yet, when the team is faced with a routine task, the coxswain/captain may assign to you a role in which you are not experienced or sure of. These are the dynamics of a growing and improving SAR team.

There are only a handful of positions you can assume on a small vessel, but without those positions the vessel cannot perform the duties it was intended for. These jobs are the basic areas of responsibility; they do not imply one person per position. A small CCGA vessel on a towing mission may only have two or three crew. In this case, the coxswain may occupy the helm position while an experienced crewmember will be the line handler and the tow watch. Each vessels' coxswain/captain will define these duties as required for a given mission. It is important that the entire crew is familiar with all of the areas of responsibility so that the key elements of safety and effectiveness are not missed on an incident. It is the captain's/coxswain's responsibility to assign the positions to capable individuals, and to ensure that all the tasks are covered.

1.3.1 General Duties

The command position holds all responsibility for the vessel's actions and the welfare and safety of her crew.

1.3.2 Helm

The helm position (sometimes taken by the coxswain /captain).

General Duties and Responsibilities of Helm

- Ensuring all on board are equipped, secure and ready to proceed
- Communicating all intentions to manoeuvre the vessel before manoeuvring
- Wearing a Kill switch (if one is present)
- Safe manoeuvring of the vessel through the various evolutions
- Manoeuvring the vessel in the event of a Crew Overboard
- Lookout ahead for traffic, obstacles, objects in the water
- Identifying all navigation aids
- Search spotting duties for the forward sector in a search
- Monitoring of the speed, throttles, engine warnings, gages, pressures, electronics, alarms, power and signalling/horn (smaller vessels 20m and under)
- Listening to engine sounds and machinery space sounds
- Steering a compass course or on a landmark
- Changing the vessel's course smoothly and efficiently
- Observing the SAR operations and watching for hazards

Radio/Communications Watch

A Radio Watch will be held at all times when a CCGA vessel is underway. Each crewmember shall know all of the duties involved when keeping a radio watch. The radio watch position is in many incidents the most important position on the vessel.

General Duties and Responsibilities of Radio/Communications Watch

- Testing all communication systems prior to departure
- Activating and using the radios

- ➡ Regularly checking and, testing the status and function of the radio/radios
- ➡ Listening to all designated channels, especially VHF 16, for signs or signals of distress
- ➡ Advise coxswain/captain if overhearing a distress signal or the spoken words **MAY DAY**
- ➡ Notifying the coxswain if overhearing **PAN, PAN, Securité, or a relevant broadcast / radio traffic**
- ➡ Logging all communication relevant to the vessel or the mission
- ➡ Answering and communicating vessel business

- ➡ Relaying messages and instructions to vessel coxswain/captain and crew

1.3.3 Navigation Monitor

It can be the crewmembers' responsibility to keep watch over the vessel's position and path. Often the coxswain or navigator will be deciding the route and planning the courses for the transit.

You shall monitor the position of the vessel in relation to the paper chart, electronic chart and radar. You must be aware of the intended path defined by the coxswain/captain and routinely checking that the vessel's position is on that path using all available means (see chapter 7- Navigation for list of available means).

Crew of the vessel shall STOP the vessel in event of:

- ⇛ Close proximity to unknown object detected by sight, sound or radar ahead of the beam
- ⇛ A major unexpected departure from the course line
- ⇛ Another vessel turning or veering into your vessel's path.
- ⇛ Uncertainty of your vessel's general position
- ⇛ Impending landmass detected by sight or radar
- ⇛ Close proximity to dangerous submerged objects (rocks, shoals or wrecks) charted or sighted
- ⇛ Depth sounder consistently reading shallow depths
- ⇛ Moving in or near conditions of reduced visibility due to rain, snow, sleet or fog
- ⇛ Whenever you are in doubt of the situation

You must notify the coxswain if:

- ⇛ If you are unsure as to the safety of the vessel
- ⇛ There are Aids to Navigation previously unreported
- ⇛ Any new vessel traffic comes into view by sight or radar, or is detected by sound
- ⇛ Any fixed hazards come into view by sight, radar, or electronic chart
- ⇛ There are any differences between what you should see (according to paper/electronic charts) and what you actually see
- ⇛ There is any malfunction of any electronic device
- ⇛ Any information available to you is not fully understood (chart symbol, radar image, GPS data, or instruction or request from the coxswain)

1.3.4 Linehandler / Operations

The linehandler and operational positions will vary with the mission requirements but in general this person performs the functional duties required by the mission. The linehandler will ready and prepare any lines or tackle required for the securing and mooring of the vessel or securing of gear on the vessel. The linehandler will ready and prepare any lines or tackle required in the assistance of another vessel. The operational person will identify hazards on deck or related to the operations (e.g. "don't stand in the bight!").

General Duties and Responsibilities of a Line Handler

- ✓ Be responsible for crew and deck safety during line handling operations
- ✓ Verify the plan with the captain/coxswain
- ✓ Inspect all lines and equipment to be used for wear or damage prior to starting operations
- ✓ Secure the decks of all gear and lines for getting underway
- ✓ Coil and stow all line hanging or in lockers
- ✓ Secure lines
- ✓ Check the lead of line to make sure crew are clear of the bight and running gear
- ✓ Keep line clear of running gear, especially in the water (stern and propellers)
- ✓ Continuously report progress of line handling operations and the tension state of lines and any other dangers
- ✓ Ready and toss the heaving line

1.3.5 Equipment setup and operation

The crew is responsible for knowing the location, setup and operation of all emergency and rescue gear. The only way to get familiar with the setup and operations, the tension in the tow line, and any other dangers. Each vessel will have different types and models of equipment.

Line handling while towing

Some deck equipment:

- Salvage and fire pumps
- Hoses and nozzles
- Foam adductors
- Re-boarding device
- Towing lines and tackle
- Fire extinguishers
- Search lights
- Cranes winches or lifting devices
- Davits and vessel recovery systems
- MOB pole or life ring
- Stokes litter or stretchers
- Life rafts (if your vessel carries them)
- Datum marker buoy
- Direction finder
- Night vision goggles

Suggested Duties and Responsibilities for Equipment Set-up and Operation

- Ensure and test state and function of listed equipment
- Report deficiencies
- Ensure safety of crew during the equipment operations
- Stow and secure all equipment for vessel underway
- Break out equipment and ready it for use
- Must have a comprehensive working knowledge of the operational procedures, maintenance, and specifications for each piece of equipment

Example of Commands and Signals for Equipment Set-up and Operation

Thumbs up – ready for operation
Arms across chest – secure and ready
Hand across throat – Stop and shut equipment down
Hand outstretched palm out – halt action
Palm down swinging forearm up and down – slow down
Rotate index finger while pointing up – speed up or hoist

1.3.6 Lookout

A lookout is someone who is watching over the path of the vessel and reporting any objects, oddities, land masses or vessels that may present a danger to the vessel or be relevant to the safe navigation of the vessel. Lookouts may use all available means to determine the safety of the navigation path. The lookouts' secondary duty is to identify objects, targets, or details that may prove relevant to the vessel's mission.

Suggested Roles and Responsibilities for Lookout

- ✓ Performs constant visual scans of the vessel's path and reports all objects forward of the beam
- ✓ Routinely looks aft for overtaking vessels
- ✓ Maintains communications with the Helm and Captain/ Coxswain
- ✓ Uses all available means to keep a lookout (hearing, sight, smell, night vision goggles, binoculars)
- ✓ Reports the positions and estimated heading of vessels approaching using a designated sighting system (See commands and signals for lookout)
- ✓ Reports conditions of visibility and changes in weather
- ✓ Protects eyes from wind and spray and sunlight by using appropriate eye wear

1.3.7 Common Positions According to Vessel State/Mission

Transit

- Command
- Helm
- Navigation Watch
- Radio Watch

Towing/Salvage

- Command
- Helm
- Line Handler
- Tow Watch/Salvage Operations
- Navigation/Radio Watch

Search
- Command
- Helm
- Pattern Timing and Control
- Spotters
- Navigation/Radio Watch

Rescue /Medical
- Command
- Helm
- Equipment set-up and operation
- Medical attendant
- Navigation/Radio Watch
- Radio Watch

1.4 Vessel Fitness

1.4.1 Routine Inspection

Routine vessel inspection and maintenance is one of the most important activities that we partake in other than the SAR mission itself. If the vessel is not safe or seaworthy it cannot perform the tasks we ask of it, therefore jeopardising the mission at hand.

Vessel inspection should occur regularly, for example, on a monthly basis. This inspection will be combined with any routine maintenance that the equipment should require, such as manufacturers recommended maintenance on outboards, as well as any underwater maintenance. The entire vessel should be gone over checking all electrical components and connections, hoses and connections, tubes' condition and security to hull. As well, all portable equipment should be inspected for serviceability and lockers cleaned out before replacing equipment. These are just a few of the items to be checked during routine maintenance, but are by no means the complete list of items.

Every vessel will require a different checklist, which should be made up by the individual unit. Do not expect the first list to cover every item but add to it as deemed necessary. This does not mean that the vessel shouldn't be inspected at the beginning of every crew rotation but routine vessel maintenance should take place as well as at crew rotation.

It is the responsibility of the crew coming off of rotation to ensure the vessel is in good operating order and that all gear is accounted for and working properly. If something is found in need of attention, fix it immediately and don't leave it for the next person.

All crewmembers should partake in routine maintenance on a rotational basis as it will not only teach the member more about the vessel, but it will instill a sense of ownership and pride in being an integral part of the crew.

Each crew member should be familiar with controls

Routine Inspection of Personal gear

- ✓ Flashlight with good batteries
- ✓ Knife (with blunt end on inflatables)
- ✓ Strobe with good batteries
- ✓ Whistle
- ✓ New rubber gloves and breathing airway
- ✓ Notebook and pen or slate with grease pencil
- ✓ Watch with second sweep hand easily visible in low light
- ✓ PFD or Cruiser suit in good condition and straps adjusted correctly

1.4.2 Pre-departure Inspection

Pre-departure inspection may seem redundant after reading the last section, but on the contrary, this is the last chance to discover a possible problem before heading out. This inspection is not as complex as the other two mentioned in this chapter and can typically be carried out rather quickly and done in conjunction with the start-up procedures for the vessel. Items most concerned with are first and foremost tube pressure (if applicable), lights, including hand held spotlights, electronics and safety gear.

There should be a pre-departure checklist posted on the vessel, so that it can be readily referred to and can usually be carried out by the first crewmembers at the vessel while waiting for the rest of the crew.

1.5 Mission Execution

1.5.1 On Call

The most important asset of a crewmember is reliability, as the vessel is useless if the coxswain is the only person to show up to the vessel when the pagers are activated. For safety reasons, the vessel must **NEVER** leave the dock with less than a full compliment on-board, as you never know what you will be tasked to do or how long you will be out. When "on call" you will be expected to remain within 15 minutes of the vessel at all times unless otherwise arranged with your coxswain or designated person. If you will be unavailable it is imperative that you contact the designated person or at the very least have someone stand in for you.

When your pager is activated and you are required to attend an incident, regardless of the urgency, you have no right to violate any traffic laws on your trip. Remember that you are no good to anyone if you don't arrive at the vessel safely.

1.5.2 Mission Preparation

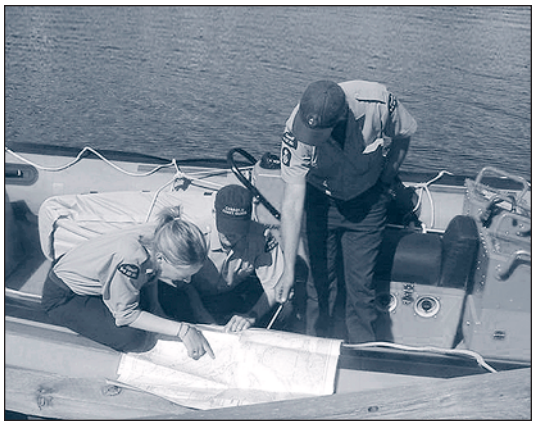
In preparation for the mission, there are a few items to be concerned about upon arrival at the vessel. Firstly, personal safety gear, including helmets, must be worn at all times when underway; this means putting your gear on before you leave the dock. The weather will determine if the crewmembers will want to don extra personal gear and this will be done at this time. Some units have a locker on the dock for storage of seldom used items, (pumps, spine boards etc.) which, when needed, can be loaded aboard the vessel. It is recommended that all gear should be stowed and secured on board at all times if possible.

1.5.3 Mission Briefing

Briefing the crew prior to departure, or before arrival on scene provides the following:

- ➜ Mentally prepares your crew to perform
- ➜ Establishes mood of communication
- ➜ Ensures you and your crew work together (cockpit approach)
- ➜ Ensures that standard procedures are utilised and enhanced
- ➜ Reduces the possibility of error
- ➜ Decreases stress and pre-incident anxiety by eliminating the unexpected
- ➜ Establishes greater crew confidence

The most valuable part of the mission preparation is the briefing. Once the crew is assembled, the coxswain will give the crew a short description of the incident at hand including number of persons involved, type of incident, type of vessel, location and any other pertinent information. He may also wish to bring the local chart out and use it to discuss any concerns as to the incident's location as well as the route to be taken. The coxswain will then assign duties for each crewmember and ask if they have any concerns or questions about the tasking. Crewmembers are encouraged to give input and ask questions. A good coxswain will share all of his information with his crew, as it is almost useless if he keeps it to himself.



1.5.4 Response Priorities (get there safely)

Two factors will increase risk during the transit. The first factor is the urgency of the call which will increase the navigation speed on the route, and the second is the incident having the crew focussed on the rescue or search instead of on safe navigation. Rescue vessels end up being at a higher risk of collision or grounding from navigational mistakes than incurring damage in a rescue.

Safe speed is dependent on many things like sea conditions, amount of debris in the water, visibility, abilities of the helmsman and route to be taken. If you don't get there safely, you could very possibly become another incident requiring aid yourself. It is better to get there a few minutes later than not at all, no matter what the level of urgency.

Setting up while underway may not be a good plan

Imagine your vessel is rushing to the aid of a sinking fishing vessel. The fishing vessel is taking on water fast and declaring a Mayday. The seas are choppy and your motivated and experienced crew moves forward to break out the fire pump and suction hose. The vessel hits an unexpected wave and one of your

team is tossed into the bow locker, dislocating his shoulder, and the fire pump is now bouncing around the foredeck. You stop the vessel and put your injured crewmember in the seat and carry on at high speed to the scene. The fifty-foot trawler is about to slip beneath the waves so you quickly evacuate all of the crewmembers. The evacuation does not go well because the fire pump is on the deck and one of your crew is no longer able to help pull the people off of the sinking vessel.

In this situation the preparation hindered the effectiveness of the vessel and injured a volunteer. This is a classic example of a team that is trying to be efficient by planning their response prior to their arrival. Your vessel may be at the highest risk during the transit, and your best energy should be spent during the pre-departure check and briefing or setting up once on scene. There is always enough time to Stop, Assess and Plan when you have the real scene to observe.

The scene you arrive to is very rarely the scene that you envision. Plans made enroute usually fit the imagined scene and not the real scene. Once you have arrived and discovered that your enroute plan does not fit, then your team has two choices: forget the old plan and make a new one, (this rarely happens) or fit the old plan to the real scene. Thus a bad plan is better than no plan. What often occurs upon arrival is the enroute plan is tossed out and the team goes into the scene without a plan (because a new plan would take too long!). This can be a fatal mistake, because a team without a plan cannot work together. Any accident scene that is complex or unstable is likely to injure or kill rescuers who are acting on their own, without a backup plan or even an initial plan.

1.5.5 Night Operations

When operating at night, as we do almost exclusively for about five months of the year, it becomes readily apparent that everything that we do is hampered when in darkness. The most important thing to remember when running in darkness is to slow down due to lack of visibility. All lighting and illumination systems on board shall be tested prior to departure. Personal safety becomes a bigger priority in darkness as well. While on board carrying out your duties, slow down to avoid tripping and falling, possibly overboard. There is always a risk of falling overboard, even more so in darkness, so it is imperative that every crewmember has a personal strobe and whistle as part of his gear. It is almost impossible to find a person in a seaway without some sort of detection device.

1.6 Team Communication

Verbal communications are very important in a small team. Messages must be loud and direct; simple gestures aren't good enough, and can be easily misunderstood. It pays to project your voice and speak in common terms. Every order or request must be repeated or at least confirmed by the recipient.

- Make direct eye contact
- Say the person's name and wait for a reply before giving the message
- Direct your speech to ensure that you've been heard
- Acknowledge any requests or commands by repeating the information or stating that you understand
- Provide as much relevant information as possible. If you're a crew member, remember to only give the leader essential information
- If you don't understand the information given to you, ask that the instruction/command be repeated or explained
- Work as a team. If you're the leader, ask for input and give your team the details of your knowledge. Teams function more effectively when members are encouraged to contribute their ideas and expertise
- Do not scream. A good leader only screams when there is danger, and there is no better way of alerting others

Steps to 2 Way Communications

1 Look

2 Name

3 Say Message

4 Repeat

5 Confirm

1.6.1 Open Boat Communications

At high speeds and in noisy environments it is sometimes impossible to communicate verbally; this is where signals come in. Helm control is one of the most critical communication routines there is. Mistakes in helm commands can result in the vessel heading off in the wrong direction. This is why some coxswains will give their helm commands by hand.

1.7 Risk Assessment

As soon as you become a part of a response team you enter into a different realm of risk and you must follow different rules for survival.

Imagine that a neighbour's house is on fire. Her dog Fluffy is barking in a lower floor window and your neighbour is crying "save my puppy!" You know that by the time the fire department arrives, the house will be fully involved and it will be too late for Fluffy. Would you go in to save the dog? Maybe you would assess the risk and determine that the smoke is still high and the flames are in another part of the house; therefore you rush in and grab the dog. The mission was a success and you are an unscathed hero. What do you think was the actual level of risk that you encountered? Maybe a 5% chance of being injured and a 1% chance of dying. This level of risk was probably acceptable, especially considering a life was saved.

When the fire department arrives, what levels of risk do you think they are willing to take? A 1% chance of death and a team of five would mean that they lose one fire fighter every twenty calls. At a 5% chance of injury this means that a busy fire department would lose 5-10% of their crews per year. If you were Chief of this fire department how long do you think you would keep your job? The concept of acceptable risk changes when you take on the role of a rescue team member.

You as a team member must take every action possible to reduce the levels of risk that you face routinely. What seems like reasonable risk on scene may be well above an acceptable level. A one percent risk taken routinely means you will not survive a long career in the field.

1.7.1 Stop Assess and Plan (SAP)

When things go wrong on a rescue scene and team members get hurt it usually stems from one of two problems: a loss of scene awareness and/or a bad action plan. Teams need to observe the scene carefully and notice all the details and they need to agree to a plan before entering the event zone. SAP is an on scene assessment protocol that can be used by response teams when approaching unknown situations.

Panic and poor judgment kills rescuers as well as victims. When faced with unusual circumstances, in adverse conditions, proper assessment is the key to survival. These few moments standing away from the action observing, communicating with your team, and formulating a plan, will save countless minutes in fumbling, re-planning or winging it. Time spent carefully may prevent a serious accident or save a life. In extreme conditions this allows time for the team and team leader to act calmly and not be prisoners of their adrenaline. Often a scene will contain hidden or subtle dangers that are missed at first glance. These unknowns can kill.

The SAP protocol was originally developed to prevent volunteer and professional marine-rescue crews from rushing into a scene and getting injured. It is an easily remembered and quickly applied tool that is based on the same common sense approaches taught in many fields. The most experienced rescue and enforcement crews all have pre-action assessment tools that allow teams to recognize dangers before it is too late.

SAP is a structured habit that can become a basic tool used in any situation of risk. Using SAP, a small team can:

- ⇛ Identify all the hazards at a scene
- ⇛ Receive input from all team members
- ⇛ Formulate a solution that best fits the problem
- ⇛ Communicate an action plan with the roles for each team member

A **SAP** assessment can be as short as fifteen seconds for routine situations and could take as long as an hour for major incident or disaster scenes. **SAP** can be used at any stage of the response, to the preplanning before entering the scene, prior to boarding the vessel, or prior to making the entry to an enclosed space below decks. A short discussion about dangers at any stage can reduce the risk.

Special points of interest:

- ⇛ SAP forces communication and ensures that scenes that appear routine are still assessed thoroughly
- ⇛ This tool is easy to remember and easy to use in the field

Event Zone

Surrounding every serious incident there exists an area of involvement called the event zone. Inside this zone, the urgency of the incident influences and compels the team to act immediately. Once you have stepped into that zone you are within range of any dangers that may be present, and involved in the scene. Rescuers, enforcement officers and good Samaritans all lose their ability to calmly assess when inside the event zone. They are pushed to act quickly and solve the problem as it presents itself. This is why it is critical to practice stopping outside the event zone for a proper assessment. It is the small or partially hidden clues that can quickly turn a routine situation into a disaster. When rescuers get killed or injured on the scene it is usually because of a loss of situational awareness. They have missed some details that would

have indicated an unstable or more complex scene than was immediately apparent.

Hollywood and re-runs of Rescue 911 give a false impression of what real incidents are like. They constantly review incidents that portray "nick of time" rescues that are not accurate depictions of reality. Very seldom is a situation so urgent that a team does not have time to stop and assess.

You know you are in the Event Zone when:

- The people involved are able to look you in the eye and speak to you
- You feel compelled to forget the assessment and just do it
- If something goes wrong you may have to move back
- You are having to act, or manoeuvre to keep yourself and your team oriented and in safety

Pre-Arrival Planning Trap

Not to be confused with proper pre-departure planning, planning for an incident enroute is a common practice for many fast response teams. Crews should focus on safe navigation enroute. There is a perceived need for an instant response upon arrival. When the fire truck arrives, people want to see the fire fighters rush into the burning building, not sit around and chat. The response team feels this pressure and will feel compelled to act first. This has been a fatal mistake many times when crews missed key clues.

Too much response planning before arrival can be dangerous. If the team is responding to a sinking, then the team should check and load a salvage pump and damage control gear. Response plans should not be made based on dispatch information. The scene and problems that they visualise enroute will be different from the scene that they arrive to, and so will the solutions to the problems. Upon arrival, the team will have to consciously forget about their previous plan and make up a new one or try to make the pre-arrival plan fit the real scene. It is hard to give up a plan (even a bad one) and start again. Pre-arrival planning can lead to disaster when team leaders go with a pre-made plan that does not fit the scene. When the team arrives, they should be able to have a fresh, unbiased view of the scene from outside of the event zone.

Stopping

This is a simple step, yet many team members have problems with it. In most situations, the vessel should come to a complete stop (all way off). The important thing is to avoid getting any closer to the scene; only then can the assessment begin. In some situations, it may be necessary to maintain steerageway in a current, to slowly and completely circle a scene or even pace a vessel underway in order to keep a constant position outside of the event zone. This all counts as stopping.

Assessing

The most important step, assessment, must be only assessment with no planning. Here the whole crew observes the scene carefully trying not to be distracted by the main elements (fire, injured people etc.). Details can make a profound difference. Planning is natural instinct that creeps into places where it has no business. One must make a conscious effort to only speak in the language of observation.

If the scene is complicated, it may be necessary to have five seconds of silence while people observe; this gives the crew time to focus on their task of observation. (see example in sidebar)

Planning

The planning stage is the stage where the crew gets to discuss the most effective plan. Everyone gets input but the leader has the final say. Once a plan is decided the leader assigns jobs and gets verification from the crew.

Sometimes situations can change and make a good plan into a bad one. If the leader can foresee certain circumstances then a backup plan can be discussed.

Example: "If the boat starts to sink, pass everyone off of the stern and get off."

If things go wrong and the scene becomes unstable or if the team does not have a back up plan then the leader pulls the team out of the event zone and re-assesses the scene for a new plan.

Language of Observation Example:

"I see lines leading off the stern"

"I see that fellow has a rifle"

"The water looks shallow"

"There is gas leaking from the tanks"

Coast Guard's Letter of caution

Dear Coast Guard Auxiliary Crews:

The Canadian Joint Rescue Co-ordination Centre values the vital contribution that the Canadian Coast Guard Auxiliary vessels make to Search and Rescue in our national waters. The tasks that they perform are often complex and demanding. The CGA volunteers train constantly to be capable of responding to any call for help. We wish to reinforce our message of caution regarding the difficult situations that auxiliary vessels and crews have to face. The Coxswain or Captain's first responsibility is to the safety of his or her crew, and the second is to execute the tasking effectively.

Here are some points to be aware of:

Excessive speeds can degrade both crew safety and SAR effectiveness, and must be avoided. Many survivors report that SRUs passed by without detecting them, both when the SRUs were in transit and when executing a search. Excessive SRU speed contributes to this problem. CGA (and CG) FRCs have been involved in several situations where the crew was thrown from the craft due to high-speed collisions - e.g., with log booms and points of land. These incidents could have caused loss of life, needlessly (often the speeds involved were inappropriate).

It is usually better to search thoroughly rather than quickly. It is always better to arrive safely rather than not at all.

It is JRCC's responsibility to assign search areas that can be covered effectively without need for excessive SRU speeds.

Bottom line: Coxswains should use high transit and search speeds only when the safety of the crew can be maintained and when absolutely necessary to execute the SAR response.

Moderate your speed according to these factors:
Close to shore wave direction, frequency, steepness and height; wind speed and direction; visibility; crew experience, fatigue and training levels; craft design, trim and equipment condition; debris in the water; other traffic; navigational hazards (land, reefs, etc).

We at the Joint Rescue Co-ordination Centre value your contribution to Search and Rescue in Canada, but we value your safety and well-being more. Keep up the fine service and be careful.

John Palliser
Superintendent of Marine SAR (Pacific)

1.8 Critical Incident Stress (CIS)

As a Canadian Coast Guard Auxiliary crewmember you may occasionally experience conditions involving a high degree of risk. While working on a vessel, the potential exists for you or one of your team to become involved in a critical incident. Should this happen, both you and your family could experience emotional or physical trauma as a result of the incident. Through training and safety awareness you can minimise the risk of trauma, but you can't always prevent a critical incident from occurring.

1.8.1 A Normal Reaction to an Abnormal Event

A critical incident is any traumatic event which shocks you enough to upset your normal means of coping during or after the incident. How much an incident affects you depends on many factors: the time of day the incident occurs, the number of people involved and the severity of any injuries. Your stress level prior to the incident and the support you receive also makes a difference. You must remember that this reaction is a normal reaction to an abnormal circumstance.

You may experience a critical incident differently from others. You may have been through trauma before without any effects, but find that a certain incident leaves you feeling unable to cope. How you react depends on the particular circumstances at the time of the incident.

Learning about CIS before you become involved in a traumatic event is an important means of prevention. If you are involved in a critical incident it is quite normal for you to have a reaction to the event. The reactions experienced are called critical incident stress (CIS). The CIS Program was developed and initiated by the Department of Fisheries and Oceans to assist those involved in critical incidents. Similar programs have shown that providing prompt CIS support to those involved in an incident greatly assists them in recovering from the stress triggered by the incident.

1.8.2 Activation of the System

Should you or another crewmember become involved in a critical incident, your coxswain, or a controller at the Joint Rescue Co-ordination Centre will activate the CIS program on your behalf, by calling a 24-hour emergency number. Whatever CIS support you, your fellow auxiliarists or family require will be arranged. Department of Fisheries and Oceans and DFO Headquarters will pay CIS Program costs.

In cases where the critical incident is particularly traumatic, a Mental Health Professional (MHP) will hold a CIS debriefing. Your Coxswain or unit leader will ask you and all others involved in the incident to attend the debriefing. The debriefing will give you the opportunity to learn more about CIS, and to explore your reaction to the incident. When appropriate, CIS family support will be provided at your family's discretion.

1.8.3 Signs of CIS

Everyone reacts a little differently to a critical incident. Some of the most common reactions include:

- Nausea and digestive disorders
- Sweating and profuse tremors
- Increased heart rate and blood pressure
- Sleep disruption
- Confusion and disorientation
- Poor concentration and decision making
- Flashbacks
- Anxiety
- Withdrawal and depression
- Sense of loss or grief
- Emotional numbness and helplessness
- Anger and resentment

An integral part of the CIS Program is the assurance of confidentiality. The CIS Policy stipulates that no Peer Team member or Mental Health Professional can be called to testify in any internal review. Further, no names of individuals or conversations are ever recorded.

Whenever a debriefing is conducted, confidentiality is the first ground rule established by the MHP. A CIS debriefing is not a performance review or an operational critique. Whatever experiences you choose to discuss during the debriefing remain in confidence with the other participants.

Remember that the goal of the CIS Program is to provide support to you and your family following a critical incident, so that you may all resume your roles at work and at home without any lasting effects.

2 Personal Safety

The vessel turned yet the crew did not. Two twenty-year veterans flew gracefully out of the Zodiac and landed in the water. Their heads popped to surface and they established that they were unhurt.

"I thought I was holding on"
"Yeah,... you were holding on to me!"

When involved in search and rescue there is always a chance that something may go wrong and you may end up in the water regardless of your experience or your preparation. This chapter lays down the essentials to surviving the experience. If you take the time to wear the proper thermal protection and put the right gear in your pockets then you may be able to laugh about it later.

Personal Safety

Contents

A Kayaker who prepared for the worst

Written By Bryan Pennell (Victoria Joint Rescue Co-ordination Centre)

Early May 2000, at 08:55 local time, JRCC Victoria monitored a mayday relay by Victoria MCTS regarding a red overturned kayak with a person (male) in the water. The position given was in the vicinity of Chatham and Strongtide Is. near Discovery Islands. No other details followed. A fishing vessel that had answered the initial call was tasked by JRCC. The following resources were in the area and were briefed, tasked, and departed at approx. 09:00: CGA Oak Bay, CGA Victoria, Sir Wilfred Laurier 733 from Victoria base, CG helicopter 357 flying locally, and the navy patrol boat HMCS Whitehorse.

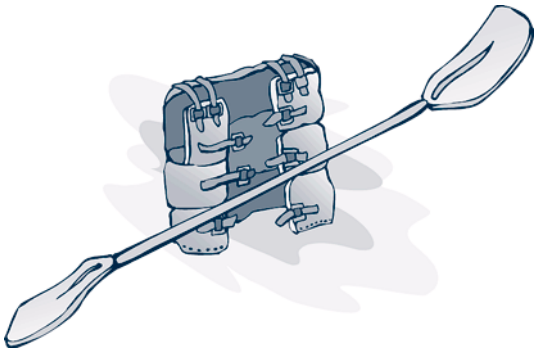
During briefing and tasking, communications were established with the kayaker. He had a hand-held VHF radio and he was in direct contact with Victoria MCTS. He gave his position and additional details regarding his craft and equipment onboard. The Kayaker who was swimming for shore relayed this information in a calm and rational manner. The SAR units were not able to locate him. As the Search progressed his battery ran out and his transmissions stopped. Rescue Centre now feared for his life because when the search units got close he could no longer guide them towards his position.

The Radio crackled and the kayaker announced that he had just changed his radio batteries. When the helicopter was close he told MCTS that he could see the aircraft and vessels in the area. The search units were still unable to locate him. Pulling himself up onto a rock, the kayaker reached into his life jacket pocket and pulled out his flares, his dye marker, and his flashing light.

CG helicopter 357 now reported she was low on fuel and would have to return to base in the next minute or so. CG 357 then sighted the flare and set down in his vicinity at 09:15. CGA Oak Bay was on scene at 09:21 and treated the kayaker with hot packs and proceeded to evacuate him to an ambulance at Oak Bay. The Laurier's Fast Response craft towed the kayak to Oak Bay and assisted as necessary. All other resources were stood down once it was determined there were no other individuals involved and the patient was safely transferred to Emergency Health Services. This incident started at 08:55. First on scene resource was at 09:15. The incident was resolved at 09:31 when the kayaker was landed at Oak Bay. The incident was closed at 09:42 when Emergency Health Services reported they had care of the kayaker.

The patient suffered mild hypothermia and minor cuts and bruises. JRCC spoke to him directly after he recovered and commended him for being so well prepared on the water. This individual had paddled the local waters for years in fine and adverse conditions. He was familiar with local tides and currents and he indicated that he simply got taken unawares by the local rips and undertows.

This incident illustrates a few key factors regarding our present SAR system. Even though an area can be saturated with resources in good time after an initial reliable alert, people in the water are extremely difficult to find. The kayaker, who was more prepared than your average mariner, was truly responsible for getting himself found.



2.0 Introduction

Imagine having fallen overboard at night, floating in frigid waters. What kind of safety gear would you wish for while you patiently tread water waiting for rescue? Answering that question will give you a good idea of what you may need to carry with you. Be warned: most drowning occurs in good weather, when danger awareness is at its lowest.

It is easy to underestimate your needs when the sun is shining at your departure. Always remember that you may know the weather when you leave, but you can never know for sure what it will be like when you try to come back.

Like the kayaker in the story, you, the CCGA crewmember, are responsible for getting yourself found. What you wear, what is in your pockets and in your kit bag will make the difference between getting rescued or watching the vessels and aircraft fly by. It is you who may face the consequences if your gear is not adequate. Give yourself a chance to survive by thinking ahead.

It is easy to forget how quickly the water can claim a life. It removes heat from our bodies twenty-five times faster than air at the same temperature. Yet, individuals who are not wearing flotation will not be given the chance to get cold. The shock of the icy waters forces them into hyperventilation and they ingest water. This is called cold shock. Spasms in the upper airway will prevent the entry of water into the lungs, causing "dry drowning." These people will die from suffocation. In most cases, water will eventually penetrate into the lungs and cause drowning.

Those that are wearing flotation will find it easier to guard their airway and survive that critical first minute in the water. Yet if the seas are rough and winds are churning the waves, then even a PFD may not provide the protection needed for a victim's airway.

Search and rescue crews that hit the water will be wearing enough insulation and protective gear to prevent death from cold shock, yet surviving the initial immersion simply allows them to begin the struggle for survival in the icy grip of Canadian waters.

Professionals who work on the water must be prepared for the unexpected. Wearing gear suited to the job provides a survival advantage.

Environmental Exposure and Fatigue

Fast, open vessels can move quickly through conditions that many other vessels would find cumbersome and inhibiting. This fact alone can make the ride very uncomfortable. If exposed to adverse conditions for extended periods of time coxswain and crew will suffer from fatigue. Some studies suggest that even after half an hour fatigue may have serious effects. This is a concern because it affects the ability of the operator to safely handle the boat.

Any experienced crewmember has noticed that the ride gets rougher as the driver gets tired; this is because the reactions needed to provide a smooth ride suffer as a result of prolonged exposure to adverse conditions. It is safe to assume that judgement may also be affected by exposure.

Most of the biggest advantages can also be disadvantages. As the rescue vessel advances at high speed through stormy seas many factors can increase or decrease fatigue such as weather, temperature, sea state, wind chill, noise level and the constant pounding over the waves.

Most designs offer no protection from the elements, only a platform to stand on. In adverse winter conditions certain situations occur in which crew are exposed to weather more severe than any other natural environment endured by humans. Up to negative sixty-degree wind chill factors, 11G impacts and

noise levels approaching two hundred decibels have been recorded. Some crewmembers become violently seasick in these small vessels without ever being prone to seasickness before.

Fatigue effects should be considered when your vessel is assigned to a particular role. Prolonged extensive searching with search patterns may be a waste of time for not only is the vessel a poor search platform (visibility wise) but the fatigued crew are also too busy dealing with the weather to keep an effective lookout for prolonged periods. Proper clothing is the only barrier the operators have between themselves and the weather.

To increase your chances of survival in cold water:

- ➜ Wear gear that fits you
- ➜ Wear gear that fits the weather
- ➜ Wear gear that fits the mission

Wearing the Gear that Fits the Weather the Mission and You

Life jackets are designed for two purposes only: To assist the survivor to stay afloat (conscious or unconscious) with his or her airway above the water line and to aid in detection when rescuers are close by.

Safety equipment that does not fit is of no use to you. There are many stories of people struggling to survive and being hampered by exposure coveralls that are too big or a PFD floating above their head.

Safety-conscious crewmembers organise their gear before they leave and usually leave it set up and ready to put on quickly. Safety equipment chosen must have five essential features:

- ➜ Flotation
- ➜ Insulation
- ➜ Protection
- ➜ Mobility
- ➜ Visibility

2.1 Flotation

How do rescue personnel survive the first few minutes of exposure, and protect their airway from the water? Flotation keeps your head above the water and reduces the physical struggle to stay afloat. A PFD or life jacket is essential for surviving those first dangerous minutes in the water. As a Coast Guard Auxiliary crewmember you will be required to wear your PFD at all times when in an open vessel or on the deck of a larger vessel.

Mustang Survival

Flotation devices are made from either kapok or unicellular foam. Despite the mildew inhibitor treatment required for the cloth, the webbing tapes, tape threads and certain areas of the envelope will occasionally rot. Seriously affected areas will appear aged, stained or otherwise discoloured. Kapok buoyant devices will frequently become water-logged and unserviceable. This is most common with old devices exposed to oil vapours or new devices whose plastic pad covers have been punctured or remain wet and difficult to dry. Flotation devices should be thoroughly dry and stored in well-ventilated spaces. They should be kept clear of the bottoms of lockers or stowage boxes where moisture may accumulate. They must be stowed away from excess heat.

The small vessel regulations state that all boaters must carry buoyant devices to fit the persons on board. SAR units should carry some additional devices to accommodate the occasional passenger (injured, rescued persons etc.). Since SAR personnel should wear PFDs at all times when on board, the only necessary recommendation is to choose PFDs that are comfortable and visible (red, orange or yellow).

2.1.1 Life Jackets

There are two main types of life jackets: the standard and small vessel life jackets. Life jackets are designed specifically for two purposes: to assist the survivor to stay afloat (conscious or unconscious) with his or her airway above the water line and to aid in detection when rescuers are close by.

The life jacket has bulky float pads on the front and usually no flotation on the back. This arrangement ensures that these devices will right a person in the water. Some things that life jackets do not do:

- ⇛ Do not provide insulation from heat loss
- ⇛ Do not protect the body trunk from injury with padding
- ⇛ Do not serve as comfortable work dress
- ⇛ Do not have pockets to keep gear

The CCGA crewmember requires most of these features when engaged in SAR. This is why it is recommended that rescue crew wear PFDs rather than life jackets.

Standard Life Jackets

The approved standard life jacket is mandatory equipment on all commercial vessels subject to Marine Safety Inspection and on all small fishing vessels.

The Canadian approved standard life jacket is built to the provisions in the International Convention of the Safety of Life at Sea (SOLAS) of which Canada is a signatory. These provisions cover such features as:

- ➜ Workmanship and materials
- ➜ Buoyancy capabilities and wearability
- ➜ Head support and face and body position for an unconscious person in the water
- ➜ Effect of petroleum products and colour

Mustang Survival

Standard life jackets are manufactured in only one style -keyhole -but are available in two sizes. The adult size is designed for a body weight of 40 kg (90 lbs) or greater, and the child size for a body weight of 40 kg and under. All jackets should be fitted with whistle, retro-reflective tape and light. The main feature of a standard life jacket is its ability to turn an unconscious person in the water from a face down position to face up, with the mouth and nose clear of the water. However, the bulkiness of the life jacket makes it quite uncomfortable to wear for long periods. Life jackets are to be donned when immersion is imminent (e.g. boat is sinking).

Small Vessel Life Jackets

Approved small vessel life jackets are for use on all pleasure craft and certain classes of small commercial craft (excluding fishing vessels) and arenot subject to inspection by Transport Canada Marine Safety. Small vessel life jackets are designed in two styles. One-piece (slab or keyhole) and open front (vest). They are also manufactured in three sizes: “A” for body weight over 41 kg, “B” for body weight between 18 kg and 41 kg, and “C” for body weight up to 18 kg.

Mustang Survival

These devices have less buoyancy and righting moment than a standard life jacket, but must be able to turn the body to a safe flotation position once it enters the water. They must also support the head so that the face of an unconscious person is held above the water, with the body inclined backward from the vertical position. As for the standard life jacket, small vessel life jackets tend to be relatively uncomfortable. PFDs remain the best alternative for SAR crews.

2.1.2 Personal Flotation Devices (PFDs)

It is important that the PFD be worn with straps and zippers fully fastened, and that it be in good condition.

Approved personal flotation devices (PFDs) may be used in lieu of standard or small vessel life jackets on all pleasure craft, and are designed to be worn constantly while boating. They represent the best balance of flotation, mobility and comfort.

Although the PFD does not turn survivors face up in the water the design requires that they must not have a tendency to turn the wearer face down. This gives the unconscious survivor a 50/50 chance of landing face up and staying that way.

There are two approved types:

Type I has inherent buoyancy capabilities due to its construction from unicellular foam or macro cellular elements.

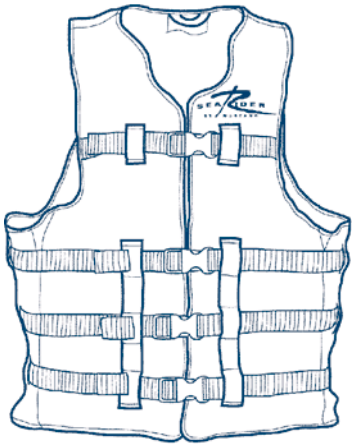
Type II has two buoyancy types: inherent features and inflatable capabilities.
The inflatable section has an oral inflation device and a manual device consisting of a cylinder of compressed CO_2 operated by a manual trigger.

Type II Inflatable

Mustang Survival

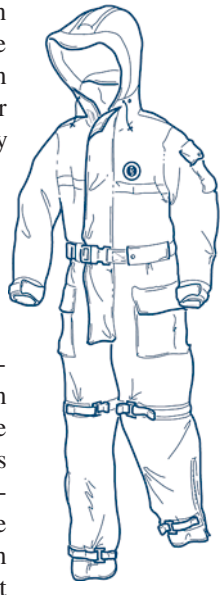
It is important that the Personal Flotation Devices (PFD) be worn with straps and zippers fully fastened, and that the PFD be in good condition. PFDs are designed to offer padded protection for the front and back of the body during high-speed operations: their straps and buckles will stay fastened on impact with the water. A snug fit and slim design give the wearer comfort and mobility to work. Remember that PFD flotation foam will deteriorate after heavy use and exposure to the elements.

While Transport Canada has approved colours such as blue and purple for PFDs used by recreational boaters, some of these colours are not that visible. CGA encourages use of the standard red, yellow and orange PFDs, preferably properly fitted with retroreflective tape for maximum visibility. Those who work on the water usually choose the more visible colours to increase their chance of survival if they fall overboard. It is important to note that the approval for PFDs is valid only if the PFD is intact (no tears or holes) and unmodified (nothing has been glued, sewed or written on the PFD). Any PFD that has tears or holes should be replaced.



Mustang Survival

2.1.3 Anti-Exposure Work Suits

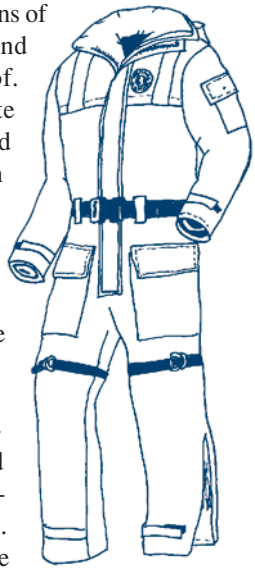


Mustang Survival

Anti-exposure work suits (often referred to as flotation suits) are a good choice for operations in colder weather conditions or when water temperature may cause hypothermia. The flotation suit is one of the most common pieces of safety equipment being used by rescue personnel today because it offers warmth and protection as well as many pockets for carrying safety equipment. Flotation jackets can also be a good choice for warmer days. Some models have a beaver tail that straps between the legs to protect the groin area from heat loss. Both these flotation garments offer at least fifteen pounds (6.8 kg) of positive buoyancy, and some models incorporate an inflatable flotation collar that can be activated by an oral inflation hose. The flotation collar provides additional buoyancy about the head and shoulder area

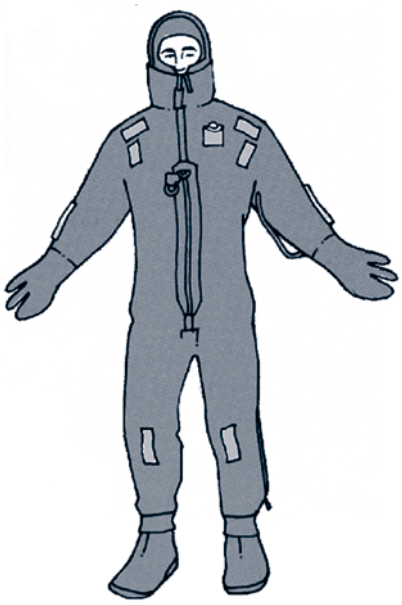
to keep the wearer's head clear of the water. Heat loss is greatly increased if water is allowed to circulate freely throughout the suit. Many designs have straps located on the arms and legs that restrict the water flow when pulled tight. Maximum hypothermia protection is ensured when the hood is on the head, all zippers are fully closed, and all straps are fully tightened.

The most common designs of anti-exposure coveralls and jackets are not waterproof. These items can deteriorate rapidly if not properly washed and maintained. The foam flotation can break down and become matted and lumpy after a few years of use. When this occurs, the suit will no longer offer the positive buoyancy required in order to keep the head out of the water. Suits and jackets that are worn often should be replaced when the material begins to deteriorate. These garments will increase survival time in cold water, but do not offer the same protection as a drysuit or a survival suit. The full-exposure coveralls can severely limit swimming and movement, especially if they do not fit properly.



Mustang Survival

2.1.4 Abandonment immersion suits



An abandonment immersion suit is a heavy rubber suit somewhat similar to a diver's drysuit. These suits are designed as abandonment devices and should not be viewed as working flotation devices such as PFDs or anti-exposure work suits.

Owners of abandonment immersion suits are encouraged to practice donning their suits in all kinds of conditions (at night, in rough weather, etc.) to simulate actual emergency conditions. A device to assist with pulling the zipper can be used. Whistles, strobe lights, flares, etc. should be stored with, or attached to the suit. Suits should be stored in an accessible location for quick and easy access in an emergency situation. Many manufacturers of immersion suits recommend factory servicing of the suits every five years, but owners of these suits can try them on at least once a year in the water to check for small leaks. These suits must be checked periodically for:

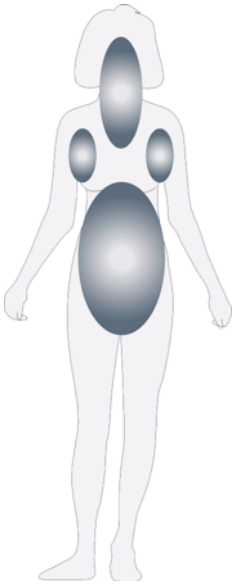
- Holes, punctures, and rips
- The teeth of the suit's zipper are aligned
- The zipper works all the way up and down (The zipper should be periodically lubricated with silicone spray.)

An immersion suit is truly the best thing one could wish to be wearing while floating in cold water. It keeps dry and is very well insulated. The only problem is mobility. With big floppy arms, feet, and thick neoprene rubber, the immersion suit is almost impossible to walk or move in. It is solely designed for survival in case of immersion.

Owners of abandonment immersion suits are encouraged to practice donning their suits in all kinds of conditions.

2.2 Insulation & Thermal Protection

So you have made it past the first few minutes with your PFD or life jacket keeping you afloat. Now, if you are swimming in 11 °C Canadian waters, hypothermia is your next concern. Without thermal protection, chances of survival after a long exposure to cold water are slim. The high heat loss areas of the body are the head, neck, torso and groin. When you are dressing for cold weather try to protect these areas first. Use a wool toque or balaclava on the head and a scarf or a polypropylene neck warmer. Covering the head and neck can reduce heat loss by 25%.



Heatloss areas

2.2.1 Thermal Underwear

Thermal underwear constructed of polypropylene fibres provides good insulating value in a marine environment. Maximum protection from hypothermia can be achieved by layering thermal underwear. Polypropylene tends to keep moisture away from the wearer, increasing comfort and aiding in reduction of heat stress. The best wicking characteristics are obtained when the fabric is worn next to the skin.

To achieve maximum cold protection, it is a good idea to use layering. Tight polypropylene or polyester light underwear will keep the moisture away from your skin. Additional heavy underwear will provide insulation. Cleaning routines for thermal underwear are limited to laundering after use.

- ☛ **Polypropylene** Uses heat energy to keep moisture away from the skin. It provides better insulation than natural fibres.
- ☛ **Wool** Stays warm when it gets wet, reducing heat loss, but retains water, making it heavy.
- ✘ **Cotton** (**DO NOT WEAR**) Soaks up water like a sponge, and holds it against the skin. As the water evaporates, heat energy is pulled away from your body. Cotton is a very poor choice for our operational environment.

Polypropylene underwear gives you a heatloss advantage

On warm days, bring both cold-weather and warm-weather gear for added safety. The weather can change in minutes, and you may be caught by surprise. Thermal underwear like polypropylene or wool long johns will help keep you warm. If you are wearing a drysuit, don a fleece or polypropylene liner for excellent thermal insulation. This liner can be worn underneath a floater suit as well. Do not wear any cotton clothing under a liner, because cotton will keep the cold water against your skin.

2.3 Protection

SAR vessels often operate in severe weather conditions. With frequent heavy impacts due to waves, high wind chills, and excessive noise levels, a crewmember can find himself or herself in an extremely hostile environment, even when things are going well. In the event that something goes wrong, crewmembers may be at risk for head injuries and/or blunt trauma (internal lesions caused by a collision with an object that does not cut well). Protective gear is essential, given that your vessel may be engaged in SAR operations in these conditions.

2.3.1 Drysuit

For open fast rescue craft, the crew does not have a cabin to provide protection from the weather. These crewmembers require a higher level of protection from exposure. The most effective way to keep warm is to stay dry. A lightweight drysuit offers the best balance of dryness and mobility in cold weather. The drysuit is ideal for extended missions in severe climates.

A lightweight drysuit delivers the optimum combination of dryness and mobility in cold weather. Most drysuits worn by SAR vessel crewmembers are made of nylon polymer. There is no valve on the SAR drysuits, and they generally come with reinforced knees and buttock areas. Hoods are not attached and the suit is worn with a thermal liner. Wrist and neck seals may be made of latex or neoprene. The choice of seal is often a matter of personal preference. Refer to the manufacturer for specific information regarding the choice of seals. Some drysuits also have integral work boots or soft-shoes.

A drysuit's floatation is dependent on its watertight integrity. If punctured, the inherent buoyancy provided by this suit will be lost. This is why drysuits are not approved as flotation devices and consequently, they must always be worn with a PFD.

Drysuits alone do not provide adequate insulation or hypothermia protection. Thermal underwear must be worn beneath the drysuit to provide insulation. In areas of very cold water temperatures, layering of underwear is recommended. Always use underwear that is specifically designed to keep you warm in a wet environment.

Drysuits provide thermal protection in the case of acidental immersion

2.3.2 Helmets

Head protection is very important for survival onboard any kind of Fast Rescue Craft (FRC). On-board these craft, crewmembers will be exposed to strong and sometimes sudden impacts and accelerations.

Under these circumstances, the risk of head injury is high. It is imperative to wear helmets to minimise that risk. Helmets must be specially designed for use in the water: otherwise, they may fill with water and act like anchors. In addition, helmets must be lightweight to minimise stress on the neck during sudden speed change.

2.3.3 Eye Protection

Eye protection is vital, particularly in extended operations. Glare, salt, and wind easily damage eyes. The eye protection that you choose should protect you from all the elements but not interfere with vision by excessive fogging or restrictions on peripheral vision. If you wear eyeglasses, you should purchase goggles that fit over them, or buy prescription goggles.

2.3.4 Gloves

Gloves are a matter of personal preference. Some people prefer ski gloves, while others prefer a lightweight wet suit glove. Gloves should allow unrestricted circulation in the fingers to ensure sufficient warmth.

- ➜ Wool gloves will get wet, but stay warm
- ➜ Neoprene diving gloves aren't very warm in the wind, and tend to fit too tightly
- ➜ **Gore-Tex**™ gloves are effective, but need to be rinsed after every use, or the salt will destroy the material
- ➜ Rubber gardening gloves can be very effective and inexpensive, but they are cold
- ➜ Mittens, either wool or **Gore-Tex**™, provide hands with warmth, but reduce finger dexterity

2.3.5 Footwear

When your work involves handling heavy objects that could drop, you must wear protective footwear. Footwear worn under these conditions must not only protect your toes, but the bridge of your foot as well. Good safety footwear provides:

- ➜ Steel toe cover
- ➜ Cushioned bridge pad
- ➜ Sole guard to prevent nail punctures

With all these safeguards, the footwear can be too heavy or too cold to be worn comfortably. Not all operations require protection from injury, so requirements for traction, warmth and comfort become paramount. CGA crewmembers need a quality boot that provides good adhesion to the deck. A soft sole deck boot or shoe provides good traction. Footwear must not be so tight as to restrict circulation. If it does, then cold feet and cramps will occur.

2.4 Mobility

All personal gear should allow the wearer to move and work freely. In extreme conditions some restriction of movement may be necessary to give the crew adequate protection from the elements. Make sure all gear fits you properly.

2.5 Visibility

All protective and thermal gear (outside layers) should be highly visible. Items like PFDs must be red, orange or yellow. Vests, drysuits or floater suits should have reflective tape that illuminates in the beam of a searchlight. Automatic strobes or chemical light sticks will draw attention to you.

Active signalling devices require you use them to draw attention your way. All these devices should be inside the various pockets of your equipment vest.

{Personal safety equipment must be considered lifesaving equipment and treated as such.

Personal safety equipment on loan to an individual must be maintained in appropriate condition in accordance with the manufacturer's maintenance guidelines. Each person to whom the gear is issued is responsible for keeping the gear in proper condition. Faults or problems which are beyond the scope of maintenance by the individual, are to be reported to the captain or coxswain for appropriate follow-up (e.g., personal strobe-light batteries must be changed annually). It is the responsibility of the master or coxswain to ensure that every crewmember wears their personal safety equipment as needed. It is also the responsibility of every crewmember to wear their safety equipment when they feel they should do so.

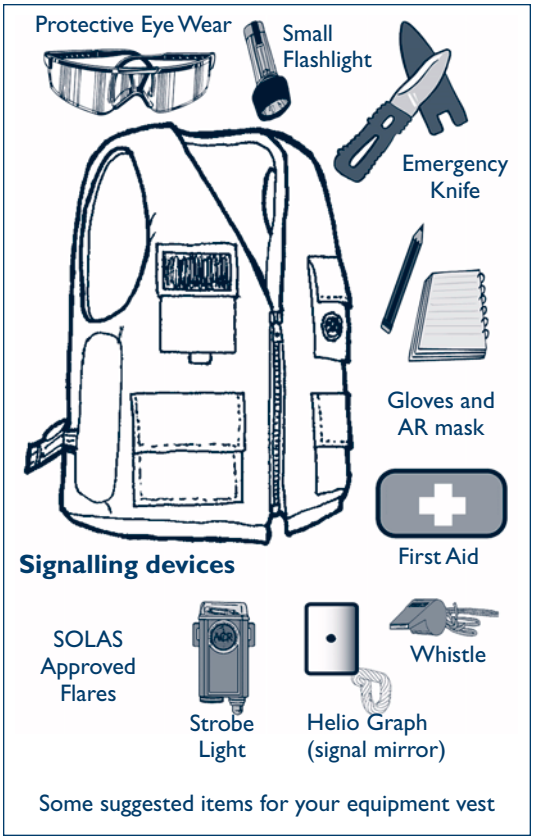
2.6 Signalling for Distress

It is critical for survival that you can call for help or at least attract attention to yourself when you are in the water. See Chapter 3.

2.6.1 Equipment Vest

Equipment vests allow you to carry required safety items without having to duplicate them for each type of clothing worn. The safety vest is worn over all of your other gear. It is used over your PFD alone, over your drysuit and PFD together, or over your floater suit.

A safety vest should contain the following minimum amount of gear:



Some suggested items for your equipment vest

Note: *Items can be secured to the vest with a long enough lanyard to permit easy access and use. The pocket snaps require frequent lubricating with Vaseline.*

Strobe light

A small waterproof strobe light can be used to attract attention. Strobe lights are especially useful if you need to be seen at night. Some models will activate automatically in contact with water. This is a useful feature since it will increase your chances of being detected even if you are unconscious in the water and unable to use whistles, flashlights or your voice to assist in detection. Other models need manual activation. The personal emergency strobe light emits a high-intensity flashing white light of 40-60 flashes per minute, visible for two miles. It may be used to attract the attention of aircraft, ships, or ground search parties. A lanyard must be fastened to the light and to the wearer's clothing to prevent loss of the light during use. The lanyard should be of sufficient length to allow the arm to be extended to the maximum reach with the light held in the hand. When donning safety gear for use, you should check the strobe light by activating the switch for a couple of flashes before proceeding with the task.

Personal distress flares

It is recommended that three SOLAS approved personal distress flares be carried by all crewmembers embarking on small SAR vessels during hours of darkness. Flares are normally carried in a pocket of the equipment vest, flotation jacket or drysuit or in a fanny pack with other items of personal safety gear.

All distress flares approved for marine use in Canada have an expiry date of four years from the date of manufacture. Check the dates on your flares regularly and take steps to procure replacements before the expiry date.

Flares should be inspected weekly by the individual to whom they are issued, outside the vessel or buildings in an open area. Handle flares with care, and be particularly careful not to pull on the launch cord or chain while conducting the inspection.

Check the flares for splitting, cracking, loose caps, or any other signs of deterioration. Check the waterproof wrappings on your flares to ensure that they are still water tight. All the flares should be stored in their designated stowage pouch or pocket.

Whistle

The whistle is an effective and inexpensive item of personal protective equipment that has been instrumental in locating and saving many lives at sea. A whistle should be attached to every crewmember's equipment vest zipper. Units that do not have equipment vests may attach the whistles to the zippers of PFDs, jackets and flotation suits.

Whistles should be of a type intended for marine use, such as standard life jacket whistles. Choose a unit that has no moving parts (peas), is compact and break-resistant and above all, produces a loud piercing tone during use.

Whistles should be checked frequently for cracks, breaks, or deterioration. Ensure that the whistle remains securely fastened to the item of personal flotation and that it can be brought to the wearer's mouth without removing it.

In addition, if the wearer is immersed in water, the whistle must reach his or her mouth without the need to put the face into the water. Test the whistle by blowing into it. Replace any whistle that fails the physical examination or fails to sound a loud shrill tone.

Heliograph (mirror)

In addition to flares, strobe lights, and whistles, some SAR units issue an emergency-signalling mirror. The emergency signalling mirror is a compact unit that is used to attract the attention of passing aircraft or boats by reflecting light at them. The reflected light may be seen from two to four miles from the point of ori-

gin. The signalling mirror is used and maintained in accordance with the manufacturer's specifications. A weekly inspection of the mirror should be conducted to ensure that the surface is clean and polished, and the lanyard secure and in good condition.

Flashlight

A flashlight can be used to attract attention on the water and serve as an effective tool at night on the boat. Waterproof flashlights are preferable for obvious reasons. Check the batteries once a week and lubricate the o-rings with silicone grease or spray before closing the flashlight. Rinse your flashlight with fresh water after exposure to salt water.

Portable VHF radio

Many crew are also carrying a waterproof portable VHF radio in their vest. The portable radio can be used to call for help when needed or anytime one crewmember becomes separated from the rest of the crew. Note that some new models are compatible with Global Marine Distress Safety System, (GMDSS) - a useful feature.

2.7 Additional gear

Some extra equipment is advisable for spending long hours on the water. Extra gloves and an extra hat are always a good choice. High energy snacks like granola bars or peanuts will get the crew through long hours at night or long patrols.

2.7.1 Knife

A knife is always handy. It is a good idea to have one in one of the pockets of the equipment vest. A lanyard should be used to keep the knife attached to the vest. Choose a blade that is designed to cut lines and that has good resistance to corrosion. Knives designed for scuba diving and kayaking often provide adequate resistance to corrosion. Always rinse your knife with fresh water after exposure to salt water. Dry your knife before putting it into storage. Keep your knife sharp. Lubricate the blade once in a while with a fine layer of oil to increase resistance to corrosion. On inflatable boats the blade tip must be blunted or squared off.

2.7.2 Pocket Mask, Rubber Gloves and Eye Wear

Some kind of barrier between you and potential bodily fluids of patients is vital to your safety. AIDS and Hepatitis are real risks when dealing with all patients. The CGA crewmember must be ready to set up a protective barrier, donning gloves before handling the patient and preferably before arrival, eyewear in case of projectile vomiting, and pocket mask when carrying out rescue breaths.

2.7.3 Gear Bag

Each crewmember should bring a small waterproof bag that contains some items that could be required depending on your mission. Some suggested items for your gear bag:

- Toque or hat, scarf or balaclava
- Extra gloves or liners
- Chemical hand warmers
- High energy snacks, and water
- Spare glasses or contact cases
- Phone number and ID
- Small first aid kit
- Quarters and cash (small amount)

WARNING

SAR crewmembers should not be asked to carry and use cartridge-fired devices as personal flares. Firing these devices by a crewmember in the water requires a degree of co-ordination and dexterity not needed for self-contained devices. Co-ordination and dexterity may be depressed by the effect of hypothermia, causing the act of firing the cartridge type to be very difficult. It is recommended that SAR crews use the compact type of flares to allow easy fitting and comfort in pockets of work suits and clothing. All SAR personnel should be well informed regarding the firing procedure for these flares. Seek training if necessary.

2.8 Maintenance & Cleaning

Maintaining your gear

After use, suits should be rinsed with fresh water and hung in a ventilated area to dry.

Sewing or patching may repair suits that are damaged by small tears, broken zippers, open seams, or small burns. Suits that are more severely damaged should be removed from service. After use, suits should be rinsed with fresh water and hung in a ventilated area to dry. Do not expose to direct sunlight. Zippers should be lubricated periodically with silicone spray; it lubricates and retards corrosion.

2.8.1 Drysuit Maintenance

To prolong the life of the drysuit and ensure that it is ready for your next use, the following steps shall be followed after each use:

- ➜ Close the zippers and rinse the suit thoroughly to remove salt or other contamination
- ➜ Pay special attention to folds and creases
- ➜ Clean the zipper teeth and outer zipper guard (if fitted) with a soft wet brush, such as a toothbrush, to remove dirt and salt
- ➜ Thoroughly wash all seals, inside and out, using a mild soap-and-water solution to remove body oils or other contaminants
- ➜ If required, turn the suit inside out and rinse with fresh water
- ➜ When cleaning is completed, hang the suit on a sturdy wooden or plastic hanger to dry. The inside of the suit should be dried first, and then the outside. Do not expose the suit to bright sunlight or excessive heat. Do provide adequate circulation
- ➜ Once a month or as required, lubricate the zippers with paraffin wax or beeswax on both the inside and the outside of the teeth.
- ➜ Protect the seals in accordance with the manufacturer's recommendations. Unscented talcum powder can be used on seals. Do not use baby powder. Do not apply oils of any kind to seals

2.8.2 Drysuit Repairs

Drysuits cannot usually be repaired in the field. Many suits come with a manufacturer's warranty for repair of defects. Always contact the manufacturer if your drysuit needs repair. The only temporary repair that can be done in the field is replacement of a defective latex wrist seal when used with dry gloves and wrist rings. Note that this is useful only when the leak is located somewhere above the ring. If it is located between the ring and the sleeve, you will have no other choice but to have the seal replaced.

WARNING:

Flotation suits should not be dry-cleaned.

Polypropylene underwear should be washed by machine in warm water up to 38°C, and rinsed in cold water. Air-drying is recommended, but a dryer on permanent-press cycle may be used.

Areas that become soiled may be washed with a mild soap solution, rinsed with fresh water, then hung to dry in a ventilated area. Do not wring the suit. Do not attempt to use solvent or thinner to clean suits. Salt, corrosion, and grease are the main enemies of safety gear. Given time, salt can cut material like a knife, transforming a drysuit into a wet suit and a rain jacket into a well-ventilated jacket. The salt molecules penetrate the fibres while in solution and crystallise when they dry. These crystals then cut the fabric during normal motion. Rinse your gear thoroughly with fresh water.

Grease should be washed out with a mild non-abrasive detergent. All zippers, metal buckles, and brass snaps or buttons should be protected with silicone spray or glycerine (hand soap).

2.8.3 Float Test

Vest pockets can be used for a wide variety of equipment, depending on the nature of work to be done. Pockets soon become full and the equipment vest becomes heavy. Fifteen pounds of buoyancy on your PFD will quickly become useless if you carry 30 pounds of equipment. Weigh all your gear that you would wear on the heaviest day. Rig a diving weight belt to the equivalent weight and put on your PFD. Jump into a swimming pool (not too deep) and count how many minutes you can tread water. If you sink to the bottom like an anchor, you should re-evaluate the equipment you carry with you and/or your flotation. The weight test can also be used to determine whether your flotation device is still in good condition. For this test, look at the label to find out how many pounds or kilograms the device is supposed to support. Rig a weight belt to that weight and attach it to the flotation device. Drop everything in a pool. Does the flotation device float or sink? Small variations between the rated buoyancy and the actual buoyancy may be acceptable, but any significant difference would suggest that the flotation device needs to be replaced.

2.9 Cold water survival

Cold waters can claim a life very quickly. This is why it is imperative that cruiser suits or dry suits are worn.

The Cold Water Boot Camp figures use the 1-10 -1 rule. From entering cold water, you have 1 minute to get your breathing under control. 10 minutes maximum of useful movement of the hands, arms and legs, and 1 hour before hypothermia sets in. If you are not wearing flotation, within ten minutes you will not be able to tread water or keep yourself afloat.

Research done by the University of Victoria shows that most people who are not wearing thermal protection will die of hypothermia within the first few hours of exposure to 10°C water, even if they're wearing flotation.Hypothermia is a drop in body "core" temperature caused by cold water immersion, exposure to cool/cold air in water-soaked clothing and prolonged exposure to low environmental temperatures.

When the body core starts to cool off rapidly, the brain takes action to prevent the vital organs from becoming too cold. The warm blood is shunted away from the extremities, and restricted to the torso and head; circulation is reduced to a minimum.

One of the greatest variables in the survival times of people, who have actually been lost overboard, is the will to live. But even if you have an iron will, it's best to be prepared by wearing good thermal protection and ensuring that you don't fall overboard in the first place.

2.9.1 Preventing Hypothermia

The best way of dealing with hypothermia is to prevent it. Being aware of the risks is a good place to start. The following may provide additional protection from hypothermia:

- Drysuit
- Wet suit
- Immersion suit
- Survival suit
- Exposure coverall
- Multiple light layers of dry clothing
- Water or wind-proof outer layer

If you find yourself floating, try to climb up onto something. If there's nothing to climb onto, then use the Heat Escape Lessening Position (HELP). This position will protect your body's heat loss areas. By keeping your arms and legs in, and your body still (weather permitting), you can reduce the amount of water flow over your body core.

One of the greatest variables in the survival times of people, who have actually been lost overboard, is the will to live.

If you are floating in a group, then everyone should huddle together, keeping their chest walls close together. This position also reduces the circulation of cold water around the bodies.

2.9.2 Signs and Symptoms

1. **Skin colour** – with no blood in the limbs or near the skin, the victim will appear pale and blue.
2. **Restricted movement** – with no blood circulation to the limbs, a victim's movement will be slow and listless. The victim will be uncoordinated and clumsy.
3. **Altered state of consciousness** – with reduced brain cell activity, the victim may behave strangely or say inappropriate things.
4. **Shivering stops** – in severe hypothermia, the shivering response stops and the person becomes subdued and dopey.
5. **Slowing pulse and decreasing consciousness** – when the core temperature is very low, the

victim's pulse will feel weak and slow, or not be felt at all. The level of consciousness will be reduced.

6. **Unconsciousness** – cardiac arrest usually follows after the victim loses consciousness by drowning or the dropping temperature.

Personal Survival

Remember the priorities outlined in chapter one, crew safety comes before anything else. Your survival will depend on your forethought and preparation more than the actions taken after you find yourself in the water.

3

Vessel Fitness and Safety

"Life Saving Vessels fulfil their function under conditions which, for other craft and equipment, are regarded as extreme – to be avoided, if possible.

Thus the concept of 'Acceptable risk of failure' cannot apply.

It is when other vessels have failed that the lifesaving vessel must work."

G. Klem, Senior Research Engineer,
Norwegian Ship Research Institute

Vessels Fitness and Safety

Contents

The Moore family was in distress on board their vessel *Concreta*. Captain Brown took the Rivtow vessel *Lumba Lumba* out into one of the infamous Western Canadian North Coast storms to rescue the stricken vessel. Captain Brown describes the beating that he and his crew took in Keith Kellers' book *Dangerous Waters*.

Excerpts taken from Dangerous Waters

Written by Keith Keller

The Lumba Lumba was a 90-foot personnel carrier originally built to cross the Strait of Malacca in Indonesia. At approximately one-thirty in the afternoon, with a volunteer crew in place and Brown at the wheel, the Lumba Lumba headed into the face of the storm ……

It was estimated that the Concreta was somewhere between Lucy Island and Stephens Island. That's where George Moore estimated his position. We had quite a radio system going, with the Concreta talking to Bob Pederson ashore on the CB, Bob relaying by phone to our dispatch, who was relaying on to me on the VHF. But it worked really well. Everybody was really cool. I can't say enough about that part. But it was snowing and the wind wasn't easing off and the swell was getting worse, if anything and the Moore family had a dead reckoning position only. Because of the heavy sea we'd had to tone the radar down a bit, which cut out any targets, but otherwise you couldn't see anything-the sea was just making a mess of it. Of course we weren't able to pick him up at all ……

Brown: I tried to go almost straight across the harbour to go through the Metlakatla Pass. The Lumba Lumba is a tremendous sea boat, and she laid right over-came very near to standing on her beam ends with the wind velocity and swell. We finally had to run down to the throat of the harbour and then tack back taking it on our quarter, and then through Metlakatla Pass.

Once we got through the pass it was really, really dirty. I would say we had a sea running at that point near thirty feet and winds were definitely gusting up to 80 plus. I think there's comments about 60 and so on, but it would have been around 80, gusting to 85 even. At times we buried the bow, and she had somewhere in the order of twelve feet of freeboard and normally skipped right over most of the swells. She buried her bow under six to eight feet of water, and we had both screws out of the water at times. I had one engine full ahead and one astern at times to keep her head-to.

Somewhere around there the anchor which was lashed forward came loose. And without a thought George Salome, one of the certified masters, went out the side door and forward and the next thing I know he was gone. I thought he was gone completely but the swell wrapped him right around the handrail aft of the starboard wheelhouse door. The handrail saved him from going overboard but he took a beating. It took a couple of fellows to get him unwrapped and secured. We didn't see it until the next day but he was black and blue over his whole body.

He just wasn't thinking for the moment. He'd always been that type of man who responded immediately. We were very very lucky that we didn't lose him. But the anchor was sloshing around, and it weighed a hundred and some pounds and it was bouncing sometimes four and five feet off the deck and he felt, like the rest of us, that it could have come right through the wheelhouse window.

There was a point once we were clear of Metlakatla Pass, two props out of the water, bow buried, anchor loose, one skipper hurt, that I had some doubt about whether we were going to get back. I figured that was the time I'd better ask everybody. I was prepared to go on but I thought I'd better have a show of hands and make sure that everybody else felt the same way. And they did. There was no doubt, no hesitation whatever. So away we went.

We took an awful hammering. At times I went right to my knees. You're hanging on to something and suddenly you don't know how you let go but you did. You just couldn't withstand it, it was such a crashing, crushing kind of thing.

Extreme conditions can test a vessel's limits

3.0 Introduction to Vessel Fitness & Safety

The *Lumba Lumba* continued on and got the Moore family off of the *Concreta* in extremely heavy weather. Both vessels were damaged but Captain Brown knew the limitations of his vessel and crew enough to make the rescue successful.

The only thing separating sailors and the ocean is their vessel. When a rescue crew accepts their pagers and begins a shift on call or the auxiliary vessel that you crew is called to action, your vessel had best be fit and ready to handle the worst surprises. It is every crewmember's responsibility to ensure the fitness of the vessel. Only routine inspection and a relentless regimen of care and upkeep can accomplish this job.

It is the Coxswain's/Captain's duty to make sure that the vessel and the crew are prepared to arrive on scene safely, solve or stabilise the incident, and return home. This cycle demands constant diligence from the crew in the practices of inspecting and maintaining the vessel and preparing for on board emergencies. It is a never ending process that starts with the individual crewmember.

Almost every rescue team will encounter situations that require teamwork and positive action to survive. In order to accomplish the goal of assisting people in distress the team and the vessel must be fit and prepared. If something goes wrong the team must be ready to respond with or without direction. This is why we practice.

A rescue vessel can never be too prepared. Caring for a vessel is usually twice as much commitment as originally expected, and the care of a rescue vessel is double that.

Each Rescue Vessel shall be subject to the following constant cycles:

Routine Cycle

- Regular Inspection
- Maintenance and Repair
- Practice for on board emergencies
- Practice for Transit
- Practice for SAR

SAR Cycle

- Alert
- Pre-departure briefing
- Crew dons gear and performs personal equipment check (PEC)
- Crew performs a pre-departure check on vessel
- Vessel departs
- Vessel arrives on scene and resolves or stabilises incident
- Vessel returns home
- Crew de-briefs
- After mission: fuelling, damage check, and minor repair if necessary

3.1 Briefing

3.1.1 Pre-mission Briefing

For the crew of the vessel it is important that everyone know the details of the mission and the plan in order to function effectively as a team. In missions such as a search, the Joint Rescue Coordination Centre will have given the coxswain/captain an action plan. It is his or her job to convey the main points of that plan to the crew. Your Coxswain/Captain will give pre-departure briefings. This gives the team a focus and opportunities to develop or modify the plan before you get underway.

The military use the SMEAC model (Situation, Mission, Execution, Any questions, Check understanding); this is a format that extracts the most amount of relevant information and puts it into a form that is easily communicated and remembered.

3.1.2 Passenger Briefing

Each crewmember shall be able to give passengers and new members an orientation to the vessel and a basic safety briefing. There are some fundamental procedures and rules that should be established before anyone goes out on a rescue vessel. Each Auxiliary unit should adapt this list to fit the vessel and the equipment stored on board.

Use the following points to brief the crew

Situation **M**ission **E**xecution
Administration **C**ommunications

Some examples of points

Situation

- Nature of the distress
- Short summary of the history of the report

Vessel:

- Safety / signalling gear on board

Missing persons:

- Gender, height, weight, hair colour
- Colour of clothing: jackets, pants, layers of warmth, hat
- Wearing flotation

Mission

Action Plan:

- General area of mission
- Action to be taken

Execution

Any special instructions from coxswain and division of roles for en-route:

- ETA
- Route to area
- Other units involved
- Action to be taken before arrival

Administration

- Predicted duration of incident
- Relief, if planned
- Fuel stops
- Tide, wind, and weather information
- Equipment and supplies
- Phone numbers and log books

Communication

- Call signs of all units
- Working frequencies
- SITREP times
- Radio checks and cell phone #'s

Example of a Passenger Briefing List

- Location of PFDs and/or lifejackets
- How to put on a PFD and/or lifejacket
- Reminder to passengers that all on board shall wear a PFD and/or lifejacket at all times
- Location of flares and how to use them
- Location of the emergency kit
- Importance of keeping oneself low, on the centre line, and holding onto a rigid part of the vessel while moving around on board
- Importance of keeping one's hands, arms, and legs inside the vessel when approaching or leaving a dock
- Reminder to passengers of the physical effects that they will experience as a result of vessel motion, sunlight, waves, wind, and sound
- Role of each crewmember and/or passenger's role in an emergency

3.2 Pre-Departure Check

If a vessel has been regularly inspected, the pre-departure check will hold no surprises. The principle behind an effective pre-departure check is to test and inspect the critical systems on the vessel before leaving. This check should not take more than a few minutes. Vessel fitness and watertight integrity are things that need to be verified. Major safety and communication systems must be inspected and tested (if practical).

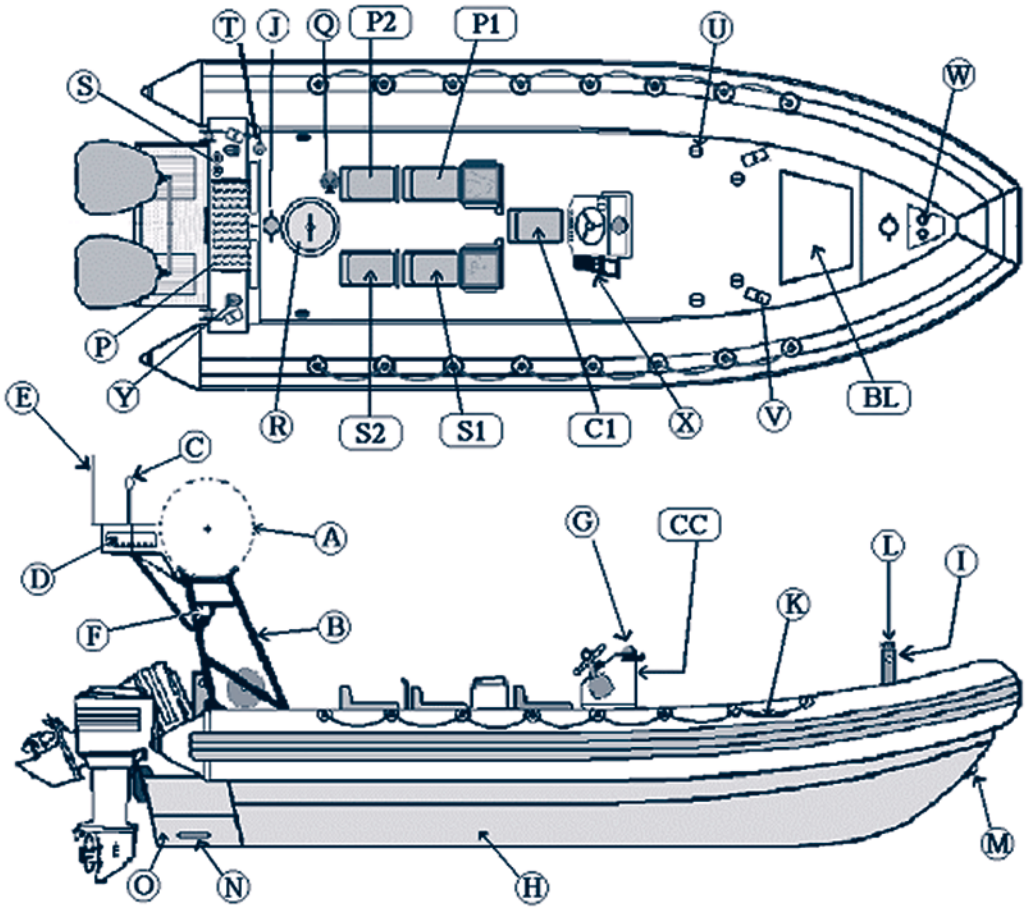
One crewmember or coxswain/captain can read out the list while the others check the equipment. Each item should be verified verbally or written before departure. Any shortfalls shall be reported immediately to the coxswain/captain.

Example Pre-Departure Checklist

- ✓ Verify last regular inspection
- ✓ Attach kill switch to driver
- ✓ PFDs and personal equipment check
- ✓ Tube pressure hull check
- ✓ Fuel / oil levels, tanks pressed up
- ✓ Bilge pump
- ✓ Navigation lights, instrument lights
- ✓ Search lights

Zodiac Hurricane 8.5 M
CCGA-Pacific

Sample Equipment Plan



Deck Layout

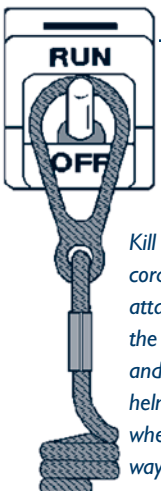
BL • Bow Locker*
Fire Pump Storage
CC • Command Console*
Engine Controls & Instruments
C1 • Coxswains Console
Operators Position
P1 • Port Fwd. Console*
Nav & Com Position
P2 • Port Aft Console*
Lookout Position
S1 • Stbd. Fwd Console*
Nav & Com Position
S2 • Stbd Aft Console*
Lookout (Spare)

* • *See list for all items stored in Consoles and Boxes*

A • Self Righting Bag
B • Self Righting Frame
C • All Around / Anchor Lt
D • Radar Dome
E • VHF Antennae*
* • Not shown GPS, VHF(#2)
Wind Indicator
F • Stbd Nav. Light
G • Magnetic Compass
H • Aluminium Hull
I • Fwd. Tow Post
J • Aft Tow Post
K • Grab Lines
L • Bow Lt. Mount
M • Bow Eye
N • Zinc's (P & S)
O • Engine Mounting Box
P • Tow Rope Reel
Q • Fire Extinguisher
R • Deck Hatch
Auto Bilge Pump
S • Oil Fillers (P & S)
T • Manual Bilge Pump
U • Deck Tie Downs (4)
V • Lifting Eyes (4)
W • Fuel Fillers (F & A)
X • Engine Controls
Y • Fuel & Aft
Compartment Vents

Transom Compartment-
Fuel Selector Valves
Fuel Filters, Blower Fan

- ✓ Void spaces or tanks (doors & deck)
- ✓ Self bailing freeing ports/scuppers clear
- ✓ SAR equipment state and stowage
- ✓ Major safety systems (engine space fire system, EPIRBs, GMDSS, life rings, strobes)
- ✓ Navigation systems: radar powered and transmitting, GPS position acquired
- ✓ Engine lines fittings and propellers (steering test)
- ✓ Tools and spares on board
- ✓ Rigging or mast works, antennae and radar tight
- ✓ Self righting equipment connected, pressured, tight, personal recovery line and trigger handle present and ready
- ✓ JRCC notified
- ✓ Radio communications VHF, portables charged and tested
- ✓ Weather & SAR information on board
- ✓ Cellular telephone and extra batteries (if carried)



Kill switch cord must be attached to the kill switch and the helmsman when underway.

CCGA vessel (20-50 feet) Pre-departure Checklist

- ✓ Check fuel levels. Consider free surface effect - keep tanks full
- ✓ Check water tanks. Consider free surface effect - keep levels full
- ✓ Check oil levels. Keep levels full
- ✓ Check filters and ensure they are clean
- ✓ Ensure anchor secured and spurling pipe capped
- ✓ Ensure all hatches are closed and secured
- ✓ Store all ropes and fenders in bow lockers and ensure lockers are locked
- ✓ Ensure life raft is secured and in good condition
- ✓ Check bilges to ensure they are dry
- ✓ Ensure bilge pumps are in good working order
- ✓ Secure all internal lockers and drawers
- ✓ Ensure galley secured
- ✓ Check provisions and replenish as necessary
- ✓ Secure all loose items, include main salon and aft cockpit
- ✓ Check safety equipment and ensure it is in good working order
- ✓ Check all personal safety equipment - strobe, knife, flares, radio
- ✓ Check radios to ensure they are in good order
- ✓ Ensure electronic navigation equipment is in good working order
- ✓ Do a radio check and establish communications with radio station and JRCC
- ✓ Check there are adequate spares on board
- ✓ Check fuel filters, oil filters, impellers
- ✓ Check belts and clips
- ✓ Check tool kit
- ✓ Check pre-cut plywood for window repairs on board and secure

Before your vessel departs, it is important to take time to consider the factors necessary to ensure a safe and productive voyage. Remember that there aren't any second chances.

3.2.1 Bring the Weather and Tide Information

Each rescue vessel should have a designated crewmember that provides the weather forecast and tidal information and brings it on board before departing. This allows the coxswain/captain to prepare the route so as not to put the vessel at risk. You can obtain weather information from radio, newspapers, television, and every meteorological office in the country.

Marine weather forecasts focus on wind direction and strength, precipitation and squall activity, and factors likely to affect visibility, such as haze and fog.

Weather radio Canada, operated by Environment Canada, provides weather information 24 hours/day on VHF/FM radio, as does the Coast Guard on VHF Channel 21B and Channel 83B (try the WX button on the VHF radio). Wind reports heard on the radio will include the following terms:

- ➡ Light Winds (0 -15 knot winds)
- ➡ Moderate Winds (15 - 19 knot winds)
- ➡ Strong Winds (20 - 33 knot winds)
- ➡ Small Craft Warning (20 - 33 knot winds)
- ➡ Gale Warning (34 - 47 knot winds)
- ➡ Storm Warning (48 - 63 knot winds)

All mariners should learn to read the weather themselves, so that they can detect telltale signs of approaching storms.

Check currents and local hazards

There are danger spots in many areas of our coastal and inland waters. A professional mariner should know where these spots are, and be familiar with how the tides, currents, wind hazards and local outflows will affect them.

3.3 Emergencies

Rescue vessels have specially trained crews because the vessel may find itself in harm's way. On board emergencies are the great equalisers because a small vessel needs all of the crew to respond effectively and skilfully without leadership in the event of an accident aboard the vessel. You may be required to respond without guidance. To accomplish this, you must be trained and practised in the responses to on board emergencies.

3.3.1 Crew Overboard

Recovering a person from the water is one of the most important procedures that a rescue vessel can practice. If the captain is doing his/her job correctly each crew should have practised this manoeuvre many times. It takes preparation and repetition to ensure that your crew is ready to respond in the event of an emergency.

Develop a safe and efficient method for bringing persons into your boat from the water and practice it with your crew.

If a crewmember falls over the side, he or she is facing two immediate dangers:

- ➜ Hypothermia and drowning
- ➜ Not being found

To effectively recover a person from the water, the boat and driver should take the time to Stop, Assess and Plan (SAP) the recovery, without ever losing sight of the person in the water.

Maintain verbal contact with the person in the water. This will enable you to assess the person's level of consciousness as well as to reassure them.

Note: If the operator observes a person falling overboard, alter course to steer the rudder/skegs and propellers away from the person in the water.

Crew Overboard Procedures

1. Shout "Man Overboard!" and throw a buoyant object (buoyant heaving line, throw bag or lifebuoy) to assist the person and to mark the spot.

2. Appoint a spotter to keep sight of the person in the water, and have them point and wave their arm towards the person when they have the victim in sight. If they have momentarily lost sight of the person, they should hold their arm out straight in the direction of the last sighting.

3. Contact Coast Guard Radio on VHF 16 (if available), or contact people on shore. Issue a **MAYDAY** if the person isn't recovered immediately.

4. Keep your bow into the predominant conditions (wind current or swell), with the person in the water ahead of you.

5. Stop Assess and Plan when you are 2-3 boat lengths away.

6. Go slowly on final approach. It's better to take your time and succeed the first time, than to have to go around again.

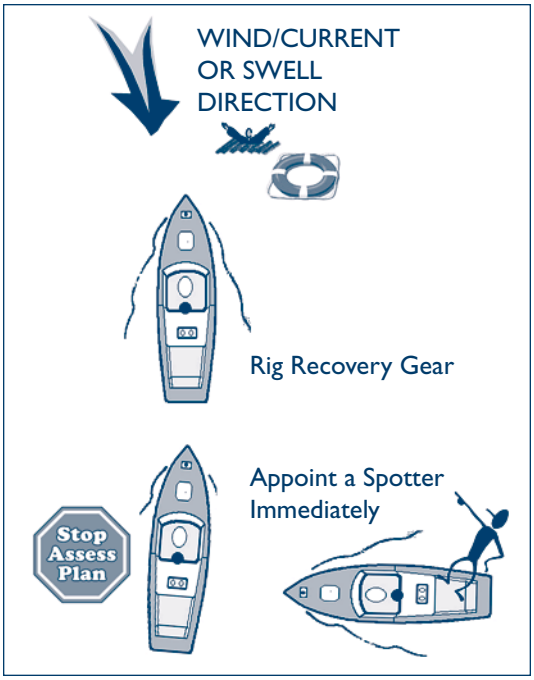
7. Put throttles into neutral when the person is alongside. Do not touch the throttles until the person is onboard or well past and clear of the engines.

8. Use a re-boarding device if necessary. Be careful in retrieval. Persons in distress have pulled many would-be rescuers into the water. Keep your centre of gravity inside of the boat.

Once you have recovered your crewmember, have them lie still while they are checked for spinal or other injuries and signs of hypothermia (if exposed for more than a few minutes). If the crewmember's protective clothing is wet on the inside then the vessel may have to return to shore and get the crewmember to shelter, depending on the conditions and shelter provided on the vessel.

If there is a possibility of the person in the water suffering from hypothermia, having been immersed for a long period of time, always parbuckle them on board, keep them horizontal, and treat them gently to prevent cold blood from the extremities rushing back to the heart.

Recovering a person from the water is one of the most important procedures that a rescue vessel can practice



Treating Hypothermia

1. Remove the person from the source of cold exposure, handling the victim gently and keeping them horizontal. Severely hypothermic casualties must be considered stretcher patients, even if they appear to be able to walk.

2. Provide shelter. Once you get the person into a warm environment, remove the victim's wet clothes.

3. Insulate against further heat loss. Cover the victim with blankets or other insulating materials and vapour barrier.
4. Apply warmth to the body core only. Use heat pads or dry, warmed blankets and apply them to the torso, head and neck. Do not give the victim anything by mouth, especially caffeine or alcohol.

5. Be careful of the limbs. A hypothermia victim's arms and legs are full of very cold blood. If the limbs are over-stimulated (e.g. the person is required to move on their own, or the limbs are

rubbed or warmed aggressively), this icy blood will be sent to the heart like a bullet. Cardiac arrest will result if the victim's core temperature is low when the cold blood is received from the limbs. Focus re-warming efforts on the body core.

6. Get medical assistance immediately, using or exhibiting distress signals as necessary. Hypothermia is a medical emergency that can present a number of potentially fatal complications.

7. Provide basic life-support as required. If the victim appears to have succumbed to the cold, don't give up. Continue to provide life-support (CPR) until emergency medical personnel arrive.

Recover patient gently using stretcher

3.3.2 Capsize, Sinking

In the event of a capsize, the coxswain must continually assess conditions to ensure the safety of the boat crew and of those in distress. However, all crewmembers must be prepared to perform all the duties involved, for the coxswain/captain may not be able or available to lead.

A boat is less likely to capsize in deep open water.

A boat is less likely to capsize in deep open water. The chances of capsizing are greatest during operations in or near surf or breaking seas. The force needed to capsize is most likely to come from heavy seas directly astern (following seas), or large breakers striking abeam. Stay at sea until conditions change. The safest point for most boats to take heavy seas is nearly bow-on. Vessels should not operate or tow in conditions beyond the capability of the boat or crew.

Factors that can cause a vessel to capsize or swamp:

- Shifts in load (standing up in small boats)
- Mishandling at high speed
- Surf or breaking seas
- Surf or swell in shallow water depth (less than 20 ft.)
- Heavy steep seas
- Sudden stops at high speed
- Overloading
- High wind
- Current and tide rips with steep following seas
- Fast river rapids
- Loss of stability due to low fuel in the tank, excessive amounts of water in bilges, icing of topsides, or too many people on board

Self-Righting Lifeboats and Rigid Hull Inflatables

Specially designed lifeboats and many sailboats are able to roll through a capsize and right themselves. If you are on board one of these vessels the best action is to hold on tight and do not jump off the vessel. Each self-righting vessel should have a specific set of procedures in place. All crew must be familiar with these procedures and be ready to respond to this situation.

Some Rigid Hull Inflatables are equipped with manually triggered self-righting systems. It may be your responsibility to trigger this system and right the vessel in the absence of a coxswain/captain.

Capsize Reversal Training For 7.3 metre Zodiac RHI as Taught in RHIOT School

1. Check crew for injuries and confirm the number of persons on board (POB).

2. All crew to assemble at the transom.

3. First crew member deploys the safety line and swims it out the complete distance (length of line). Remaining crew assist with deployment of safety line, then follow the line out themselves. The coxswain remains at the transom.

4. After the crew are safely out of the way, the coxswain activates the capsize reversal system by pulling firmly on the handle. As soon as the system is activated, the coxswain will swim/pull himself down the safety line and out of the way.

5. If the capsize reversal system is operating properly, it should take approximately 7 seconds for the vessel to right itself.

6. After the vessel has righted itself, the crew can begin boarding. Use the windward side of the vessel. Do not try to climb over the engines - it's dangerous!

7. After the crew are onboard:
   • Check your crew for injuries and numbers

- Test your radio
- If no radio contact, activateEPIRB
- Deploy the seaanchor
- Recover the safetyline
- Remember that you do have flares, but use themwisely
- In all probability, the engines will havewater in the cylinders,&the electrical systems, including the EMM are now,not going to work. Unless it is safe to do so, removing spark plugs, & trying to re start the engines is not an option to be undertaken. Stay with yourvessel, maintain situational awareness, provide first aid (comfort), asnecessary, & provide information to rescue services (location, POB)
- PREPARE FOR RESCUE

Emergency Outboard Restart after submersion

(This only works with normally aspirated outboard engines)

In all probability, the engines will have water in the cylinders. Get the water out by removing the spark plugs and turning over the engine until the water is gone. Replace spark plugs and prime fuel lines, then try to start the engines.

Water is expelled from cylinders

Remember: Since the engines will have water in the carbs and cylinders (from the exhaust system), you will have to turn them over for approx. 10-20 seconds. Water will spray out of the spark plug holes. Once the engine is able to turn over without water spraying out, pump the **FUEL** priming bulb to prime the carbs. **DO NOT PRIME THE OIL SYSTEM.** If the starter is unserviceable, use the pull start method. Remember to activate primer and turn on key when it's time to start the engine. This procedure is taught at the Canadian Coast Guard's RHIOT School.

Recovery after self righting

Once the crew is on board:

- ➡ Check your crew for numbers and injuries
- ➡ Try your radio and send a MAYDAY
- ➡ If no contact, activate the EPIRB
- ➡ Deploy the sea anchor and recover the safety line
- ➡ Remember that you do have flares, but use them wisely

Some Basic Guidelines to Capsize Survival

Increase your chance of escape by planning ahead

Take the time to Stop Assess and Plan, but the crew must make every effort to escape

If the hull is intact after capsizing, it will not sink for some time, even in rough seas. The crew will have time to escape if panic is avoided. Precautions to be taken ahead of time include:

- ➡ Learn the boat's interior. Initially the crew will be disoriented due to being upside down with inadequate lighting
- ➡ Stow all loose gear and have all equipment and doors operating properly for ease in escaping
- ➡ Know the location and use of all survival equipment. Check it regularly to be sure it is appropriate and in good repair. Be sure that all signalling devices work

Don't let go of the boat

If you're not threatened by any danger from surf or rocks, then stay with the boat. An overturned vessel provides a better visual search object than people in the water do, particularly for search aircraft.

In a capsize scenario, the crew should immediately grab onto the hull or lines to ensure the vessel doesn't blow away.

Coaching from outside

If people are trapped under an overturned boat (and still conscious), attempt to have them swim out under their own power. They may have to remove a flotation device to escape an enclosed space. Hold onto a PFD to use as a possible aid in the rescue.

Escape procedures

If trapped in or under the boat, seek out an air pocket near the top (inverted bottom). Gather the crew together in the air pocket and take time to have everyone settle down and focus on planning a safe escape. Discuss the escape route and objects of reference along the route. Look down; light may be visible and escape immediate.

Take the time to Stop Assess and Plan, but the crew must make every effort to escape. The boat may sink, and the air in the space will soon disappear or go bad. Before attempting to escape, check for needed survival equipment, especially flotation and sig-

nalling devices. PFDs may have to be removed temporarily for people to fit through spaces or to go underwater to reach an exit. If necessary, tie a line to the PFD and pull it out after exiting.

Guidelines for escaping from a capsized vessel

- ⇛ Avoid the stern if the engines are still running
- ⇛ If a line is available, the best swimmer should exit first through a cabin door or window, carrying the line
- ⇛ If caught in an open cockpit area, swim down below the gunwales and surface alongside the boat
- ⇛ Locate exit route and reference points from the compartment to open water
- ⇛ Swim underwater through the exit and out from the boat
- ⇛ If no line is available, have the best swimmer go first, followed by a poorer swimmer and lastly a good swimmer (If the poorer swimmers are left alone inside, they are likely to panic and not escape.)
- ⇛ The first swimmer, when free, should signal (e.g. tap on the hull) to indicate success in escape

3.3.3 Crew Strategies for Cold Water Survival

In the event of the rescue vessel being lost the remaining crew can work together to increase their chances of survival. The key actions are conserving energy, preventing heat loss and signalling for help. (See Chapter 2 Personal Safety Section 2.9)

Prevent Heat Loss

- ➜ Get on board a life raft if available
- ➜ The group should decide who is at the greatest risk and allocate the resources for preventing heat loss with that crewmember
- ➜ If a life raft is not available, climb onto the boat, if possible, in order to conserve body heat (heat loss being 25 times greater in water). Otherwise, hold onto the largest floating object available
- ➜ Generally, everyone should stay with the boat and not swim for shore. Distances to the beach can be deceiving, and strenuous activities such as swimming in cold water can hasten the onset of hypothermia
- ➜ Survivors should consider tying themselves to the boat if there is a rapid means of untying or cutting free, in case the boat shifts or sinks. Most people are likely to become tired or develop hypothermia
- ➜ Huddling together in a group with the coldest in the middle prevents excess circulation
- ➜ Survivors should keep their spirits up by devising games or routines that keep the groups focused and aware

3.3.4 Fire On-Board Your Vessel

The crew of any vessel must prepare and practice the control and suppression of a fire onboard their own vessel. The key to survival is to save your vessel by suppressing the fire quickly.

Theory: The Fire Tetrahedron

For a fire to occur, four factors must be present:

1. Fuel
2. Heat
3. Oxygen
4. A chain reaction (the chemical reaction between fuel, O_2 and heat)

Remove the Legs of the tetrahedron, any one of these four factors (the four sides of the fire tetrahedron), and the fire is extinguished.

Removal of the fuel source

- ✓ Removal of the fuel source (i.e. wood)
- ✓ Removal of adjacent fuel sources
- ✓ Cut off fuel supply (i.e. liquid gases)

Removal of Oxygen (O_2)

- ✓ Smother flames by the use of CO_2 or foam extinguisher
- ✓ Cut off the O_2 to the fire (i.e. if the fire is in a garbage can, put the lid on the can to cut off the O_2 supply)

Removal of the heat source

- ➡ Attack the base of the fire with water to cool and remove the heat source.

Break the chain reaction

- ➡ Extinguishing agents like Halon or Dry Chemicals attack the molecular structure of compounds during the chain reaction and reduce the flame-producing capability of the fire.

Most vessels carry small (BI, BII) dry chemical, carbon dioxide, or Halon portable extinguishers, along with buckets, fire axes and in some cases, pumps. This equipment is designed for rapid reaction to and control of relatively small fires at the time of ignition.

Given that most small vessels are constructed using readily flammable material (fibreglass, plastic, wood, etc.) and fuels (gasoline, diesel, propane), response time is critical. The crew of a vessel on fire may be able to extinguish and/or contain the fire before it develops beyond the fire fighting capability of the vessel equipment. The vessel's captain or coxswain must assess a fire situation relative to the crew's ability to cope with it.

Use of Fire Extinguishers

There are four types of extinguishing agents commonly found aboard vessels:

- ➜ Water
- ➜ Dry chemical powder
- ➜ Carbon dioxide
- ➜ Halon gas (no longer acceptable in government)

Procedures for Fighting a Fire On board

Find

✓ Find the fire, the location, and its size

Inform

✓ Inform the Captain immediately to sound the general alarm to muster the crew and notify all hands.

✓ Make a distress call to any nearby vessels. Activate emergency fire fighting equipment

Restrict

✓ Restrict the fire. Shut off air supply to the fire – close hatches, ports, etc.

✓ De-energise electrical systems in affected space. Set fire boundaries to confine the fire. Shut off fuel supply and ventilation.

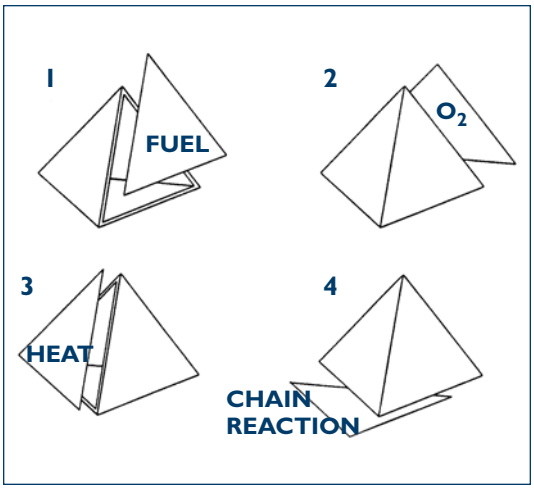
✓ Manoeuvre vessel to minimise the effect of wind on the fire

✓ Prior to activating fixed extinguishing system, ensure that all personnel have been evacuated from the space

Extinguish

✓ Extinguish the fire

✓ Determine class of fire, appropriate equipment, extinguishing agent and method of attack



Four ways to put out a fire.

(1) Remove the fuel

(2) remove the air with a smothering agent like CO_2 or foam

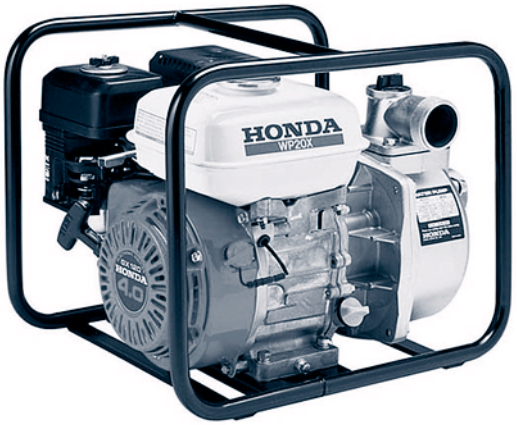
(3) remove the heat with water.

(4) or break the chain reaction with dry chemical.

✓ Overhaul and set re-flash watch Muster crew to account for all personnel

✓ **If unable to control fire, prepare to abandon the vessel**

Using a fire /Salvage Pump



Example Fire/Salvage Pump

The vessel master must assess a fire situation relative to the crew's ability to cope with it.

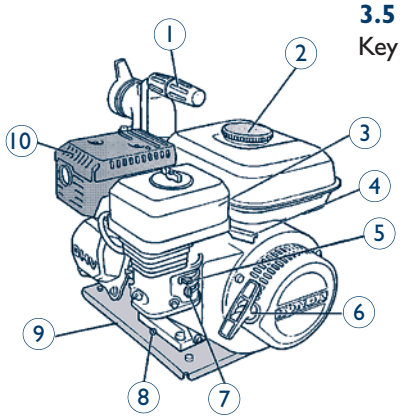
The portable fire and salvage pump is important equipment when it comes to SAR vessels. The pump is not as readily available or as quickly deployed as the fire extinguisher but this pump may save your vessel and many other vessels if you are practised at using it.

Water

Water is always in plentiful supply in the marine environment. While water is found in portable extinguishers, it is more likely to be applied from buckets or pumps. Water is most effective when used under pressure, in the form of fog. Water applied by

3.5 H.P Honda Pump

Key to numbering below



1. Carrying Handle
2. Fuel Tank Cap
3. Air Cleaner
4. Throttle Lever
5. Choke Lever
6. Starter Cord (Handle)
7. Fuel Valve
8. Oil Drain Plug
9. Base Plate
10. Muffler

Steps to Starting a Fire Salvage Pump

If you maintain and test the pump regularly then it will start and run when you need it the most.

Set up

- ✓ Place in a spot where the exhaust is clear of flammables
- ✓ Get suction hose and fire hose ready
- ✓ Check fuel

Start

- ✓ Turn on power
- ✓ Adjust choke
- ✓ Open fuel line
- ✓ Set throttle to 3/4
- ✓ Open chamber lid
- ✓ If not a self priming pump, prime chamber (pour water into chamber or fill hose)
- ✓ Attach suction hose
- ✓ Put suction hose over the side
- ✓ Ready output end (control hose nozzle)
- ✓ Pull start cable

Operating

- ✓ Surge the suction hose to help with prime
- ✓ Ease choke until pump runs smoothly
- ✓ Adjust throttle to full
- ✓ Monitor suction
- ✓ Check that exhaust is clear from objects
- ✓ Control water flow with nozzle

bucket or by hose can be used effectively to extinguish burning wood, upholstery, bedding and other combustible solids, excluding fibreglass.

When using water to extinguish a fire aboard a vessel, you must keep the following in mind:

- ➜ Sporadic dousing by bucket will not be effective against major fires
- ➜ Water directed in stream at fuel fires can splash the burning fuel to areas that are not on fire yet
- ➜ Water will turn into steam when placed on a fire, thus further hampering visibility already obscured by smoke
- ➜ Large quantities of water used to fight a fire may affect the stability of the vessel, and thus dictate limited use

Dry Chemical

These extinguishers are given either:
A '**BC**' rating for use on combustible liquids (gas, oil, etc.), and on energised electrical fires; or an '**ABC**' rating to include all of the above, as well as combustible solids. As with any other extinguisher, the user of a dry chemical extinguisher must read the directions on the extinguisher to ensure its proper use.

Before attacking a fire with a dry chemical extinguisher, the seal should be broken, the safety pin removed, and a short burst triggered to ensure that the device is functioning (a good shake may dislodge any compacted powder). When using a dry chemical extinguisher against a fire, the powder should be directed at the base or source of the flames, using a repeated lateral sweeping motion. Try to avoid breathing the powder if possible. It is not toxic, but can cause breathing difficulty.

If there is a choice of extinguishing agent readily at hand, CO_2 or Halon is preferable to dry chemical powder in situations involving carburated engines and low-voltage energised fires in electronics.

Carbon Dioxide

CO_2 gas is another common extinguishing agent found around small craft. Carbon Dioxide extinguishers are usually either:

The **BI** type, which contain a minimum of 5 lbs. of gas or;

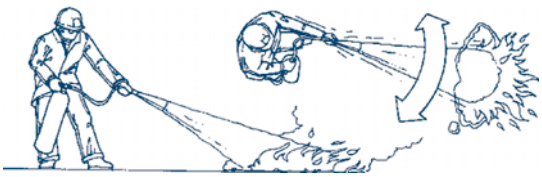
The **BII** type, which contain a minimum of 10 lbs. of gas.

Carbon Dioxide extinguishers are given a '**BC**' rating for use on combustible liquids and on energised low voltage, low amperage electrical fires (Carbon Dioxide gas discharge results in a fog of highly conductive frozen water vapour). Do not use on high voltage or high amperage electrical fires.

Carbon Dioxide suppresses fire by displacing oxygen. When deployed in an enclosed space, CO_2 can cause suffocation. Do not remain in any area where CO_2 has been deployed. As with dry chemical or any other extinguisher, the user must be familiar with the instructions on the device.

Before attacking the fire, trigger a short burst to check that the extinguisher is charged. (The nozzle assembly should never be held after it has been moved into position, as severe frost burn will result.) When using a carbon dioxide extinguisher, the gas should be directed at the base of the fire using the same lateral sweeping motion as with a dry chemical extinguisher.

Carbon Dioxide gas is preferable for use in enclosed spaces where it can be concentrated. It is not effective in exposed situations, particularly if there is a wind blowing. Carbon dioxide can be used to cool surfaces that have exceeded the flash point of combustible liquids, such as in the case of manifolds, turbochargers, and stoves.



Attack fire with low sweeping motion

Fighting fire on an outboard engine

If fire occurs on an outboard engine, in addition to raising the alarm, broadcast a distress message, and steering away from danger:

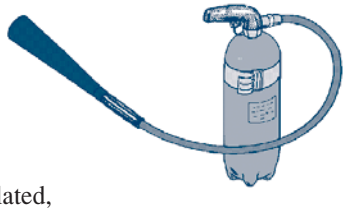
1. Turn engine off, and back on only to raise out of the water (to prevent drag if tilt motor becomes damaged).
2. Electrically isolate the engine.
3. Turn off the fuel.
4. Use fire extinguishers or dewatering pump to douse flames.

Fires in Engine Spaces

Fires that occur in engine spaces are generally the result of fuel or lubrication oil leaks, or ignited by a backfire, exposed electrical connection, or overheated engine compartment.

Before attempting to extinguish a fire in an engine compartment:

- ✓ Attempt to close fuel supply valves (if accessible)
- ✓ Shut off the electrical current at the battery switch.



Once the fuel and/or ignition source is isolated, attempt to introduce an extinguishing agent into the compartment. This is a dangerous manoeuvre requiring extreme care, as any attempt to open the compartment will introduce more oxygen, which in turn may cause a back flash or explosion. The engine hatch cover should be opened slowly and in such a fashion that, if an explosion does occur, the hatch will not be blown against or into any part of the firefighter's body. It should be opened away from the firefighter.

All of the '**BC**' rated extinguishers can be used effectively on engine space fires. However, gas types (CO_2 and Halon 1211) are preferable; they leave no residue which may compromise chances of repairing and restarting the equipment involved.

Steps to take in the event of an Engine Compartment Fire

- ✓ Shut off all engines. generators, and ventilation systems
- ✓ If boat is equipped with an automatic extinguishing system, ensure it is discharging
- ✓ If the system is manually operated, energize it, and check to ensure it is discharging
- ✓ Initiate a mayday call to alert boats in the area of the situation
- ✓ Have all crewmembers don PFDs and move to a smoke-free and flame-free area of the boat
- ✓ When the captain gives the order, put a life raft or dinghy over the side and ready it for boarding

Opening a hatch

If you must open a hatch to discharge a portable extinguisher, you may get burned. As the fresh air enters the compartment, it will feed the fire and cause it to "blow up." The best method of opening a hatch is to stand to the hinged side of the hatch. Then, wearing gloves or using something other than bare hands, pull the hatch open. If the boat has a closed engine compartment and no fixed system, it is a good idea to make a small hole with a pivoted cover into the

Classes of Fires and Extinguishing Agents

Class of Fire	Fuel Source	Extinguishing Agent	Primary Effect
A	Fires involving common combustible materials. Fuel sources within this class include wood and wood-based materials; cloth; paper; rubber and certain plastics.	**Water**	**Removes** the **heat** element
B	Fires involving flammable or combustible liquids, flammable gases, greases and similar products. Fuel sources within this class include petroleum products.	**Foam AFFF** (Aqueous Film-Forming Foam) **CO_2** (Carbon Dioxide) **Dry Chemical** **Halon**	**Removes** the **oxygen** element **Removes** O_2 **Breaks chain reaction** **Breaks chain reaction**
C	Fires involving energised electrical equipment, conductors or appliances.	**CO_2** (Carbon Dioxide) **Dry Chemical** (PKP) **Halon**	**Removes** the **oxygen** element **Removes** O_2 **Breaks chain reaction**
D	Fires involving combustible metals. Fuel sources within this class include: Sodium; Potassium; Magnesium and Titanium.	**Water** (high velocity fog) **Sand**	**Removes** the **heat** *and* **oxygen** elements

space. A portable extinguisher may be discharged through this hole.

3.3.5 Signalling a Distress

If your situation becomes serious, the coxswain/captain may decide to issue a distress. This is a decision that should always be made by the coxswain or captain unless they are physically unable to issue the order. Once the order is given, it may be your job to issue that distress. There are many ways to do this and you should know them all. Use any and all available means to call for help.

Communication of distress

Electronic signalling of a distress can be done in many ways (See Chapter 4 Communications Section 4.5 Distress Communications). The main VHF, handheld VHF radios or cellular phones offer the best chance of quick reponse. The EPIRB may take up to an hour for the distress to be received by a Coast Guard radio station.

Visual Distress Signals

Pyrotechnics or Flares

The purpose of distress signalling is to first attract attention and second, to provide a homing signal to guide the responding vessel to your craft. The most effective distress signals for attracting attention are aerial flares and parachute flares because they are moving, spectacular, and cover a large sighting area. Once help is on the way, handheld red signal flares, orange smoke signals and orange distress flags serve as beacons helping rescuers to pinpoint your position and keep them on course.

Types of Flares

Type A – Parachute flares

Type B – Multi Star Rocket Flares

Type C – Hand held Flares

Type D – Smoke Flares

Type A, C, and D pyrotechnics are SOLAS approved and have a much longer duration of visibility. CGA recommends use of these types of flares on its vessels. Aerial signals – A SOLAS parachute flare will last for at least 45 seconds.

Aerial Signals

Aerial flares should be fired after sighting or hearing a potential rescue vessel. To attract attention to your distress situation it is recommended that you fire two aerial flares, one immediately after the other, so rescuers can confirm the sighting and the direction of the signal. Parachute flares do not need to be fired in twos since a single parachute flare has adequate burn time (25 to 30 seconds) to confirm sighting and position.

Hand-Held Signals

Hand-held signal flares are intended as homing signals to pinpoint your position. Surface to surface sighting range on water is approximately 3 to 5 miles, depending on boat elevation. If a rescuer is 5 miles away and running at 20 miles per hour, it will take 15 minutes to reach you. Therefore, you should have at least 12 minutes (total burn time) of signals on board to maintain a strong homing signal until help arrives.

When to Signal

Remember, search and rescue missions often establish grid search patterns, which means you may see the same aircraft two to three times coming from different directions. Do not waste aerial flares if the aircraft has initially passed by you. Carrying extra pyrotechnic signals will improve your chances of being sighted.

Four Rules of Signalling

1. Conserve your signals until you are reasonably sure of being sighted. Wait until you see or hear a vessel or aircraft before using "one-time" signals.

2. Stay with the boat if it is safe to do so. A boat is easier to spot than a swimmer.

3. Coast Guard approved marine signals improve your chances, but anything that works is good. Shout, flash your running lights, wave a piece of clothing, use your windshield as a mirror, flash a flashlight, use anything that's available to attract attention.

4. Familiarise yourself with your signals before you leave shore. Time is important in any emergency and shouldn't be spent reading instructions.

Smoke

Smoke flares emit orange smoke for at least three minutes. They are excellent daytime signals and allow vessels to track your position over time. Smoke can be any other colour, caused by intentional fire or otherwise.

Strobe Lights

White strobes are a recognised personal inshore distress signal in Canada, but are also used as an anti-collision device by many fishing vessels offshore.

Lamps/Heliograph (Mirror) Reflections

SOS signals (three short – three long – three short flashes).

Dye Marker

Bright orange dye in sea adjacent to vessel or person in the water. These work well for aircraft in daytime.

Arm Wave

Prescribed signal is arms extended from sides, then raised and lowered slowly.

Audible Distress Signals

Loud noises can be made at distinct intervals, such as Morse Code, SOS, or continuously.

Collision Regulations

You should memorise all of the distress signals listed in the collision regulations (Annex IV) before you ever find yourself in trouble.

Distress Signals

Taken From Annex IV (Collision Regulations)

- ⇛ A gun or other explosive device fired at intervals of about a minute
- ⇛ A continuous sounding with any fog signalling apparatus
- ⇛ Rockets or shells, throwing red stars fired one at a time at short intervals
- ⇛ A signal made by radiotelegraphy or by any other signalling method consisting of the group … _ _ _ … (SOS) in the Morse Code

- ⇛ A signal sent by radiotelephony consisting of the spoken word "Mayday"
- ⇛ The International Code Signal of distress indicated by N.C
- ⇛ A signal consisting of a square flag having above or below it a ball or anything resembling a ball
- ⇛ Flames on the vessel (as from a burning tar or oil barrel, etc.)
- ⇛ A rocket parachute flare or hand held flare showing a red light
- ⇛ Smoke signals giving off orange-coloured smoke

Stay with the boat if it is safe to do so

- ⇛ Slowly and repeatedly raising and lowering outstretched arms to each side
- ⇛ The radiotelegraph alarm signal
- ⇛ Signals transmitted by emergency position-indicating radio beacons (EPIRBs)
- ⇛ Approved signals transmitted by radio communication systems, including survival craft radar transponders

Aviation-Oriented Distress Signals

A piece of orange canvas with either a black square and circle or other symbols appropriate for identification from the air. As mentioned before, a dye marker deployed in the water is easily seen from above.

Canadian Modifications:

a) A square shape or anything resembling a square shape

b) A high-intensity white light flashing at regular intervals of 50 to 70 times a minute

3.4 Vessel Inspection

Your auxiliary vessel keeps you alive during an incident. The crew and vessel may be asked to endure extreme conditions and perform extraordinary tasks in the course of their duties. If the vessel is not ready, then the crew is at risk as soon as the key is turned. You, the crewmember and the coxswain/captain are responsible for keeping that vessel ready. Regular inspections are an essential component to a search and rescue unit's routine. The crew must share responsibility in the state of the vessel. Boats need constant attention and upkeep. Special attention should be given to any shortfalls in the vessel fitness and safety equipment.

With basic maintenance and a regular tune-up, a car will run for years. But a boat needs constant attention if it's to remain shipshape. A boat that's being neglected will start to show signs almost immediately, and if the problems are ignored, it can become dangerous.

Vessel Husbandry

When you see a clean and tidy boat that is well equipped and running smoothly, it's usually because someone takes pride in its upkeep. Vessel Husbandry is the caring and conscientious maintenance of a vessel.

3.4.1 Regular Inspections are Mandatory

Each CCGA Vessel will have its own inspection routine. It is the crew's responsibility to find out what the routine is and participate. A daily inspection routine is ideal but not always feasible with volunteer run vessels. Each crew must be confident that the CCGA vessel they operate has been inspected recently and is fully operational. If there are any vessel shortfalls then each crewmember must be aware of those before departure.

Regular inspection is a necessary part of a rescue crew's routine. Each crew must inspect the vessel when they start an on-call shift or before the start of a scheduled voyage. A rescue crew should never be operating a vessel that has not been recently inspected by that crew. The coxswain/captain should be involved in this routine so they may be aware of the location and status of all gear and equipment.

Each vessel will have its own sheet to use during the inspection. Here are some examples to use as guides for the development of your inspection routine:

3.4.2 Example General Weekly Inspection List for Larger CGA Vessels

General

- ✓ Hull and superstructure
- ✓ Lines/fittings/rails
- ✓ Mast and equipment
- ✓ Mountings
- ✓ Anchor and Windlass
- ✓ Moorings
- ✓ Anchor locker
- ✓ Lazarette
- ✓ Void spaces

Lights

- ✓ Running lights
- ✓ Search lights fixed
- ✓ Search lights portable
- ✓ Navigation lights
- ✓ Instrument lights
- ✓ SAR Horn
- ✓ Loud hailer

Safety

- ✓ Life Jackets
- ✓ Fire extinguishers
- ✓ Flares
- ✓ Anchor & line
- ✓ Flash lights
- ✓ EPIRB
- ✓ Life rafts/life rings
- ✓ Fire Pump
- ✓ Sea anchor
- ✓ Heaving line
- ✓ First aid bag/stretcher

Electronics

- ✓ Shore power
- ✓ GPS
- ✓ Radar/direction finder
- ✓ Radios/cell phone
- ✓ Depth sounder
- ✓ Single side band
- ✓ Engine hours

Engines

- ✓ Water level
- ✓ External leaks
- ✓ Transmission oil
- ✓ Fuel level sound/gauge
- ✓ Oil level
- ✓ Bilges, through hulls
- ✓ Generator levels
- ✓ Spare fluids
- ✓ Belt tension
- ✓ Run up/in gear
- ✓ Running gear and steering
- ✓ Pumps and lines
- ✓ Rudders

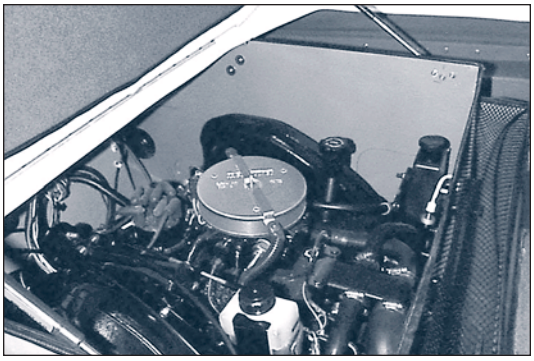
Your auxiliary vessel keeps you alive during an incident.

Gas vapours are highly explosive, so the smell of gas fumes should always trigger caution

3.5 Vessel Systems Maintenance

3.5.1 Inboard Engines

With inboard engines come engine and machinery spaces. These spaces, along with the machines they house, require regular maintenance and upkeep. The area should be kept tidy. Any loose parts or tools can cause a fire, or a breakdown in rough weather. If you're operating a vessel with inboard drives, you will have to check this space before start-up.



The inboard engine requires special care where the propeller shaft passes through the hull (stuffing box). The stuffing box is a vulnerable spot for damage, and a loss of lubrication or cooling here can become a serious problem.

Fuel Systems

Gas vapours are highly explosive, so the smell of gas fumes should always trigger caution when working with these engines. The blower should be run for a few minutes before starting up, and the engine's fuel lines should be checked visually each day. A vapour detector will help you prevent most gas explosions.

Water Contamination

Any marine fuel system is prone to water contamination, and should be equipped with in-line filters and water separators. If there is water in the separator cups, then consult your manual for the appropriate water decontamination procedure.

Diesel

A diesel system experiences many different contaminants and therefore the filters should be checked and changed regularly. Consult your manual for the appropriate procedures required to clean the fuel system filters.

Ignition System

A clean spark is required for a smooth running gasoline engine. The distributor, points and plug leads should be inspected and cleaned once a month. Dirty spark plugs may cause rough-running engines or engine vibration. Spark plugs should be replaced in accordance with the manufacturer's recommended schedule.

Lubrication

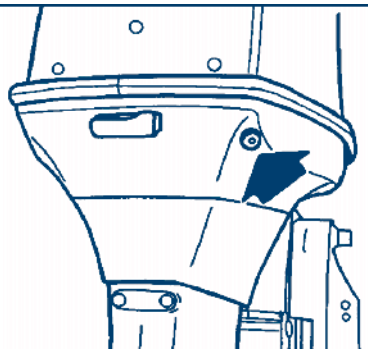
When you're at the fuel dock, take time to top up the oil reservoir

Clean oil means longer engine life. Your oil should be checked daily, and changed on a regular basis. Oil filters should be replaced each time the oil is changed.

Open Cooling System

The hull intakes (if a raw water system) should be checked for obstructions. The pipes should be visually checked for leaks or corrosion. Wet exhaust ports can be inspected for adequate circulation.

If the system is not circulating, it is usually the result of an air lock or obstructed intake. If that isn't the problem, then consult the manual.



Cooling indicator port

Closed Cooling System

Most inboards are water-cooled systems that need to be periodically flushed and topped up. Closed cooling systems have a heat-exchanger which acts like a radiator does on a car. All of the links in the system should be checked regularly. If the vessel has a fresh water, closed system, then antifreeze levels can be checked when the water is changed.

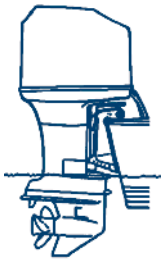
3.5.2 Outboard Engines

An outboard power plant provides efficient and reliable propulsion. It can be detached and replaced in minutes, or taken in to the shop for repairs. But outboards still need care and attention to remain reliable. They usually operate on one to six cylinders.

Maintenance

Outboard motors should be cared for year-round, and maintained to cope with the changing seasons and use in different operating environments. Here's a maintenance routine that you can follow when checking your motor. Outboards have the same basic needs as inboard engines:

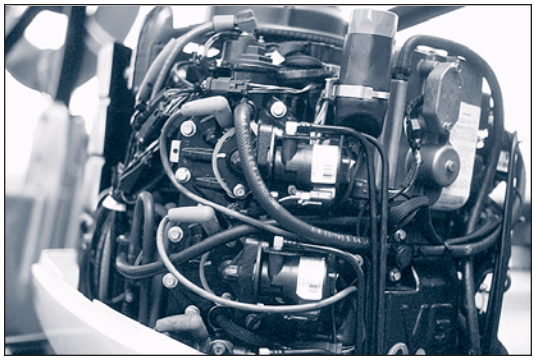
- Fuel
- Lubrication
- Ignition
- Cooling
- Cleaning



Fuel

Engines that are more modern have an oil injection system that actually mixes the oil at the carburetor. This oil is supplied from a separate reservoir, and is directly injected by a variable ratio pump. When you're at the fuel dock, take time to top up the oil reservoir.

Mixed or straight gas must be filtered for contaminants and water. Sometimes the engine's filter will quickly fill with water, making the system run roughly or stall. A separate water filter system installed outside the engine can eliminate any water problems. These filters should be checked and replaced as per manufacturers recommendations.



Lubrication

Two-cycle oil lubricates the cylinders directly, since it's mixed with the fuel. It is critical that the oil used is the grade recommended by the manufacturers' specifications.

Outboard Engine Trouble-Shooting Guide

Some Common problems to Check

Motor won't start
- ✓ Fuel supply
- ✓ Fuel line connected, fuel filters and/or screens clear, spark plug wires firmly connected
- ✓ Throttle position (neutral position for starting)
- ✓ Kill switch off

Motor hard to start
- ✓ Out of gas
- ✓ Fuel tank vent is closed
- ✓ Fuel line pinched
- ✓ Fuel line primed
- ✓ Choke malfunction
- ✓ Water or dirt in fuel
- ✓ Loose spark plug wire
- ✓ Dirty or improperly gapped plug tune-up required

Motor runs rough
- ✓ Water or dirt in fuel
- ✓ Carburetor idle, needle needs adjustment
- ✓ Spark plug problems (hard to start)

Loss of power
- ✓ Propeller fouled
- ✓ Not in gear
- ✓ Sheer pin broken
- ✓ Spun prop hub

Vibration
- ✓ Loose mounting clamps
- ✓ Bent propeller

Motor stops
- ✓ Fuel supply
- ✓ No oil in fuel (for 2 stroke engines)
- ✓ Loose spark plug wire
- ✓ Water intake blocked or poor water pump
- ✓ Kill Switch

3.5.3 Checking the Electrical System

The use of electronic devices in the marine environment presents a real maintenance challenge. Electrical connections need constant attention or they will corrode, causing faults and shorts.

Most small craft electrical systems are not complex. They consist of a battery, an engine charging system, and the battery's grounded power support. The engine's ignition system is completely separate from the battery system (outboard only).

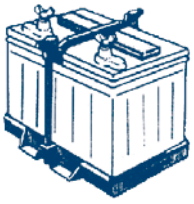
Trouble-Shooting Your Electrical System

Most electrical problems result from three things:
- ➡ Loose fittings (or broken connections)
- ➡ Corrosion
- ➡ Low battery voltage

Regular inspections of the system and its connections will prevent these problems. All connections should be protected with a corrosion-resistant coating.

Battery Care and maintenance

The lead acid wet cell battery is the workhorse of most boats and automobiles. It has a long life, and can deliver enough amps to turn over a large diesel engine. Your battery should be covered and secured in a well-ventilated space to prevent fire or explosions. Five maintenance rules will prolong the life of your lead acid batteries.



Hydrogen gas is released when a battery is charging

1. **Reduce or prevent deep-discharge cycles**
   Every time a lead acid battery is allowed to completely run down, it loses some of its longevity. The metal plates inside the battery area are called cells. These cells degenerate rapidly after the battery cycles (discharged and then recharged). After continuous cycling, the cells lose their ability to hold a charge.

2. **Provide air circulation:**
   Explosive hydrogen gas is released when a battery is charging. This gas may ignite if not diluted with circulating air. Battery spaces should

have constant air circulation to prevent explosions and fire. When working around batteries, it is important that there are no sparks from tools or electrical connections.

3. **Maintain electrolyte fluids:**
   Fill your battery cells with distilled water when they get low. Tap water will introduce contaminants into the cells, and will reduce charging capacity.

4. **Do not overcharge:**
   Charging your battery too fast, or for too long, will use up its fluid and the cells will become dry. When the cells dry, the battery will be irreversibly damaged. Use a proper charger for recharges, and monitor the amperage generated by your engines.

5. **Keep the battery and its terminal clean:**
   Baking soda neutralises the acid that may be on your battery, or spilled around the battery tray. A damp cloth with baking soda will clean the surface and sides, while a wire brush can eliminate corrosion on the terminals.

3.6 Fuelling

All small craft should keep their fuel and oil tanks full. This helps vessel stability and reduces water accumulation in the fuel caused by condensation in the tanks. Having pressed up tanks will ensure a CCGA vessel is capable of response at all times. Auxiliary vessels should set a good example to the boating public by never running out of fuel.

3.6.1 Fuel Consumption and Range

Each crewmember should memorise the fuel consumption rate of the vessel at cruising speed and full out. This way everyone on board has a general sense of how much fuel has been consumed and the vessel's current range. This type of information can be extremely useful to a coxswain who is thinking about keeping the vessel on a safe course or responding effectively to an incident.

NOTE: Instrument warning:
Some modern vessels have consumption rate gages on the engine controls, where most vessels simply have fuel gauges. These instruments are notoriously unreliable and should be monitored but not trusted.

Know your vessel's fuel capacity/consumption and plan your trip accordingly.

Example: *Canadian Coast Guard Auxiliary Vessel "Speedy Gonzales"*

- Cruising RPM 2200
- Approximate Speed at 2200 (20 knots)
- Fuel consumption at 2200 (50 litres per hour)
- Fuel Capacity 1000 litres

- Maximum Hours at Cruising speed **1000/50 = 20 hours**

- 20 hours at 20 knots = 400 nautical miles (-20% safety margin)

- Basic operating range at cruising speed **360 miles** (180 miles out and 180 miles in)

3.6.2 Safe Fuelling

When taking on fuel at the dock, follow the steps outlined on the following checklist to prevent accidents and embarrassment. Coast Guard Auxiliary vessels must set an example at the fuel dock by demonstrating safe fuelling practices.

Steps to Safe Fuelling

1) Secure vessel to mooring.
2) Shut down engines.
3) Move portable tanks ashore.
4) Ensure all non-fuelling crew are ashore.
5) Extinguish all open flames prior to arrival.
6) Shut off main power.
7) Shut off bilge pump power.
8) Place fire extinguisher on standby.
9) Close all doors and windows.
10) Plug drain ports and scuppers.
11) Use the correct oil.
12) Ground nozzle against the fill pipe before fuelling.
13) Fuel slowly to prevent spillage.
14) Wipe up any spillage.
15) Check for vapours or odours.
16) Operate bilge blower for 2-4 minutes before starting engine.
17) Turn bilge pump back to auto.
18) Avoid over-filling expansion.

4

Electronic Communication & Record Keeping

The CCGA vessel is one part of a response system. Professional communications are the most important component of an organised response in Search and Rescue. Communicating well is a skill that one never stops developing. Each member should focus on improving their skills throughout their training and contributing to the overall professionalism of the vessel.

Electronic Communication and Record Keeping

Contents

A Fisheries Patrol vessel is moving in the fog towards one of the deadliest narrows on the West Coast, Seymour Narrows. The navigation officer identifies a tug and barge on the radar screen entering the narrows from the north.

"Southbound tug and barge entering Seymour Narrows, this is the Fisheries Patrol vessel Felix on channel 16 VHF."

"Fisheries Vessel Felix, this is the Haida Dolphin go ahead, switch to working channel."

"Haida Dolphin, this is the Felix, I have to stay close to the point so shall we pass red to red?"

"Fisheries vessel Felix that sounds fine. See you in the narrows."

The lookout on the Felix spots the tug and barge coming out of the fog and reports "Haida Dolphin turning to starboard." The Felix hugged the starboard side of the channel and the two ships passed red light to red light.

As the tug's bow passes the lookout shouts excitedly "That's not the Haida Dolphin. That's the Island Monarch!" "Where is the Haida Dolphin?" the navigation officer shouts as another tug and barge enter the narrows on the radar screen.

The reality of the officer's mistake made his heart pound with fear even though the stranger had passed without event. The approaching Haida Dolphin also turned to starboard and slipped by red to red.

4.0 Introduction

The VHF radio is your unit's voice in times of action. It is this voice that is recorded, logged, reviewed and assessed every time the vessel is tasked or responds. Other units, the Rescue Centre, pleasure boaters, and Coast Guard Radio are all paying very close attention to those words you transmit over the radio. This is the reason why constant practise and diligence is required when using the VHF. The world is listening.

4.1 Radio Watch & Log Keeping

A Radio Watch will be held at all times when a CCGA vessel is underway. Each crewmember shall know the all of the duties involved when keeping a radio watch. The radio watch position is in many incidents the most important position on the vessel, for only through effective communication with other vessels can the Search and Rescue Unit function in the roles of searching and rescue operations. The duties of the Radio Watch are as follows:

4.1.1 Duties and Responsibilities

- Testing all communication systems prior to departure
- Keeping weather reports and tidal information ready for reference
- Activating and setting up the radio/radios for monitoring of the distress channel as well as any working channels
- Trouble shooting in the event of electronic failure or mechanical breakdown
- Regularly checking and testing the volume level
- Maintaining, inspecting and activating any electronic signalling devices (DSC, DMB or EPIRB).
- Keeping spare batteries for hand-held radios, pager and cell phones
- Keeping cell phones and pagers fully charged accessible and close enough to hear them
- Keeping and recording weather reports and tide information on board
- Listening to all designated channels especially VHF 16 for signs or signals of distress
- On hearing a distress signal or the spoken words MAYDAY, slow or stop the vessel, record time and all details, and if no other response, answer
- Notifying the coxswain if over hearing PAN, PAN, securité, or a relevant broadcast / radio traffic
- Logging all communication relevant to the vessel or the mission
- Answering and communicating all vessel business
- Relaying messages and instructions to vessel coxswain/captain and crew
- Sending a regular SITREP to JRCC via Coast Guard Radio.

4.1.2 Log Keeping

Note:
Most radio logs and deck logs are combined

Canadian Coast Guard Auxiliary standing orders require all auxiliary vessels to maintain a vessel log. The log is a legal document that can be called into "inquiries and courts of law." It must be completed in pen, pages are continuous (not torn out or removed), entries are legible, any errors are corrected by drawing a single line through the error and the log keepers initials beside the error. A running log may be kept on the vessel by using waterproof notepads or plastic slate and grease pencil and transcribed to a station log when back at base.

Following are log item entries required in your units radio log.

Normal deck entries are to include:

- Vessel's name
- Names of coxswain/captain, crew and passengers
- Times of departure and arrival
- Weather
- Time the vessel passed navigational landmarks
- Any problems with the vessel, damage to the vessel or props

- ➜ Any abnormal activities sighted, (oil slicks, illegal activity etc) reported to CGRS or JRCC.
- ➜ All distress, urgency signals received.
- ➜ All distress/urgency signals exchanged by your station
- ➜ All communications sent/received by your station.
- ➜ Any strange signals or circumstances monitored

In addition, entries bear the time of the entry, and should include the frequency/channel.

Key to abbreviations commonly used

Normal method of abbreviating: Drop vowels. Shorten words. (ie. dep for depart etc.)

⊣	**Abeam** a point on the side of the line
16/04A –	VHF Channels monitored 04A means 04 Alpha or US/CAN mode
A/C	Aircraft
Adv	Advise
Alngsd	Along side
Ch 16	The channel used for communicating this message
B/D	Broken Down
Descrptn:	Description of vessel/person
DF	Direction Finding
DMB	Datum Marker Buoy
F/G	Fibre Glass
F/V	Fishing Vessel
Ft.	Foot
GMB	General Marine Broadcast
GRT	Gross Registered Tonnage
I/O	inboard out board
L/B	Life Boat
LOC	Location
M/V	Motor Vessel
MOB	Man Over Board
NM	Nautical Miles
O/B	Out Board
O/D	Over due
P/C	Pleasure
Pgd	Paged
PIW	Person in the Water
POB	Persons on Board
POS	Position
JRCC	Joint Rescue Coordination Centre
RTB	Return to Base
S/V	Sailing Vessel
SITREP	Situation Report
Std	Dn Stood Down
Super/Wlhse	Super structure and Wheelhouse
TOW	Taking on Water
V/L	Vessel
VAC	Station designation (different for every MCTS centre)
VTS	Vessel Traffic System
WX	Weather

4.1.3 Vessel Log Keeper

The written log officially represents all of your vessel's actions and deeds. As a crewmember it may be your duty to write down everything that happens. As one Coast Guard captain told his third officer, "Mate, if it is not written in the log, it did not happen, and that includes your overtime pay."

A vessel log is to be maintained for normal activities and especially during SAR operations to be able to determine times and events. All information recorded must be legible and accurate. Larger vessels may have printed logbooks that are always kept on the vessel, but this may prove to be difficult for units utilising small open boats in their units.

Additional information that is required during a SAR incident may include all or any of the following:

- ➜ Time tasked by JRCC or CGRS
- ➜ Time of departure for incident
- ➜ Time and brief content of SAR Communications with JRCC or CGRS
- ➜ Last known position of search object
- ➜ ETA on scene
- ➜ Actual time of arrival on-scene
- ➜ Description of search objects
- ➜ Type of search pattern and areas searched
- ➜ On scene weather
- ➜ Tide and current
- ➜ Information on the distressed vessel
- ➜ Name and address of owner/operator
- ➜ Number of persons on board (POB)
- ➜ Vessel license and registration number (V/L Lic#)
- ➜ Type of assistance to the vessel or persons
- ➜ Distance towed
- ➜ Time of stand down
- ➜ Time of return to base or resume normal operation
- ➜ JRCC incident number

TIME	Log of Unit 35 COMS	Crew: Annik Baker Charles
0810	Pged code 3 by JRCC M/V Token taking on water 2NM south	
	of Stains Point. Descrptn 84ft.wood tug black hull white super	
	red funnel. 3 POB.	Pgr
0823	Unit 35 departs advises Victoria CG Radio ETA 20 Minutes	04A/16
0828	USCG helicopter G2965 ETA 18 mins	Chn 22A
0835	Overhear MAYDAY on Channel 16 Token is carrying 3 feet water	
	in her bilge all POB OK	16
0838	Advise VAK/JRCC M/V Token in sight	04A
0841	Unit 35 on scene alngsd SAP done Adv VAK/JRCC Token listing	
	to starboard but looks stable to board. JRCC advises "do not go	
	below decks" Switch to 22A working channel	04A
0845	Adv VAK/JRCC Two 35 crewmembers on board rigging pump	22A
0846	M/V YG151 Can Navy vessel ETA 45 mins	22A
0846	USCG helicopter G2965 Arrives on scene drops Skad pump	22A
0847	Unit 35 pump running and all POB with lifejackets and ready to move	
0853	Unit 35 gets Skad Pump running Adv VAK/JRCC	22A
0858	Adv VAK/JRCC pumps are not keeping up and vessel is in danger of sinking	
0905	Adv VAK/JRCC All crew and POB taken off of Token	
	two pumps still running	22A
0910	YG151 Can Navy vessel arrives and JRCC advises to stay	
	clear of vessel	22A
0913	Adv VAK/JRCC M/V Token rolls and sinks	
	position N 48 21.55' W 123 18.34' Depth 104 metres of water	
	all persons safe and accounted	22A
0920	Advs VAK/JRCC small slick on the water	22A
	WX : SS 4ft. chop, Wind 20 kt. sw, Vis 10+	
	Log continues...	

Note: The names and places have been changed in this incident.

Example of vessel information recorded

1535 S/V "Bounty"
Owner: Her majesty the Queen of England
Operator : William Bligh
12 Whalen Way
New South Whales
Australia W2Z X6Y
Phone 011 234 4567
Operator does not have operator competency card
Passengers : Fletcher Christian, Seaman Adams
Vessel Specs:
142 ft LOA Three masted Barqenteen wood hull with doilies and girl under bowsprit
Gold trim , two super structure cabins on deck
Built 1784 (no engine)
Registration # 666 0001234 Portsmouth England
Vessel in rough condition (wood rot and broken rigging)
Note: Vessels destination Island of Tonga, Off course
Plank rigged over the side Obvious tension in crew demeanour, Captain abrupt and hostile
No Radio No Charts
14ft dinghy wood (no engine)
1550 WX: sea state calm, wind 15kts nw, sky partly cloudy
1600 Bounty Taken in tow will tow to Lund Harbour

As can be seen, this type of log keeping (accepted practice) would require some explanation of the abbreviations; an alternative is to write in a more lengthy style.

4.2 VHF Communication System

The VHF radio coverage on Canadian waters is achieved through many strategically placed Marine Communications and Traffic Services (MCTS) Centres. These facilities control remote peripheral radio sites, which increase the area of radio coverage in their assigned area of responsibility. The primary role of these centres is the detection of radio transmitted distress calls, and the subsequent co-ordination of communications between the distressed vessel, the SAR response, and the Joint Rescue Co-ordination Centre.

MCTS Centres also provide information to larger vessels to ensure safety of navigation. Radar coverage is provided in most major shipping channels which allows MCTS to provide radar target information to JRCC and the SRU when required.

Industry Canada designates VHF channels for specific uses or users. Awareness of these channel designations can be used to expedite the SAR process. A search unit may contact vessels on those channels to make enquiries for information, and/or solicit assistance. The vessels listening on these channels often have expert knowledge of the area (tidal currents, drifts, hazards etc.).

Waters under federal responsibility include the east and west coasts, the St. Lawrence River, all the Great Lakes and the Arctic region. If you want to report a marine incident in these waters by telephone the best way is to directly call the nearest Joint Rescue Co-ordination Centre (JRCC) or Maritime Rescue Sub-Centre (MRSC). Every rescue centre has a toll-free number and can be reached by regular or cellular phone.

In addition, for marine emergencies only, MCTS can be reached by cellular phone by dialling *16.

4.2.1 Canadian Joint Rescue Centres

JRCC Victoria, British Columbia
Toll-free number: 1-800-567-5111

JRCC Halifax, Nova Scotia
Toll-free number: 1-800-565-1582

JRCC Trenton, Ontario
Toll-free number: 1-800-267-7270

MRSC Quebec City, Quebec
Toll-free number: 1-800-463-4393

MRSC St. John's Newfoundland & Labrador
Toll-free number: 1-800-563-2444

4.2.2 Radio Operators Certificate (ROC)

An ROC can be obtained by taking the Canadian Power and Sail Squadron's (CPSS) Marine Radio Telephone Course (VHF). The course is offered via their manual "The Radio Talk Seminar" and is available through Power Squadron. The examination process is through CPSS or through a certified examiner. Most independent examiners will have access to the study material as well.

4.3 Operating the VHF

Every piece of electronic equipment is different and it is imperative that each crewmember has access to the operating instructions and has ample opportunity to become familiar with the electronics on-board. You should start with the radio or radios. Crewmember problems with the radio are at best embarrassing, and at worst may render your vessel ineffective in a search or even prevent a distress signal from being sent.

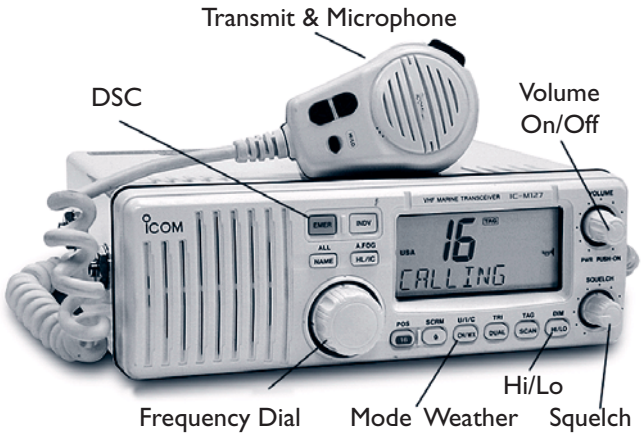
- Get used to using the basic controls. You will have to adjust and set them in the dark and in rough seas.
- Some concerns to address when familiarising yourself with the radio are as follows. Can you adjust the controls with your gloves on or do you need to take them off?

Is the microphone waterproof or will it short out and transmit a constant signal if wet? Does the radio switch back to Channel 16 on its own?

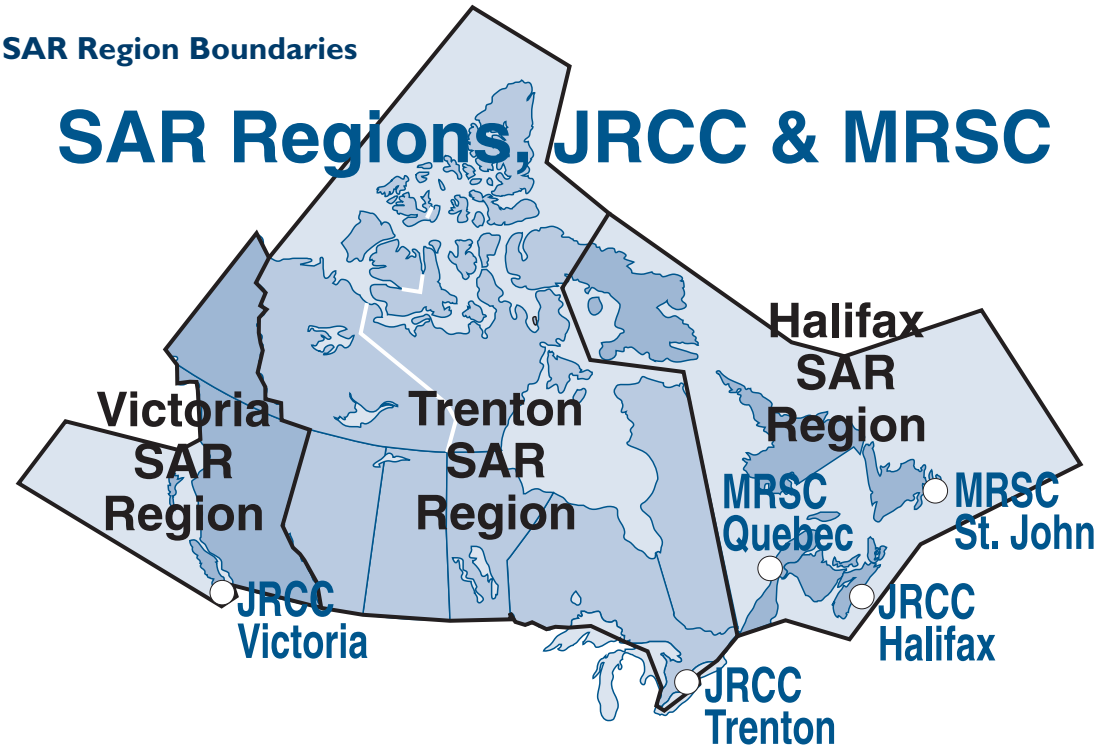
4.3.1 Basic controls on VHF radios include

- on/off,
- volume,
- squelch,
- channel or frequency selection
- mode
- hi/low

Every piece of electronic equipment is different and it is imperative that each crewmember has access to the operating instructions and has ample opportunity to become familiar with the electronics on board.



SAR Region Boundaries



On/off, and volume

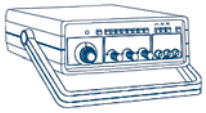
(see manufacturers instructions)

Squelch

Adjusts the receiver sensitivity and limits unwanted radio noise. It also opens the receiver circuit, resulting in a "rushing noise." The squelch should be adjusted to make this noise, then backed off to the point where the noise quits. If the circuit "breaks" occasionally, readjust the squelch. As you leave "noisy" radio areas (such as a harbour), the squelch should be periodically adjusted. Too high a squelch setting will result in weaker signals not being heard.

Channel or Frequency Selection and Mode

Depending on the model, VHF radios may be marked *Intl* (International), *US* or *USA*, and/or *CDA* Canada. Understanding this function can either give you a good day, or give you a bad day. Some channels are **simplex**, others **duplex**. On a simplex channel, the send and receive frequencies are the same. A duplex, radio transmits on one frequency, but receives on a different frequency. The Duplex system allows for private conversations and more control by the MCTS Centre. This only concerns ship to shore operations (vessel to a coast station).



Other Emergency Frequencies:
2182 Khz
121.5 Mhz

Example: Coast Guard Radio ship-shore telephone channel 26. These duplex channel frequencies are indicated as "**A**" side (ship transmit), and "**B**" side (Coast Guard Radio transmit). Channel 26 ship transmits (**A**) 157.300 MHz, and Coast Guard Radio transmits (**B**) 161.900 MHz. Obviously when they communicate, the ship receives the "**B**" side, and the Coast Guard Radio receives the "**A**" side. When your radio is in the International mode, your radio will be set to the international frequency allocation standards. Channels such as **04, 61, 62, 78, 22** are used in other areas as telephone or **duplex** channels.

Note that these channels in Canada are designated as "ALPHA" channels. **04A, 61A, 62A, 78A, 83A**. To operate in the alpha mode, you must switch your radio mode to **CDA** or **US**. This function switch modifies your radio so that the send and receive frequency are the same. Thus, it becomes simplex.

Note: It is wise to keep your radio in the USA/CDA mode at all times, with the following exceptions; to place a ship-shore telephone call, or listen to continuous marine broadcasts on channel 21B. This can also be accessed on WX1, WX2, WX3, or WX4, depending on the area.

Hi / Low

The Hi/Low switch toggles the transmitter power output between high and low. Most marine VHF radios have a high power of 25 watts and a low power of 1-5 watts. The high power output of a handheld radio is usually 5 watts with a low power setting of 1 watt. If you are working close to the station you are calling and you do not wish to broadcast your conversation to the world then low power may be an option. During SAR incidents all transmissions are made on high power.

Other Types of Radios

VHF radios are most common in recreational vessels today yet commercial vessels and some recreational boaters will occasionally use other radio types. These may include:

GRS (General Radio Service)

- ➜ Better known as Citizen's Band (CB)
- ➜ Not monitored by MCTS Centres
- ➜ Monitored by some service organisations and clubs

MF SSB (Medium Frequency–Single Side Band)

- ➜ Not common on pleasure craft
- ➜ Common aboard larger commercial and fishing vessels
- ➜ Long-range capability

4.3.2 International VHF Radio Procedures

The following includes the accepted procedures and the phonetic alphabet for use with VHF radio, as approved by the International Telecommunication Union (ITU):

- ⇛ Channel 16 is the international calling and distress frequency. Use Channel 16 for initial calling only, never for the passing of messages, with the exception of distress (May Day) traffic.
- ⇛ Always monitor Channel 16 for distress calls.
- ⇛ Always name the station you are calling first and identify yourself second, e.g. "Vancouver Coast Guard Radio this is Auxiliary Vessel Mary Jane, over."
- ⇛ Never make any transmission without identifying yourself by your vessels name and/or call sign.
- ⇛ Use recognised VHF language. Some of the more common are listed on the next page.

4.3.3 Terms for Use with Marine VHF

OVER	I have concluded this transmission and expect a response
OUT	I have concluded this transmission and do not expect a response
ROGER	Your message has been received and understood
CHANNEL	Switch to channel _____ .
SAY AGAIN	Please repeat (the word "repeat" is not normally used for radio communication)
I SAY AGAIN	Repeat
STANDBY	Please wait on this channel until further notice
ALL AFTER	Used when referring to a specific portion of a message
WORD AFTER	Used when referring to a specific word
ALL BEFORE	Used when referring to a specific portion of a message
WORD BEFORE	Used when referring to a specific word
AFFIRMATIVE	"Yes" or confirms information is correct
NEGATIVE	"No" or confirms information is not correct
THAT IS CORRECT	What you told me is correct
CORRECTION	Change what I just said to you (followed by correct version)
READ BACK	Repeat all of the following message back to me after I have said "over."
I SPELL	What follows is the phonetic spelling of the previous word or sentence
BREAK	Interrupt a transmission in progress between two stations Separate portions of a message
SEELONCE	Silence has been imposed on this channel for all except distress traffic
SEELONCE FINI	The channel is open for regular use - distress situation is over

4.3.4 Communication Example

"Auxiliary Coast Guard Vessel SALVATION this is Vancouver Coast Guard Radio. Confirm disabled vessel is sinking in position ZERO NINE ZERO degrees magnetic FIVE nautical miles from datum. Over."

"This is SALVATION. Negative. Disabled vessel's name is SIN KING. I spell, Sierra India November, SIN. KING, I spell, Kilo India November Golf, KING. I say again, the disabled vessel's name is SIN KING. She is position ZERO FIVE ZERO degrees magnetic NINE nautical miles from datum and not in distress. Over."

"This is Vancouver Coast Guard Radio. Roger, understand SIN KING' S position is ZERO FIVE ZERO degrees magnetic NINE nautical miles from datum. Over."

"This is SALVATION. Affirmative, OUT" or "Salvation OUT"

Phonetic Alphabet
Letter/Word to use

A	ALPHA
B	BRAVO
C	CHARLIE
D	DELTA
E	ECHO
F	FOXTROT
G	GOLF
H	HOTEL
I	INDIA
J	JULIETT
K	KILO
L	LIMA
M	MIKE
N	NOVEMBER
O	OSCAR
P	PAPA
Q	QUEBEC
R	ROMEO
S	SIERRA
T	TANGO
U	UNIFORM
V	VICTOR
W	WHISKEY
X	X-RAY
Y	YANKEE
Z	ZULU

NUMBERS are spoken as normally, remember 0 is always ZERO (not Oh)

4.4 Search and Rescue Communications

It's important for government and auxiliary vessels to maintain effective radio communications with other boats and the nearest Marine Communications and Traffic Services Centre (MCTS). Radio transmissions provide you with safety, weather and navigational information. If you're working for extended periods in small boats, a radio check-in schedule with your parent unit may be your only safety net.

4.4.1 Calling the Joint Rescue Co-ordination Centre

When using the telephone to communicate with JRCC during a SAR incident, the following points should be remembered:

- ➜ Always identify your SAR Unit/Vessel
- ➜ With regard to an incident, say that you want to speak to a Marine Controller

JRCC can be contacted by telephone in a number of ways, depending on the caller's needs. (See phone list near the beginning of this section).

4.4.2 JRCC Use of Pagers

The Joint Rescue Co-ordination Centre uses an agency's tone or voice pagers to alert and dispatch SAR personnel from shore. Routinely test your pager.

Code	JRCC Pager Codes
0000	Stand Down
1111	Information Only – Call JRCC.
2222	Urgent
3333	Distress
4444	Contact JRCC – The safety of your vessel is in doubt.

4.4.3 Communication Tips

Be prepared.
Vessels should carry a communications pack

Whenever possible take back-up radios, such as a hand-held VHF or carry a cellular telephone in a waterproof bag. Always ensure that all radios have been checked before you leave. Carry a spare battery or power pack. Know the local radio protocols and dead spots for your area.

Correct calling procedures and transmitting techniques will ease communication response by the station being called. The standard or routine call consists of the name, call sign, or identification of the station being called spoken not more than 3 times, "this is" and the name, call sign, or identification of the calling station not more than 3 times. On the initial call, twice for each identification should be sufficient.

CCGA units will identify as "Coast Guard Auxiliary and the name or identification of their vessel."

Think "BASS"
B*revity* ***A****ccuracy* ***S****peed (speech rate)* ***S****ecrecy*

Be brief, think of the essentials you want to transmit. Ensure the accuracy of your information. Keep your speech rate slow, the receiving station is writing it down. If the information is sensitive, you may want to use a communication system that is more secure (i.e. cellular phone etc).

- Think before you speak.
- Key the mike for 1 second prior to speaking.
- Keep your messages short and to the point.
- VHF Channel 16 is for distress and calling use only – excessive conversation or any other superfluous use of the system is against the law.
- Establish a working frequency with your base or someone on shore, and remember that a listening watch must still be maintained before and after communications on channel 16. If the vessel is equipped with two or more radios one should always be set to channel 16, unless otherwise required.
- Listen to ensure that the channel is clear before you speak.
- Keep the microphone approximately1 to 3 inches (25 - 75mm) away from your mouth, and speak in a calm, clear voice. Do not yell
- Preface the start of a new transmission regarding a distress call with the word MAYDAY. All answers to this transmission do not need this included
- Never use profane or offensive language – it is illegal
- Use proper words and expressions, spell difficult words phonetically, speak numbers individually.
- Do not use excessive "air time." Think "BASS"

4.4.4 Initial Departure Message

Whether leaving for training or departing on a mission. The Coast Guard Auxiliary Vessel should notify the local MCTS Centre. Coast Guard Radio will advise JRCC of your actions. This is an example of typical communications between an Auxiliary vessel and Coast Guard Radio. Notice the repeating of the names in the initial call and the subsequent shortening of the titles as the conversation continues. If reception or clarity is garbled then the stations will go back to repeating the names and messages two or even three times. Each crewmember should listen to marine radio conversation and practice the procedures before operating the radio.

Example: Departure Message

Halifax Coast Guard Radio, Halifax Coast Guard Radio, this is the Coast Guard Auxiliary vessel Challenger, Coast Guard Auxiliary vessel Challenger on channel two seven, OVER.

Auxiliary vessel Challenger, Halifax Coast Guard Radio go ahead.

Halifax Coast Guard Radio, this is Auxiliary vesselChallenger. We are departing Lunenburg for the stricken vessel off Head of StMargaret's Bay, our ETA is 2 hours. Challenger has a total of 4 persons on board. We will listen on channels one six and two seven, will advise on scene. OVER.

Challenger, Halifax Coast Guard, roger your ETA two hours, and four persons on board. Will pass that on to JRCC. OVER.

Halifax Coast Guard Radio , Auxiliary vessel Challenger, Roger OUT.

When calling Coast Guard Radio you should state the channel you are calling on. Coast Guard Radio monitors numerous VHF frequencies, and this allows the station to respond immediately without having to

guess the channel. It is important that any time your unit proceeds to sea on a SAR response, that your message includes the total number of personnel on board. In the event of loss of communications, or an emergency the SAR system will be aware of your crew compliment. Units should also have a status board at their base, showing the names of all crew who are out on the vessel.

SAR Communications Checklist

If your vessel is asked to respond to a search and rescue incident, this checklist will help you effectively manage the communications demands of the mission. Units are reminded that communications, where possible, are best conducted on the working VHF radio channel, so that all response units and MCTS will have simultaneous access to the information

Initial Contact Phase of the SAR Incident

- ➜ Brief Joint Rescue Co-ordination Centre (JRCC) on intentions
- ➜ Obtain information
- ➜ Other resources responding
- ➜ Establish a communications plan

Transit Phase of the SAR Incident

- ➜ Advise JRCC that you are underway
- ➜ Establish a working frequency or frequencies
- ➜ Contact On-Scene-Commander or Co-ordinator Surface Search, give ETA

On-Scene Phase of the SAR Incident

- ➜ Inform JRCC after arriving on-scene
- ➜ Establish an on-scene radio frequency or frequencies
- ➜ SAR Units contacted/ tasking delivered
- ➜ Situation Reports received from SAR Units
- ➜ Situation Reports delivered to JRCC or On-Scene-Commander

Wrap-up Phase (after receiving Stand Down msg)

- ➜ Advise JRCC Units intentions – patrol/return to base
- ➜ Advise JRCC when normal operations resumed

Situation Reports (SITREPs)

If you have been tasked to respond to an incident by JRCC it is important to keep them updated on your progress. The SAR Units send SITREPs to JRCC unless a Co-ordinator of Surface Search (CSS) or an On Scene Commander has been appointed. In that case, all SITREPs should be sent through them.

SITREPS are normally atleast every hour, and may be as frequent as 15 minutes. JRCC may indicate their reporting requirements during the initial tasking. SITREPS can be sent via Coast Guard Radio, or direct by telephone, VHF radio or fax.

A normal SITREP will consist of the following information:

- ➜ SAR Unit position, course and speed
- ➜ ETA on-scene
- ➜ Current weather conditions

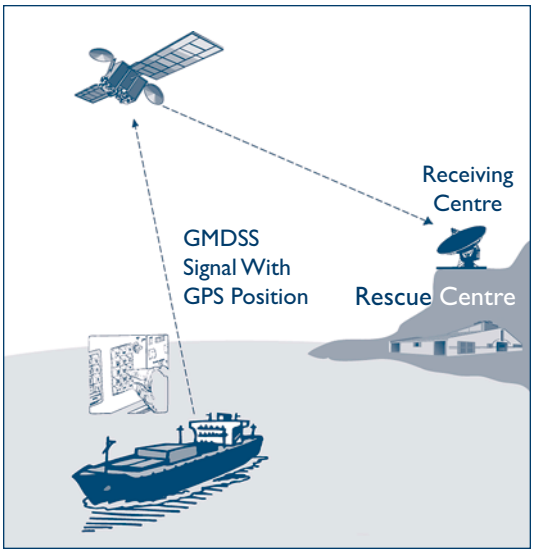
Once a SAR Unit has arrived on-scene, SITREPs will also include:

- ➜ Search area covered to date (the CSS would report on the area covered by the entire SAR Unit group)
- ➜ Assistance rendered
- ➜ Location of datum marker buoy
- ➜ Any additional information or requests

4.5 Distress Communications

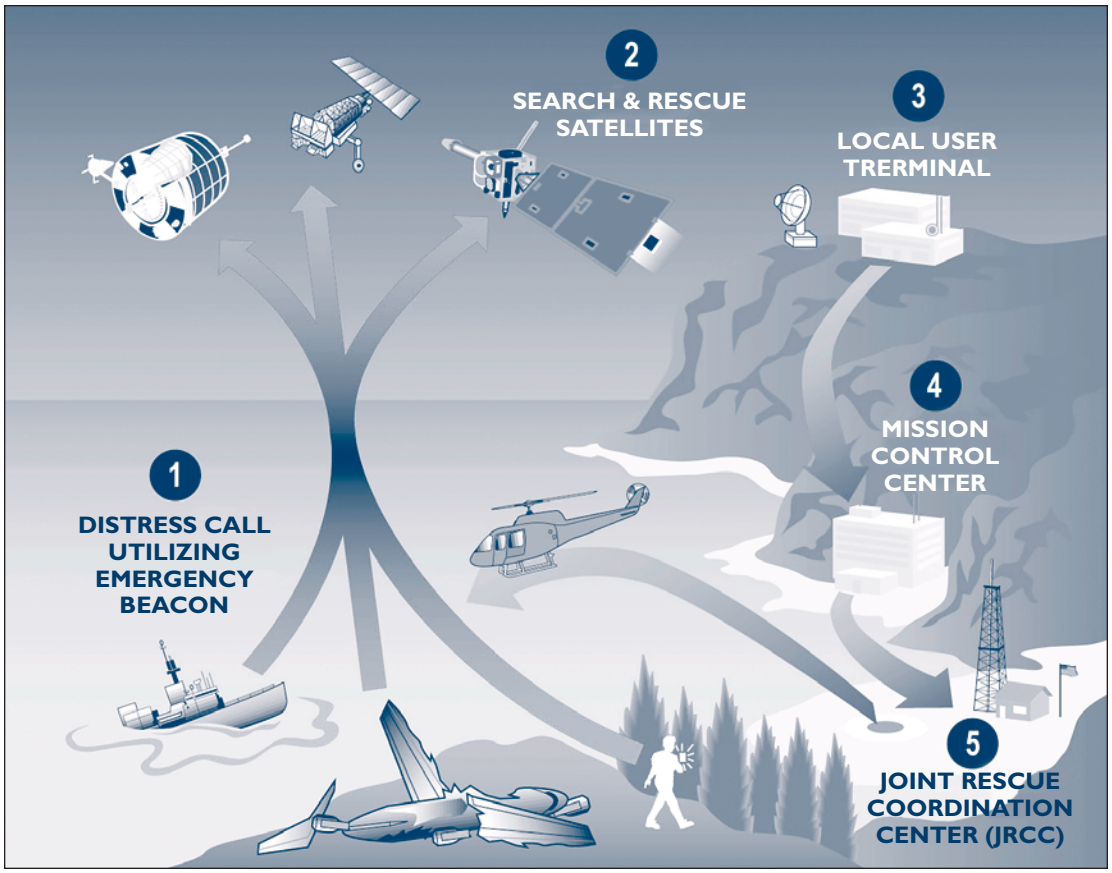
4.5.1 GMDSS (Global Maritime Distress and Safety System)

The GMDSS utilises terrestrial, satellite and shipboard radio systems to ensure rapid alerting of rescue agencies, and vessels in the immediate vicinity, and to provide improved means of locating survivors. The "compliance regulations" came into effect February 1, 1999. Vessels of 300 GT or greater, vessels carrying passengers on international voyages etc., are required to fully fit GMDSS equipment as outlined in their area of operation.



Overview of SARSAT System

1. Vessel in distress signals with EPIRB
2. SAR sats receive signal and get a rough position 3-5km
3. Local user terminal relays message to Mission Control Centre. (Trenton ON)
4. Mission Control Centre relays to local JRCC
5. JRCC coordinates response



WARNING

The DSC system only works when the DSC Radios have been registered and installed properly, and the radio cannot transmit the vessel's position unless it is hooked up to a GPS receiver.

WARNING

If you receive a digital selective calling (DSC) distress signal on your VHF, do not electronically acknowledge it. Pushing the acknowledge button will cancel the distress broadcast to all stations.

Most small pleasure craft are excluded from these mandatory fitting regulations, but many are voluntarily fitting some equipment.

The GMDSS system identified specific communication needs for high seas, arctic zones, near shore etc. Thus, as a vessel proceeds further to sea, the higher the need for specific systems. These areas are defined below.

Digital Selective Calling (VHF) Channel 70

On Canada's coasts, VHF DSC implementation was scheduled to begin in 1998 to cover the busiest areas. Full implementation, similar to today's VHF coverage, is planned for 2002. The DSC system has several advantages. The unit provides a very brief data burst (digital) which transmits the essentials of the distress call and message, mainly the identification of the vessel, its position, and the nature of the distress. It will repeat the message until another unit acknowledges its reception. It is used for urgency and safety information, and it can be used to call other stations (thus reducing calling congestion on channel 16).

The DSC is an alerting device. Once received and acknowledged, other vessels and units activate their radio telephone transceivers and voice communications are carried out. Channel 70 is reserved strictly for DSC, no radio voice transmissions are permitted.

Maritime Mobile Service Identification (MMSI)

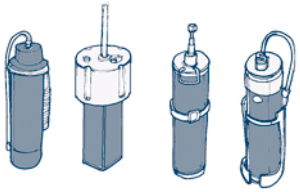
Each DSC unit has a unique 9-digit number called an MMSI. It is a "radio call sign" type identifier. Canadian registered vessels start with the digits 316. A group of vessels (such as a specific fleet of fishing vessels or Canadian Coast Guard vessels) can be registered for group calling.

Emergency Position Indicating Radio Beacons (EPIRBs)

The COSPAS-SARSAT detects emergency radio beacon signals on **121.5 MHz** and **406 MHz**. It can also detect the military alert signal **243.0 MHz**, but this frequency is not sanctioned under GMDSS guidelines. General "beacons" in use that utilise 121.5/406 MHz include:

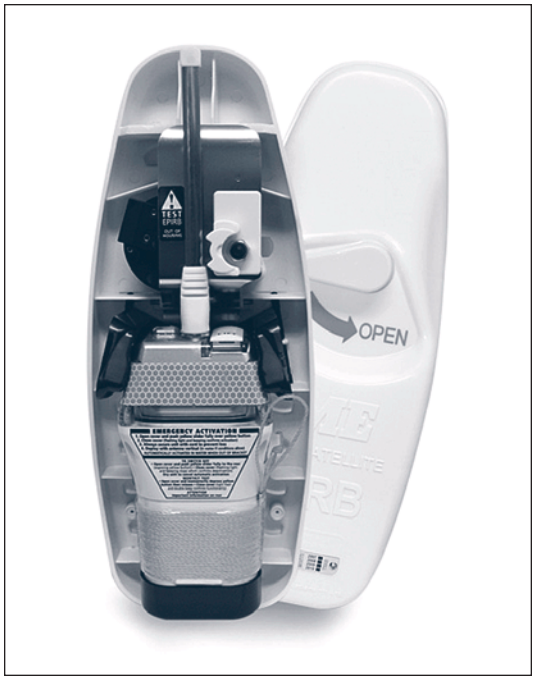
- Emergency Locator Transmitters (**ELTs**) (primarily aircraft)

- Emergency Position Indicating Radio Beacons (**EPIRBs**) (primarily maritime)
- Personal Locator Beacons or **PLBs** (primarily land).



406 Mhz EPIRBs

Each 406 beacon is registered with its own unique identification number. This provides information on the owner, and the craft to which it is registered. An important feature of 406 MHz emergency beacons is the addition of a digitally encoded message, which provides such information as the country of beacon registration and the identification of the vessel or aircraft in distress, and optionally, position data from onboard navigation equipment.



Category I EPIRB

Category 1 EPIRB: Automatically deployed. Designed for float free. Should be mounted outside the wheelhouse, in an area where the EPIRB can be deployed free from interference of equipment. These units are mounted antennae down. Do not lift them out and turn upright, such action will activate the transmitter and result in a false ALERT.

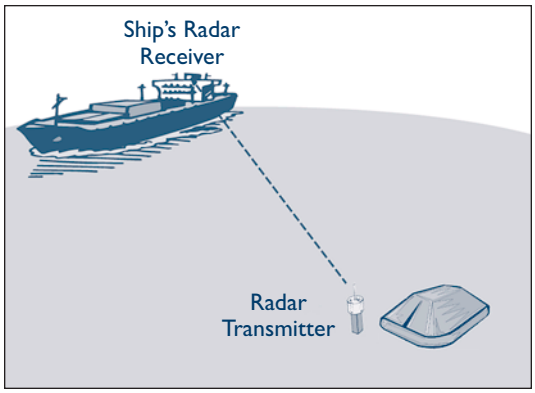
Category 2 EPIRB: Manually activated.

Emergency Locator Transmitters (ELTs)

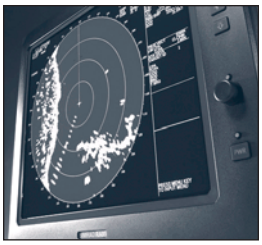
Carried by aircraft. The unit is activated on impact or manually. Operating frequencies are 121.5/406/243 MHz.

Search and Rescue Transponders (SARTs)

The SART provides a homing signal to those searchers who have entered into the search or alert area, to home in to the exact position. SARTs are radar transponders. When ship or airborne radar hits the lifeboat transponder, it will generate a response signal. This return signal is 12 blips or dots which appear on the search unit's radar, lining up outward along its line of bearing. As the search unit approaches to within 1 mile of the SART, the blips will change into wide arcs. Then become a complete circle the closer the search unit approaches. This warns the search unit to slow down, approaching the target.



e.g. EPIRB is to be tested every 3 months (or, as per manual instructions)



SART response on a radar

4.5.2 VHF Distress Messages and other Urgent Traffic

The decision to issue a distress is solely the Captain's. Each crewmember must be able to effectively issue a distress in on the Captain/Coxswain's orders or in the event that the Captain/Coxswain is physically unable to issue those orders and the vessel is in imminent peril.

In distress communications, all calls should be prefaced with the distress signal ***MAYDAY***

The steps to transmitting a **MAYDAY** for your vessel are as follows:

- ✓ Transmit an alarm signal if you have one
- ✓ Speak the distress signal "**MAYDAY**" 3 times
- ✓ Identify your vessel by saying, i.e. "This is the Auxiliary vessel Wall Flower, Auxiliary vessel Wall Flower, Auxiliary vessel Wall Flower."
- ✓ Give your position, by distance and bearing for a known geographical point, or by latitude and longitude
- ✓ State the nature of the distress and type of assistance required

- ✓ Give the number of persons on board and vessels involved, and any injuries
- ✓ Describe your vessel
- ✓ Provide any other information that could assist your rescuers, i.e. "Preparing to abandon ship with floater suits."
- ✓ Repeat your message until someone answers
- ✓ Maintain radio contact on the distress frequency
- ✓ If necessary use any means at your disposal to attract attention. Turn on EPIRBs, use pyrotechnics, smoke, if no response on Channel 16 use any frequency to gain attention. See vessel safety Section 3.0 for the 18 or so ways of attracting attention.

Mayday Relay

Another ship or shore radio station can issue a Mayday Relay, where the transmission of the distress call is weak, or has been sent using a cellphone to the 911 system, and then onto JRCC/ MCTS.

The radiotelephony broadcast of a Mayday Relay shall consist of:

- ➜ The alarm signal
- ➜ "MAYDAY RELAY" (3x)
- ➜ "THIS IS" (centre identification) (3x)
- ➜ (repetition of the distress message)
- ➜ "OVER"

MCTS will control traffic during a distress through the impositions of the following:

Imposition of Silence

- ➜ MAYDAY"
- ➜ (All stations or station specific call)
- ➜ "SEELONCE MAYDAY"
- ➜ (centre identification)
- ➜ "OUT"

Urgency Call

The radiotelephony urgency call shall consist of:

- ➜ "PAN PAN" (3x)
- ➜ ("ALL STATIONS" or station specific call) (3x)
- ➜ "THIS IS"
- ➜ (centre identification) (3x)

To issue an urgency call on SafetyNET, see section 4.5.1, "Global Marine Distress and Safety System."

Urgency - Acknowledgement of Receipt

The radiotelephony acknowledgement of an urgency message shall consist of:

- ➜ "PAN PAN"
- ➜ (the name and/or call sign of the station sending the urgency message) (3x)
- ➜ "THIS IS"
- ➜ (centre identification) (3x)
- ➜ "RECEIVED" (or "ROMEO ROMEO ROMEO" for language difficulties);
- ➜ "URGENCY"
- ➜ (words indicating that the JRCC will be advised)
- ➜ (a request for additional information required)

Urgency Cancellation

The radiotelephony cancellation message shall consist of:

- ➜ "PAN PAN"
- ➜ "ALL STATIONS" (3x)
- ➜ "THIS IS"
- ➜ (centre identification)
- ➜ (a brief description of the resolution of the incident)
- ➜ "URGENCY CANCELED"
- ➜ "OUT"

4.5.3 Distress Calls Received by Telephone

If you have received a telephone call concerning a distress or potential distress situation, you should:

- ✓ Note the caller's name and telephone number
- ✓ Advise the caller to contact JRCC directly
- ✓ Check with JRCC that the caller has indeed contacted them;
- ✓ Call and brief your coxswain/captain and relay all of the information you have received
- ✓ Advise the Coxswain to call JRCC and be ready to proceed to assist if immediate danger exists
- ✓ If proceeding, advise JRCC of your response, or standby (if the call is of a non-distress nature) and await dispatch by JRCC

5

Practical Seamanship

For thousands of years human beings have gone to sea, and out on lakes and rivers - many of them and their vessels or ships have not returned. During the history of seafaring, mariners have made many mistakes and those that survive, learn to change their behaviour. These lessons are translated over the years into traditions. Old mariners pass on these traditions to young mariners.

Practical Seamanship

Contents

The Footstool that Stopped a Ship

A Canadian Coast Guard ship was responding to a vessel in distress north of Cape Scott in 90-knot winds and 6-9 metre seas. She had been well secured for weather by her crew and was taking forty-degree rolls in the heavy seas. All was going well until a small footstool broke free from its rack in the emergency generator room. It careened around the engine space only to get lodged underneath the protective cover of the emergency generator panel. The leg of the stool hit the only switch that could black out the entire ship. The bridge instruments went out and the helm control died.

The powerless ship swung into the weather and was hit by a huge sea. She rolled onto her side and the bridge crew hung from handles on the consoles waiting for the ship to come back up. While hanging the Captain phoned the engine room and asked when power might be back. The engineers were scrambling to isolate the circuit. As the ship slowly came back up she was slammed by another huge sea. The Captain phoned again and politely said,

"Hi guys, uhh… power would be nice, anytime now."

The lookout reported another huge sea approaching. At that moment the power flashed on and the Captain dove to the throttles.

The ship met the towering wave bow on.

"Helmsman resume last heading please."

"Course steady on 330°, Sir."

5.0 Introduction to Practical Seamanship

A new Canadian Coast Guard Auxiliary crewmember must learn the basic procedures for survival while working at sea. As one starts to spend time on the flat calm water many of the routines seem at first to be redundant and unnecessary. It is not until the vessel and its crew are thrown into a treacherous situation that it will become apparent why these rules exist. If you have not learned to practise safe procedures by then, it may be too late. This basic set of traditions is called seamanship and seamanship training prevents crews from repeating the mistakes of the past.

Most of seamanship can be covered by three fundamental principles:

Order

One of the first doctrines of seamanship is order. In this chapter you will learn that everything on a boat has a place. Things out of their place can cause delays when responding to emergencies and/or can be the cause of a catastrophe in heavy weather situations.

Redundancy

Every critical system on board a rescue vessel should have a backup. All actions and procedures should be checked and double-checked. This routine becomes tedious for new crewmembers that at first think it excessive.

Habit

Each mariner must form habits that happen automatically, habits such as shutting doors, coiling lines and double-checking for loose gear and open hatches It is not unusual to see a deckhand re-secure a piece of gear three or four times before finally being satisfied with the tie downs.

5.0.1 Line Handler

The linehandler and operational positions will vary with the mission requirements but in general this person performs the functional duties required by the mission. The linehandler will ready and prepare any lines or tackle required for the securing and mooring of the vessel or securing of gear on the vessel. The linehandler will ready and prepare any lines or tackle required in the assistance of another vessel. The operational person will identify hazards on deck or related to the operations (e.g. “don’t stand in the bight!”).

General Duties and Responsibilities of a Line Handler

- ✓ Be responsible for crew and deck safety during line handling operations
- ✓ Verify the plan with the captain/coxswain
- ✓ Inspect all lines and equipment to be used for wear or damage prior to starting operations
- ✓ Secure the decks of all gear and lines for getting underway
- ✓ Coil and stow all line hanging or in lockers
- ✓ Secure lines
- ✓ Check the lead of line to make sure crew are clear of the bight and running gear
- ✓ Keep line clear of running gear, especially in the water (stern and propellers)
- ✓ Continuously report progress of line handling operations and the tension state of lines and any other dangers
- ✓ Ready and toss the heaving line

The only rope on a ship is the one that rings the bell. A rope becomes a line when it assumes a purpose on a vessel. The care and handling of lines is the primary skill of any sailor.

Suggested Commands and Signals for Line Handler

Clear – all crew are clear of lines, gear and machinery that is about to be engaged

Clear Forward Clear Aft – all mooring lines are off the dock and the vessel is clear to proceed

Standby to … get ready to perform a task

Let go stern, bow, spring or breast lines – untie the line and get it clear of the dock or vessel

Ready Lines stern, bow, spring or breast lines – untie and hold line with on wrap / loop on the rail or cleat and stand by to let go

Ready Lines for port/starboard tie up – break out mooring lines and fenders and rig them for tying up on a designated side

Pass the line – throw the line or hand it to its destination

Make fast – tie up the line

Take a wrap – to control the line without making it fast, wrap it once under the rail or on a cleat and pay out or take in slowly

Slack the line – loosen the line

Pay out / surge the line – feed more line out in a controlled manner

5.1 Knots and Lines

5.1.1 Construction

The care and handling of lines is the primary skill of any sailor

Natural Fibres

Natural fibres such as manila, sisal, hemp and cotton will shrink when they get wet and also tend to rot or become brittle. Manila is still used today on large ships and is the best natural fibre for mooring lines, anchor lines and as running rigging. Manila has little stretch and is very strong. However, it has only about one-half the strength of a comparable-sized synthetic line.

Natural fibre line should be uncoiled from the inside of a new coil in order to prevent kinks. Always whip the ends of natural fibres to keep them from unravelling. When natural fibre lines have been in salt water you should rinse them in fresh water and allow to dry thoroughly. They should then be properly coiled and stored on grates above deck in a dry, well-ventilated place to help prevent mildew and rot. Natural fibre ropes should be maintained in a clean and dry state, as rot and mildew are their main causes of deterioration. They are, however, more resistant to heat than traditional synthetic fibre ropes; they do not burn quickly and their breakdown is slower.

These lines are rarely used on rescue vessels.

Example of three strand

Synthetic Fibres

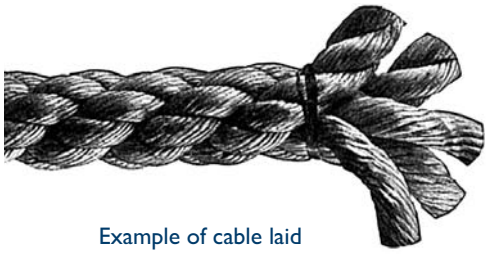
Nylon

This synthetic fibre is stronger, more elastic and more durable than manila. However, when placed under excessive load, nylon will break without warning. It is expensive and does not float. Nylon is the best known and most used of the synthetic fibre used in ropes. It has high breaking strength wet or dry and a strong weather resistance. It is highly elastic and and when under load can stretch up to 40%.

Nylon ropes are used for shock absorbing when used as mooring lines and are often used to secure fenders to permit stretch as the vessel moves up and down against the dock. Nylon ropes are light to handle and give the appearance of a smooth slippery surface. They have a high melting point (250°C) and are pliable in normal temperatures.

Samson braid line

Polyesters



Example of cable laid

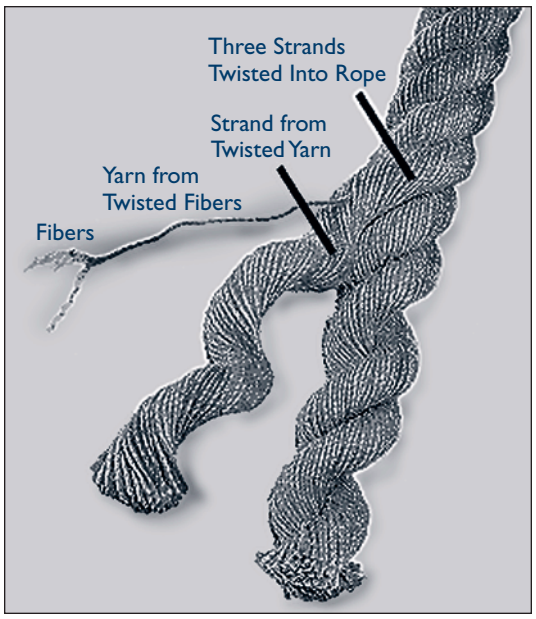
Initially known as Dacron© and Terylene©, polyesters are not as strong as nylon and have inferior stretch properties. Their abrasion and temperature resistance are similar to nylon. Polyesters are considered to be more resistant to acids, oils and organic solvents than their nylon counterparts. Their strength remains the same in wet or dry conditions. These characteristics make them ideal for most running rigging of sailboats. The disadvantage of polyester is very similar to that of nylon: it will not float. Its use should be kept to a minimum when working about bitts or warping drums. The melting point is between 230 and 250°C.

Polypropylene

This synthetic line is light, flexible and falls between manila and nylon for strength. It's available in bright colours and will float. Floating line stays away from propellers, making it a good choice for a towline and recovery line. However, polypropylene is susceptible to UV damage and will deteriorate over time.

When you see a wet polypropylene rope steaming under tension, it is getting close to reaching the propropylene's melting point and breaking.

5.1.2 Lay and Weave



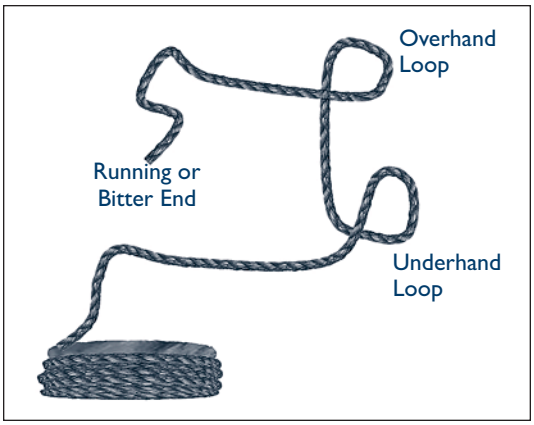
Most line is made from three strands twisted together. The 'lay of the line' is the term used to describe the manner in which the line has been twisted. Some of the stronger and more expensive lines are braided together with inner and outer cores. One common line of this type is called Samson Braid.

5.1.3 Knots, Bends and Hitches

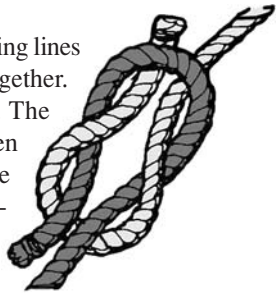
Knots have many uses in the maritime world. However, not all knots are equal; some knots are better than others. This section lists various knots that meet the three important conditions for all good knots:

- Easy to tie
- Easy to undo
- Safe (if used as and where recommended)

A crewmember should understand that any fastening (ie. knot) reduces the strength of a rope. Knots and bends reduce the rope strength by up to 50%, while hitches reduce it by 25%. Well-executed splices can be used to join ropes while retaining 80% or more of rope strength. Most knots in polyethylene or polypropylene monofilament ropes tend to slip. These knots must be "doubled-up" in order to hold, due to the waxy monofilament surfaces.



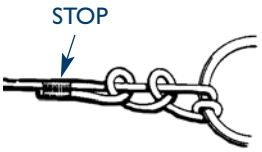
Reef Knot



This knot is good for joining lines of the same thickness together. It can be easily undone. The reef knot is used to fasten two lines of equal size when no great load is anticipated. If used to connect lines of different sizes, it will slip and if used to join two towlines, the knot will jam under heavy stress and be extremely difficult to untie. The reef knot needs constant tension on both lines, for a sharp pull on one of the ends may cause the knot to fall into two half hitches and subsequently binding.

Never use the reef knot to join two lines when significant loads are anticipated. Never rely on this knot when life, limb or valuable property is involved. Severe injury or damage could result from misuse of this knot.

Round Turn and Two Half Hitches

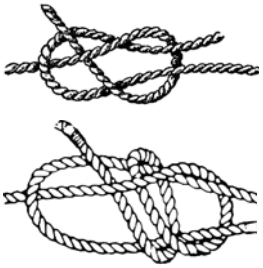


These can be useful to bend the end of a rope to a spar, stanchion, bollard, or ring. To reinforce or strengthen the single half hitch, two half hitches may be used.

Bowline

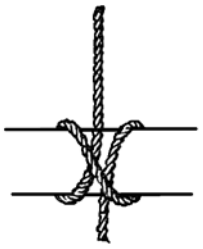
One of the most versatile knots, the bowline is good for forming loops in lines with the loop retaining its size. It is a knot that will never slip and rarely jams. The bowline is one of the most valuable knots for day-to-day use on a boat. It is easy to untie after it has been under load. Two bowlines can safely join two towlines of equal or unequal size.

Sheet Bend



A single sheet bend, also known as a becket bend, is used to join lines of unequal thickness. The double sheet bend gives a more secure connection when unequal-sized lines are used, particularly when one line is considerably thicker than the other. This knot is ideal for joining lines together, even if they are of different sizes.

Clove Hitch



This knot is good for making a line fast to a spar or a smaller line fast to a larger rope. It will not slip because the second half hitch rides over the standing part of the rope. The clove hitch is a good choice to use when temporarily securing a line to another rope, a railing, a spar or similar object. It can work loose and should not be left unattended. Under heavy load, it can jam tightly. It can be made more secure with half hitches.

5.1.4 Coiling and Stowing

Lines can become a pile of spaghetti very easily, unless one takes the time to handle them correctly. To avoid kinks, twisted ropes should be coiled in a clockwise direction (or in the direction of the lay of the rope) and uncoiled in a counter-clockwise direction. Another method is to flake out the line figure-eight fashion. This method avoids putting twists in the line

Method One

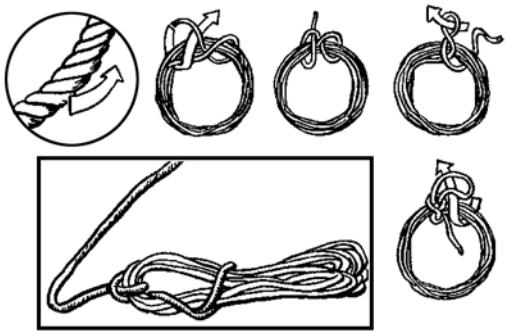
When stowing line away in a locker you can use this method to secure it.

in either direction and minimises the risk of kinking. Braided ropes have no inherent twists and are thus far more resistant to kinking. Even if kinks develop, they cannot develop into knuckles. The best way to prepare braided ropes for deck stowage is with the figure eight method. The rope can be flaked either flat on the deck or figure-eight style, vertically around bulkhead cleats. Hand coiling should be avoided since it will put turns in the rope that are likely to develop into kinks during paying out.

To coil a 3 strand line from a secured end:

- ➜ Start at the cleat, with the line in your left hand
- ➜ Make smooth, even sweeps with your right hand, and lay the coils (approximately 2 ft. in diameter) one at a time, into your left hand
- ➜ If the line is twisted or crossed, spin the line with your thumb to twist the kinks out of it
- ➜ Always start from the secured end, or it will end up with twists and kinks
- ➜ When stowing lines, make sure the space is flat and even
- ➜ When line is coiled, there are two methods used to secure them, see diagrams.

Method Two



If hanging or stowing the line up for frequent use then a single wrap coil is all that is needed see diagram

5.1.5 General Precautions for Working with Rope

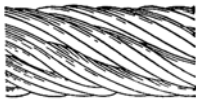
- ➜ All rope should be kept dry and clean and away from chemicals, acids, alkali, drying oil, and paint to avoid damage and strength reductions
- ➜ Never overload a rope
- ➜ A frozen rope should be allowed to thaw and dry before re-use
- ➜ A rope should never be dragged over the ground or over sharp objects
- ➜ Avoid abrupt bends if possible, as they weaken rope strength considerably. Pad all sharp corners
- ➜ Synthetic ropes can be slippery when wet or new
- ➜ Store lines in a dry cool place with good ventilation. Hang them in loose coils well above the floor or deck
- ➜ Dry and clean wet lines before storing. Allow them to dry naturally, as too much heat will make the fibres brittle
- ➜ Keep lines away from all sources of heat
- ➜ Lines should be kept out of direct sunlight, when not in use
- ➜ Be sure to seal any tail ends of strands by whipping. Artificial fibre ropes can have the cut ends melted, and a heat shrink sleeve shrunk on to the end. Do not use tape for that purpose

5.1.6 Line Inspection

Lines should be checked regularly. The main points to check are external wear and cutting, internal wear between the strands and deterioration of the fibres:

- ➡ Check the entire length of the line for breaks on the outside fibres, cuts, burns, signs of abrasion, unlaying and reduction in diameter; each represents a loss of strength
- ➡ Untwist the strands carefully to observe internal condition of the line. It should be bright and clean. Excessive wear of interior fibres is often indicated by the accumulation of a powder-like dust
- ➡ Pull out a couple of long fibres from the end of the line and try to break them. If they break easily, replace the line
- ➡ If a line is found unfit for use, it should be destroyed or cut into short lengths
- ➡ If you have any doubt as to whether or not a line is fit for use, replace it immediately

5.2 Deck Safety and Lines Under Load



Lines and wires are of paramount importance in SAR operations. No matter what kind of rescue you are to perform, in the vast majority of cases, you will have to use one of them at some point in the process. When a line is bearing weight (or is tight), it is said to be "under load". When handled carelessly, loaded lines can kill in the blink of an eye.

Lines or wires that part (break) under strain can kill or injure crewmembers nearby. Especially with artificial fibre ropes, as the line parts, the line will immediately return to its unstretched length, causing it to lash back at high speed. Anyone caught in the path may not survive the experience. By following simple safety rules we can avoid breaking our lines and wires, or at least be out of the way if they do part.

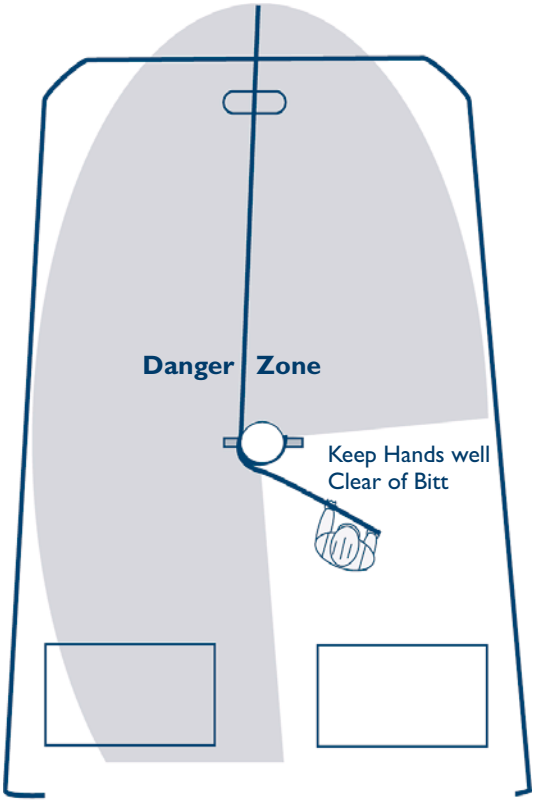
Know the Signs of Overload

When a line or wire is overloaded it will give off warning signs such as:

- ➜ Groaning, creaking and popping sounds
- ➜ Rotating and stretching
- ➜ Shrinking in diameter
- ➜ Losing its natural shape
- ➜ Strands breaking and peeling
- ➜ A steel wire may bleed out the lubrication from the hemp core
- ➜ Steam rising from rope

If you suspect that a line is being overloaded then you should take immediate action. Take the load off of the line by communicating with the helmsman to ease the throttle or manoeuvre the vessel to relieve strain, slacking or surging the line if you can approach it and control it safely (see warning).

Do not wear gloves or mitts when working with rope lines. When undoing a line under load, keep your fingers clear of the cleat. When the line comes free it can run quickly, pulling your hand into the cleat or guide. Never stand directly behind a line under load. If it breaks it will whip back and could injure anyone standing in the opposite direction of the load.



The danger zone highlights the area that is in the direct path of a recoil in case the towline parts.

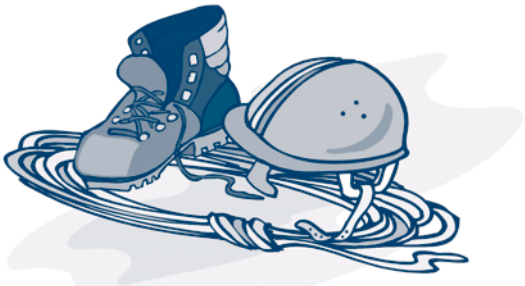
If a line is showing more than one of the signs of trouble, you should shout a warning and get clear. DO NOT try to approach the line to slacken it yourself.

5.2.1 Never Stand in the Bight!

The bight is the loop of a line lying on the deck. If your foot is in the loop when the line tightens, you could easily have your foot cut off or you could be pulled over the side. A bight may not be apparent where the working area is large and where the line may quickly straighten in the event of a cleat, guide or block breaking.

5.2.2 Watch your head!

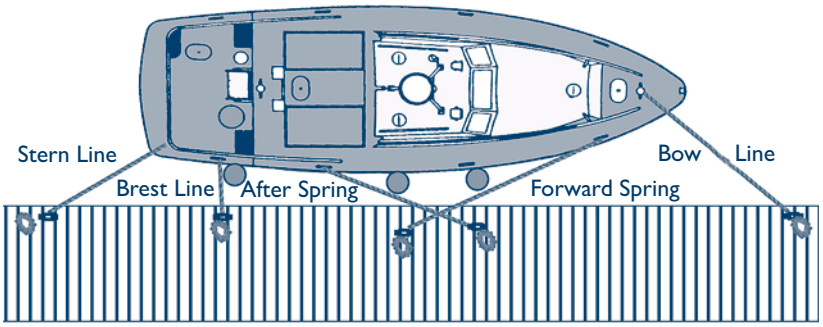
Never stand under a load, or in areas where overhead equipment may swing and cause serious injury. Always wear a hard-hat, steel toed boots and a PFD when working with overhead loads on board a vessel or at dockside.



Safety equipment is important when dealing with deck safety.

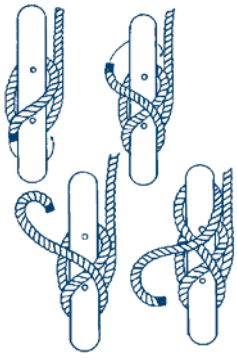
5.3 Mooring and Securing the Vessel

A small boat can have as few as two and as many as eight mooring lines, depending on the weight of the vessel, weather conditions, location and length of stay. If your vessel has a permanent mooring, you may leave the lines on the dock to be picked up when you return.



5.3.1 Tying Up

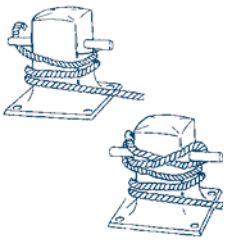
The order by which your boat's lines are to be secured or let go will depend on the preference of the helmsman. He/she may want to use the forward spring to swing the stern out, or the after spring to swing the bow out. The bow line is generally the first on and last off. When tying up at someone else's dock, we can use slip lines on our bow and stern for ease of control. There are many variations to mooring a small boat. The method will depend on the moorings at the dock or facility.



5.3.2 Cleat

The cleat is the most common fitting found on recreational craft. Take a complete round turn around the base of the cleat and lead the line around the horn to form a figure eight. Avoid locking tucks when turning up a cleat, as if it comes under load it will be difficult to undo in a hurry.

5.3.3 Sampson Post

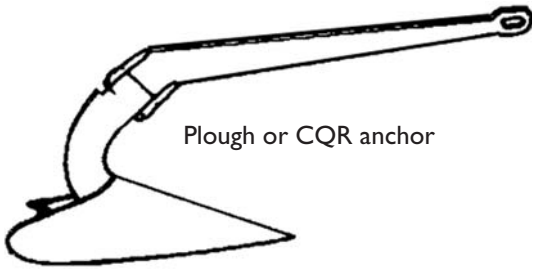


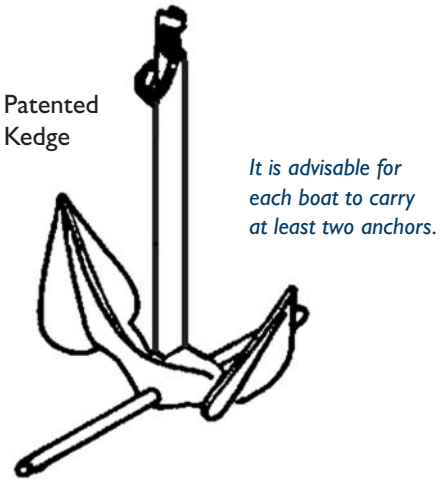
A Sampson post is a special type of deck fitting sometimes used in place of a standard cleat. Begin by making a complete round turn around the base of the Sampson post. Then form several figure eights around the horns. Finish by taking a half hitch around each horn.

5.4 Anchoring

Small open boats usually use their anchors for a short rest, or to wait out weather or fog. If severe weather threatens, or if you lose power and find yourself drifting into danger, you'll want an anchor that will do the job – grab the bottom and hold on. Many people believe that anchors can hold by their weight alone. Anchors actually hold by digging into the bottom, and therefore the type of anchor you use will depend on the type of bottom you'll be digging into.

5.4.1 Anchor Types



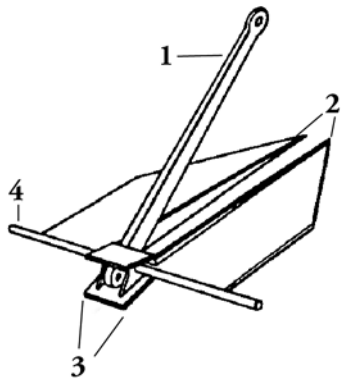


It is advisable for each boat to carry at least two anchors.

There are different types of anchors with specific advantages for each type. The type of anchor and size (weight) of anchor a boat uses depends upon the size of the boat. It is advisable for each boat to carry at least two anchors. The rope or chain that attaches the anchor to the vessel is called the anchor rode.

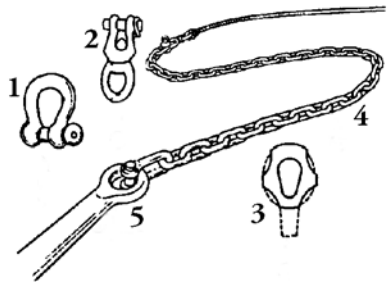
5.4.2 Main parts of a typical anchor

1. **Shank:** Aids in setting and weighing the anchor. Attachment point for the anchor line.
2. **Flukes:** Dig in the bottom and bury the anchor, providing holding power.
3. **Crown:** Lifts the rear of the flukes, and forces the flukes into the bottom.
4. **Stock:** Prevents the anchor from rolling or rotating.



5.4.3 Anchor Fittings

There are various methods for securing the rode to the anchor ring. With fibre line, the preferred practice is to work an eye splice around a thimble and use a shackle to join the thimble and ring.



1. **Screw Pin Shackle** – Bends the length of chafing chain to the shank of the anchor.
2. **Swivel** – Attaches the chafing chain to the detachable link. Allows the line to spin freely.
3. **Thimble** – Protects the anchor line from chafing at the connection point. Use synthetic line thimbles for lines 2-3/4" in circumference (7/8" diameter) and larger. The **Eye Splice** is used around a thimble to connect it to a ring on the anchor by a shackle.
4. **Chafing Chain** – Tends to lower the angle of pull of the anchor and assists in preventing chafing of the anchor line on the bottom. The minimum recommended length of chain should be equal to boat length.

5.4.4 Setting the Anchor

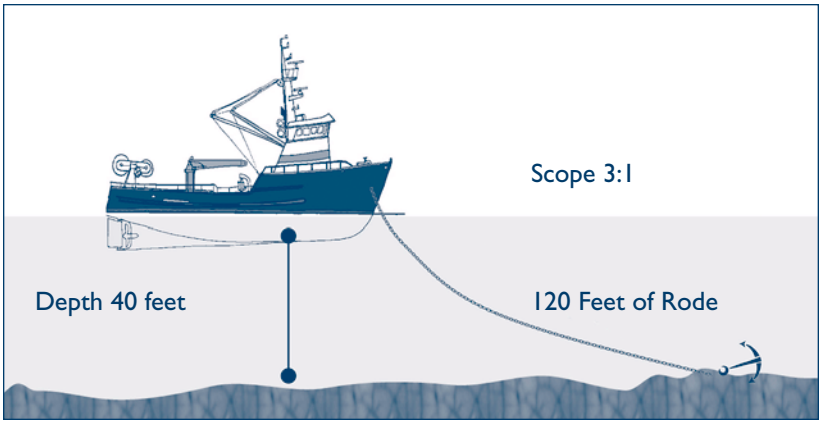
Five steps to anchoring

1. Fasten the inboard end of the anchor line to a secure point on the vessel, and securely fasten the outboard end of the anchor line to the anchor.
2. Approach your spot slowly, and put your vessel in reverse when you're over the desired location.
3. When the boat begins to gather sternway, lower the anchor to the bottom, and gradually pay out the rode.
4. Take a turn around the bit, snugging up the line, causing the anchor to "bite", then pay out the rest of the rode to the appropriate scope. If there is any doubt, prove the anchor's holding by backing against the rode using reverse power.
5. Finally, check the set of the anchor by choosing 2 objects abeam, which form a range. Periodically check your position in relation to them. Any change in their bearings means that you should try again.

Remember that boats of different sizes may swing to a different scope than yours, so it's important to give other boats as wide a berth as possible

5.4.5 Scope

Scope length is the length of rode required for anchoring, which depends on the depth of the water. The ratio of the length of rode to the vertical distance from the chock to the bottom is called the scope.



Scope length depends on the type of rode you are using, the weather, and bottom conditions. A scope of 7:1 is ideal in most conditions. For temporary fair-weather anchoring a 3:1 ratio will suffice.

To ensure an effective hold, the angle of pull should be kept as close to horizontal as possible. Heavy weather will demand greater scope.

5.4.6 Weighing Anchor

When you are ready to weigh anchor and get underway under power, go forward slowly and take in the anchor rode to prevent fouling the propellers. Have the person on the bow lifting the anchor indicate to the helmsman which direction the rode is leading, so the helmsman can steer in that direction and take the weight off the rode. When the boat approaches the spot directly over the anchor, and the rode is tending straight up and down, the anchor will usually free itself from the bottom.

5.4.7 Clearing a Fouled Anchor

If the anchor refuses to break free, snub the anchor line around the forward bitt or cleat and advance the boat a few feet. Sometimes even this will not free the anchor, and the operator should run in a wide circle, slowly, to change the angle of pull. Take extreme care to ensure the anchor line does not tangle in the propellers during this operation.

Another way to break out an anchor is with a "trip line," if one was rigged during anchoring. A "trip line" is a line strong enough to stand the pull of a snagged anchor. Attach the "trip line" to the crown of the anchor (some anchors have a hole for this purpose). The "trip line" should be long enough to reach the surface in normal anchoring waters, with allowance for tidal changes. Pass the "trip line" through a float and end the line in a small eye-splice that can be caught with a boat hook. If the anchor doesn't trip in the normal manner, pick up the trip line and haul the anchor up crown first.

6

Boat Handling

The skills involved in handling a vessel are learned over time and come with practice. A new boat handler will fair better if they understand and can apply some of the principles and basic tools outlined in this chapter.

"The difference between a rough docking and a smooth easy docking is around 900 attempts."

Boat Handling

Contents

Excerpts taken from the book "High Seas High Risk"
Written by Pat Wastel Norris 1999

(The Sudbury II was a legendary offshore salvage tug that had taken a large oil drilling platform in tow during the summer of 1961. This drama occurred in the Caribbean as Hurricane *Hattie* approached.)

The Offshore 55, a towering oil rig, was at that time the largest rig in the world. It was the size and shape of a city block and sat there in the water like a small square island. "And that's going to be a bugger to tow," the mate remarked to Harley (as Master of the Sudbury II)… The centre of the platform of the Offshore 55 was filled with drilling equipment and, on either side of this machinery, eight huge jack-up ladders rose a hundred feet in the air. When the rig was in place these ladders became the legs that anchored it to the sea bottom. They could be raised and lowered hydraulically and were now in their raised position; even so, they protruded 10 feet below the waterline and created, the Sudbury II crew soon found, enormous drag. "What a lump to tow," said George Winterburn. "Right off the bat Number Four main engine blew up. We had nothing but grief." Towboat men count patience among their many virtues…

Next day the Sudbury II's radio provided the unsettling news that the hurricane, christened Hattie, was bearing down upon them at increasing speed. Harley altered course to port. The hurricane veered off to port as well. Now there were long slow swells-rolling away from the disturbance behind them and a line of ominous black clouds forming. As the wind increased it became capricious, blowing first from one direction and then from another.

Harley talked to the alarmed occupants of the Offshore 55, weather worsening as he spoke. The Americans, having those same weather reports, were by now clamouring to be taken off. Harley outlined his plan of action: he would haul in line and when the Sudbury II was close enough he would float a life raft and let it drift back to them on a line. "Right at the crucial moment our towing winch loused up," said Winterburn. "It was an electric winch with burnt out wiring. We couldn't retrieve the towline. We cut it." Two thousand feet of wire dropped into the sea.

Harley circled the rig cautiously and brought his stern up close as he dared. Waves were now breaking over both the tug and the oil rig. Splashing around in this water, the Sudbury II's deck crew launched the life raft and attempted to guide it to destination. Time after time it slipped past the rig, out of the hands of the four life-jacketed figures that clung to the pipe rail. Then, as those on the Sudbury II watched helplessly, a wave burst over the Offshore 55 and smashed one of the waiting men into the deckhouse. The rig's formidable bulk was now heaving out of the seas, and then buried in them. Her jack-up ladders were shaking with a noise like garbage day in a can factory, broken pipes and machinery clattering across her decks adding to the din.

Four times the size of the tug and completely out of control, the rig lurched toward the Sudbury II like a menacing drunk. Harley moved the telegraph from Slow Ahead to Half ahead. From the engine room there was instant compliance. The tug's captain picked up the radio phone that connected him with the oil rig. "How are you guys making out ?" Harley's voice was even. Not so the voice that replied. "For christ sake forget that Jeezely life raft and get us off of here," it screamed. "Come alongside and get us off. We've got a guy here who's hurt."

Continued page 102…

6.0 Introduction

Boat handling requires an understanding of many variables and complex problems. Though you can only develop boat-handling skills through hands-on experience, the information covered in this chapter will provide you with a basic description of principles and practices.

Though good coxswains and captains are familiar with the characteristics of their boat and how it operates, the best coxswains are knowledgeable in the operation of all types of small craft, including sailboats and personal watercraft. They know how varying weather and sea conditions affect the operation of their vessel, and are keenly aware of the limitations that weather and sea impose on other vessels.

Some helpful hints are:

1. Plan your manoeuvres ahead of time. Think of what you will need to do, and what you should have at hand to accomplish the task. Brief your crew on both the hoped-for result and the steps to achieve it.
2. Do things slowly, unless it's obvious that power is needed in a particular situation. Boats have momentum, and every action has a reaction. As you try out different actions at different speeds, carefully observe the effect that the manoeuvres have on your boat. Wait for the reaction because it is rarely immediate. Always practice in a safe location away from other boats.
3. Learn the theory presented here. Practice at every opportunity. Enjoy your developing skill. Good boat handling will make your time on the water safe and productive.

6.1 Helm Position

The person at the helm is responsible for:

- Ensuring and monitoring the positions and safety of crew
- Ensuring all on board are equipped, secure and ready to proceed
- Communicating all intentions to manoeuvre the vessel before manoeuvring
- Wearing a kill switch
- Safe manoeuvring of the vessel through the various evolutions
- Manoeuvring the vessel in the event of a Crew Overboard
- Looking out ahead for traffic, obstacles, objects in the water
- Identifying and altering correctly for all aids to navigation
- Search spotting duties for the forward sector in a search
- Monitoring of the speed, throttles, engine warnings, gauges, pressures, electronics, power and signalling/horn (smaller vessels 20m and under)
- Monitoring fluid levels, especially fuel and oil
- Monitoring the depth sounder
- Listening to engine sounds and machinery space sounds
- Steering a compass course or on a landmark
- Changing the vessels' course smoothly and efficiently
- Observing the SAR operations and watching for hazards

Commands and Signals for Docking & line handling

Clear – All crew are clear of lines, gear and machinery that is about to be engaged

Clear Forward, Clear Aft – All mooring lines are off the dock and the vessel is clear to proceed

Standby to… – Get ready to perform a task

Let go stern, bow, spring or breast lines – Untie the line and get it clear of the dock or vessel

Ready Lines stern, bow, spring or breast lines – Untie and hold line with on wrap / loop on the rail or cleat and stand by to let go.

Ready Lines for Port/Starboard tie up – Break out mooring lines and fenders and rig them for tying up on a designated side.

Pass the line – Throw the line or hand it to its destination

Make fast – Tie up the line

Take a wrap – To control the line without making it fast, wrap it once under the rail or on a cleat and pay out or take in slowly

Slack the line – Loosen the line

Pay out / or surge the line – Feed more line out in a controlled manner

cont' d from page 100

"I can't get alongside. That thing would smash us to pieces. I'm going to shoot you a line. It'll be coming against the wind so be ready to grab it quick. Fasten it onto that Carley float you've got and then put the Carley's line around your bollard."

Once more Harley positioned his ship in the heaving seas. From the Sudbury II's stern a line arced through the air and, with more good luck than good management, landed right at the feet of the men at the rail of the rig. A deckhand bent a heavier line onto it. Now, as Harley had instructed, the raft was secured by two lines-one from the tug, the other from the rig. Fighting for balance, the oilmen man-handled their Carley float into the sea and those on the tug's afterdeck hauled in their line. As they pulled it across the 100 feet that separated the two vessels, the waves dropped the raft deep into the troughs and then hurled into the air.

The Sudbury II's chief officer, a young Maritimer named Caldwell, now prepared to ride the raft back to the rig. Balanced on the bulwarks, he timed his exit with exquisite precision: as it flew past him on its upward trajectory he scrambled into it positioning himself carefully in its centre. Now it was the oil-men's turn to pull the raft through the waves. They had secured a lifeline to the injured man and as the raft reached the rig it rose on the crest of a wave, the men threw the coil of the line to Reg. The injured man worked his way onto an exposed section of the deck and then, as a wave washed over it, he let go and went with it. Reg reeled him in until he lay sprawled half in and half out of the raft. Shock and pain made any further effort on his part impossible and Reg, fearing that any attempt to wrestle him into the raft might capsize it, left him there for the few minutes it took them to reach the tug. One by one the others made the perilous journey and clambered over the bulwarks and into the outstretched arms of those on the stern of the tug. Finally Reg, who had supervised their evacuation from the rig, let go the line there and pulled himself across to the tug. Both he and the Carley float were yanked aboard the Sudbury II. The raft remained a souvenir of that day. "We had that Carley around for a long time," Bob Gray remembers.

All contact with the Offshore 55 had now been severed and, as the tug got clear, those on deck saw the rig drift away and disappear in the maelstrom that surrounded them.

Commands and Signals for Manoeuvring and Steering

Steady – Hold that course

Port/Starboard Easy – Turning to Starboard or Port gently

Hard over – Wheel all the way to Port or Starboard

Come to course 000° – repeat the course. Bring vessel's heading to the course. Report the heading when on course

Sighted Target or Vessel – report the contact using agreed upon sighting methods eg. on the Port/starboard bow, beam, quarter etc.

Steady Bearing – An approaching vessel bearing has not changed and we may be on a collision course

Secure – Ready to proceed underway (In fast response craft it means ready to accelerate onto a plane.)

Stop – Throttles to neutral immediately

Full Reverse – Throttles to reverse

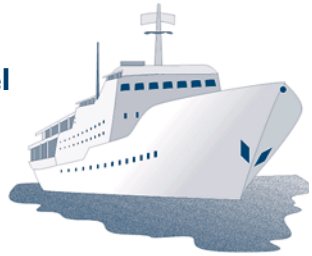
Take way off – Use reverse to gently stop the vessel

Maintain Steerage – Use engines in forward gear to keep the vessel manoeuvrable

Trim up Trim down – Adjust the angle of engines or trim tabs while underway to optimise performance.

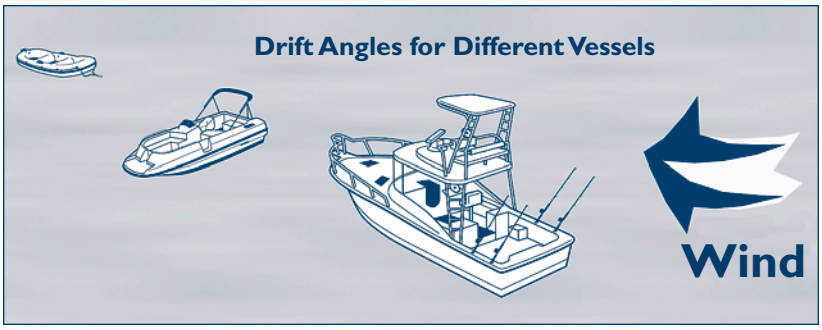
Weight Aft/Forward, Port/Starboard – Move people or gear around the vessel to change trim.

6.2 Forces on Your Vessel



Even on calm days the strength of wind, seas and current can be overwhelming. Ship captains that have thousands of horsepower at their fingertips make a habit of diligently watching the changing natural forces. A huge ship can be rendered helpless at the mercy of a mild current and gentle breeze in minutes resulting in millions of dollars worth of damage to the ship and the environment. When you are on the helm of a small vessel that same responsibility is now yours. You must take the time to observe how the wind, seas and current, alone and together, make differences in your boat's response to helm and thrust. Experienced operators learn to use the natural forces to their advantage.

6.2.1 Winds



Winds will always be a main factor in all manoeuvring. The wind acts on the hull topsides and superstructure, and on smaller boats, the crew. The amount of surface upon which the wind acts is called sail area. The vessel will make "leeway" (drift downwind) at a speed proportional to the wind velocity and the amount of sail area. The "aspect," or angle the vessel takes due to the wind, will depend on where the sail area is centred compared to the underwater hull's centre of lateral resistance. A vessel with a high cabin near the bow and low freeboard aft would tend to ride stern to the wind. If a vessel's draft is shallower forward than aft, the wind would effect the bow more than the stern. A sudden gust of wind from abeam when mooring a vessel like this might quickly set the bow down on a pier.

Knowledge of how the wind affects a vessel is very important in all close quarter situations, such as docking, recovery of an object in the water, or manoeuvring close aboard another vessel. If manoeuvring from a downwind or leeward side of a vessel or pier, look for any wind shadow. The helmsman should account for the change in wind by planning manoeuvres with this wind shadow in mind.

6.2.2 Waves

Waves are a product of the wind acting on the surface of the water. Waves affect boat handling in various ways, depending on their height and direction, and the particular vessel's characteristics. Vessels that readily react to wave motion, particularly pitching, will often expose part of the underwater hull to the wind. In situations such as this, the bow or stern may tend to "fall off" the wind when cresting a wave, as less underwater hull is available to prevent this downwind movement.

FRC Ops:
During high speed operations on a Fast Rescue Craft the navigator or coxswain will give commands by touch signals. Here are examples of signals used in the Canadian Coast Guard's Rigid Hull Inflatable Operators Training (RHIOT) School:

Touch Signals

Stop
– Tap the operator on the top of the head or helmet.

Maintain course
– Push the operator in the middle of the back.

Slow down
– Pull on the back of the operator's vest.

Come slightly to port and steady
– Tap the operator's left shoulder.

Turn to port continuously
– Pull on the operator's left sleeve until the desired heading is reached.

Come slightly to starboard and steady
– Tap the operator's right shoulder.

Turn to starboard continuously
– Pull the operator's right sleeve until the desired heading is reached.

6.2.3 Current

When the water under your vessel is moving quickly it takes great skill to make your vessel respond to your helm and thrust corrections. Current will act on a vessel's underwater hull. Though wind will cause a vessel to make leeway through the water, current will cause drift over the ground. A one-knot current may effect a vessel to the same degree as 30 knots of wind. Strong current will easily move a vessel upwind.

Learn to look for the signs of current flow so that you are prepared when current affects the vessel. Be particularly aware of instances where current shear is present. As with wind, a large, stationary object like a breakwater or jetty will cause major changes in the amount and direction of current. Note the amount of current around floating piers or those with open pile supports. Use caution when manoeuvring in close quarters to buoys and anchored vessels. Observe the effect of current by looking for current wake or flow patterns around buoys or piers. Watch how currents affect other vessels.

6.2.4 Combined natural forces

Environmental conditions can range from perfectly calm and absolutely no current, to a howling gale with a spring tide. Chances are that even if you don't operate at either extreme, some degree of environmental forces will be in action.

Know how your vessel responds to combinations of wind and current and determine which one has the greatest effect on your vessel. It may be that up to a certain wind speed, current has more control over a given vessel, but above that certain wind speed, the boat sails like a kite. Know what will happen if you encounter a sudden gust of wind; will your boat immediately veer, or will it take a sustained wind to start it turning?

When current goes against the wind, the wave patterns will be steeper and closer together. Be particularly cautious where current or wind is funnelled against the other. Tide rips, breaking bars, or gorge conditions frequently occur in these types of areas, and may present a challenge to even the most proficient coxswain.

On the other hand, making leeway while drifting downstream (down current) requires a change in approach to prevent overshooting your landing.

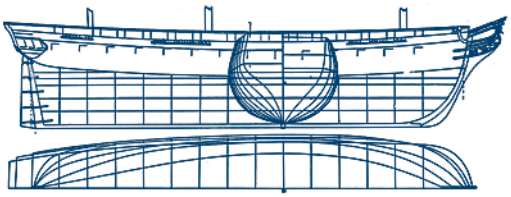
Compensate for wind or current

Check the conditions before manoeuvring. Always try to take advantage of wind and current when docking or mooring. To maintain best control, approach against the wind and current and moor on the leeward side of a mooring when possible. Chances are that when you get underway, conditions aren't the same as when you moored.

6.3 Vessel Characteristics

6.3.1 Displacement Hulls

From the slow and steady pace of a seaworthy wooden trawler to the bright orange rescue Zodiac that streaks by us at a dizzying rate, different hull designs behave differently in the water. From another viewpoint, they are the logical extension of an evolutionary progression that began with boats more than 2000 years ago. What limits certain shapes of vessels from moving faster than their hull speed? Why do other vessels not have hull speeds, and are only limited by the size of the engine on the stern?



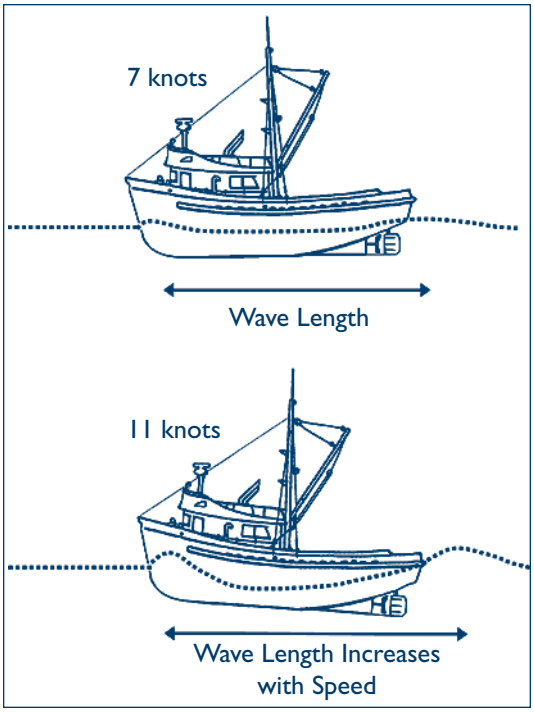
Displacement hulls are common in vessels old and new

Wave Drag and Theoretical Hull Speed

The term "displacement" refers to the fact that at the dock, a boat of any sort displaces a weight of water equal to its own weight. The difference between a displacement vessel and a planing vessel begins when they depart. Underway, a displacement vessel constantly displaces or shoves aside the water in its path, while water from either side closes in behind it. At any given moment, however, the weight of the displaced water continues to equal the weight of the vessel. The planing vessel, on the other hand, uses hydrodynamic lift to push the water underneath the bow downwards. At slow speed it obeys the displacement rule, but when enough power is applied to the leading edge of the hull the boat will climb its own bow wake and escape the slothful confines of the displacement rule. The sheer design of the displacement vessel's bow will never let it escape from the boundaries of its bow wave.

In order to understand why escape is not possible we must elaborate on exactly what occurs at the bow of a displacement vessel. The bow of a moving boat tends to push water both sideways and ahead. In the process, it creates a localised zone of higher pressure and the water bulges above the average level of the

surrounding surface. The result is a bow wave. Near the stern, another bulge forms as the surrounding water surges inward and upward to fill the space that the hull is vacating. The net result is the familiar v-shape wake or wave array that constantly streams away from a displacement vessel - at least, a displacement vessel that is moving smartly. The existence of this self-induced wave system often lowers the average water level in the immediate vicinity of the vessel. When this occurs, the hull will settle a little deeper to maintain the essential equilibrium between its weight and the amount of water it displaces.



Anyone who has watched storm surf breaking on a beach is well aware that waves transmit energy. Storm waves are created by wind energy, while a boat's wake is a manifestation of propulsion from either engine(s) or sails. A bigger wake represents more energy being dispersed, or in other words, more wave-making resistance.

At a speed below the theoretical hull speed, the quarter wave of a typical displacement hull is situated along the flanks of the vessel, well forward of the stern. The length of the arrow in the diagram above indicates the wavelength of the "entrained" wave system.

Physicists tell us that as the speed of this self-induced wave pattern increases, so must the wavelength (for sailors, this is the running distance between the two peaks). The problem is that the two peaks of the first wavelength are holding up the boat. As the speed increases and the second peak moves back the stern will lose its peak to sit on and drop into the trough. The farther away the stern is from the bow (length of the waterline or LWL) the more the wavelength can increase, (along with it speed), before the stern falls off.

The difference between a displacement vessel and a planing vessel begins when they leave the dock.

As the vessels' speed and the distance between the two peaks (wavelength) increases the stern drops into the trough. Then the vessel's length limits the speed that the vessel can travel. Why can't the boat go any faster when the stern drops off the hump?

As the vessel reaches theoretical hull speed the bow wave and quarter wave enlarge and separate, with the crest of the quarter wave moving aft to the transom. If the quarter wave moves out from under the stern then the stern loses lift and drops into the hole.

When the stern drops into the trough the boat is now sitting on the back of its own bow wave. This means that the bow is pointed towards the sky and the stern sinks. It is at this point that a planing hull begins to climb up the wake and because of its specially shaped bow and buoyant stern it can actually climb up over top of the wake and take off. The displacement hull does not push the water down and under, creating lift. It simply kicks it aside and therefore is doomed to always inhabit the back of its bow wake. Once the wavelength is exceeded then the more power we add to the throttles the more water we push aside and the larger the wake gets. We don't end up going much faster.

The sheer design of the displacement vessel's bow will never let it escape from the boundaries of its bow wake.

The length between the two humps (wavelength) is directly related to the speed of the two waves travelling along. Since our new boat can only speed up and spread the wavelength apart until the stern drops off of the back hump, then the wavelength of the boat cannot exceed the boat length.

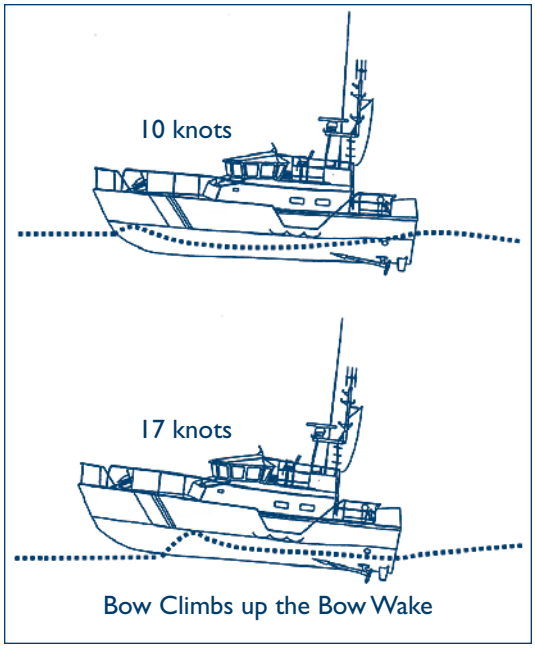
6.3.2 Planing Hulls

Planing

Planing is sliding or skimming over the surface of the water. Any true displacement vessel, including a planing hull at low speed, is sustained - buoyed up - by hydrostatic forces exactly equal to its own weight. The surrounding water pushes inward and upward with equal force. Therefore, when a boat is launched it automatically settles into the water until the weight of the water it displaces exactly equals its own weight.

Underway, many boats, particularly the planing designs, convert some of the energy of their forward motion into vertical lift by deflecting water downward. A flat stone skipped across a pond obtains lift in the same way, temporarily remaining above the water's surface despite the fact that stones are too dense to float. Unlike the skipped stone, which rebounds from the surface at high speed, a planing boat can never obtain enough dynamic lift from the water to lower its displacement all the way to zero,

although fast ones come close. (Of course, with the addition of aerodynamic lift, light racing hydroplanes readily become airborne and, not infrequently, crash as a result).



A boat on a clean plane is perched just behind the crest of the wave it creates by deflecting water downward, forward and outward

Speed potential in a displacement vessel is harshly limited by the inherent speed of the wave system it generates as it shoulders water aside. In simple terms, the displacement vessel lacks the power to climb appreciably up the back face of its own bow wave. On the other hand, a boat on a clean plane is perched just behind the crest of the wave it creates by deflecting water downward, forward and outward. The water shoved down and aside by the passage of the hull, instead of closing in directly behind the boat and forming a distinctive stern or quarter wave, breaks cleanly away at the transom and chines. The faster the boat goes, the longer it takes this water to rebound in the boat's wake. Thus the stern wave of a planing hull, unlike the well defined quarter-wave of a displacement hull, trails a substantial distance behind the transom. The faster the planing boat goes, the further it lags behind.

Trim Angle in Stepless Planing Boats

The vast majority of runabouts, fishing boats, and planing cruisers are flat or v-bottom designs with no transverse steps or discontinuities in their running surfaces. When a boat of this type accelerates from a standstill the trim angle first increases, peaking about the time that planing commences (i.e. the water begins to break cleanly away at the transom and the chines), and progressively levels off as the speed continues to climb. This self-trimming feature is characteristic of all stepless planing hulls.

The drag associated with too large a trim angle (bow in the sky) can prevent a boat from climbing "over the hump" and onto a plane if the available power is marginal for the load. As any experienced small boat operator knows, a boat struggling to get onto a plane often can be helped along by shifting weight toward the bow. On the other hand, the highest speeds for a given hull, load and power plant are generally attained when the boat's centre of gravity is quite far aft, despite the fact that this load distribution often makes it significantly harder to start planing in the first place.

Planing boats have two main sources of resistance. The first is the energy required to deflect water downward as it encounters the bottom. A steeper trim angle causes water to be deflected abruptly, which not only creates larger lifting forces, but absorbs more energy in the process. Roughly speaking, the work of generating dynamic lift matches the work of a loaded boat hauling up a friction's ramp whose slope equals the trim angle.

The second source of resistance is, of course, skin friction. Frictional drag is determined mainly by wetted area and secondarily by surface finish. Skin friction and trim angle drag are, to some extent, inversely related. For example, if trim angle is increased and speed held constant, wetted surface (and skin friction) will decrease somewhat. Minimising total drag in a planing boat boils down to obtaining the optimal combination of trim angle and wetted surface to carry the chosen load at the desired speed. Obtaining this optimal combination is more a matter of initial hull design than movable weight positioning, trim tab adjustments or the like. Fortunately, the basic elements of sound hull design are by now well understood, thanks to the pioneering work of such naval architects as Lindsey Lord, and later, Raymond Hunt.

The Advantage of V-Bottomed Hulls

V-bottom boats have acquired their overwhelming popularity partly because their extra wetted length along the keel makes them highly resistant to porpoising which is a tendency to pitch and slam. (Two other advantages of v-bottoms, their enhanced ability to negotiate rough water at high speed and bank into turns, will be discussed a bit later.) For a given speed and load, a v-bottom will create more drag and require more power than a flat bottom. In almost all cases, this trade-off is worthwhile.

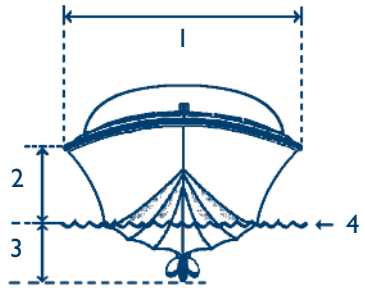
Banking, Heeling and Stability

Good planing hulls, instead of leaning away from turns like displacement boats or automobiles, bank into them like motorcycles. The explanation for this is rooted in the basic principles of planing. When a

boat enters a turn, centrifugal force causes it to skid sideways. In the process of skidding, the boat is actually planing sideways as well as forward. As a result, the high lift leading edge area shifts toward the side of the bottom that is on the outside on the turn, raising it and causing the boat to bank.

V-bottom boats bank harder and more reliably in turns than flat bottom boats. As a v-bottom boat skids sideways, the outer side of the hull meets the water at a large trim angle and develops lots of lift, while the inner side contacts the water at a much smaller angle and may easily develop suction.

Good planing boats are more stable at speed than they are at rest. When weight is shifted to one side of a displacement boat, the boat heels, moving the centre of buoyancy laterally until it is again in vertical alignment with the centre of gravity - this time with the boat heeling to some extent. However, when a boat is planing, the same weight shift will also alter the trim angle on one side of the bottom relative to the other, inducing an additional and comparatively large dynamic righting force.



1. Beam
2. Freeboard
3. Draft
4. Waterline

Terms Referring to Direction on a Vessel

Forward	Towards the bow
Aft	Towards the stern
Abaft	A position behind a reference position on the vessel
Port Side	Left side, when facing the bow
Starboard	Right hand side, when facing the bow
Beam	The boat at its widest point or width
Amidships	The centre of the vessel
Athwartships	Travelling across the breadth of the vessel
Aloft	Above the deck or in the rigging
Inboard	Inside the boat or towards the centre line
Outboard	Outside the boat or away from the centre line

6.4 Propulsion and Steering

Propulsion and steering are considered together here for two reasons. Applying thrust has no use if you can't control the vessel's direction, and often the device providing the propulsion also provides the steering. There are three common methods of transfering power and providing directional control:

- Rotating shaft and propeller with separate rudder
- A movable (steerable) combination, such as an outboard motor or stern drive
- An engine-driven pump mechanism with directional control, called a waterjet

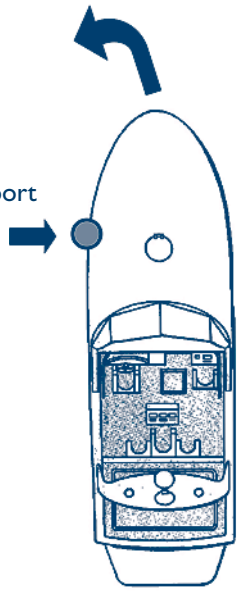
Good planing hulls, instead of leaning away from turns like displacement boats or automobiles, bank into them like motorcycles

All three arrangements have their advantages and disadvantages from the standpoint of mechanical efficiency, ease of maintenance and vessel control. Using one type of propulsion instead of another is often a matter of vessel design and use parameters, operating area limitations, life cycle cost and frequently, personal preference. There is no single "best choice" for all applications. Regardless of which type you use, become familiar with how each operates and how the differences in operation affect vessel movement.

The following assumptions will apply to our discussion of propulsion:

- If a vessel has a single-shaft motor or drive unit, it is mounted on the vessel's centreline
- When applying thrust to go forward, most propellers turn clockwise (the top to the right or a "right-handed" propeller), viewed from astern. When going astern it turns counter clockwise viewed from astern when making thrust to go astern
- If twin propulsion is used, most vessels have counterrotating drives in the following configuration: starboard propeller, when going ahead, operates as above (right-hand turning), while the port unit turns counter clockwise (left-hand turning)

6.4.1 Pivot Point



When moving forward with the helm turned to port the pivot point is here

On almost every boat, the propulsion and steering arrangement is designed to operate more efficiently and effectively when going ahead than when going astern. When turning, a vessel will rotate on a specific point, called the pivot point. The fore and aft location of the pivot point varies from boat to boat, but is generally just forward of amidships when the boat is at rest. As a hull moves either ahead or astern, the effective position of the pivot point moves either forward or aft respectively. A sense of the location and behaviour of the pivot point is a critical component for boat handling at slow speed.

6.4.2 Trim

Trim is the angle of the hull in reference to the water's surface; there are a few ways to adjust this angle:

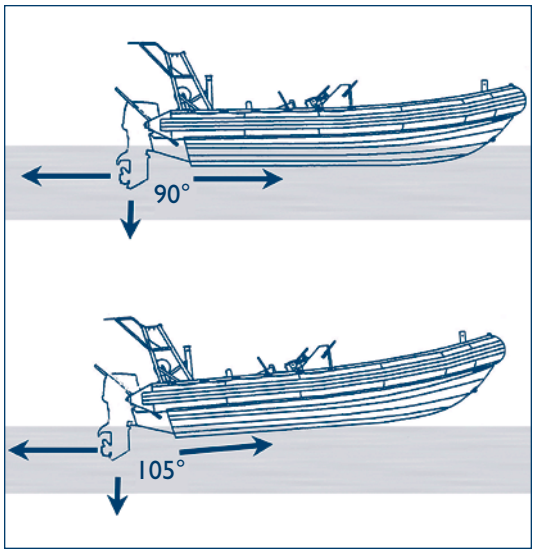
- Adjust the angle of propulsion
- Adjust the weight onboard the vessel
- Use trim tabs or fins attached to the hull or engine leg to create lift (stern up) or suction (stern down) from the water travelling along the hull surface.

The angle of propulsion in reference to the angle of the transom can affect trim

When moving on to a plane, the boat is actually climbing up its own bow wave. Displacement mode describes the vessel at slow speed displacing its weight in the water. During the transition between displacement mode and planing mode, the vessel must overcome its bow wave and ride on the after part of the hull, suspended on a cushion of air and water it develops dynamic lift. In order for the transition to occur smoothly, the boat must be properly trimmed.

Adjust the angle of propulsion

The angle of propulsion in reference to the angle of the transom can affect trim. This is most commonly achieved by adjusting the a trim ram on a drive mount. Trimming up increases the angle and drives the stern down while lifting the bow up. Trimming down does the opposite. The ideal trim angle vs. power ratio is when the boat is stable, but has a minimum amount of hull surface in the water. As the angle of trim is

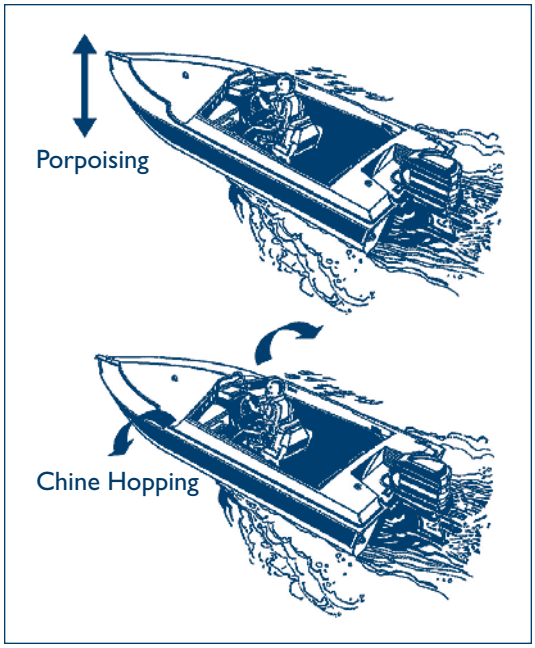


increased or "trimmed up," more horsepower is required to hold the hull out of the water. If there is a lot of horsepower and too much of the hull is lifted out, then the boat becomes unstable. There are two indications of being trimmed up too high:

Porpoising: When the bow bobs up and down, even in calm water;

Chine Hopping: Violently hopping; when the boat sways from one side to the other, with increasing frequency.

The boat is not trimmed high enough when the steering is stiff and sluggish and the bow wake is still up at the bow. The boat will be pushing a lot of water along like a snowplough, rather than gliding along.

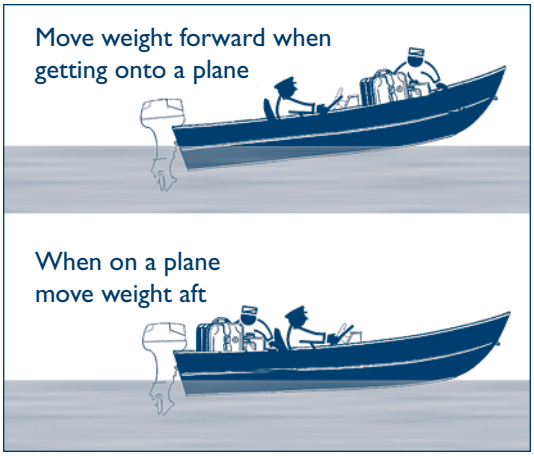


Optimum Trim

A good trim angle is characterised by responsive steering, and the feeling that the boat is floating on a cushion of air. At this angle, the boat is using less fuel, is more stable, steers easier, and is going faster.

Adjusting the Trim with Weight

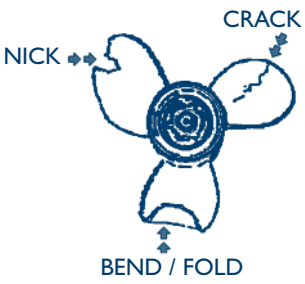
With small boats, we usually have portable ballast (people) that we can move around to balance out the boat. When first accelerating, move weight forward to help the bow climb the wake. Once up on a plane, move the weight aft to trim up the bow. If you have power trim, then trim down first. When up on a plane, trim up to the optimum.

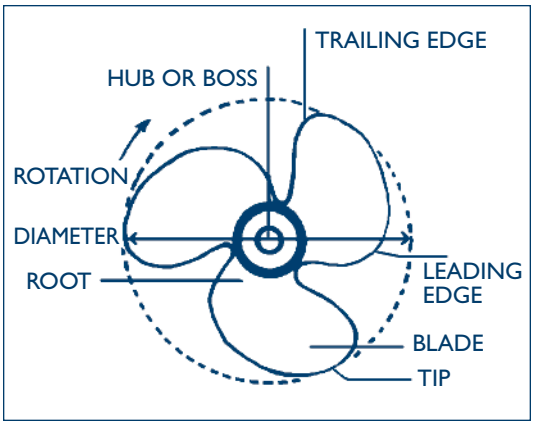


6.5 Propellers

A boat is only as good – or bad – as its prop. With the right prop, your boat is a joy. Fast, smooth, comfortable, fuel-efficient and just plain fun. With the wrong prop, your boat will feel rough, or slow, or sluggish or lacking in top end. The wrong prop can even damage your engine through lugging or over-revving.

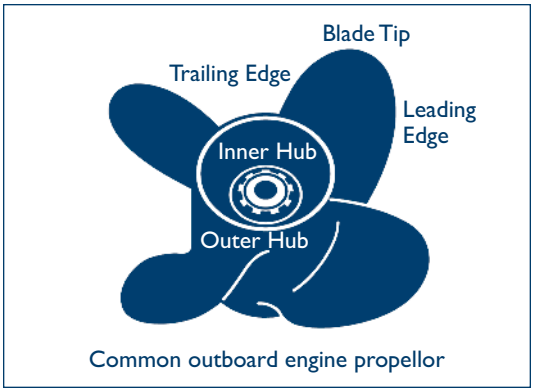
Even the right prop, when damaged, can drastically reduce performance and fuel efficiency. Just running a prop through silt or sand can damage it enough to affect how your boat runs. In one test, a damaged prop dropped top speed more than 13%, acceleration 37%, and optimum fuel miles were reduced 21%. So you can see why you should check your prop often and have a damaged prop checked and repaired by an authorised dealer or repair station.





6.5.1 Parts of a Propeller

To understand how propellers work, we have to familiarise ourselves with the parts of the propeller. We have chosen a complex propeller to illustrate a high-performance design. Smaller outboards have simpler designs with fewer parts. This is also true with displacement hull propellers.

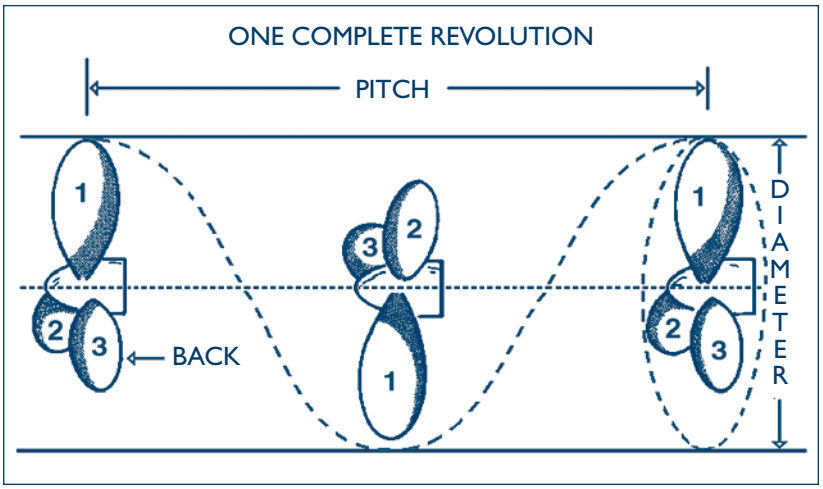


Common outboard engine propellor

1. **Blade Tip:** The maximum reach of the blade from the centre of the propeller's hub
2. **Leading Edge:** The part of the blade that leads as it rotates
3. **Trailing Edge:** The part of the blade that trails
4. **Inner Hub:** This contains the slip hub (usually rubber). The forward end transmits the drive from the shaft to the propeller body
5. **Outer Hub:** This contains the open exhaust passage, suspending the inner hub with spokes

Pitch

Pitch is the theoretical forward distance the prop would move in one full revolution if it were moving through a solid. To get maximum efficiency from your engine, the pitch should be matched to engine power, gross weight and intended use of the boat. The diameter of a propeller is the diameter of the circle through which the blades turn.



Pitch is the theoretical forward distance the prop would move in one full revolution if it were moving through a solid

WARNING

Directed thrust steering is only effective when the engine is in gear and directing thrust. If you are in neutral your vessel will not respond to helm changes. This is especially true with jet drives.

Propellers may have two or more blades on a hub. The hub size is dependent on the shaft size and is bored to fit the shaft. Propellers are specified by diameter, pitch, number of blades, direction of rotation, and bore. Diameter and pitch are usually stamped on the hub, for example: 12 X 14RH means 12 inch diameter, 14 inch pitch, right-hand rotation

Best all-around engine performance is achieved when the prop is matched to give just under the top recommended full-throttle rpm. Generally, the heavier the boat, the lower the prop pitch. The right prop allows the motor to operate in its optimum rpm range. The same horsepower motor on a lighter boat needs a higher pitched prop than on a heavier boat to give it more speed and to efficiently use the rpm.

Cavitation

Even slightly chipped blade edges can cause surrounding water to boil ("cavitate"). Gas bubbles then collapse elsewhere on the blade, releasing energy that causes metal erosion or "cavitation burn."

Ventilation

Air from the water surface or exhaust gases from the exhaust outlet being drawn into the prop blades causes ventilation. This reduces normal water load, causing the prop to over-rev and lose a lot of thrust. Ventilation is most common with high transom mounting, extreme trim-out and sharp turns.

6.6 Basic Manoeuvres

Often the presence of other craft or obstructions will complicate the clearing of a berth, or any simple manoeuvre. Wind and/or current can also become a factor. Before manoeuvring, evaluate the options in order to take full advantage of the prevailing conditions.

Fenders

Never attempt to fend a boat off a pier, float, etc., by hand or foot always use a fender. Always keep the proper sized fenders handy.

Mooring/off-dock wind

When mooring with an off-dock wind, the approach should be made at a sharp angle.

Mooring/on-dock wind

When mooring with an on-dock wind, approach parallel with the intended berth and rig the fender in appropriate positions. Ensure that the boat has no fore and aft movement when contacting the dock.

Protecting the stern

Keep the stern away from danger. If your propellers and rudder become damaged, you are crippled. If the stern is free to manoeuvre, you can work your boat out of trouble.

6.7 Manoeuvring

Directed thrust is used in the following types of drives:

- Jet boats;
- Outboard drives; and
- Inboard/outboard drives.

6.7.1 Directed Thrust

When the drive unit is turned to the port or starboard, the thrust is applied to that direction. The stern will swing around the pivot point and the boat will turn.

Thrust and directional control

Outboards and stern drives have a small steering vane or skeg below the propeller. The housing above the gear case (below the waterline) is foil shaped. Though these features help directional control, particularly at speed, the larger amount of steering force from an outboard or stern drive is based upon the ability to direct the screw discharge current thrust at an angle to the vessel's centreline. This directed thrust provides extremely effective directional control when powering ahead.

6.7.2 Twin Engine Directed Thrust

Use the outside engine for the turn

The engine on the outside of the arc of a turn provides the more effective directional thrust compared to the inside engine. When trying to turn in a tight

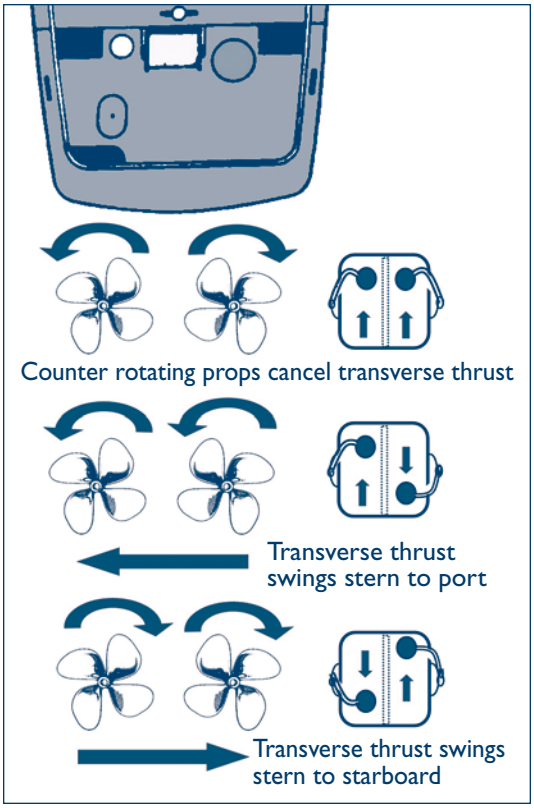
space, the operator can apply power to the outside arc engine for maximum effect. This works for both forwards and reverse. If you imagine a wrench stretching from the pivot point (dot) to the engines then the engine that is farthest away from the pivot point provides the better lever. Out of the two wrenches port or starboard the starboard one is the farthest away and it is on the outside of the arc. When manoeuvring in confined spaces, always use your outside arc engine.

Transverse Thrust

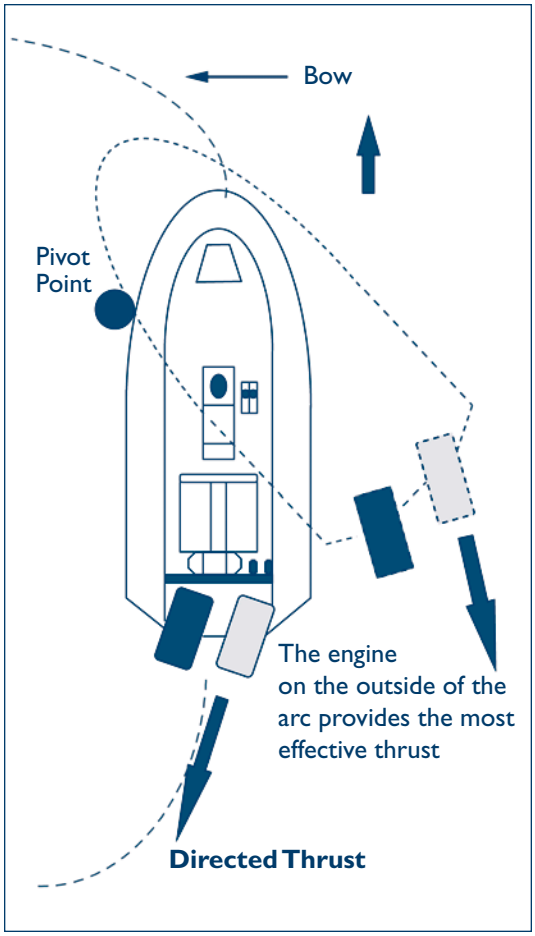
Transverse thrust is the sideways force generated by the propeller blades paddling through the water. The propeller will push water through the blades to create thrust ahead. But the turning blades will also wash water sideways and create a small amount of sideways motion. With many single screw vessels a large propeller will create enough transverse thrust to render your helm ineffective when backing up. The result is a vessel that will only back one way (to port).

Using opposing engines can help manoeuvre in tight spots

With counter rotating screws (propellers) power vessels can use transverse thrust to advantage and get the stern to slide sideways. By using one throttle ahead and one in reverse the vessel can turn on its own length. This is very handy in tight spots.



If the vessel's propellers are not counter-rotating (not spinning in opposite directions when both ahead), then using opposing engines (one ahead and one astern) will not be as effective as on a counter-rotating propped boat. Splitting the engines moves the pivot point of the vessel back between the two engines drastically reducing your leverage and increasing your required power. We can still use opposing engines to help manoeuvre in tight spaces, but often in conjunction with the wheel.



Pivot Points

The dot on the port bow indicates the spot where the boat will pivot in a port hand turn. As the boat turns around the pivot point the stern travels most of the distance. When trying to judge what the boat is doing at any one time, it is better to look at the stern then the bow. The stern will give the operator a better gauge for the movement of the boat. When operating in reverse, the pivot point moves aft, just ahead of the engine well, and the bow will tend to swing more than the stern. The change in pivot point is the reason that vessels are so difficult to manoeuvre in reverse. If the wind catches your bow when you are backing in, be careful, because it will swing.

When backing to starboard, the side force tends to cause an element of astern motion and also tries to offset the initial starboard movement. Many lower units are fitted with a small vertical vane, slightly offset from centreline, directly above and astern of the propeller. This vane also acts to counter side force, particularly at higher speeds.

6.7.3 Waterjets

Courtesy of: Hamilton Jets

A waterjet is an engine-driven impeller mounted in a housing. The impeller draws water in and forces it out through a nozzle. The suction (inlet) side of the waterjet is forward of the nozzle, usually mounted at the deepest draft near the after sections of the hull. The discharge nozzle is mounted low in the hull, exiting through the transom. The cross-sectional area of the inlet is much larger than that of the nozzle. The volume of water entering the inlet is the same as that being discharged through the nozzle, so the water flow is much stronger at the nozzle than at the intake. This pump-drive system is strictly a directed-thrust drive arrangement. A waterjet normally does not extend below the bottom of the vessel hull, allowing for operation in very shallow water.

Thrust and directional control

Vessel control is through the nozzle-directed thrust. To attain forward motion, the thrust exits directly astern. For turning, the nozzle pivots (as a stern drive) to provide a transverse thrust component that moves the stern. For astern motion, a bucket-like deflector drops down behind the nozzle and directs the thrust forward. Some waterjet applications include trim control as with a stern drive or outboard. With this, thrust can be directed slightly upward or downward to offset vessel loading or improve ride.

From time-to-time, you might see a waterjet with a small steering vane, but in most cases the only vessel control is by the nozzle-directed thrust. If a waterjet craft is proceeding at high-speed, power brought down quickly to neutral, and the helm put over, no turning action will occur. Of the three drive arrangements discussed, the waterjet alone has no directional control when there is no power.

No side force

Since the waterjet impeller is fully enclosed in the pump-drive housing, no propeller side force is generated. The only way to move the stern to port or starboard is by using the directed thrust.

Cavitation

Waterjet impeller blades revolve at an extremely high speed. A much higher degree of cavitation normally occurs than that associated with external propellers without a loss of effective thrust. In fact, a telltale indicator of waterjet propulsion is a pronounced aerated-water discharge frequently seen as a rooster tail astern of such craft.

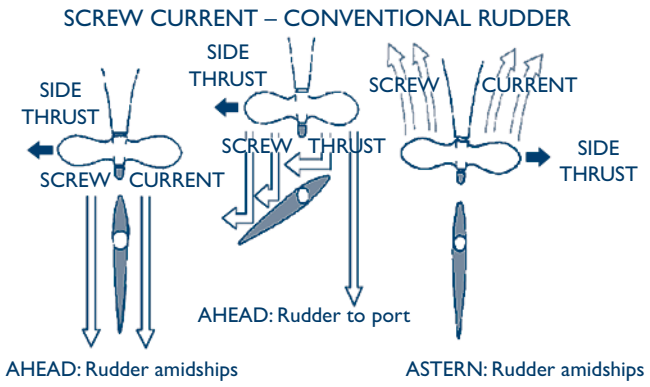
As the impeller rotation does not change with thrust direction, frequent shifting from ahead to astern motion does not induce cavitation. However, as the thrust to make astern motion reaches the waterjet inlet, the aerated water is drawn into the jet, causing some reduction of effective thrust. As with all types of propulsion, slowing the impeller until clear of the aerated water reduces cavitation effects.

6.7.4 Non-Directed Thrust and Rudder Deflection

If a vessel is moving through the water (even without propulsion), you normally use the rudder to change the vessel's heading. As a hull moves forward and the rudder is held steady, amidships, pressure on either side of the rudder is relatively equal and the vessel will usually keep a straight track. When you turn the rudder to port or starboard, pressure decreases on one side of the rudder and increases on the other. This force causes the vessel's stern to move to one side or the other. Because a vessel rotates about its pivot point, as the stern moves in one direction, the bow moves in the other.

The speed of the water flowing past the rudder greatly enhances the rudder's force. The thrust or screw discharge current from a propeller while operating ahead increases the water flow speed past the rudder. Also, if you turn the rudder to a side, it directs about one-half of the propeller thrust to that side, adding a major component of force to move the stern.

Because a vessel rotates about its pivot point, as the stern moves in one direction, the bow moves in the other



When operating astern, the rudder is in the screw suction current. The rudder cannot direct any propeller thrust, and since the screw suction current is neither as strong nor as concentrated as the screw discharge current, water flow past the rudder does not increase as much. The combined effects of screw current and rudder force when operating astern are not nearly as effective as when operating ahead.

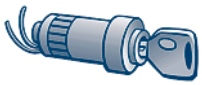
As rudder force is determined by water flow along it, a rudder loses some of its effectiveness if the propeller cavitates and aerated water flows along the rudder.

6.8 Getting Underway

Starting the Engine

Before starting the engine, be sure that it is in Neutral. Different engines have different requirements for start-up and warm-up. Most outboards require some type of choke or priming before they start. Larger outboards have a priming pump that injects extra fuel into the carburettor. Small outboards have a choke on the carburettor that can be engaged while starting, and disengaged after ignition. Read the engine manufacturer's "Operating Instructions."

Vessel Start up Procedure



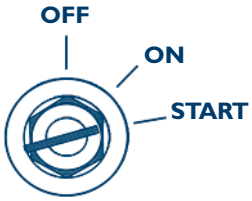
- ✓ Make sure that the vessel is secure, and that the crew is ready.
- ✓ Check small outboard's transom mounting and back-up cord.
- ✓ Check fuel line attachments and fuel level.
- ✓ Do not proceed if you detect the smell of gasoline or there is evidence of any fuel leaks.
- ✓ Turn on battery power or ignition switch.
- ✓ Pump prime bulb (if applicable).
- ✓ Attach Kill Switch lanyard.
- ✓ Check throttles (in neutral) or in Start position.
- ✓ Prime engine or engage choke.
- ✓ Pull Start cord or turn key until ignition.
- ✓ Bring RPMs to recommended warm-up speed.
- ✓ Warm-up for 2 to 3 minutes (in neutral).

Leaving the Dock

Most vessels are better off backing out when leaving a berth alongside, due to the position of the pivot point. In larger vessels, if there is a problem getting the stern away from the dock, you can go ahead on the forward spring to swing the stern out. After the stern has swung well away, then reverse out of the berth. If you have to power out forwards, then the bow should be pointing away from the dock first. To manoeuvre the bow out, let go all the lines except the after spring, and back on it until the bow swings out.

To manoeuvre out without using lines or a push:

1) Turn the wheel hard at dock and give a shot in forward. Let stern swing out.
2) Turn the wheel hard away from the dock and reverse out, manoeuvring the wheel as you do, to bring the vessel to parallel the dock.
3) You should now be far enough away from the dock to drive forward away without clipping your stern on the dock



6.9 Approaching the Dock

Rig and lead mooring lines and fenders early

Rig and lead mooring lines and fenders well before the approach. Get the noise and confusion over with long before the coxswain must concentrate and manoeuvre to the dock.

Though common practice is to leave mooring lines attached to the home pier, always have a spare mooring line and moveable fender on the boat and at the ready while approaching any dock, including the home pier.

Control, not speed

Keep just enough headway or sternway to counteract the winds and currents to allow steerage while making progress to the dock. Keep an eye on the amount of stern or bow swing. With a high foredeck, the wind can get the bow swinging much easier than it is to stop. In higher winds, a greater amount of manoeuvring speed may be needed to lessen the time exposed to the winds and currents, but be careful not to overdo it.

When requiring precise control, keep the boat's heading into the predominate wind or current, or as close as possible. When manoeuvring the boat so that the set from the wind or current is on either the starboard or port bow, the boat may "crab" (move sideways) in the opposite direction.

STP
Speed:
Using too much speed in a confined space.

Throttles:
Forgetting whether the throttles are engaged (ahead, in neutral, or in reverse).

Position of Helm:
Looking at the bow and forgetting whether the rudder is hard over or amidships

Use clear line handling commands and signals

Line handling is extremely important when docking. Give specific line-handling instructions in a loud, clear voice. Ensure commands are understood, by any helpful individuals near the dock. Poor line handling can ruin the docking at the end of a perfect approach. Ideally, try to have the boat stopped alongside the pier before putting lines over.

Steering is more effective when thrust is applied

Directed thrust (turning the angle of the propeller to steer), offers quick and responsive manoeuvrability in most situations. Outboard engines act as a rudder, and even when in neutral (no directed thrust) will steer the boat slightly. But don't count on this to turn you at slow speed.

Don't add more power if things go wrong

Adding more power to a troubled docking is usually a recipe for disaster. If the coxswain is patient enough to use short bursts of power, and wait to see the outcome before manoeuvring again, then a crash may be avoided.

Turn the wheel first, then apply power

If you want to turn your car in a tight spot, you crank the wheel hard over and then step on the gas. If you step on the gas first, then you run out of room. When manoeuvring your vessel in a confined space, the same rules apply.

Use the outside arc engine with twin screw vessels

The engine on the outside of the arc of a turn provides a better thrust angle than the inside engine. When trying to turn in a tight space, the operator can apply power to the outside arc engine.

6.10 Station Keeping

(Definition: The ability to keep the vessel stationary relative to a reference point.)

Station keeping is a learned skill. Understanding the principles of particle motion and wave theory helps in effectively manoeuvring a vessel in tight areas near shore or at sea.

Waves at sea are energy in motion. The water does not flow or move with the wave, it just goes up and down. As the energy moves through the water, the particle motion in the wave is circular. The largest circle is near the surface, getting smaller in size toward the bottom. The wave will remain constant, or nearly constant, as long as there is no object or current present to alter it.

As the wave approaches shore, the circular motion is squashed flat as it nears the sea bed. The circular motion becomes elongated to the point that the wave is now water flowing ashore and then back to meet the next incoming wave.

As you near shore, you must use this understanding of particle motion to anticipate the movement of your vessel, thus being able to use your vessel's power to counter the forces of the wave. As the wave approaches, the vessel will be pulled toward it. As the wave reaches the vessel, the vessel will lift and be carried in the direction of the wave until the wave passes the vessel, at which time the next approaching wave's circular motion will pull the vessel back toward the incoming wave.

To be able to maintain station, the vessel operator has to counteract each of the forces that the circulation motion of the wave applies to the vessel. You must be able to react to each wave as it approaches, anticipating how much force it will carry. Once you understand how your vessel will react to the approaching energy, then you can apply the counter power necessary to remain in one position relative to a fixed object.

Always SAP (STOP, ASSESS, and PLAN) before entering the area where you will be required to station keep.

Stop and Assess the following:

- ⇛ Observe wind, tide and current.
- ⇛ Observe water colour.
- ⇛ Identify shallows, ledges and aerated/turbulent water, and stay away from these areas.
- ⇛ Assign a lookout to maintain a sea watch. Discuss with your lookout which are the small, medium and large waves of the series, and have your lookout notify the operator of these large waves before they reach you. Remember that there is always the rogue or extra large wave that will come ashore from time to time. Be on the lookout for the larger waves and move out of the area before they reach too close to shore or your position.
- ⇛ Approach slowly, the reverse power is not sufficient to overcome vessel momentum when combined with the surge force of a wave.
- ⇛ The vessel is always easier to control when the bow is kept to seaward or toward the incoming wave or current. Do not allow your vessel to get turned beam to an incoming wave near shore. Any wave taken on your beam in this situation puts the vessel in a hazardous position, that is difficult to manoeuvre away from.
- ⇛ Choose two exits for your vessel. Do not get caught with a boat or debris blocking your path to safety if you get too close to something. Always have an alternate in mind.

7

Foundations of Navigation

"Sometimes knowing where you are not is just as important as knowing where you are."

The new Coast Guard Auxiliary crewmember may not be fixing positions, planning routes and giving courses to steer - that would be the job of the vessels' navigator or captain. Yet it is imperative that everyone on board the rescue vessel is able to use their eyes and charts, along with the electronic nav aids to monitor the safe track of the vessel.

Every CCGA crewmember shall be able to recognize when their vessel is standing into danger and they shall know how to react quickly and assertively in the interest of the vessel when they recognize a risk.

Foundations of Navigation

Contents

Royal Majesty

Excerpt from ***GPS Instant Navigation*** by Kevin Monahan & Don Douglass

On June 10, 1995, at about 2230, while transiting from Bermuda to Boston, the Panamanian cruise ship Royal Majesty ran aground on the Rose and Crown Shoals near Nantucket Island, Massachusetts. On board were over 1500 people, including crew. Luckily, the weather was fine at the time and no injuries or deaths resulted from the grounding. However, weather conditions worsened. The passengers, who were forced to remain on board while the ship was refloated, were not able to disembark in Boston until 48 hours later. The incident resulted in a nasty repair bill and a great deal of embarrassment on the part of the navigation officers. The Royal Majesty had deviated 17 NM off course at the time of the grounding!

The ship was fitted with an Integrated Navigation system, with positioning information provided by GPS and Loran C receivers. This type of equipment bears the same relationship to the average consumer GPS Navigator as the space shuttle does to a bicycle. The Integrated Navigation system was of the type that takes inputs not only from positioning devices, but also from a gyrocompass and a Doppler speed log; it is programmed with waypoints and the manoeuvring characteristics of the individual vessel. It was capable of being connected to an autopilot and steering the ship in reference to a predetermined track, automatically compensating for gyrocompass error, wind, and current.

The Integrated Navigation system was capable of calculating a dead reckoning position based on course steered and speed through the water. It was programmed to sound an alarm if it detected a difference of more than 200 metres between its DR position and the GPS or Loran C position.

At the time of the grounding, the Integrated Navigation system was in operation, but for some reason it failed to keep the ship on course. Afterward, many people wondered how this happened. An investigation by the United States National Transportation Safety Board revealed the cause: a frayed wire and a duplicated function in the GPS that provided position data to the Integrated Navigation system.

As is common with many older satellite-based positioning systems, the GPS unit on board the Royal Majesty was programmed to default to a DR position when satellite signals became unavailable. Rather than freezing up and displaying the last satellite-based position available, it applied data from the gyro-compass and speed log to project the position along its course steered. (When the unit was manufactured this was an intelligent choice, because in the early days of GPS there were frequently not enough satellites available to provide an adequate fix.) When the GPS itself reverted to DR mode, it sounded an alarm, but this alarm was not very loud.

At some time prior to the grounding, the shielding on the GPS antenna wire came loose from the antenna itself. The GPS could not derive a position, so it defaulted to DR mode. Because the GPS was mounted behind a bulkhead, both its alarm and visual fault-indication display went unnoticed. Since it continued to supply position data to the Integrated Navigation system, the system did not automatically switch to Loran C positioning, but the GPS Navigator was supplying DR positioning based on the courses steered and the speed logged since the last valid position fix.

The Integrated Navigator was using the same gyrocompass and speed inputs as the GPS to derive a DR position, so the two positions never differed by more than 200 meters; consequently, the Integrated Navigator never sounded an alarm. It “assumed” that the position data it was receiving was a GPS-derived position, not a DR position, since the data came from the GPS Navigator itself.

Meanwhile, current and winds forces were slowly pushing the Royal Majesty off her Intended Track until the time of the grounding when the vessel was 17 NM off course to the west. For this amount of Cross Track Error to accumulate, the antenna shielding likely separated soon after departure from Bermuda, over a day before. The NTSB report noted that at no time were the bridge officers aware that the ship had strayed from her course, even though they had numerous other means at their disposal to determine their position including passing navigation buoys they should not have been able to see, land they should have been no where near, depths of water that were far more shallow than on the chart, and worst of all fishing boats warning them that they were in danger.

Complacency seems to be the main cause of many accidents; navigators must constantly guard against placing their trust where it might not be due. Though there were valid reasons for the failure of the Integrated Navigation system, the report indicates that the officers neglected to monitor the ship’s progress by other means at regular intervals.

In this case, the marvellous accuracy and ease of use of GPS and its derivative systems may have lulled the navigators of the Royal Majesty into the habit of using the GPS/Integrated Navigation system as their sole means of establishing position. Although not categorically affirmed, this is implied by the NTSB report. At some point, according to Murphy’s Law, if you depend on it, it will fail, and it will fail at the most inconvenient time. Hopefully we can all learn a lesson from this incident.

7.0 Introduction to Navigation

Navigation is the system that vessel operators use to plan and travel along a sea route, including determining a vessel's position and avoiding hazards. The art of navigation embraces two basic concepts and four basic disciplines. The concepts are location and direction. The disciplines are dead reckoning, piloting, celestial navigation, and electronic navigation. Celestial navigation is not used by small coastal rescue craft so it will not be covered.

Dead Reckoning

Dead reckoning is the determination of position by course and distance from a last known position without regard for current or other external influences. It is arguably the most basic discipline, yet without it, none of the other disciplines would be possible.

Pilotage

"*Sometimes knowing where you are not, is more valuable than knowing where you are*." Pilotage involves determining a vessel's position relative to known objects, such as landmarks or aids to navigation. In some cases, all that's needed for navigation by pilotage is sound knowledge of the area, including local weather, tides and currents, hazards to navigation such as shoals, aids to navigation and traffic and of course, your chart.

Eyes and Chart

Your vessel may be equipped with the latest GPS and chart plotter, an integrated, stabilised radar and a colour depth sounder, but the only truly reliable navigational aids found on onboard your vessel **are your eyes and your chart**.

The most important skill required of navigation by pilotage, is that of observation. For pilotage in particular, the good navigator will make use of all his or her senses to determine a vessel's position relative to hazards, and guide it to its destination.

Observation skills can't be taught by this book. All of us already use such skills to a certain extent anyway. The goal here is to point out how valuable some of the skills you already have can be in navigation. Awareness and practice are the best methods for honing these skills.

Eyes

Buoys, beacons, ranges, day marks, landmarks such as peaks or breaking surf are just a few of the visual clues you can use to tell you where you are. By lining up two recognisable man-made or natural objects you can create transits that tell you where the safe water is and how the tide is affecting you.

The good navigator, no matter how skilled in the use of navigation instruments and techniques, will always use all the information available, and never rely on just one source of information, when others are available. This is very important to remember with some of the navigation instruments available today. While GPS and electronic charts have greatly simplified some aspects of navigation and are now available on the smallest boats, these systems may and can fail, or even worse, give false or misleading information. More traditional aids to navigation, such as buoys can also fail or give false or misleading information if they drift off position. The consequences of over-reliance on any one system can be disastrous.

Some available means for checking position are:

1. *Eyes for visual references*
2. *Hydrographic Chart*
3. *Boat Compass*
4. *Radar*
5. *GPS*
6. *Electronic Chart*
7. *Local Knowledge*
8. *Hand Compass*
9. *Depth sounder*
10. *Smell and Hearing*

7.1 Navigation Monitor

As a crewmember in the navigation monitor position you may not actually be navigating the vessel. Rather, your primary responsibility will be monitoring the position of the vessel in relation to the paper chart, electronic chart and radar. You must be aware of the intended path defined by the coxswain/captain and routinely checking that the vessel's position is on that path, using all available means.

A crewmember will be in constant communication with the captain or coxswain during the vessel's advance. It is the navigation monitor's primary responsibility to watch for dangers regarding the vessel's path, yet all crew shall be on the lookout for the following situations and all crew will take these actions.

You must STOP the vessel in event of:

- ⇛ An unknown object in close proximity is detected by sight or radar ahead of the beam
- ⇛ A major unexpected departure from the course line
- ⇛ Another vessel turning or veering into your vessel's path
- ⇛ Uncertainty of your vessel's general position
- ⇛ Impending landmass detected by sight or radar
- ⇛ When in close proximity to dangerous submerged objects (rocks, shoals or wrecks) charted or sighted
- ⇛ Depth sounder consistently reading depths not expected

Note: *All crew are responsible for the safety of the vessel at all times.*

You must notify the coxswain if:

- ⇛ Moving in or near conditions of reduced visibility due to rain, snow, sleet or fog
- ⇛ There are aids to navigation previously unreported
- ⇛ Any new vessel traffic comes into view by sight or radar
- ⇛ Any fixed hazards come into view by sight, radar, or electronic chart
- ⇛ If there are any differences between what you should see (according to paper/electronic charts) and what you actually see
- ⇛ There is any malfunction of any electronic device
- ⇛ There is any uncertainty in your operation of any device
- ⇛ Any information available to you is not fully understood (chart symbol, radar image, GPS data, or instruction or request from the coxswain)
- ⇛ The scale of any electronic navigation aid is changed (GPS or Radar)

Courteous and Professional Vessel Operation

- ➜ Vessel operators shall always proceed with caution to ensure that their vessel's wake and wash does not adversely affect other vessels, shoreline, docks, floats or wetlands, swimmers and divers, bathing beaches and anchorages
- ➜ Vessel operators shall always use courtesy and common sense to avoid creating a hazard, threat, stress or irritant to themselves, others, the environment or wildlife
- ➜ Vessel operators shall stay well clear of swimmers and properties
- ➜ Vessel operators shall follow *Collision Regulations*
- ➜ Vessel operators shall know that a craft moving at high speed requires more stopping distance in an emergency and therefore be more attentive because the operator has less time to act

7.1.1 Publications

These publications may be useful for learning:

Canadian Tide and Current Tables: Tidal and current information specific to coastal areas.

Chart # 1, Symbols and Abbreviations Used on Canadian Nautical Charts: Legend covering the symbols and abbreviations used on navigation charts published by the Canadian Hydrographic Service.

Collision Regulations: The international rules for the prevention of collisions at sea. This is your most important navigational safety publication, as it outlines the rules of right of way, lights and signals.

List of Lights, Buoys, and Fog Signals: This publication details the characteristics and descriptions of lights and navigation aids, and their positions.

Notices to Mariners: A monthly publication that contains navigational notices concerning changes in aids to navigation, hazards to navigation, chart corrections, and new charts. The Annual Edition of the Notice to Mariners should also be available.

Radio Aids to Marine Navigation: Information concerning radio weather broadcast messages and radio aids to navigation.

Sailing Directions: A book that supplements navigational charts by providing listings of associated charts related to the area; detailed geographical data; aerial photographs; and other information specific to the area.

The Canadian Aids to Navigation System: This publication details all of the different navigational aids and the Canadian/International Association of Lighthouse Authorities' buoyage system.

High Speed Doom

(A discussion paper addressing high-speed navigation associated with Fast Rescue Craft)
Written By Tyler Brand, Canadian Coast Guard (1999)

Many Coast Guard Auxiliary rescue vessels are high performance/high endurance craft capable of moving at speeds of up to 50 knots. This new speed of advance has pushed the realm of navigating these vessels into a new class with new requirements. This class of skills and knowledge is closer to the world of aviation than nautical science. In order to stay safe with these vessels, special measures must be taken with regards to training high-speed vessel crews. These platforms have evolved over the past several years and they are now being deployed.

The navigation systems that these boats are being fitted with (electronic chart plotter coupled with DGPS and radar) are in some cases more advanced than those on some large ships. These systems now allow an operator to create a route, using waypoints over the background of a digital chart. The navigator could run this route without consulting a paper chart or even slowing down for the transitions from one leg to another. The performance level of this equipment is deceiving. Most of these navigation systems were not designed to travel at this speed, and give an impression that the information that they are displaying is more current and accurate than it really is.

The new technology has surpassed the training level of the crews. An enthusiasm for the electronics coupled with a lack of formal navigation training can translate into a heads down style of navigation. At high speed this can result in catastrophe. The problems of high-speed navigation are not easily solved by our present adjustments in RHI training and an updated approach is required.

New Performance Levels

Crews are using the vessel to its maximum performance level to carry out SAR, and with an appropriate sense of urgency. Many Auxiliary Crews are becoming skilled operators of their new electronic navigation systems and when the call comes from rescue centre the crew can activate a pre-programmed route and blast off into the night following the GPS navigation screen or even the waypoint lollipop flashing on their radar screens. So far, all the vessels have returned, the incidents get resolved and the crews chalk up successful calls.

What's the problem?

The problem is that the difficulty of this type of navigational feat is not obvious to those who have been doing small boat rough navigation for years. Very gradually as the speed of the vessel has increased along with the addition of radar and GPS, so has the "safe speed" of navigation in reduced visibility. Now with the advent of the electronic charting system a fluid high-speed route makes it seem unnecessary to slow down or stop for paper chart orientation. As the navigator gives helm commands to the driver who cannot see any targets or objects, the crew must now react immediately to any dangers or unseen hazards. This feat is comparable to driving your car at 80 km per hour through downtown traffic blindfolded, while the guy in the back seat tells you to "turn right, left, watch out for the bus!" We now have the navigational equipment that allows us to do this but is it safe? The high-speed platform has arrived by virtue of its humble descendants (the little zodiacs we used to drive). The crew's standard of training has had to increase along with the boat's performance level, and must continue to do so as the technology evolves.

Safe Speed Means Safe Speed

If rescue vessel operators are following the collision regulations and always moving at *safe speed* then why would we need special navigation training? Ideally, this would always be the case but safe speed is a matter of judgement and judgement can vary. FRC navigators can overestimate their abilities to detect and avoid objects at these speeds. If your vessel's range of speed is 0-15 knots then the range of judgement for a safe speed will vary with conditions and confidence, and span from 7 knots to 12 knots. If the vessel is capable of 50 knots then the range of safe speed will also vary with conditions and confidence, and span from 18 knots for some operators but 40 for others.

Communication is the key to safely operating these vessels. The navigator who, is looking at the charts and the radar must be able to clearly communicate with the driver. At 50 knots or 25 metres per second a mixed-up message can mean you can travel a tenth of a nautical mile before you have time to sort out the confusion. This danger is not readily apparent to the average small boat coxswain and therefore not taken into account when adjusting for the safe speed equation. High-speed navigation requires special consideration. The solution is not to put smaller engines on the vessels or take off the electronic navigation equipment. It is simply to pay special attention to the training of these crews and have some standard of performance on the navigational level while always allowing a margin for error.

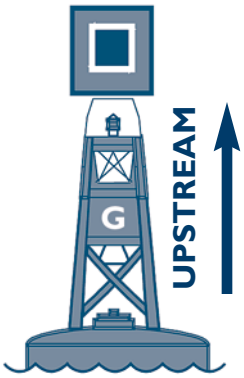
7.2 Aids to Navigation

7.2.1 Buoys and Beacons

Always consult the chart to confirm placement of buoys.

The Canadian Aids to Navigation system is a combined Lateral-Cardinal system. It is important for vessel operators to know the characteristics of each of these systems to ensure safe navigation on our waterways.

Lateral Aids to Navigation

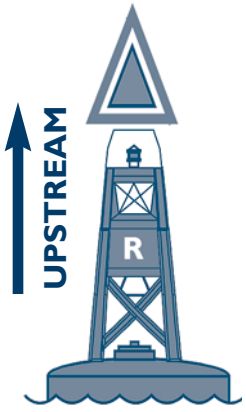


Port Hand Buoy

Lateral aids may be either buoys or fixed aids. They indicate the location of hazards, and of the safest or deepest water, by indicating the margins of the channel. The general rule is: **Red, right when returning.**

Lateral means "side." The lateral system is a convention, which tells the mariner on which side to leave a buoy to ensure the buoy is between the vessel and the danger it protects against (in channels, the buoys protect against the danger of grounding in shallow water). In North America we use IALA system B, which means red to right when returning (coming in from sea). But not all channels lead in from the sea. IALA System B is a convention that has established in-from-the-sea to be a clockwise flow around N. America, down the East coast (red buoys to starboard when heading south), across the Gulf coast (red to starboard when heading west), and up the West Coast of the Canada (red to starboard when heading north). In-from-the-sea on the Great Lakes is generally northerly and westerly except Lake Michigan, where it's southerly (leading toward the port of Chicago). The rule is to keep red buoys to starboard when returning to harbour. Obviously, then, green buoys are kept to port.

The colour of the buoy tells you where to go, ie., green (port) – go to starboard of it.



Starboard Hand Buoy

Keep the starboard hand (red coloured) markers/buoys/lights to the starboard side when your vessel is:

- Returning from sea
- Heading in an upstream direction
- Entering a harbour or
- Heading North on West Coast, or South on East Coast

Keep the red markers on your port side when:

- Proceeding out to sea
- Heading in a downstream direction
- Leaving a harbour or
- Heading South on West Coast, or North on East Coast

Lateral Day Beacons:

Although the majority of fixed aids to navigation support and display a light for night navigation, a limited number do not. These unlit aids are known as day beacons, and are used primarily to assist the mariner during daylight hours, where night navigation is negligible or where it is not practical to operate a light.

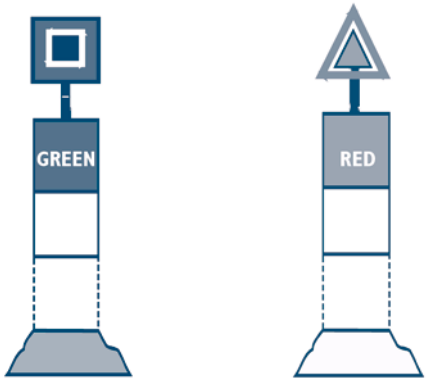
Colour, shape, and sometimes a number, are used to identify the purpose of a day beacon. Reflective material is applied to day beacons to improve their visibility and identification at night for mariners equipped with a searchlight.

Starboard Hand Day Beacon:

A starboard hand day beacon is triangular, with a red triangular centre on a white background, and a red reflecting border. It may display an even number made of white reflecting material. It marks the starboard side of a channel or the location of a danger in daylight and must be kept to the right when proceeding upstream.

Port Hand Day Beacon:

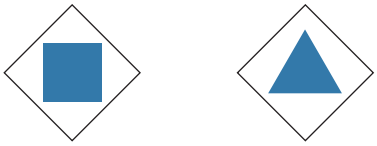
A port hand day beacon is square, with a black or green square centre on a white background, and with a green reflecting border. It may display an odd number made of white reflecting material. It marks the port side of a channel or the location of a danger in daylight. It must be kept to the left when proceeding upstream; a port hand day beacon must be kept on the vessel's port (left) side.



Port Hand Day Beacon

Starboard Hand Day Beacon

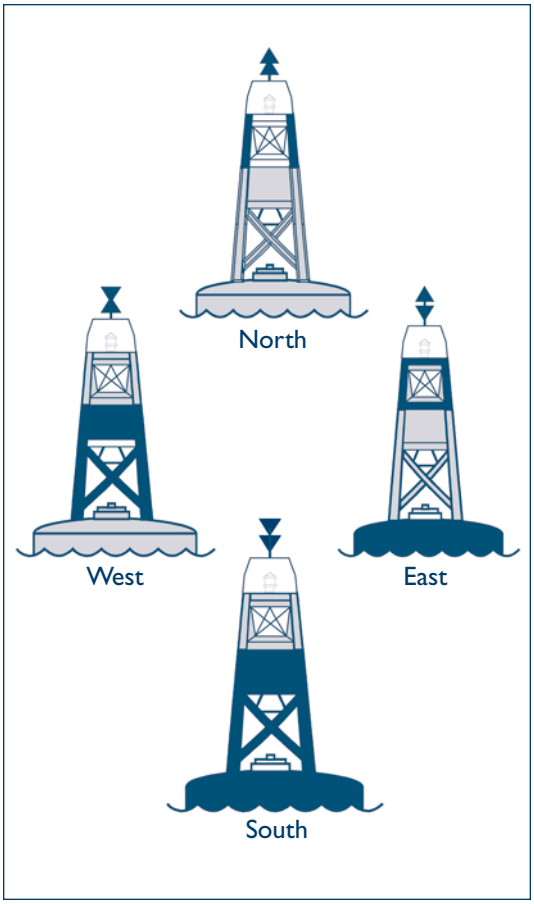
Bifurcation/Junction Day beacon:



A bifurcation/junction day beacon marks a point where the channel divides and may be passed on either side. When proceeding in the upstream direction, a bifurcation/junction day beacon displaying a red reflecting triangle on a white diamond with a red border indicates that the preferred route is to the left. Similarly, a green reflecting square on a white diamond with a red border indicates that the preferred route is to the right. When proceeding downstream, the positions and meanings of these day beacons are reversed.

Cardinal Aids to Navigation

Cardinal buoys, marked in yellow and black, indicate the location of the deepest and safest water. The North, East, South and West cardinal buoys are distinguished by their colour pattern, and by their top marks. Pass to the named side of the buoy.



North is Up

The North Cardinal Buoy is black on top and yellow on the bottom. The safe water lies to the North of this buoy. Flashing White Light: (Q) 1S (VQ) .5S

Diamonds Are in the East

The East Cardinal Buoy is black with a yellow band. The safe water lies to the East of this buoy. Flashing White Light: Q(3) 10S or VQ(3) 5S

South is Down

The South Cardinal Buoy is yellow on top and black on the bottom. The safe water lies to the south of this buoy. **Flashing White Light:** Q(6) + LF1 15S or VQ(6) + LF1 10S

Time Is In The West (Hour glass shape)

The West Cardinal Buoy is yellow with a black band. The safe water lies to the west of this buoy. **Flashing White Light**: Q(9) 15S or VQ(9) 10S

Special Buoys

For areas that are designated for special purposes and activities we have buoys that mark these areas and give information about the area. Usually an area used for swimming or an area where boats are prohibited is listed in the boating restriction regulations for the area. These regulations allow signs or buoys to be posted to mark the restriction. Regardless of the colour of reflective material, all special buoys, where lighted, will display yellow lights, and will flash regularly at intervals of 4 seconds each.

Cautionary Buoy

This is a buoy that marks an area where mariners are to be warned of dangers such as firing ranges, race courses and under water structures. This buoy may be fitted with a single yellow X as a top mark.


Cautionary Buoy

Diving Buoy

This is a buoy that marks an area where diving activity is present. The flag is red with a diagonal white stripe.


Diving Buoy

Control Buoy

This is a that marks an area where boating is restricted or controlled


Control Buoy

Keep out Buoy

Used to mark an area where boats are prohibited


Keep Out Buoy

CHARACTERISTICS OF LIGHTS

Flashing pattern and period (|-----|)	Type	Description	Abbreviation
	Fixed	A light showing continuously and steadily	F
	Fixed and flashing	A light in which a fixed light is combined with a flashing light of higher luminous intensity	F Fl
	Flashing	A flashing light in which a flash is regularly repeated (frequency not exceeding 30 flashes per minute)	Fl
	Group flashing	A flashing light in which a group of flashes, specified in number, is regularly repeated.	Fl (2)
	Composite group flashing	A light similar to a group flashing light except that successive groups in the period have different numbers of flashes.	Fl (2+1)
	Isophase	A light in which all durations of light and darkness are equal.	Iso
	Single occulting	An occulting light in which an eclipse, or shorter duration than the light, is regularly repeated.	Oc
	Group occulting	An occulting light in which a group of eclipses, specified in number, is regularly repeated.	Oc (2)
	Composite group occulting	A light, similar to a group occulting light, except that successive groups in a period have different numbers of eclipses.	Oc (2+1)
	Quick	A quick light in which a flash is regularly repeated at a rate of 60 flashes per minute.	Q
	Interrupted quick	A quick light in which the sequence of flashes is interrupted by regularly repeated eclipses of constant and long duration.	IQ
	Group quick	A group of 2 or more quick flashes, specified in number, which are regularly repeated.	Q (3)
	Morse code	A light in which lights of two clearly different durations (dots and dashes) are grouped to represent a character or characters in the Morse code.	Mo (A)
	Alternating	A light showing different colours alternately.	Al RW
	Long flashing	A flashing light in which the flash is 2 seconds or longer.	LFl

Figure from Chapman Piloting (seamanship and small boat handling) 62nd edition, p. 516.

Information Buoy


Information Buoy

This is a buoy that displays information by words or symbols information of importance to mariners.

Swimming Buoy


Swimming Buoy

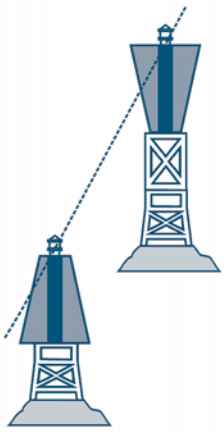
This buoy marks the perimeter of a swimming area.

Hazard Buoy


Hazard Buoy

This is a buoy that marks random hazards such as rocks, shoals or submerged objects.

7.2.2 Ranges and Transits



A range consists of two or more fixed navigation day marks or lighted marks situated some distance apart, and at different elevations. Ranges provide a recommended track for navigators when in line, and may or may not be lighted. The colour of the range day beacon, as well as the colours and characteristics of the lights are detailed in the appropriate List of Lights, Buoys and Fog Signals publication.

7.2.3 Sector Lights

A sector light consists of a single light whose total luminous beam is divided into sectors of different colours to provide a warning or a leading line to mariners. The colours and boundaries of these sectors are indicated in the appropriate List of Lights, Buoys and Fog Signals publication and on nautical charts.

When only a red sector is used within a white luminous beam, the red sector marks obstructions such as shoals. A combination of red, white and green sectors in a luminous beam is used to provide a leading line to navigators. When proceeding upstream, the red sector indicates the starboard hand limit, the white sector indicates the recommended course, and the green sector indicates the port hand limit.

7.2.4 Fog Signals

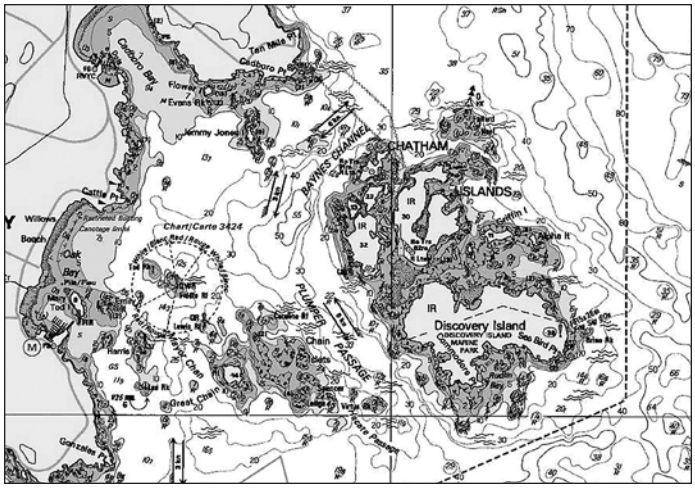
Fog signals are audible aids to navigation at lighthouses on land that warn of dangers when visual aids are obscured by weather conditions.

Fog signals are normally operated when weather conditions reduce the visibility to less than two nautical miles. While most fog signals are operated manually, or automatically by fog detection equipment, some fog signals may be operated continuously.

The mariner can identify fog signals by their distinctive sound and signal characteristics as detailed in the appropriate List of Lights, Buoys and Fog Signals publication.

7.3 Hydrographic Charts

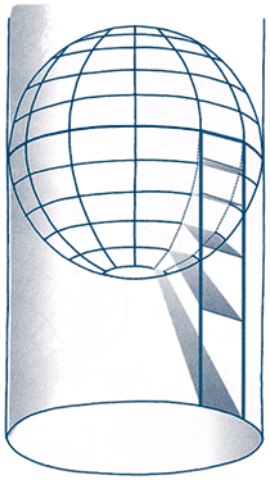
A chart is a paper representation of your three-dimensional environment. To read a chart, you have to be able to translate the information found on the chart to your actual surroundings, and then you have to be able to identify these surroundings on the chart.



Your chart must be up to date and the correct scale for the area.

Hydrographic charts allow mariners to see graphic representations depicting water areas, including the depths, underwater hazards, traffic routes, aids to navigation and adjacent coastal areas.

Topographical maps are for use on land. Some mariners use topographic maps when there are no hydrographic charts printed for an area. These maps do not depict the depth of the water areas, underwater hazards, marine traffic routes, or the aids to navigation.



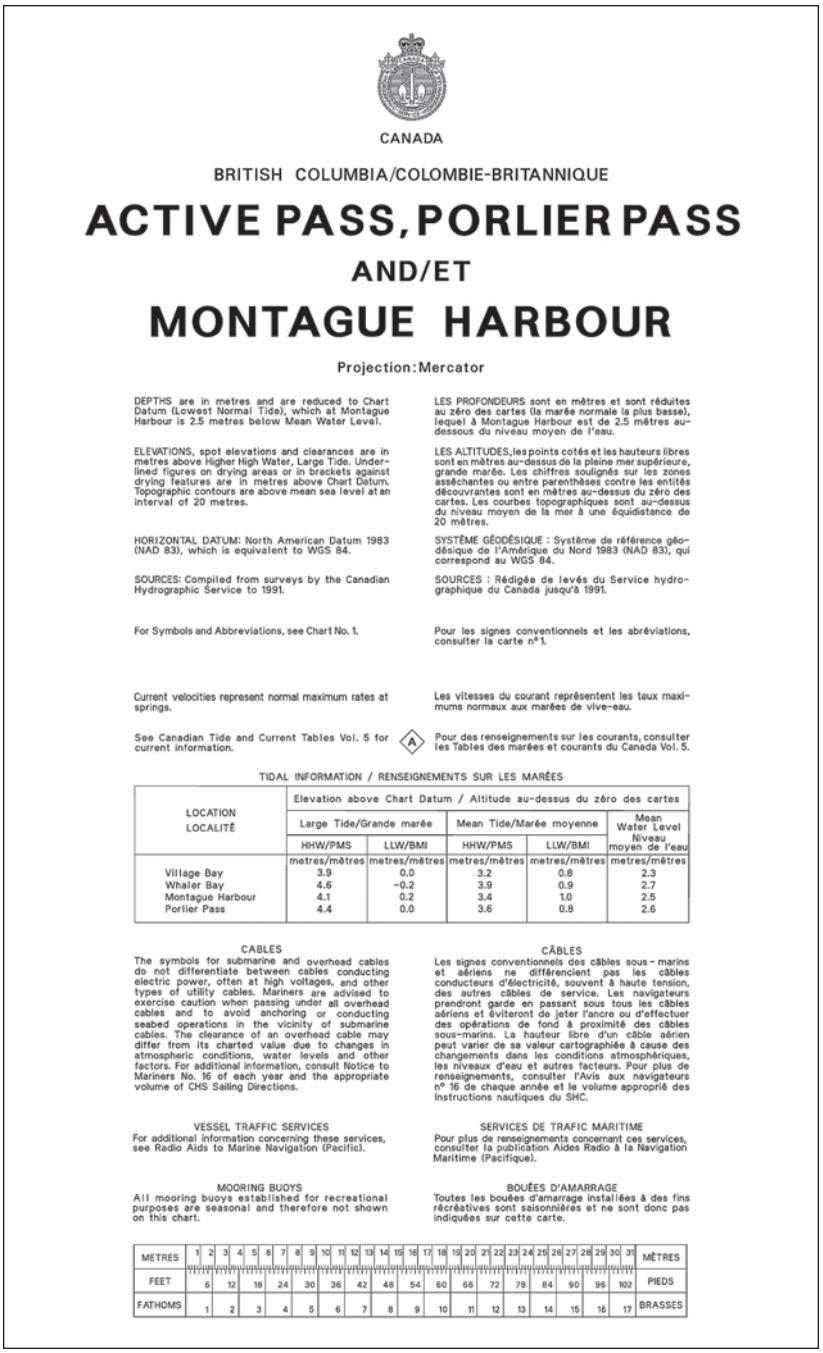
7.3.1 Mercator Projection Chart

Mercator charts are the most widely used type of charts for marine navigational purposes. Mercator charts stretch the surface of the earth to lie flat on a chart table. This will alter the image so that landmasses that are in the north will appear larger than they really are.

Title Block

The title block includes the projection and scale of the chart, sounding information, and notes and cautions. This data is very important and is provided to ensure the accurate interpretation of the information contained on the chart.

The height above and below objects is taken from a reference water height, or datum. The measurement of depth is indicated by the purple border on Canadian charts are in metres or fathoms. In addition, the most important part of the block is the title itself, which defines the geographical area covered by the chart. The chart's margins indicate a number, which is the identification number provided to that version of the chart.



CANADA

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

ACTIVE PASS, PORLIER PASS

AND/ET

MONTAGUE HARBOUR

Projection: Mercator

DEPTHS are in metres and are reduced to Chart Datum (Lowest Normal Tide), which at Montague Harbour is 2.5 metres below Mean Water Level.

LES PROFONDEURS sont en mètres et sont réduites au zéro des cartes (la marée normale la plus basse), lequel à Montague Harbour est de 2.5 mètres au-dessous du niveau moyen de l'eau.

ELEVATIONS, spot elevations and clearances are in metres above Higher High Water, Large Tide. Underlined figures on drying areas or in brackets against drying features are in metres above Chart Datum. Topographic contours are above mean sea level at an interval of 20 metres.

LES ALTITUDES, les points cotés et les hauteurs libres sont en mètres au-dessus de la pleine mer supérieure, grande marée. Les chiffres soulignés sur les zones asséchantes ou entre parenthèses contre les entités découvrantes sont en mètres au-dessus du zéro des cartes. Les courbes topographiques sont au-dessus du niveau moyen de la mer à une équidistance de 20 mètres.

HORIZONTAL DATUM: North American Datum 1983 (NAD 83), which is equivalent to WGS 84.

SYSTÈME GÉODÉSIQUE : Système de référence géodésique de l'Amérique du Nord 1983 (NAD 83), qui correspond au WGS 84.

SOURCES: Compiled from surveys by the Canadian Hydrographic Service to 1991.

SOURCES : Rédigée de levés du Service hydrographique du Canada jusqu'à 1991.

For Symbols and Abbreviations, see Chart No. 1.

Pour les signes conventionnels et les abréviations, consulter la carte nº 1.

Current velocities represent normal maximum rates at springs.

Les vitesses du courant représentent les taux maximums normaux aux marées de vive-eau.

See Canadian Tide and Current Tables Vol. 5 for current information. (A)

Pour des renseignements sur les courants, consulter les Tables des marées et courants du Canada Vol. 5.

TIDAL INFORMATION / RENSEIGNEMENTS SUR LES MARÉES

LOCATION / LOCALITÉ	Elevation above Chart Datum / Altitude au-dessus du zéro des cartes				
	Large Tide/Grande marée		Mean Tide/Marée moyenne		Mean Water Level / Niveau moyen de l'eau
	HHW/PMS	LLW/BMI	HHW/PMS	LLW/BMI	
	metres/mètres	metres/mètres	metres/mètres	metres/mètres	metres/mètres
Village Bay	3.9	0.0	3.2	0.8	2.3
Whaler Bay	4.6	−0.2	3.9	0.9	2.7
Montague Harbour	4.1	0.2	3.4	1.0	2.5
Porlier Pass	4.4	0.0	3.6	0.8	2.6

CABLES

The symbols for submarine and overhead cables do not differentiate between cables conducting electric power, often at high voltages, and other types of utility cables. Mariners are advised to exercise caution when passing under all overhead cables and to avoid anchoring or conducting seabed operations in the vicinity of submarine cables. The clearance of an overhead cable may differ from its charted value due to changes in atmospheric conditions, water levels and other factors. For additional information, consult Notice to Mariners No. 16 of each year and the appropriate volume of CHS Sailing Directions.

CÂBLES

Les signes conventionnels des câbles sous-marins et aériens ne différencient pas les câbles conducteurs d'électricité, souvent à haute tension, des autres câbles de service. Les navigateurs prendront garde en passant sous tous les câbles aériens et éviteront de jeter l'ancre ou d'effectuer des opérations de fond à proximité des câbles sous-marins. La hauteur libre d'un câble aérien peut varier de sa valeur cartographiée à cause des changements dans les conditions atmosphériques, les niveaux d'eau et autres facteurs. Pour plus de renseignements, consulter l'Avis aux navigateurs nº 16 de chaque année et le volume approprié des Instructions nautiques du SHC.

VESSEL TRAFFIC SERVICES

For additional information concerning these services, see Radio Aids to Marine Navigation (Pacific).

SERVICES DE TRAFIC MARITIME

Pour plus de renseignements concernant ces services, consulter la publication Aides Radio à la Navigation Maritime (Pacifique).

MOORING BUOYS

All mooring buoys established for recreational purposes are seasonal and therefore not shown on this chart.

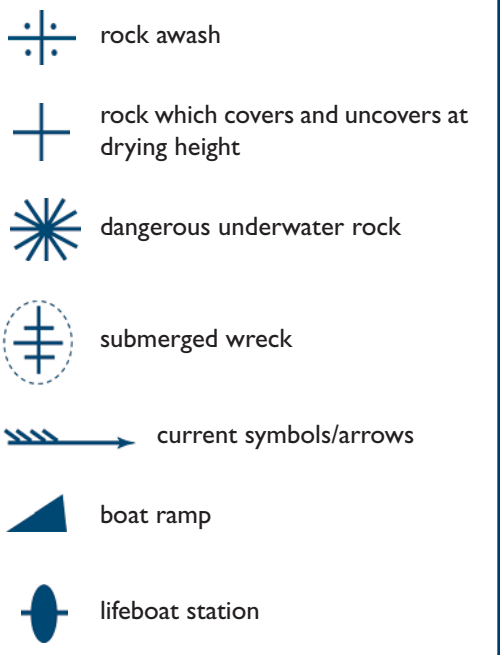
BOUÉES D'AMARRAGE

Toutes les bouées d'amarrage installées à des fins récréatives sont saisonnières et ne sont donc pas indiquées sur cette carte.

METRES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MÈTRES
FEET		6		12		18		24		30		36		42		48		54		60		66		72		78		84		90		96	102	PIEDS
FATHOMS	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	17	BRASSES

7.3.2 Chart Symbols

These symbols are just some of the many found on the Canadian Hydrographic Services charts.



7.3.3 Chart Check

Your charts should be of the appropriate scale and up-to-date.

- **Scale:** Use the best scale chart for your area. Small-scale (large area) charts won't necessarily show all the detail needed.
- **Up-to-date:** Make sure your chart is up-to-date. The date of the last update is usually stamped in the chart border. Update information is available from Notices to Mariners and Notices to Shipping. Charts should be updated from Notices to Mariner, as corrections are published.

7.3.4 Distances and Positions

Measuring Distances

Distances can be taken from the latitude scale (the scale on the side, not top or bottom) level with the length/distance measured. This distance will be in nautical miles and cables (tenths of a nautical mile).

Plotting Your Position

Latitude and Longitude provide us with a co-ordinate system that can pinpoint any position on the

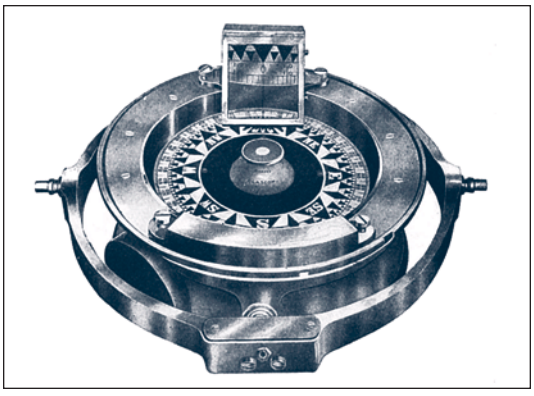
globe. By using a set of co-ordinates, we can find that position on a chart simply by lining up the intersection of the latitude and longitude.

Latitude and Longitude

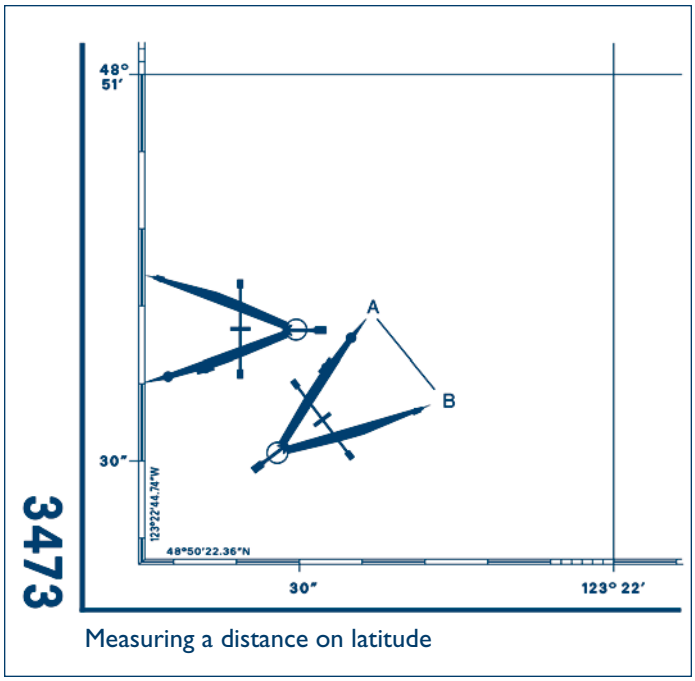
The latitude scale at the side of the chart divides the earth into even slices cut like potato chips parallel to the Equator, from the middle to the top and bottom. These slices are measured in degrees, minutes and seconds. Because the slices are even, one minute of latitude is also equal to one nautical mile (6080 ft.)

The longitude scale is made up of meridian slices cut like an apple through the center. Each of these lines goes through the poles, cutting the earth in half. These lines are also measured in degrees, minutes and seconds. Since they intersect at the pole, the closer to the pole we get, the closer these lines are together. One degree of longitude is 60 nautical miles wide at the equator, but converge at the North Pole. This is why we only use latitude for measuring distances.

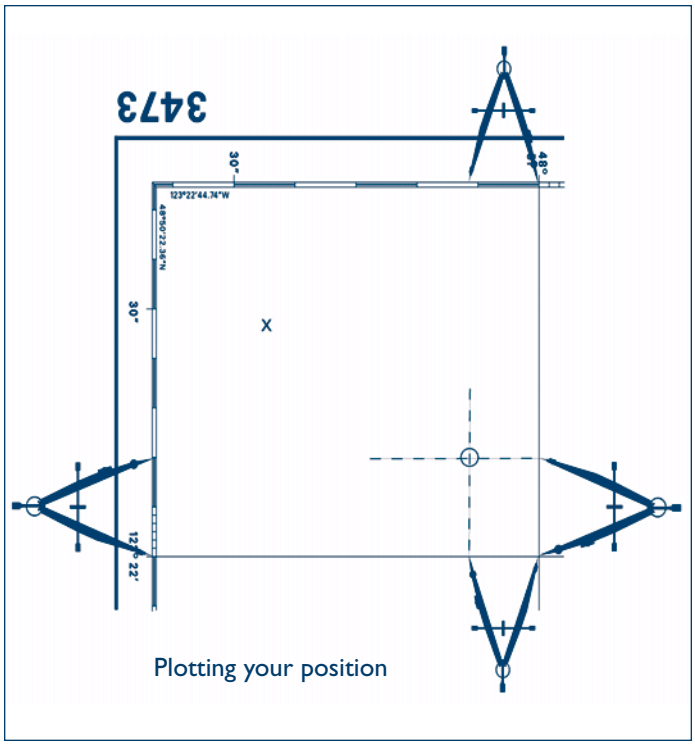
7.4 The Compass



The compass is an essential tool of navigation. It is not a complex device, but it can confuse an operator, sending a vessel off in the wrong direction. The compass card always points towards magnetic north, thus



Measuring a distance on latitude



Plotting your position

the boat actually spins around the compass rose as the course is altered.

When you observe your mounted ship's compass from the helm, you should see a lubber's line. The lubber's line is a line marked on the standing part of the compass' clear cover. It shows the direction in which your bow is pointing. The compass course that is directly below the lubber's line is your boat's heading. The compass will only point directly towards magnetic north when there are no other magnetic fields around to misdirect it. Unfortunately, almost

True bearing: (North Pole)

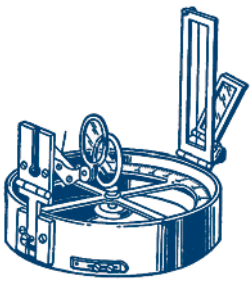
Variation: the difference in degrees between magnetic north and the North Pole

Magnetic: The direction of the magnetic pole

Deviation: The degrees of error that the magnetic fields on your vessel give your compass at different headings.

Compass/ships course: The course that you vessel is steering according to your vessels compass

Steering Compass



all boats have magnetic fields generated by the metal on the boat. This error, called compass deviation, can be measured and applied to the compass heading.

The compass is a magnet. It aligns itself with the natural magnetic field of the earth, pointing towards the north magnetic pole. The magnet is attached to a card that is divided into 360 degrees.

The small boat navigator uses the compass primarily to indicate the direction in which the boat is headed. As for the information gathered by the navigator's senses, it may be used by itself or in conjunction with landmarks or a chart.

On its own, the compass can guide you home at night, or in poor visibility. Some preparation is required though – take note of the course(s) you steered on your way out. Bear in mind though, that your drift and compass deviation may make your return courses different than the reciprocals.

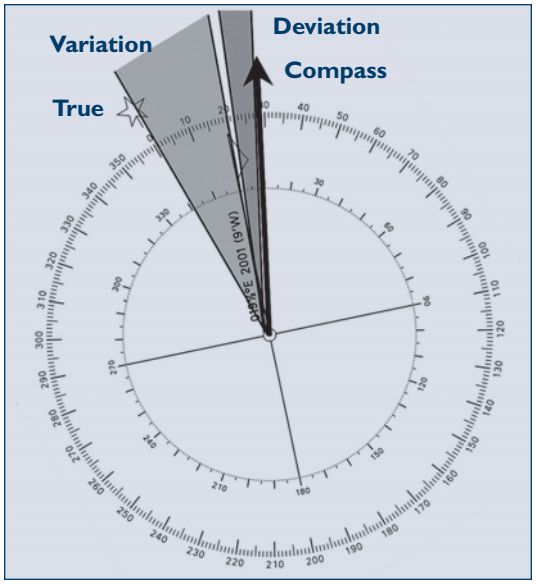
If you're steering on a landmark, make a note of the compass course. If you're still steering on the landmark, but the compass heading changes, you know you're being pushed off course.

When using a chart, a good practice is to lay out the compass courses along your intended route.

Most small boats are equipped with a steering compass. While not primarily designed for taking accurate bearings of objects, the small boat navigator can still get a reasonably accurate bearing by pointing the boat towards an object and noting the compass heading.

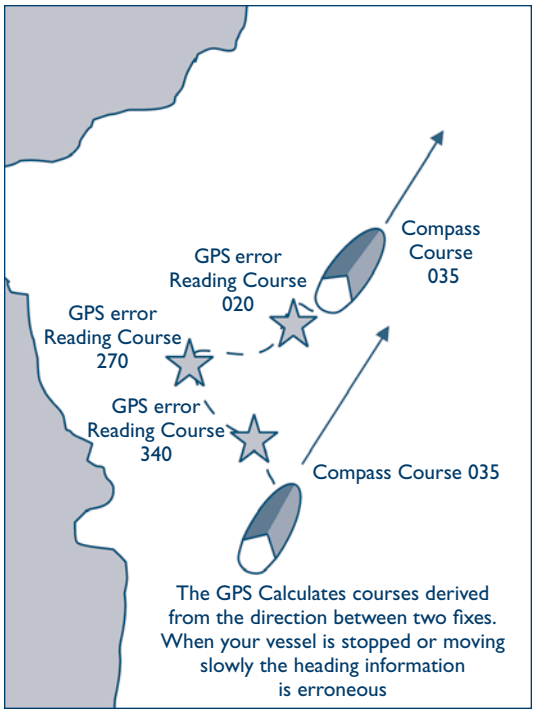
Compass Error

If your compass is a standard magnetic compass then it will try to point in the direction of magnetic north. This is not the same direction as the North Pole (True North). The angular difference between the North Pole and magnetic north is called variation. The other compass error occurs when your vessel's magnetic field pulls the compass in different directions as your vessel swings around the compass card. This error is called deviation.



GPS heading information is often displayed on the navigation screen of your GPS. This readout is derived from the GPS tracking the movement of the vessel from one point to another and calculating the direction from the last co-ordinate to the present position. This has nothing to do with a compass and navigators must remember that anytime other than when the vessel has been moving in a straight line for a while and not affected by wind or current this information will be misleading.

DO NOT use the GPS as a compass



Steering by compass

If you are supposed to be heading in a certain direction, then you must line up the lubber's line with your intended heading on the compass. If your intended heading is North, and North is to the right side of your lubber's line, then you would steer towards the N, or to the right. If your intended heading is a number of degrees, then you would steer toward that number. As the number gets closer, slow your turn. Once you are close, use small helm movements to keep the two lines together. You are now on course.

Choose a landmark

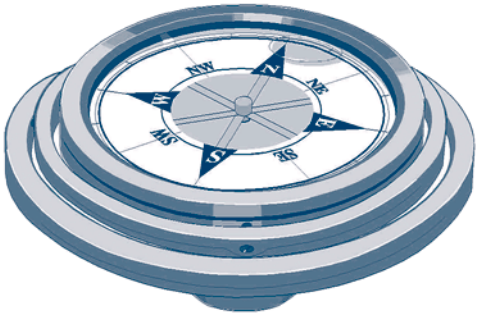
Once you are on course, you can look ahead and select a fixed landmark (mountain or rock) right ahead of your bow. Steering on this landmark will be a more accurate way to hold your course. Remember to check the course on the compass regularly. Any change in course towards the landmark will indicate set off of original track.

High-speed compass turns

When moving at speed, the compass can have trouble keeping up with your turns. If the boat turns quickly, the compass can over-swing and mislead you. This can result in your vessel chasing the compass through its swaying motion. To turn while underway, look over the compass card to the general direction of your next intended course, and pick a landmark. Start your turn and steady up on the landmark. Once the compass has recovered from the swing, you can use it to do final course corrections.

Compass Check

Many metals (primarily steel), some live electrical wires, and all magnets will affect the compass, as will a radio or speaker. To avoid errors from false readings, keep these objects away from the compass. A good rule of thumb is about 1 metre. If you're not sure if the object is affecting the compass, move it around while watching the compass at the same time. If the compass heading changes (assuming of course that the boat isn't also), then the object is too close.



Periodically check your compass against known transits on a variety of headings. Compass error can vary, depending on your heading. Also, check your compass whenever a new piece of metal or electronic gear is added, removed or changed.

Check to make sure the compass bowl is full of liquid. A bubble in the bowl means the compass may need repair.

7.4.1 Using your Eyes and Chart in Pilotage

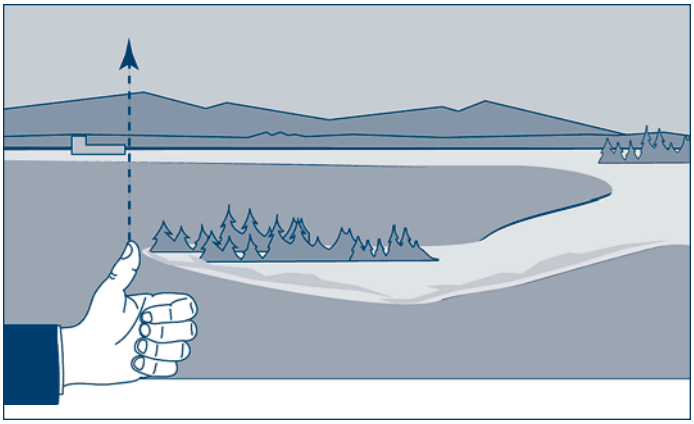
This chapter cannot begin to provide all the information necessary to becoming a navigator. Any one who is operating a rescue vessel should attend a formal navigation course. However, there are some tips and tricks that may be used to estimate your position relative to landmarks and land masses.

Terms for Current

Set: *direction of current flow affecting your vessel.*

Rate: *speed of the current.*

Drift: *distance that you have been pushed off course over a period of time.*



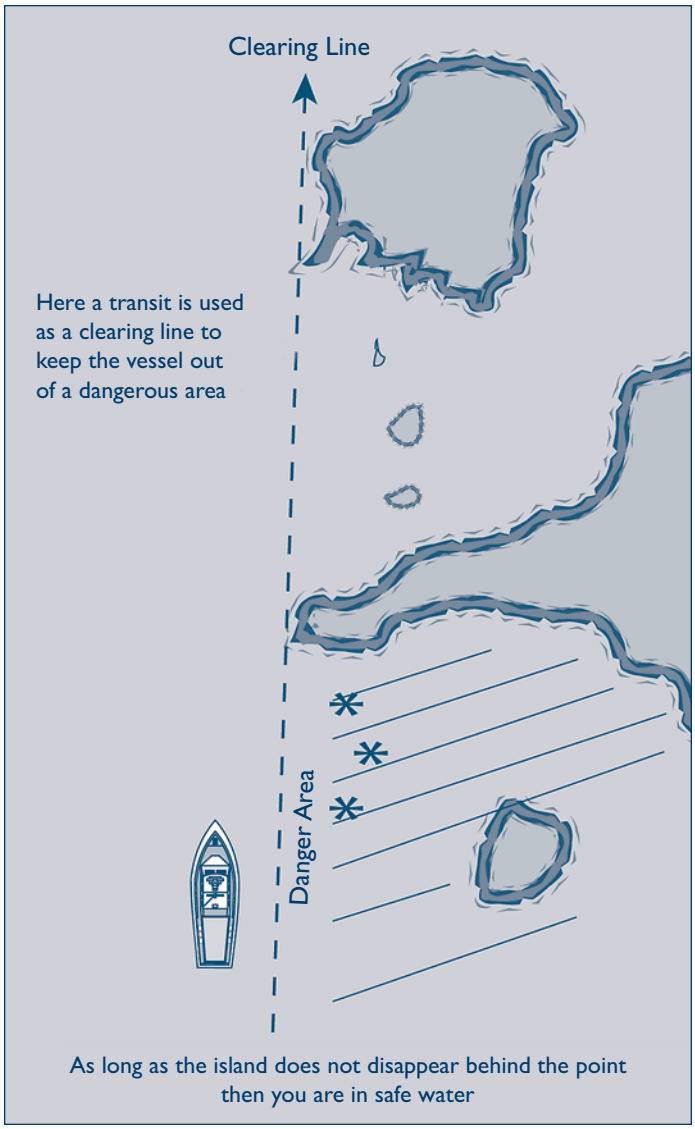
As your vessel progresses, the navigator and/or navigation monitor will be comparing the chart with what can be seen visually and by radar. There is no substitute for a tangible paper chart to get your bearings. By watching landmarks, points, islands and rocks one can make visual lines that can keep you out of trouble and in safe water.

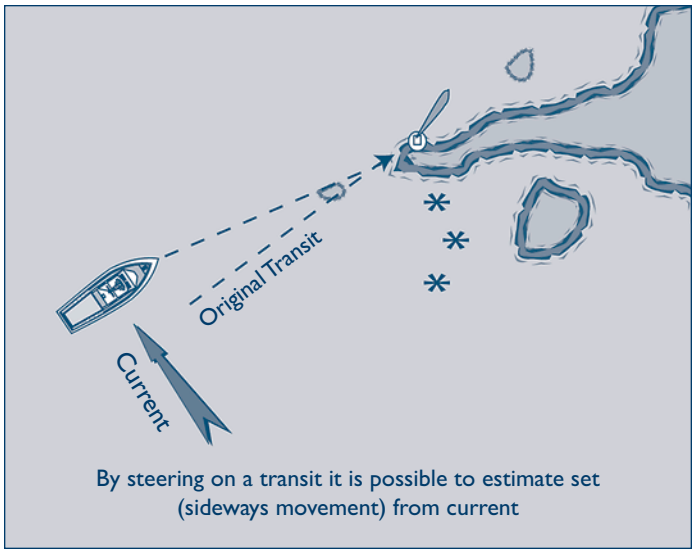
Many metals (primarily steel), some live electrical wires, and all magnets will affect the compass, as will a radio or speaker.

7.4.2 Transit Lines

A line that touches two points is called a transit line. Transits are used to establish many things but the most important are: lines of position, exact bearings, and boundaries or clearing lines. By lining up two objects and keeping your vessel to one side of the line up one can keep the vessel in safe water. This transit is called a clearing line and it sets a boundary to let your vessel clear a danger.

By steering on a transit line one can obtain a true bearing from the chart and compare that with the compass course to determine compass error. While steering on a transit line it is easy to estimate the set of the current (or cross track error) by watching which direction you move off of the transit.





NOTE: If landmasses on the chart do not appear to match the land around you, then you should notify the coxswain immediately.

7.5 Collision Regulations

This chapter only gives a brief summary of the collision regulations as they pertain to small vessels in Canadian waters. These regulations are comprehensive and many books are devoted solely to explaining and interpreting them. Each Auxiliary crewmember should study the regulations carefully.

The Collision Regulations, known as the "**Rules of the Road**", are comprised of:

- Steering and sailing rules
- Navigation lights
- Manoeuvring and warning signals
- Fog signals
- Legal responsibilities

7.5.1 Fundamentals of Collision Prevention

The Collision Regulations ensure order and safety on the seas. To navigate and ignore them is to put many lives in danger. Every confident and competent mariner must learn them and use them.

The International Regulations for Preventing Collision at Sea define the rules that vessels must follow when they are:

- At risk of collision
- Operating at night
- Displaying lights
- Using distress signals, or
- Operating in conditions of restricted visibility.

All mariners are responsible for having a comprehensive knowledge of the Collision Regulations, and operating their vessels in accordance with these rules.

Some General Definition

Power Driven Vessel: Any vessel propelled by machinery.

Sailing Vessel: Any vessel under sail, provided that propulsion, if fitted, is not in use.

Under Way: Not tied to a dock, aground or at anchor.

Making Way: Moving through the water.

Two terms are of paramount importance in a crossing situation:

Stand On: The stand on vessel is the vessel that is required by law to maintain course and speed (unless it is apparent that the other vessel has not taken the appropriate action in time to avoid a collision) and is not required to take early and substantial action to keep well clear.

Give Way: The give way vessel shall yield to the stand on vessel by taking early and substantial action, sounding the appropriate signal, and making a readily apparent alteration to course in order to pass well clear.

Responsibility

Rule 2 of the collision regulations states:

Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstance of the case.

In construing and complying with these rules, due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessel involved, which may make a departure from these rules necessary to avoid immediate danger.

Whose responsibility is it to avoid trouble? Yours!!

Starboard!!

If you are the operator of a vessel, it is always, in every situation, your responsibility to avoid a collision. When an approaching vessel is required to give way but doesn't you must take action to avoid a collision. The rules are not there to replace good judgement and practice of good seamanship. You should not put your vessel in any danger by blindly following the rules.

You must consider all factors pertaining to navigation (water depth, wind, traffic, current, and manoeuverability of your vessel etc.) when complying with the Rules.

Two Key Rules of the Road

If everyone followed rules five and six of the Collision Regulations, collisions at sea would be greatly reduced. Always keep a lookout and never go too fast.

Traffic on roads and highways would be chaos without laws to regulate the right of way. On the water, where movement is less restricted, rules of the road are even more important. This is particularly true of crossing situations.

Rule 5 Lookout states:

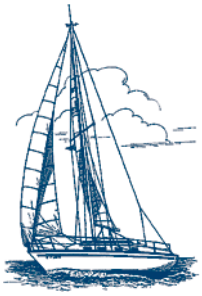
Every vessel shall at all times maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

In other words, you should always have at least one person designated as a lookout when you are on-board. Under no circumstances should your vessel be underway without someone on lookout duty. This rule may seem quite obvious, but, remember, that on a SAR case, everyone on-board may be doing something (looking at charts, taking care of casualties, talking on the radio or cellular phone, etc.) and the lookout position may be overlooked.

A lookout is someone who is watching over the path of the vessel and reporting any objects, oddities, land masses or vessels that may present a danger to the vessel or be relevant to the safe navigation of the vessel. Lookouts may use all available means to determine the safety of the navigation path. The lookouts' secondary duty is to identify objects, targets, or details that may prove relevant to the vessel's mission.

Suggested Roles and Responsibilities for Lookout

- ✓ Performs constant visual scans of the vessel's path and reports all objects forward of the beam
- ✓ Routinely looks aft for overtaking vessels
- ✓ Maintains communications with the Helm and Captain/ Coxswain
- ✓ Uses all available means to keep a lookout (hearing, sight, smell, night vision goggles, binoculars)
- ✓ Reports the positions and estimated heading of vessels approaching using a designated sighting system (See commands and signals for lookout)



All mariners are responsible for having a comprehensive knowledge of the Collision Regulations, and operating their vessels in accordance with these rules.

- ✓ Reports conditions of visibility and changes in weather
- ✓ Protects eyes from wind and spray and sunlight by using appropriate eye wear

Commands and Signals for Lookout

Communications between lookouts, the helm and the Navigation watch are critical for vessel safety. Two way loud and precise messages allow quick exchange of information. The captain should establish a reporting method (see below) before getting underway).

Five ways to call a sighting

Clock Method – The search vessel is at the centre of a clock face. The bow of the boat is 12 o'clock, with the hour hand pointing at the sighted object. An object at 9 o'clock means the object is abeam to port; an object at 3 o'clock means the object is abeam to starboard.

Degrees of the Compass – The search vessel is at the centre of an imaginary circle, divided into 360 degrees, with the bow at 000°. The spotter will indicate a bearing by calling out the number of degrees that the object is bearing at.090° means the object is abeam to starboard;270° means the object is abeam to port.

Colour and Degrees – The search vessel is at the centre of an imaginary circle, in which the centre line of the vessel divides the circle into two equal parts. The port side is designated Red, and the starboard side is green. Each half circle is divided into 180 degrees, with the ship's head being 000°. Reporting would go like this:
• Red 090° degrees means the object is abeam to port
• Green 090° means the object is abeam to starboard. This method is customary when giving radar bearing.

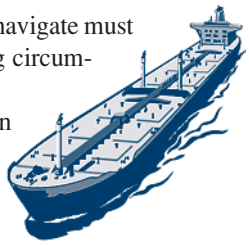
Points – The vessel is divided in 32 imaginary "points," with 16 points on each side of the vessel. Each point equals 11 and 1/4 degrees, in the same manner as the points of a compass.

Thus:
• 8 points to starboard means the object is abeam starboard;
• 8 points to port means the object is abeam to port;
• 4 points on the starboard bow is 45 degrees to starboard.

Hand/Arm Point – This last method is very simple, and suitable for use by even the most novice SAR crew member. The spotter is instructed to call out and point directly at the object until the vessel master sights it.

Rule 6 Safe Speed states:

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.



The speed at which you navigate must be adapted to the prevailing circumstances and conditions. For example, a safe speed in plain daylight may not be safe at night or when visibility is restricted by fog. Operators must use good judgement to determine safe speed. In low visibility, it is good practice to be able to stop your vessel in one-half the visibility distance. The rules go on to provide a list of the factors that should be taken into account in determining a safe speed.

- ➜ *The state of visibility*
- ➜ *The traffic density, including concentrations of fishing vessels or any other vessels*
- ➜ *The manoeuvrability of the vessel with special reference to stopping distance…*
- ➜ *Turning ability in the prevailing conditions*
- ➜ *At night, the presence of background light such as from shore lights*
- ➜ *Back scatter of her own lights*
- ➜ *The state of wind, sea and current, and the proximity of navigational hazards*
- ➜ *The draught in relation to the available depth of water*

In addition to the international rules, some modifications apply in Canadian waters.

Safe speed - Canadian modifications

In the Canadian waters of a roadstead, harbour, river, lake or inland waterway, every vessel passing another vessel at work, including a dredge, tow, grounded vessel or wreck, shall proceed with caution at a speed that will not adversely affect the vessel or work being passed, and shall comply with any relevant instruction or direction contained in any Notice to Mariners or Notice to Shipping.

Where it cannot be determined with certainty that a passing vessel will not adversely affect another vessel or work described in that paragraph, the passing vessel shall proceed with caution at the minimum speed at which she can be kept on her course.

Rule 7 Risk of Collision

Every means available must be used to determine if a risk of collision exists. **If in any doubt**, assume the risk exists. If fitted with radar, a systematic plot should be maintained to detect any risk of collision. **Proper use of radar** is required in clear daylight as well as at night.

How do you know when to worry?

If you are watching a vessel approach, and its compass bearing or reference point on your vessel does not appreciably change, then you are at risk of collision. Two vessels that remain on a steady bearing or a bearing that does not change significantly, and decreasing range are at risk of collision. Both vessels should do everything necessary to determine if there is a risk, and then follow the rules to avoid a collision.

Rule 8 Action to Avoid Collision

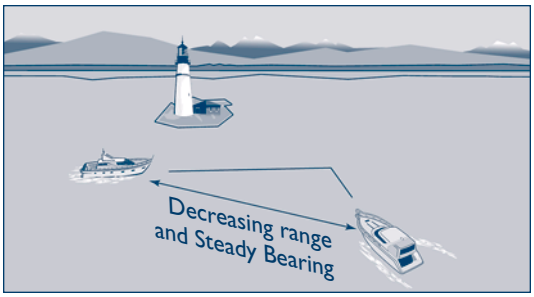
- ➜ Make positive action in **plenty of time**, well in advance of any potential meeting, in order to give the other vessel time to assess their situation adequately
- ➜ Any action taken should be **large**, so that it is immediately apparent to any approaching vessel by sight, as well as by radar
- ➜ If you have sufficient sea room, altering course is usually the best action, as long as it does not result in another close quarters situation
- ➜ A succession of small alterations of course **should be avoided**
- ➜ Pass at a safe distance, and monitor the effect of the action until finally **past and clear**
- ➜ **Reduce speed or stop** if more time is needed to assess the situation or to avoid collision
- ➜ Have full regard for the actions you are taking
- ➜ The stand on vessel must still comply with the rules

7.5.2 Conduct of Vessels in Sight of One Another

Before you leave the dock, the vessel operator must know the basic rules of safe navigation, who is stand on, and how one should behave in a crossing situation.

Navigation, like vehicle driving has its own set of rules of the "road." The problem is that not *everyone* using the "road" knows the rules. As a SAR crewmember, you may have to manoeuvre at high speed among people that are familiar with the rules and among people that know nothing about them. Knowing the rules is part of a professional attitude.

You MUST know all the rules presented in the following pages, and there is no magical way to learn them. This is a difficult subject, but always remember that your safety and the safety of other vessels may depend on your knowledge of these rules.



The problem is that not everyone using the "road" knows the rules.

With power vessels, operating when in sight of one another, one vessel is stand on over the other in three situations.

Meeting, Crossing and Overtaking

There are three situations which the regulations deal with directly: meeting head on, crossing each other's paths, and one vessel overtaking and passing another.

Meeting without risk of collision

When two vessels are meeting, and are going to pass close but without risk of collision, it is good seamanship to increase the passing distance by altering course away from the other vessel. Neither boat has the right of way, so each should preferably swing right, then straighten course to pass port side to port side. Meeting situations would almost never involve risk of collision if all boats adopted this practice.

"Two vessels that have come to a complete stop cannot collide."

– Brian Sylvester

If you must change your boat's heading to allow more room, then give:

1. one blast on your horn to indicate you are changing course to your starboard, or
2. two blasts to signal that you are changing course to your port.

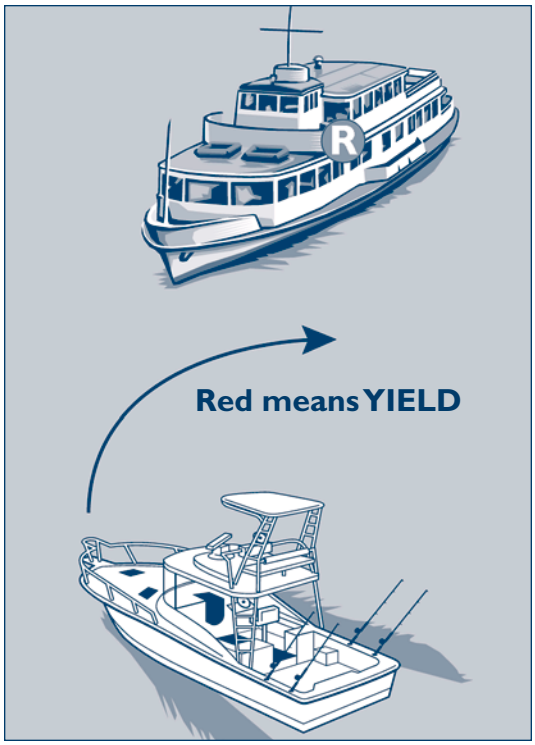
Be very careful if you are meeting close to pass starboard to starboard, and you decide to alter to starboard, just in case the other vessel alters course to port.

Meeting Head On

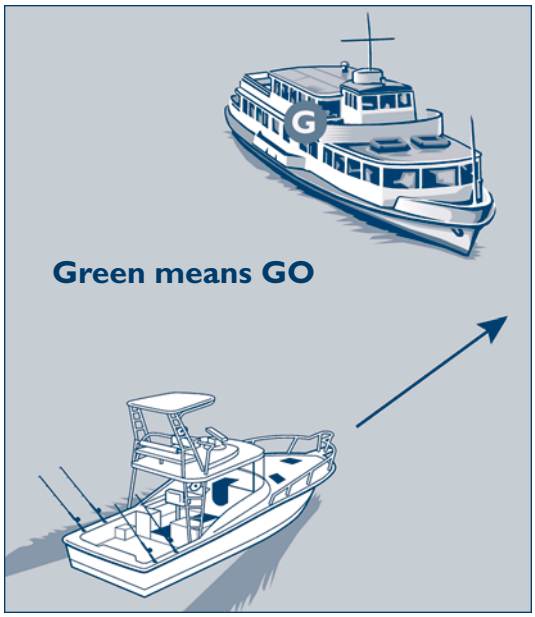
When two power driven vessels are meeting in a head on situation, both vessels shall take early and substantial action by sounding one short blast of the horn and altering to starboard. They shall pass port to port and be well clear.

Crossing

When two boats are approaching each other at an angle, they may be in danger of colliding. To help determine whether the two vessels are on a collision course, visually align some vertical part of your boat - a flagstaff or antenna, for example - with any point



A memory aid that may help is:
Red means Yield and Green means Go



on the other boat. If this bearing remains the same over a period of time, keeping speed constant, then a danger of collision exists.

When two power-driven vessels are crossing, the vessel that has the other on her starboard side shall give way in a manner that is consistent with the practice of good seamanship (don't try to outrun the boat and cross their bows). A helpful memory aid that is appropriately used in normal situations is: if you are looking at his red sidelight, then give way. If you are looking at his green light, then you are the stand on vessel (Red means Stop and Green means Go). This is only true if the give way vessel takes action.

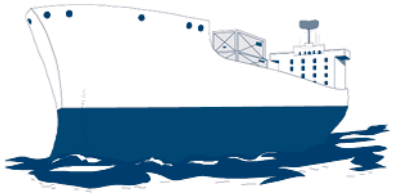
Overtaking

The boat being overtaken is always the stand on vessel. Both should use the proper manoeuvring and warning signals. Pass safely, the passing boat must be clear ahead of the other vessel before the passing situation is ended.

Actual rules for crossing situations can be found in **Section II** of the Collision Regulations.

The vessel travelling at high speed requires increased stopping distance if the operator has to stop in an emergency and requires that the operator be more attentive because the operator has less time to react to changing conditions.

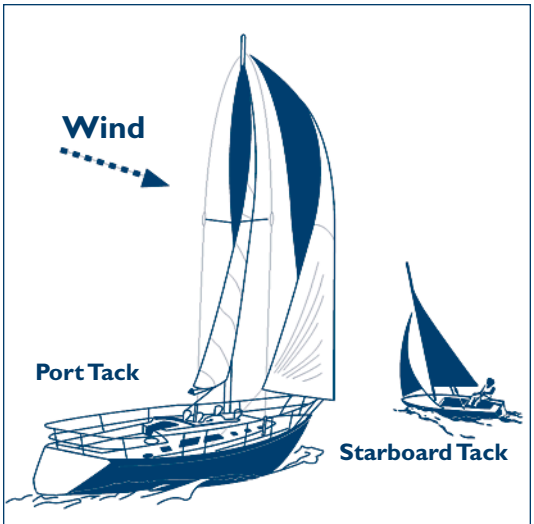
If any vessel meets a vessel not under command, that vessel must give way.



Sailing Vessels

Sailing vessels have special rules when they encounter other sailboats. They determine right of way by the wind direction and tack. A sailboat is said to be on a starboard tack when the wind is coming from the starboard side and pushing the sail out over the port side.

Sailing Vessels Approaching While on Opposite Tacks



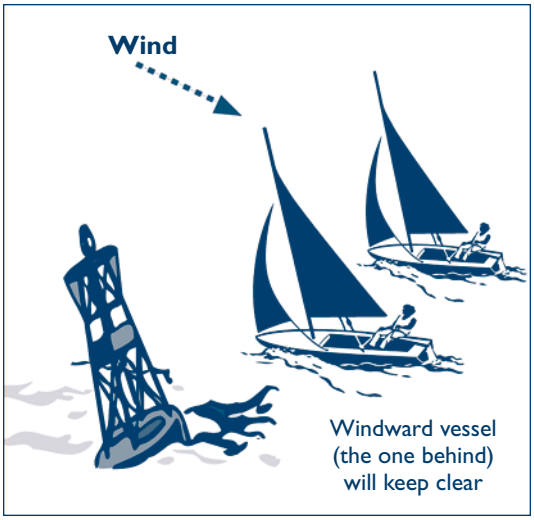
Vessel with the wind on her port side will keep clear

When two sailboats are approaching on different tacks, the boat on a starboard tack (wind on the starboard side) shall be the stand on vessel, and the sailboat sailing with the wind crossing the port side, a port tack, shall take early and substantial action to keep well clear.

Sailing Vessels on the Same Tack

When two sailing vessels are approaching while on the same tack, the vessel that is to windward (up wind; opposite to the side where the mainsail is carried) shall keep clear of the vessel to leeward.

When the sailing vessel on a port tack is not sure of the tack of another sailboat, she shall assume that the other vessel is on a starboard tack and take early and substantial action to keep well clear.



Except when overtaking, small boats not under power and sailboats under sail are stand on vessels over power-driven vessels. If a power driven vessel comes across a canoe or a sailing vessel, then the power-driven vessel should take early and substantial action to keep well clear. If a sailboat has its motor engaged, then they become a power-driven vessel and should be treated as such.

All vessels, including those operating for special purposes, are ranked with respect to give way or stand on.

7.5.3 Narrow Channels and Traffic Separation Schemes

Rule 9 Narrow Channels

This rule includes fairways. When travelling in a narrow channel or fairway, one should navigate as close to the starboard-hand side of the channel as practical. A vessel traffic lane (marked purple on a chart) should be crossed at right angles, not at long shallow angles. Small sailing vessels shall not impede larger vessels in a narrow channel or fairway. This keeps small vessels out of the way of big ships and traffic. If in a narrow channel or traffic lane, you must give way to larger vessels that cannot manoeuvre easily in that area. It is the small vessel's responsibility to keep clear, and not impede the passage of large vessels in narrow channels or traffic lanes.

Keep right and keep clear.

Rule 10 - Traffic Separation Schemes

- ➜ All vessels are still required to follow the other rules in the collision regulations
- ➜ Generally keep to the starboard side, and clear of the separation zone. If you must join or depart the scheme, use as small an angle to the direction of flow as is possible
- ➜ Avoid crossing the traffic lanes, except at right angles to the general flow
- ➜ Avoid any conduct that may impede a power driven vessel using a traffic separation lane, such as sailing, anchoring or fishing in a Traffic Separation Scheme
- ➜ Vessels that are required to work in traffic zones, (i.e., buoy tenders, etc.), are exempt while carrying out their operations, but are required to participate in the MCTS Vessel Traffic Services

Responsibilities Between Vessels

Definitions

- ⇛ **Vessel** - anything on the water capable of being used for transportation
- ⇛ **Power driven vessel** - a vessel propelled by machinery
- ⇛ **Sailing vessel** - a vessel being propelled solely by sail

⇛ **Vessel engaged in fishing** - with the particular fishing gear currently in use, the vessel is hampered by her gear

⇛ **Seaplane** - any aircraft designed to operate on the water

⇛ **Vessel not under command** - a vessel that is unable to manoeuvre due to some exceptional circumstance such as engine or steering failure

⇛ **Vessel restricted in ability to manoeuvre** - a vessel that is unable to manoeuvre due to the nature of her work, such as having divers down or having an awkward tow

⇛ **Vessel constrained by her draught** - a vessel with too much draught to deviate from the channel she is following

Note:
An Auxiliary vessel that is towing is not usually considered restricted in her ability and therefore is considered a power driven vessel.

Rule 18 General Pecking Order

The vessel at the bottom of the pecking order shall give way to all the vessels above when in sight of another vessel.

⇛ Not Under Command (NUC)

⇛ Vessels Restricted in Their Ability to Manoeuvre (RAM)

⇛ Vessels constrained by draft

⇛ Vessels engaged in fishing

⇛ Sailing vessels

⇛ Power driven vessels

⇛ Seaplanes on the water

The vessel lower on the list must stay clear.

7.5.4 Navigation Lights for Small Vessels

Every vessel must possess the correct lights and sound signalling equipment

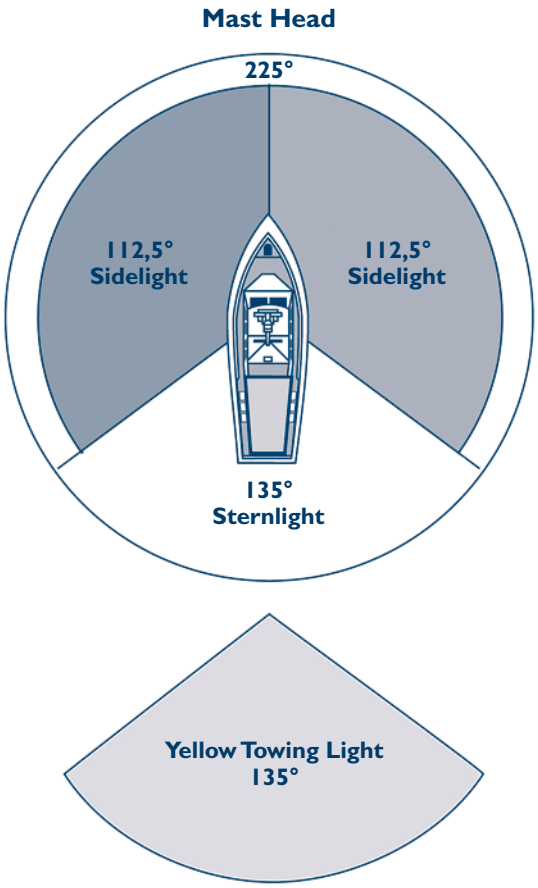
Things can get confusing on the water at night or when fog, mist, rain or snow restricts visibility. To ensure safe vessel operation, a system of lights and sound signals has been established to enable vessels to communicate their actions and intentions.

Every vessel must possess the correct lights and sound signalling equipment. Collision Regulations require that vessels be able to identify themselves, indicate their manoeuvres, and their activities engaged in.

All vessels underway shall, from sunset to sunrise, exhibit sidelights and a sternlight as described in the Collision Regulations, rules 20 and 23.

The required lights and arcs of visibility for power-driven vessels are:

• Masthead Light (WHITE)	225°
• Port Light (RED)	112.5°
• Starboard Light (GREEN)	112.5°
• Stern Light (WHITE)	135°
• All Round Light/Anchor Light (WHITE)	360°
• Towing Light (YELLOW)	135°



Sailing Vessels

Rule 25 - Sailing Vessels Underway and Vessels Under Oars

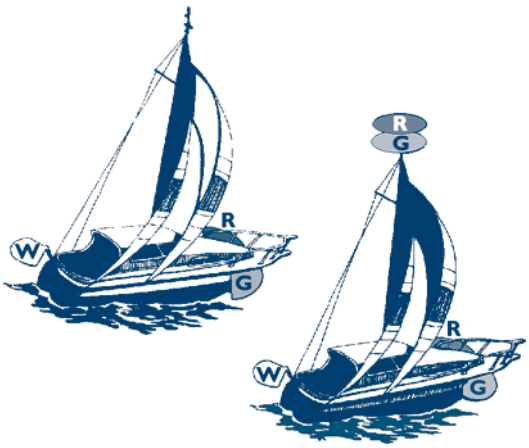
A sailing vessel underway exhibits:

✓ sidelights

✓ sternlight

Optional: two all round lights in a vertical line, the upper being red and the lower being green (these two all round lights cannot be used in conjunction with the combination tri-lantern).

Options for sailing vessels



Sailing vessels less than 20m long can display a combined red, green and white lantern (sidelights and sternlight).

Less than 20m optional configuration

Small sailing vessels less than 7m long have a fourth option for navigation lights while underway.

Vessel under oars may exhibit:

- ✓ sidelights
- ✓ sternlight; if not, a flashlight or lantern showing a white light

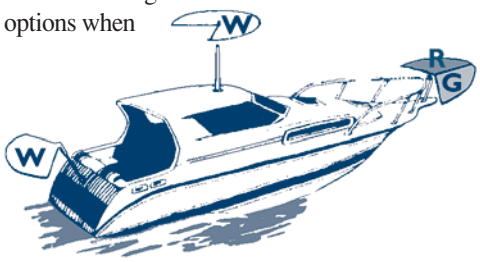
There are two options for a vessel under oars to exhibit navigation lights while underway.

Power Driven Vessels

Rule 23 - Power Driven Vessels Underway
When underway a power driven vessel shall exhibit a masthead light, sidelights and a sternlight.

- ⇛ If over 50m (164') a second masthead, light abaft and above the first masthead light, is required.
- ⇛ A vessel under 50m does not require a second masthead light but may exhibit one.
- ⇛ Hovercraft require an all round flashing yellow light as well as lights for a power driven vessel when operating in the non-displacement mode.
- ⇛ If the vessel is under 12m, it may exhibit an all round white light in lieu of a masthead light and sternlight.
- ⇛ If the vessel is less than 7m, and the maximum speed is less than 7 knots, it may exhibit an all round white light in lieu of masthead, side and stern lights. If it is practical, sidelights also will be exhibited.

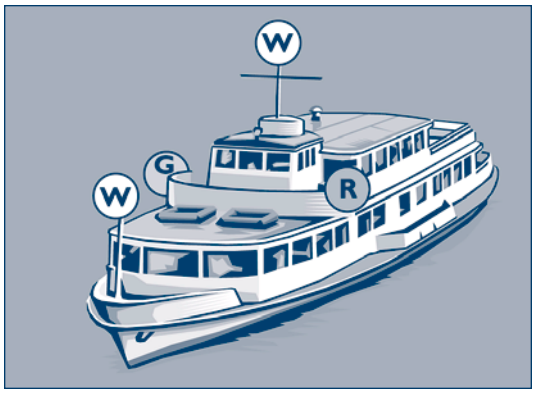
Power-driven vessels that are less than 20m long have the following navigation light options when underway.



12 - 20m optional configuration

Less than 12m

Power-driven vessels that are less than 12m in length have a third option while underway



Power driven vessel over 50m underway

7.5.5 Day Shapes Basic

Day shapes for sailing vessel operating machinery

Sailing vessels proceeding under sail, and also being propelled by machinery, must exhibit a cone shape (apex downward), by day. At night, and during periods of restricted visibility, these vessels are required to exhibit the lights indicated for power-driven vessels of a similar length

Day shapes for vessels at anchor

A vessel under 50 metres while at anchor must exhibit a black ball in the rigging where most visible.

Signals for Diving

All vessels engaged in diving must display the blue and white Code Flag "A". A red and white flag carried on a buoy is used to mark areas where diving is in progress. If you see either flag, keep well clear of the vessel and diving site, and move at a slow speed. Power driven vessels are required by the collision regulations to take early and substantial action to keep well clear of vessels engaged in underwater operations.

Radar Reflector

Vessels under 20m in length, and all non-metal craft are not easily detected on radar. Such vessels must be equipped with a radar reflector when operating in an area frequented by shipping.

Vessels that are less than 20 metres in length or which are constructed primarily of non-metallic materials shall be equipped with a passive radar reflector as described in the *Collision Regulations*, rule 40:

- ➜ Mounted or suspended at a height of not less than 4 metres above the water, if practicable
- ➜ Unless in limited traffic conditions, daylight, and favourable environmental conditions and where compliance is not essential for the safety of the vessel
- ➜ Unless the small size of the vessel or his/her operation away from radar navigation makes compliance impracticable

Navigation Lights for Larger Vessels

Not Under Command (NUC)

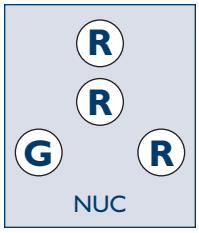
Rule 27 - Vessels not Under Command

At night:

- ✓ two all round red lights in a vertical line

If making way:

- ✓ sidelights
- ✓ sternlight



During the day:

- ✓ two black balls in a vertical line

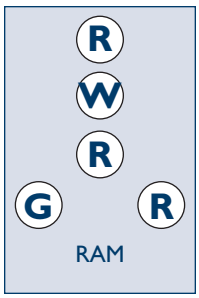
Vessel restricted in ability to manoeuvre

At night:

- ✓ Three all round lights, the highest and lowest being red, and the middle being white

If making way:

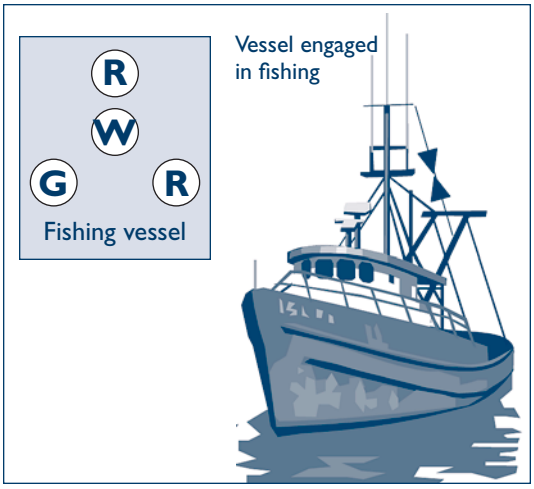
- ✓ masthead light(s)
- ✓ sidelights
- ✓ sternlight



During the day:

✓ three shapes in a vertical line, the highest and lowest being black balls, and the middle being a black diamond.

A vessel towing that is severely restricted in her ability to deviate from her course exhibits towing lights and shapes as well as the above.



Vessels Engaged in Fishing

When engaged in fishing other than trawling:

✓ two all round lights, the upper being red the lower being white,

When making way fishing vessels shall also exhibit:

✓ sidelights

✓ sternlight

Trawling – when engaged in trawling and underway:

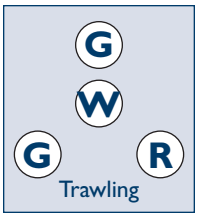
✓ two all round lights, upper being green, lower white

✓ masthead lights

✓ sidelights

✓ sternlight OR

✓ anchor lights, instead of the above, if at anchor



Towing Vessels

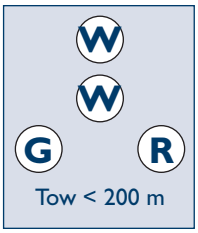
If the length of the tow is less than 200m (measured from the stern of the towing vessel to the stern of the last vessel or object being towed):

✓ two masthead lights in a vertical line

✓ sidelights

✓ sternlight

✓ yellow 135° towing light above the sternlight



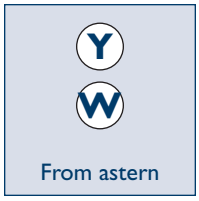
If the length of the tow exceeds 200m:

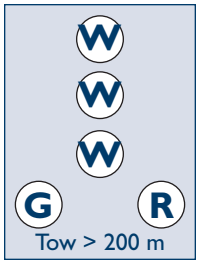
✓ three masthead lights in a vertical line

✓ sidelights

✓ sternlight

✓ yellow 135° towing light above the sternlight





Pushing or Towing Alongside

If the vessel is engaged in pushing ahead or towing alongside, and the two **are rigidly connected**:

✓ masthead light(s)

✓ sidelights

✓ sternlight (i.e. same lights as a power driven vessel)

If the vessel is engaged in pushing ahead or towing alongside **and not rigidly connected**:

✓ two masthead lights in a vertical line

✓ sidelights

✓ sternlight

The vessel or object being towed shall exhibit:

✓ sidelights

✓ sternlight

A number of vessels towed alongside or pushed as a group shall be lighted as one vessel:

✓ not part of a composite unit pushed ahead - sidelights

✓ towed alongside - sidelights

✓ sternlight

If the length of the tow exceeds 200m and is difficult to see, such as a log boom:

✓ If less than 25m (82 ft) in breadth - two all round white lights, one forward and one aft

✓ If more than 25m (82 ft) in breadth

✓ four all round white lights, to mark its length and breadth

Note:

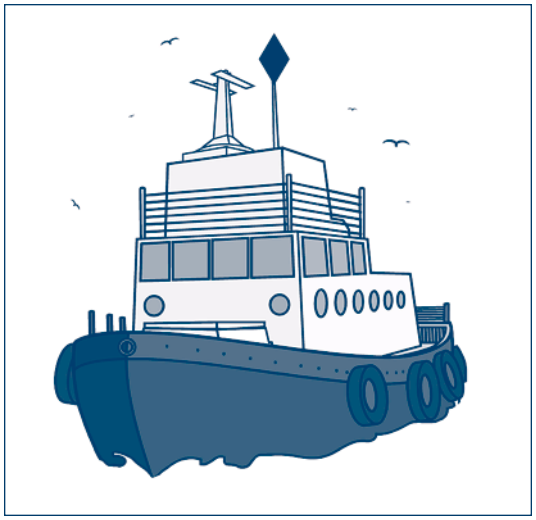
Trolling vessels are not considered vessels engaged in fishing with regards to the Collision Regulations.

✓ More than 100m (328 ft) long additional all round white lights so that the distance between lights never exceeds 100m (328 ft)

During the Day

✓ A black diamond shape where it can best be seen
✓ A black diamond shape at or near the aftermost extremity

If it is impracticable to show the proper lights and shapes, all measures are to be taken to indicate the presence of the object being towed.



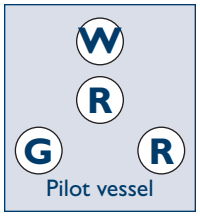
Note:
A yellow 135° towing light is used above the stern light only when the tug is towing something behind it.

Note: The towing lights are not required if the towing vessel does not normally tow, is engaged in towing another vessel in distress, or in need of assistance.

All possible measures are to be taken to indicate the relationship between the towing vessel and the vessel being assisted. A searchlight may be used to illuminate the tow or towline

Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation

Pilot Vessels



Rule 29 - Pilot Vessels

When underway:

✓ sidelights
✓ sternlight
✓ two all round lights in a vertical line, the upper being white and the lower being red

When anchored:

✓ anchor lights
✓ two all-round lights in a vertical line, the upper being white and the lower being red

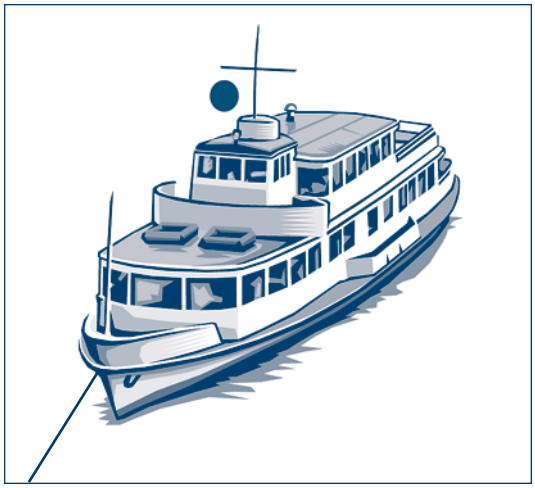
If the pilot vessel is not engaged in pilotage duties, she will only display the lights and shapes for a power driven vessel of her size.

Vessels at Anchor

Rule 30 - Anchored vessels and Vessels Aground

A vessel at anchor shall exhibit:

✓ in the fore part an all-round white light at night
✓ a black ball
✓ at or near the stern an all-round white light, lower than the forward light



If the vessel is less than 50m in length:

✓ an all-round white light where it can best be seen

A vessel aground shall exhibit:

✓ in the fore part an all round white light at night
✓ at or near the stern an all round white light lower than the forward light, where they can best be seen
✓ two all-round red lights in a vertical line
✓ three black balls in a vertical line (during daylight hours)

Seaplanes

Rule 30: Seaplanes, while on the water, are considered to be vessels so should exhibit lights and shapes as closely similar to those laid down for vessels.

Special Lights

Signals to attract attention

If necessary to attract the attention of another vessel, any vessel may make light or sound signals that cannot be mistaken for any signal authorised elsewhere in the Collision Regulations, or may direct the beam of her searchlight in the direction of the danger, in such a way as not to embarrass any vessel. Any light to attract the attention of another vessel shall be such that it cannot be mistaken for any aid to navigation. For the purpose of this Rule the use of high intensity intermittent or revolving lights, such as strobe lights, shall be avoided.

Special Flashing

A hovercraft or hydrofoil in non displacement mode will exhibit a special yellow flashing light. "Special flashing light" means a yellow light flashing at regular intervals at a frequency of 50 to 70 flashes per minute, placed as far forward and as nearly as practicable on the fore and aft centreline of a vessel and showing an unbroken light over an arc of the horizon of not less than 180 degrees nor more than 225 degrees and so fixed as to show the light from right ahead to abeam and not more than 22.5 degrees abaft the beam on either side of the vessel.

Flashing

"Flashing light" means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.

Blue Flashing

"Blue flashing light" means a blue all-round light flashing at regular intervals at a frequency of 50 to 70 flashes per minute.

A "government ship" means a ship or vessel that is owned by and in the service of Her Majesty in right of Canada or of a province and any ship that is owned or operated by a federal, provincial, harbour, river, county or municipal police force.

Any **government ship** may exhibit as an identification signal a blue flashing light where it:

- 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
- Is engaged in law enforcement duties in Canadian waters.

White Flashing - Manoeuvring and warning signals by flashing light

A vessel may supplement the whistle signals by light signals that have the following significance:

- one flash to mean "I am altering my course to starboard",
- two flashes to mean "I am altering my course to port",
- three flashes to mean "I am operating astern propulsion".

and the duration of which shall be about one second for each flash.

The light used for a signal shall, if fitted, be one all-round white, visible at a minimum range of 2 miles, synchronized with the whistle signal, and shall comply with **section 12 of Annex I** of the Collision Regulations.

7.5.6 Sound Signals

Sound Signalling Equipment

The Collision Regulations (Rule 33) requires that vessels of 12 or more metres in length be provided with a whistle, and if greater than 20 metres in length, in addition a bell, which conform to the specifications detailed in **Annex III** of the regulations.

Vessels in excess of 100 metres in length shall also be provided with a gong, the tone and sound of which cannot be confused with that of the bell.

Vessels less than 12 metres in length shall not be obliged to carry the sound signalling appliance outlined above, but must carry some other means of making an efficient sound signal.

Legend of Sound Signals

Whistle	Any sound signalling appliance capable of producing loud blasts as specified in *Annex III of the Collision Regulations*.	
Short Blast	A blast of approximately one second's duration.	
Prolonged Blast	A blast of approximately four to six second's duration.	
Rapid Ringing of Bell	Ringing the bell rapidly for approximately 5 seconds in the forward part of the vessel.	
Rapid Sounding of Gong	Banging the gong rapidly for approximately 5 seconds in the aft part of the vessel.	

The Signals Defined

The Collision Regulations define sound-signalling terms as follows:

Manoeuvring and Warning Signals

Rule No.	Vessel or Situation	Signal Required
34a	Power-driven vessels in sight of one another: ***"I am altering course to starboard."***	
34a	Power-driven vessels in sight of one another: ***"I am altering course to port."***	
34a	Power-driven vessels in sight of one another: ***"I am operating astern propulsion."***	
34c	When vessels are in sight of one another in a channel or fairway, a vessel intending to overtake another: ***"I intend to overtake you on your starboard side."***	
34c	When vessels are in sight of one another in a channel or fairway, a vessel intending to overtake another: ***"I intend to overtake you on your port side."***	
34c	When vessels are in sight of one another in a channel or fairway, the vessel about to be overtaken shall indicate agreement with the following whistle signal:	

Cont'd page 146…

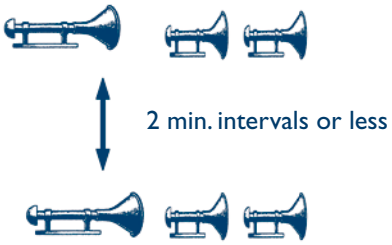
(Continued)

Manoeuvring and Warning Signals

Rule No.	Vessel or Situation	Signal Required
34d	Vessel in sight of one another are approachnig each other, and from any cause either vessel fails to understand the intentions or actions of the other, or is in doubt as to whether sufficient action is being taken by the other to avoid collision, the vessel in doubt shall make the following whistle signal:	
34e	A vessel nearing a bend or area of a channel or fairway where other vessels may be obscured by an obstruction, shall sound the following signal:	
34e	A vessel nearing a bend or area of a channel or fairway where other vessels may be obscured by an obstruction, shall upon hearing a prolonged blast, answer with the following signal:	

Restricted Visibility Signals

In or near an area of restricted visibility, whether by day or night, the signals outlined below shall be used as follows:

Rule No.	Vessel or Situation	Signal Required
35a	A power-driven vessel making way through the water.	 2 min. intervals or less
35b	A power-driven vessel underway, but stopped and making no way through the water.	 2 min. intervals or less
35c	A vessel not under command; a vessel restricted in her ability to manoeuvre; a vessel strained by her draught; a sailing vessel; a vessel engaged in fishing; a vessel engaged in towing or pushing another vessel; or a vessel restricted in her ability to manoeuvre while carrying out her work.	 2 min. intervals or less
35e	A vessel being towed; or the last vessel of a tow, if manned.	 2 min. intervals or less

Cont'd 148…

(Continued)

Restricted Visibility Signals

Rule No.	Vessel or Situation	Signal Required
35g	A vessel of under 100 metres in length at anchor.	 1 min. intervals or less
35g	A vessel greater than 100 metres in length at anchor.	 Forward  1 min. intervals or less
35g	Vessels at anchor may also choose to use an additional warning signal.	
35h	A vessel aground.	  Three (3) distinct strokes on the bell; rapid ringing of the bell, followed by three (3) distinct strokes on the bell.  1 min. intervals or less
35h	A vessel aground may also choose to utilize the optional whistle signal.	
35i	A vessel of less than 12 metres in length that has run aground shall not be required to issue the above signals, but if she does not, shall make some other efficient sound signal.	 2 min. intervals or less
35j	Pilot vessel – optional in addition to 35(a), (b) or (g).	

7.6 Electronic Navigation

Electronic Navigation embodies the basic traditional navigation methods used by the ancient mariners – the principle of "Fix-to-Fix" with a few modern twists.

Essentially, electronic navigation uses three basic tools, although any single one can provide some information.

The three basic components are:

- (D)GPS – (Differential) Global Positioning System
- RADAR – Radio Detection and Ranging
- Gyro or Fluxgate Compass

Supplementary information is also provided by electronic charts, depth sounders, thermal sensors and other technological wizardry. No single piece of equipment can replace a good watchkeeper; and extreme caution must be used when employing any electronic aids. Even now, in the 21st century, there is no replacement for an alert watchkeeper with good eyes and reliable chart.

7.6.1 Radar

RADAR is an acronym for **RA**dio **D**etection **A**nd **R**anging.

When at sea it is essential to know your position in relation to near by land and to other vessels in the vicinity. Your radar will give you this information rapidly and in any sort of visibility. Your radar is a navigational aid enabling you to fix your position by means of reflected radar signals from recognisable features such as headlands, harbour entrances and buoys.

Your radar is also an anti-collision aid enabling you to determine the range and relative bearing of other vessels in the vicinity, both in good and bad visibility.

How Radar Works

Radar, as designed for marine navigation applications, is pulse modulated. Pulse-modulated radar is used to determine the distance to a target by measuring the time required for an extremely short burst or pulse of radio-frequency energy to travel to the target and return to its source as a reflected echo. Directional antennas are used for transmitting the pulse and receiving the reflected echo, thereby allowing determination of the direction of the target echo from the source.

Radio-frequency energy travels at the speed of light, therefore, the time required for a pulse to travel to the target and return to its source is a measure of the distance to the target. Since the radio-frequency energy makes a round trip, only half the time of travel determines the distance to the target. The round trip time is accounted for in the calibration of the radar.

It should be obvious that in measuring the time of travel of a radar pulse or signal from one ship to a target ship, the measurement must be of an extremely short time interval. For this reason, the MICRO-SECOND (µsec.) unit of time is used in radar applications. The microsecond is one-millionth part of one second, i.e., there are 1,000,000 micro-seconds in one second of time.

The radio-frequency energy transmitted by pulse-modulated radars consists of a series of equally spaced pulses, frequently having durations of about one microsecond or less, separated by very short but relatively long periods during which no energy is transmitted. The terms PULSE-MODULATED RADAR and PULSE MODULATION are derived from this method of transmission of radio-frequency energy.

If the distance to a target is to be determined by measuring the time required for one pulse to travel to the target and return as a reflected echo, it is necessary that this cycle be completed before the next pulse is transmitted. This is the reason why the transmitted pulses must be separated by relatively long non-transmitting time periods. Otherwise, transmission would occur during reception of the reflected echo of the preceding pulse.

Key Concept:
*The small vessel radar regularly provides scanty information. At high speed there are only two navigational aids that you can trust on your vessel. These are your **EYES** and your **CHART**!*

Because radar is a technological aid to navigation, it's important to remember that:

- Equipment can fail;
- Operators can make mistakes; and
- Environmental conditions or improper handling can affect equipment performance.

Radar Operating Controls

Power Switch

Different types of radar turn on in different ways. In the OFF position there is no power to the equipment. All will generally turn on to a Stand By position where the electronics will warm up. No transmissions will be made at this stage. This is the setting that should be used when going alongside a berth or another vessel with people at scanner height.

Once warmed up and in the Stand By position, the radar is in a state of immediate readiness and can be brought into use whenever required. In the ON or TX position waves are being transmitted and any echoes from targets that are received are amplified and displayed on your screen. If the switch is turned directly from the OFF to OPERATE positions, there is a warm-up period of about three minutes before the radar set is in full operation.

Brilliance Control

Also called INTENSITY or BRIGHTNESS and is similar to the brightness control on the television set. It varies the background illumination against which amplified echoes appear on the screen, but does not affect the degree of amplification. The brilliance control is adjusted to make the trace of the rotating sweep visible but not too bright.

Gain Control

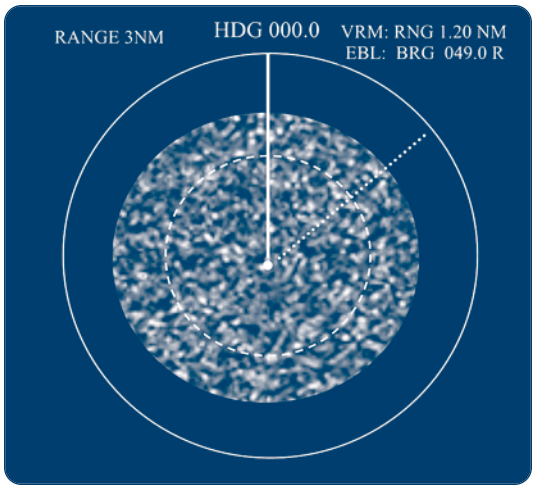
The gain control is the same as a volume control. The gain control varies the amplification of the radar receiver and thus the strengths of the echoes as they appear on the screen. The gain control is adjusted until a speckled background appears on the display. With too little gain, weak echoes may not be detected; with excessive gain, strong echoes may not be detected because of the poor contrast between echoes and the background of the display. When adjusting the gain, the radar should be set on one of the longer-range scales (6 NM) because the speckled background is more apparent. Generally the gain should not be re-adjusted throughout the other range scales.

Rain Clutter Control

Rain, hail and snow all return echoes on the radar as a blurred or cluttered area. The rain clutter control shortens the echoes on the display, reducing clutter. When used, the rain clutter control has an effect over part of the display and generally tends to reduce the receiver sensitivity and, thus, the strengths of the echoes as seen on the display.

Sea Clutter Control

Sea return or unwanted echoes that are received from waves may clutter the display, especially at short ranges. The sea clutter control is used to suppress sea clutter out to a limited distance from the vessel. Its purpose is to enable the detection of close targets



Rain can cloud your screen

which otherwise might be obscured by sea clutter. This control must be used carefully along with the receiver gain control. Generally, one should not attempt to eliminate all sea clutter. Otherwise, echoes from small close targets may be suppressed also. Normally the sea clutter should be placed at the minimum setting or off in calm seas.

Tuning Control

If the radar does not have an automatic tuning control to keep it tuned for optimum performance, the manual tuning control must be adjusted to obtain the best reception of echoes. The tuning control enables the receiver to be tuned to the same frequency as the transmitter. The tuning should be checked periodically to insure that the radar is operating properly. The radar may be tuned by adjusting the tuning control for maximum return on the echoes from the vessels wake. When sea clutter is used for manual tuning adjustment all anti-clutter controls should be off. Tuning may need adjustment with a change of range scale.

Pulse Length (Range)

The longer the pulse length, the greater the range capability of the radar because of the greater amount of energy transmitted. At shorter-range scales, a shorter pulse length provides better target resolution. Generally, long pulse for long range and short pulse for short range. However, short pulse can be used to separate targets that blend together.

Relative Motion Display

Most small vessel radars provide relative motion displays in which your own vessel is always at the centre of the display and the motion of the contact is *relative* to your own vessel. What this means is that in order to determine the direction and speed of the tar-

get, you must consider your own position in relation to that target. On relative motion display, fixed objects such as land masses move at a rate equal to and in a direction opposite to the motion of your own vessel. The relative motion display can either be heading-up or in North-up.

Vessels Head Up

Where your own vessel's heading is always at the top of the screen. The contacts are displayed at bearings relative to your own vessel's bow. In this mode the Radar operator has no idea which objects are moving and which are stationary. It is very easy to become disoriented when operating the Radar in this mode at slow speeds and variable courses (such as during a shoreline search at night). This mode should be used unless your vessel is fitted with an accurate flux gate compass connected to the radar.

North Up

The picture is gyro or flux gate stabilised and north is always at the top of the screen, the heading line wanders according to your own vessel's heading, and contacts are displayed relative to north or magnetic north.

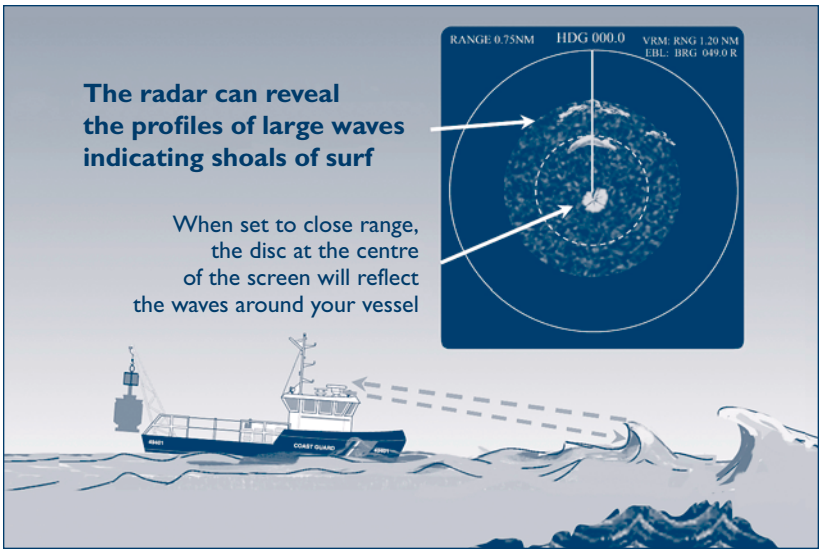
The heading-up display is most suitable for collision avoidance in crowded coastal areas or narrow channels. The North-up display is often preferred on the high seas, and simplifies plotting because target bearings appear in degrees true. The north-up mode requires that the radar unit be connected to a gyrocompass or a fluxgate compass.

Range Scale

The likelihood that a radar unit will detect a target depends as much on the size, shape, material, height and angle of the target as it does on the range of the radar. Ranges beyond 15 miles are of limited use on small vessels except for coastwise navigation. The use of a high range scale makes the picture of the more important close-range areas smaller, and makes targets in that area much smaller and less likely to be noticed. Important changes in close range targets are obscured when larger scales are used.

Most small vessels use a 6 to 12 mile radar range when running in the open and a smaller range as the circumstances may dictate. For manoeuvring close to targets, the range is usually reduced to the smallest range that will show the area of interest. A good rule of thumb is to keep objects of interest in the outer 1/3 of the display.

In the open sea, however, care should be taken not to neglect the longer distance ranges in conditions of reduced visibility, when another vessel could get dangerously close without being noticed if short ranges are used exclusively. The radar should not remain on a set range scale. The range scale should be increased to give advance warning and detection of long-range targets and reduced to a smaller scale to monitor close in targets.

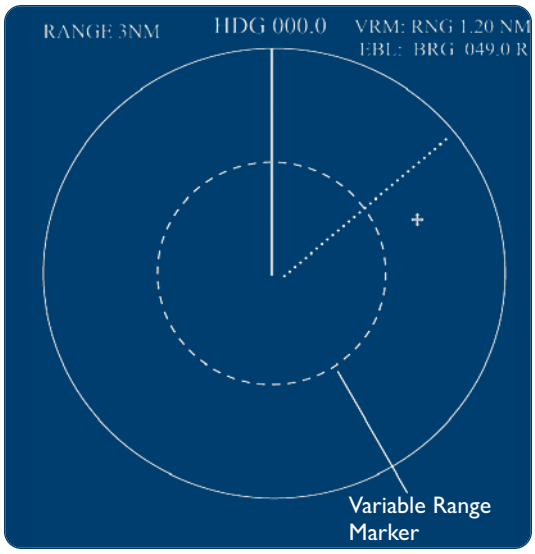


Control Type 1: Both up and down arrow buttons with range below them

Control Type 2 curved numbers around button

Variable Range Marker

The Variable Range Marker (VRM) is used to measure the range to a target. Generally there are two ways of measuring range; fixed range rings which appear on the display and the Variable Range Marker, which can be moved inward or outward so that it touches the leading edge of a target and indicate its range on a digital readout.



WARNING

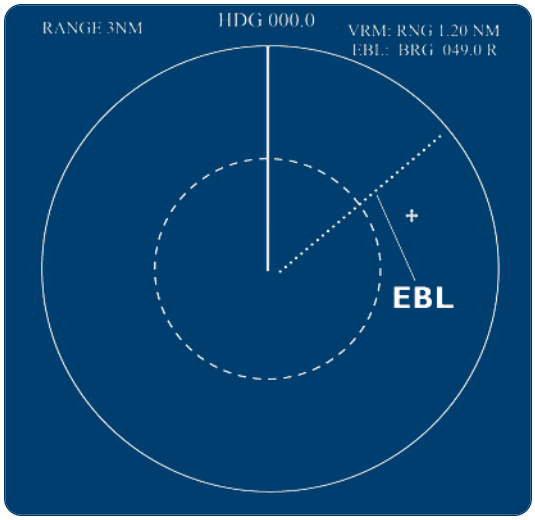
The navigator should not rely solely on radar or GPS information, and should never make assumptions based on scanty radar information.

Navigators must be able to navigate without the help of electronic navigational aids.

The radar should not remain on a set range scale

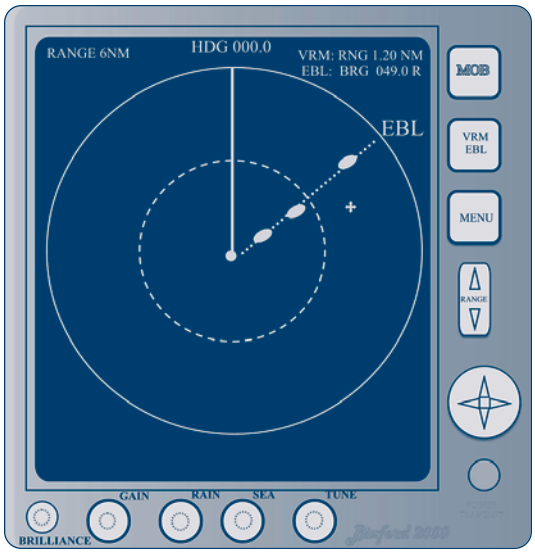
Electronic Bearing Line (EBL)

The bearing cursor or Electronic Bearing Line (EBL) is used to measure the bearing of a target. The EBL is a movable straight line that pivots around the centre point of the screen, which can be placed over the image of a detected object. The display will then digitally read out the relative bearing from the vessel to the object. There are two ways of measuring bearings, a mechanical cursor and electronic bearing line.



Collision Avoidance

The moment an echo appears on the screen, its range and relative bearing should be measured and its range and true or magnetic bearing noted. A risk of collision can be ascertained by careful watching the true or magnetic bearing of an approaching vessel.



The target has a steady bearing and a decreasing range. The Electronic Bearing Line or EBL is used to track the target's advance.

If your course and speed are remaining the same, and the bearing does not appreciably change such risk should be deemed to exist. You should then act in accordance with the Regulations for Preventing Collisions at Sea. If using a relative bearing, ensure that you are on a constant heading.

Constant Bearing/Decreasing Range

A basic method of collision avoidance is the use of the radar cursor or EBL to give an early warning of collision. When a target appears on the screen, rotate the EBL to put the line directly on top of the pip. If the target stays on this line as it gets closer, you're on a collision course. This is known as constant bearing/decreasing range. If you already have the cursor on one target and another appears, you can note the bearing on the ring around the radar screen, or, if the target is in sight, you can take a visual sight and observe whether the angle between your vessel and the target changes or remains constant. If the angle remains constant as range decreases, you're on a collision course. For example, if you see lights in line with the bow chock and they stay right there as they get brighter, you know you've got a problem.

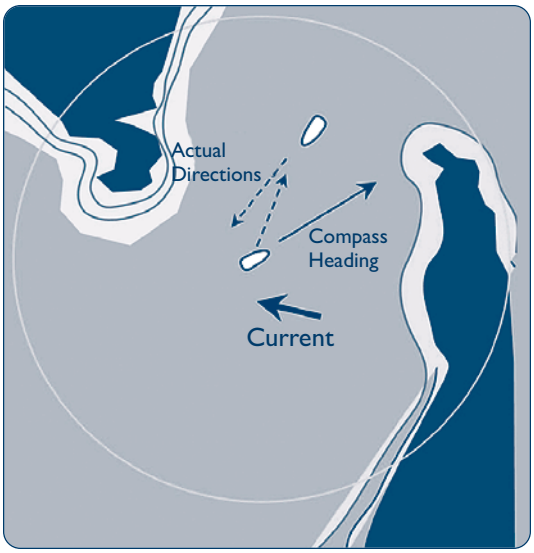
Radar Safety

Radars can cause harm if you are not cautious and follow some basic safety guidelines

- Radar must be installed according to the manufacturer's instructions.
- Antennas rotating: stay clear of transmitting radar. The microwaves being transmitted are the same ones that cook your food in a microwave oven. In open boats stay below the rotating antennae level.
- When servicing you can de-activate the radar from the display and make sure that no one transmits while your are working on it by activating the lock out switching and post signs on the set, if possible.
- Electromagnetic energy may cause harmful radiation.
- When operating in close quarters with other vessels, or coming alongside a vessel, ensure that the Radar is in Standby and not transmitting.

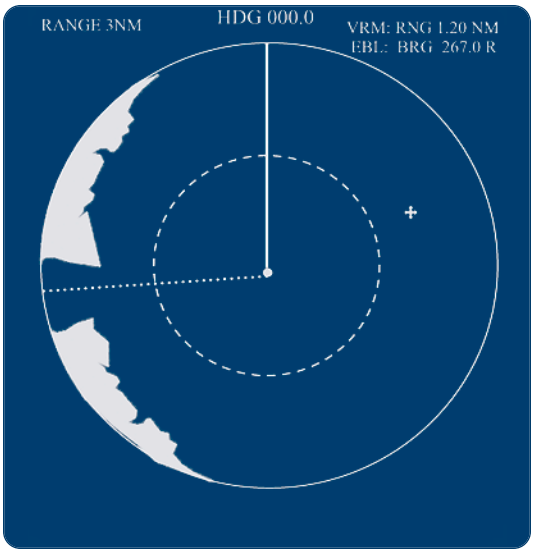
How Things Look on Radar

The radar only receives signals from objects that reflect microwaves. The picture that you see on the screen is only a representation of a reflected waves direction and the distance to where it was reflected. There are many things in the world that do not reflect microwaves very well.

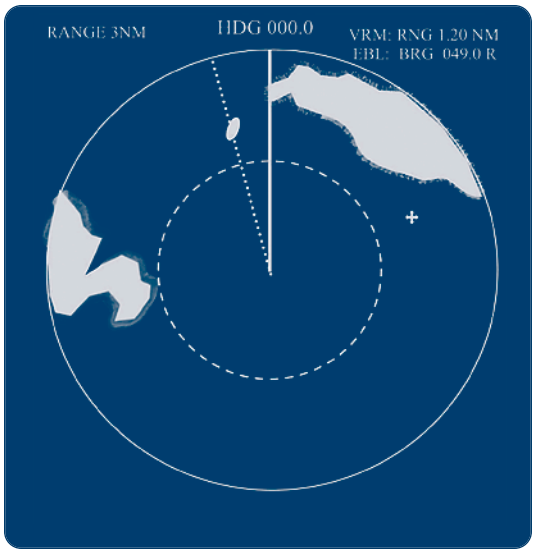


Bad Reflectors

- Trees or vegetation
- Low beaches
- Low smooth rocks
- Non metal vessels (Fibreglass, Inflatable boats etc.)
- Metal vessels that have shallow angled house works (look like stealth bombers)



Low valleys or wet lands can appear as channels or inlets. A common mistake is for navigators to be expecting to see an opening and turn when the radar screen looks like this (this is actually a beach with a valley behind it).



This drawing shows how a vessel can be pointing in a direction away from you, yet still presents a risk of collision. The radar will help you determine this.

Small vessels are particularly susceptible to blind spots because of lower energy radars and low height antennae.

Good Reflectors

- Tall steel ships
- Rocky cliffs
- Flat sided fishing vessels
- Square flat surfaces at right angles to the antennae (Radar Reflectors)
- Wave crests breaking at close range

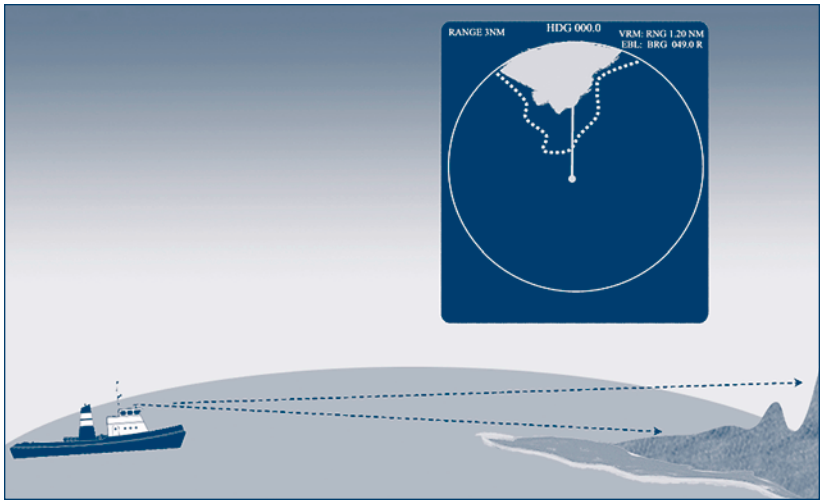
Sea returns:

In heavy weather, irregularities in the water surface may appear as a dense background of clutter forming the shape of an almost solid disc right in the centre of the display. This disc can obscure targets that are close in.

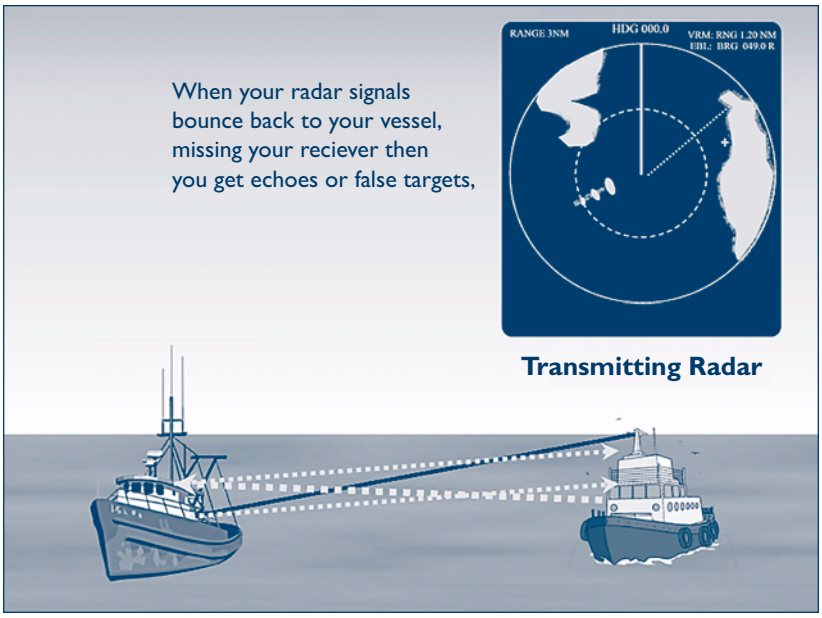
Precipitation Returns

Echoes from rain, snow, etc. appear as countless small echoes continuously changing in size, intensity and position. These returns can also appear as large hazy areas, depending on intensity of storm cell.

The Radar will deceive you!



The dotted line indicates the land not seen by the radar, as it is below the ship's radar horizon.



False targets

Blind sectors, shadow effect:

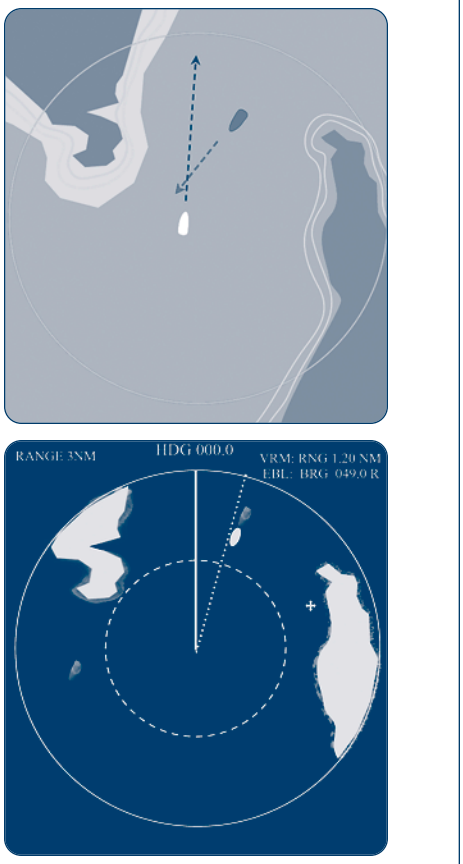
Your radar can be obscured and subsequently blinded in areas of return. This means that because of your vessel design and antennae size there are areas on your radar display that will not show a vessel even when one is there. Small vessels are particularly susceptible to blind spots because of lower energy radars and low height antennae. When objects on your vessel are in the direct path of the antennae then you can get a ghost image. This is a large contact that follows you at a constant distance and matching speed.

Reflected Images and Ghosts

Whenever radar waves behave badly, (reflect from somewhere other than the real target), you will see contacts on your display that are not there or you will see nothing where there is something. An object can appear on you display in two different places.

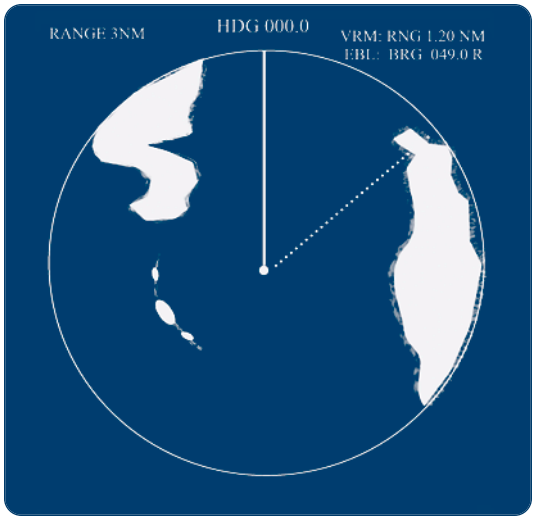
Ghost images:

- Similar in appearance to real echoes, but intermittent and poorly defined, with a tendency to smear.
- Sometimes caused by targets nearby with wide smooth surfaces.
- Retain a fixed relationship with true images.



Ghost images appear in the area away from the actual target.

Never use your radar as the sole information source for navigation.



Side Lobe Error. This is caused by the beams side lobes reflecting off the target at short range.

False echoes:

May appear when a large target is at short range, or when a reflecting surface is nearby.

Radar line of sight:

Because of the curvature of the earth the height of your radar antennae dictates how far it can detect small objects. Line of sight limits search for distant objects. The taller the object stands up from the water the farther your antennae can detect it.

Example: In standard conditions, with 6 feet height of antenna, water level objects such as; logs, rocks, liferafts, etc. have a radar horizon of 3.01 NM a 300 foot cliff has a radar horizon of 21.3 NM.

Radar Antenna Sweep Delay:

Most small craft radar antennae turn fairly slowly, and refresh the display only about once per second. When a vessel is moving slowly on a calm sea, this is not a problem. Refresh delay, or latency, becomes a problem at speeds above 20 knots. The table below summarises the distance travelled per antenna rotation.

The display may appear to look OK but the reality is that you are hurtling along blind except during the sweep of the antennae. If you imagine driving on the highway in heavy rain, the only time that you can see clearly is just after the windshield wipers go by. Normally you would turn up the speed of your wipers, thus fixing the problem. Also when you shorten the time between sweeps on your radar you increase the range; looking farther ahead gives you more warning to avoid oncoming vessels. Yet the disadvantages are at long range the objects close to you are obscured. If you decrease your range then you wait longer between sweeps. This is not safe if you are travelling at 28 metres per second. Imagine driving at 100 Km/h in heavy rain and having your wipers on low speed. The solution for your vessel is to slow down. And you should secure other means of fixing your position and spotting hazards ahead.

Radar Summary

Radar is a useful tool when used to assist a small craft navigator to detect some objects in the area of operations. The radar only shows you objects that reflect and there are many objects out there that do not reflect but will still damage your boat.

Use your **EYES** and your **CHART**. Never use your radar as the sole information source for navigation.

7.6.2 Global Positioning System (GPS)

Excerpts taken from GPS Instant Navigation by Kevin Monahan and Don Douglas

The Global Positioning System (GPS) is a worldwide 24-hour navigation positioning system operated by the US Department of Defence. It consists of a Ground Control Segment, a Space Segment, and User Equipment Segment. The User Equipment Segment is what is commonly known as a GPS receiver.

How GPS Works

24 earth-orbiting satellites in six different orbits form the Space Segment (there are also 3 or 4 operational spares in orbit at any one time). Each satellite circles 10,900 nautical miles above the earth in orbits inclined at an angle of 55 degrees to the equator. Each

satellite transmits precision timed signals (derived from onboard atomic clocks) on two frequencies, L1 and L2. A separate channel on each frequency is dedicated to each satellite.

The civilian GPS can resolve positions to approximately the same level of accuracy as the military system (within 20 metres). The difference is that the civilian service is subject to Selective Deniability, whereas the military system is not. The single largest contributor to GPS error is interference with the broadcast signals caused by the ionosphere (a shell of electrically charged particles that surrounds the earth).

Never rely solely on a navigational aid!

Each satellite also broadcasts "Almanac" and "Ephemeris" messages. Your earthbound GPS receiver uses the almanac to determine which satellites are above the horizon and what channels they are broadcasting on. The receiver then locks on to the most appropriate satellites for fixing a position. Given the exact time the navigation message was broadcast, and knowing the time it was received, the GPS receiver determines the amount of time it takes for the coded signal to travel from the satellite to your antenna. From there, it is a simple computation to determine the actual distance between the satellite and your GPS antenna. From this point, the GPS receiver calculates a position in the same way as a human navigator using radar ranges.

The single largest contributor to GPS error is interference with the broadcast signals caused by the ionosphere

The ephemeris message tells the receiver the exact location of the satellite when the message was broadcast, and since the receiver now knows the distance to the satellite, it calculates that it must be on the surface of an imaginary sphere, centred on the satellite. Where that sphere intersects with the surface of the earth, a Circle Of Position (COP) is formed.

From two satellites, the receiver calculates two COPs, which cross at two possible positions. To determine which position is the correct one, a third satel-

The high levels of GPS accuracy should not be cause to reduce your vigilance in navigation or your margin of error.

lite range is needed. Thus, for a receiver at sea level, a minimum of three satellites is needed to determine a two-dimensional position. For aircraft, and vehicles on land, which operate above sea level, a fourth satellite is needed to determine a three-dimensional position (including altitude).

Satellite timing signals are subject to small errors, so each orbiting satellite is closely monitored from five sites around the world (The Ground Control Segment). The main control facility at Falcon Air Force Base, Colorado, makes minor adjustments to keep the system within its prescribed limits of accuracy (20 metres.)

GPS Accuracy

Since the inception of the system, GPS has become the driving force behind an enormous civilian economy. In 1996, US President Bill Clinton recognised this fact and directed the United States Department of Defence to develop other methods of ensuring national security—Selective Deniability. The result of this new technology is that *civilian users of the Global Positioning System can now expect their receivers to provide positioning accurate to within 20 metres* (instead of the 100 metre accuracy available prior to May 1, 2000).

In a practical sense, it is now possible to determine your position anywhere in the world within the length of a medium sized boat. The accuracy of GPS far exceeds even the theoretical repeatable accuracy of Loran C.

As a result, your GPS may be more accurate than your nautical chart—especially if the chart edition is more than 20 years old. Chart errors now comprise the signal greatest source of error (except for human error) in the navigational equation. However, other possible sources of error may be present as well, such as:

- ⇛ Inherent chart inaccuracies
- ⇛ Mistakes in transferring positions from the chart
- ⇛ Temporary periods of degraded GPS performance due to ionospheric activity, electrical interference and other shipboard causes
- ⇛ Sudden GPS failure
- ⇛ Mistakes in entering co-ordinates into the GPS receiver/navigator

The arrangement of the satellites in the sky, as seen from the GPS receiver, can also have a significant effect on GPS accuracy. The ideal arrangement of satellites is to have one overhead and three more equally spaced around the horizon, but high enough in the sky not to be affected by atmospheric interference. Any other arrangement results in a horizontal dilution of position (HDOP), which further degrades GPS accuracy beyond the basic 20 metres. However, there are generally 6 or more satellites visible at any one time and since modern GPS receivers monitor up to 12 satellites simultaneously, HDOP effects are rarely critical.

Other factors, such as the vessel's own metal masts and rigging, large structures, and high mountains can also interfere with signal reception, degrading GPS accuracy.

Horizontal Datum

Cartographers and Hydrographers use precisely defined "datums" to determine the geographic co-ordinates of positions on the surface of the earth. With the advent of satellite positioning systems and satellite assisted surveying techniques, cartographers discovered that the assumptions they made regarding the shape of the earth were no longer valid. Consequently, the latitude and longitude grids on the maps they drew were offset from their true locations so a new worldwide datum system was developed. This is known as WGS84 (the North American version is NAD83). The result is that positions of geographic features taken from older charts (drawn to an earlier datum – NAD27) cannot be reconciled with their positions on charts drawn to NAD83.

Most GPS receivers can calculate the difference between the two datums and thus compensate for the datum shift. **But you must make sure that your GPS receiver is set to the datum of the chart you are using**; otherwise errors of up to 200 metres (in Canada) can be introduced into your position fix.

Since electronic charts are normally corrected to WGS84 (or its equivalent – NAD83), you should make sure that your GPS receiver is set to fix positions in one of those datums when using electronic charts.

Many Canadian charts are still drawn to NAD27, so check the datum of each chart when you intend to use it with GPS positioning. The information you need can be found in a paragraph named "Horizontal Datum," located in the title block of the chart.

Differential GPS (DGPS)

It stands to reason that if you have surveyed your position with great accuracy, using some other means than GPS, then you can compare it to the GPS position of the same location, and discover the amount of error in the GPS position. This is the function of a DGPS reference station. The error information is then broadcast over separate radio frequencies to DGPS receivers at sea. A built-in computer in the DGPS receiver uses the corrections to enhance the accuracy of the GPS fix. The result is accuracy in the order of two to ten metres, depending on your distance from the reference station.

This differential process eliminates the errors that are the same at both locations, such as selective availability and atmospheric effects. The greater the distance between the ship and the reference station, however, the greater the likelihood that atmospheric effects will be different at the two locations. Therefore, high order DGPS accuracy is limited to areas that are within a few tens of kilometres of a reference station. In the near vicinity of a reference station, residual errors may be as little as two metres. But as you move further from the reference station, the accuracy diminishes and errors get steadily larger.

DGPS is earth-based, and the correction broadcasts are subject to being blocked by high mountains and by atmospheric interference

When GPS Fails

Failures of GPS can be roughly classified into the following categories:

Total failure

The GPS receiver/Navigator display either dies completely or freezes up. This could be due to a power failure, corrupted software, faulty antenna connections, or failure of some component in the onboard equipment. It could also be due to the failure of one or more satellites.

Partial failure

The most dangerous failure is when the receiver/Navigator continues to operate but gives erroneous information. This could be due to overloaded memory, corrupted software, faulty antenna connections, improper antenna placement, or external or onboard interference.

Human error

Usually due to improper data entry, the receiver/Navigator operates on the wrong instructions and provides information that is not appropriate for the situation.

A total failure of the equipment is easiest to detect, but when the display is out of sight and the unit is providing data to another navigation instrument, you must continuously verify that the data source (the GPS receiver) is functioning properly.

Old Data

If your set is equipped with an "old data" alarm, stay alert for the alarm indication. An "old data" warning appears whenever the receiver loses contact with the satellite signals. This indication may not be audible, so make sure you can recognise it immediately, because the display will freeze at the moment the GPS signals were lost. An "old data" alarm is the surest way to determine if you have suffered a complete GPS failure.

The most likely cause of lost signals is a faulty antenna connection, so as soon as the indication appears, check the connection. Look for cracked insulation or pinched antenna wires. And finally, check the antenna itself. Small cracks in the covering can allow water to penetrate to the wire-wound core and corrode the fine wires inside.

An old data warning may appear when you carry a hand-held unit inside the cabin of a boat where it cannot sense any satellite signals. The warning may even appear when a large amount of rigging obstructs the satellite signals or when you are moored close alongside large steel buildings or a high cliff. Whatever the cause, the best solution is to place the GPS where it has an unobstructed view of the sky–hold it up in the air if you must. If you determine the cause is tall buildings or cliffs, there is not much you can do except wait a little and hope that, as the satellites move through the sky, enough satellites will become visible for the receiver to calculate a fix again.

An "old data" alarm is the surest way to determine if you have suffered a complete GPS failure.

Using your GPS

As a crewmember you may be using the GPS to monitor the vessel's progress or even to guide the vessel along an intended track. The GPS is a remarkable navigation aid and it has taken much of the mystery out of fixing your position. Yet in a coastal environment the GPS system error can vary and this error combined with operator error can easily place your vessel in the wrong spot. The GPS may indicate that you are in safe water while in reality; you are heading into the rocks.

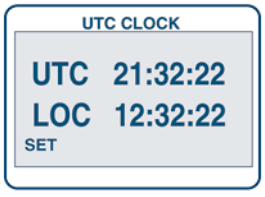
GPS receivers are subject to errors and therefore positions should not be solely based on one source of information. When underway do not fall into the trap of following the GPS arrows, look up and use your eyes, your chart, and the radar to constantly monitor the progress of your vessel.

This section outlines some of the features that most GPS receivers have in common. Generic menus are used as examples for the different features so that a new user can read this section then practice using the functions on their own GPS.

GPS receivers come in different shapes and sizes and recently many companies are making inexpensive portable models that can be used on land or sea. Every make and model is different, therefore the only way to become a skilled GPS user is to spend a few hours with the owner's manual and the machine itself pushing buttons and practicing the menu routines.

Initialize the Receiver

Each receiver has a specific set up routine outlined in the owners manual. These steps should be followed carefully for mistakes in the set-up can induce errors in the system.



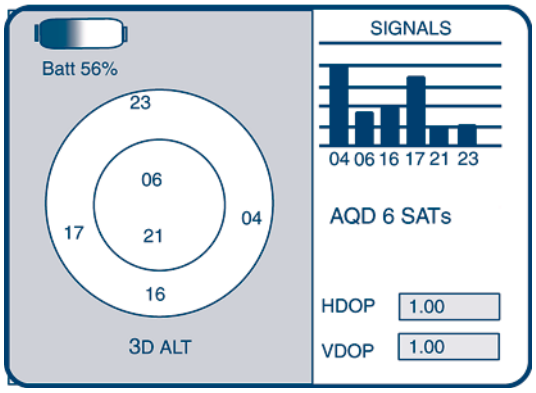
When the GPS is new or has been moved more than 500 miles since its last use it will need time to initialize. It may prompt you to enter an approximate position and a country code. You may be asked to enter the time and your time zone. The GPS system

relies on the science of measuring small amounts of time difference so it is a good idea to ensure that the clocks are set correctly.

During initialization the receiver is gathering ephemeris (schedule) information from the satellites and storing that information in the memory for the next time you use it. The next start up will acquire a position much faster from now on.

The Satellite Page

This page gives you an idea of what satellites are acquired and how strong the signals from them are. The receiver requires three strong signals for a two dimensional position and four signals for a three dimensional position. The circles represent the altitude (angular height from the horizon) of each satellite. The middle of circle is higher and the outside of the circle is lower on the horizon. There will be some measure of position accuracy on this screen. This will indicate the quality of the position information based on a few factors. Satellites can become masked (obstructed) or lose their signal strength, and the receiver may not have strong enough signals or geometry to maintain an accurate position.



Six satellites have been acquired

Position Errors

HDOP

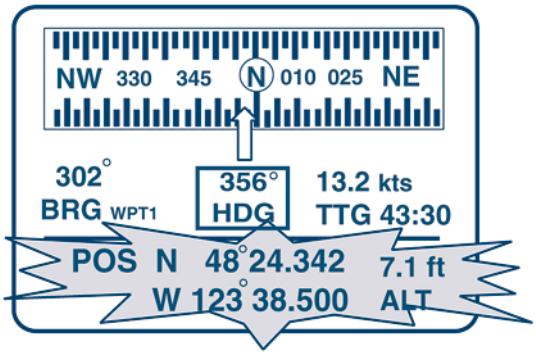
Horizontal Dilution of Position or HDOP is a measure of the quality of geometry. Signal geometry is good if you have satellites that are received from high and low altitudes. If the satellites are grouped too close together then your position accuracy becomes diluted, and HDOP goes up. Ideal reception occurs at an HDOP of 1.0 that's three satellites at 120° and one directly overhead. Questionable positions are at anything over 3.0 and when HDOP reaches over 5.0 the receiver will alert the user that the position is unreliable.

Geometric Quality (GQ) and Estimated Position Error (EPE)

These are two other measures of position accuracy found in many receivers and they usually will indicate the position accuracy within a range of metres.

If a GPS is getting bad data then it will do one of two things:

1. Sound or flash a warning alarm and switch to DR (dead reckoning) mode. This is when the receiver guesses your new position based on your course and speed from your old position. As the Royal Majesty (see story p. 120) discovered, a GPS in DR mode can be a dangerous thing if you do not know that it is guessing.
2. Most GPS receivers, when given old data will simply stop updating the position and start to flash or sound an alarm. Every crewmember should be familiar with the receiver's method of indicating an inaccurate position.

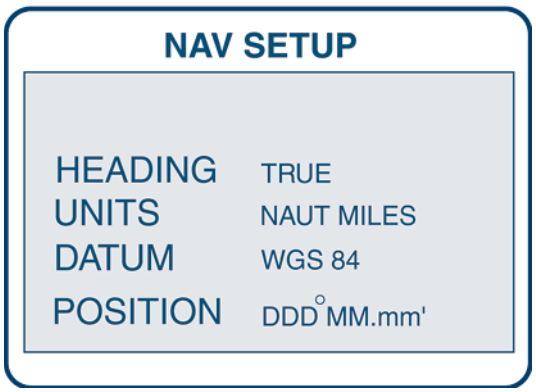


COORDINATES FLASHING

Flashing coordinates can indicate old data or an inaccurate position

Navigation Set-up:

Getting the right datum is a critical step that can't be overlooked when setting up your receiver. If your chart is based on NAD 27 and your GPS is set for WGS 84 then the GPS will indicate you are in the wrong spot on the chart. Most receivers will be set on WGS 84 as a default but have over a hundred different datums in the memory bank. Read your own-



The owner's manual will guide you through setting up the proper datum and units.

ers manual and follow the steps to setting the receiver to the correct datum and as you change charts don't forget to check your new chart for the datum it uses.

Using Common GPS Features

Waypoints and Routes (The specific menu routines for these functions can be found in the GPS owner's manual)

Waypoints are positions entered into the memory of a GPS receiver or chart plotter. A string of waypoints that is used to get somewhere is called a route. The individual paths between waypoints are the legs of the route. Most functions of the GPS are based around these three features.

Entering Waypoints

Most systems allow the user to enter waypoints using a few methods. Here are three common methods.

- ⇛ Name the waypoint and enter the latitude and longitude of the desired spot
- ⇛ Enter your present position and name the waypoint
- ⇛ Use a cursor on an electronic chart or plotter display to mark a spot and enter it as a waypoint.

NOTE: When naming waypoints, use geographical references to identify that position instead of numbers and letters (if your machine will allow this). This makes the waypoints easier to recognise in the memory and easier to place logically into routes (e.g. Henry Point ; Lama Pass East).

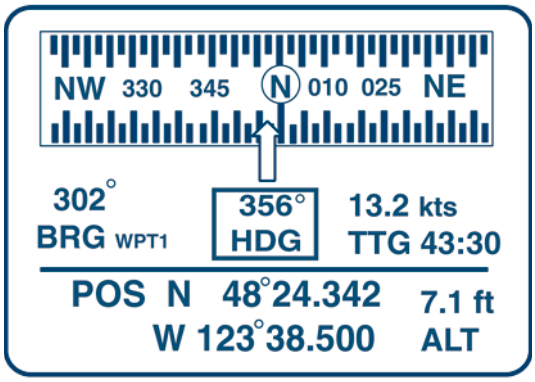
Routes

Routes can be used for regular trips that the vessel makes or for planning a passage in which you need to follow a specific path. A route is simply a list of linked waypoints that connect together. If you have a bank of stored waypoints in the memory then you can create a route by stringing them together and naming that route (e.g. Masset to Triple Island). The GPS will mathematically calculate the distances and courses to follow for each leg of the route, even without a position fix. You can use this list of leg courses and distances to verify your chartwork and make notes for your passage plan.

Underway

Position Screen

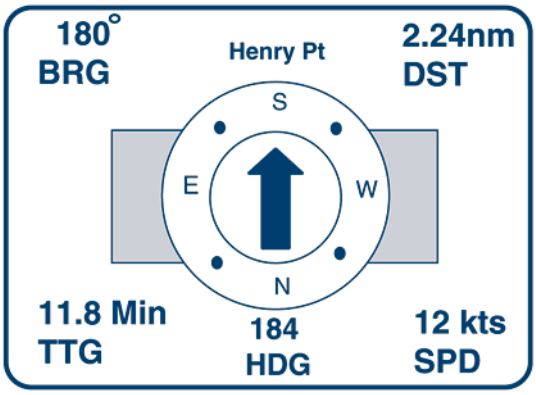
The position screen is the main screen that can be used to steer, fix your position and check the general status of the system. All the essential navigation information is here. Not all systems have the compass graphic but they will list your heading information somewhere on this screen.



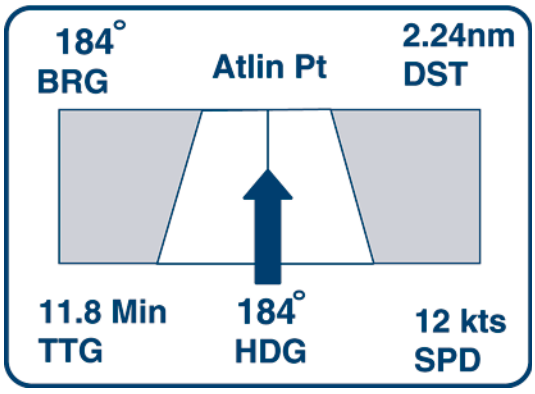
Position Screen

Navigation Screens

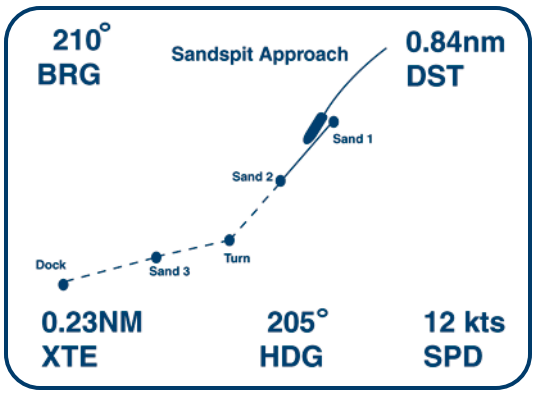
Most GPS systems have a few navigation screens to choose from, they are usually variations on the same three themes, compass screen, road screen and plotter screen. When following a route, going to a waypoint or fixing your position you can toggle back and forth to each of these screens to get the information that you need.



Compass



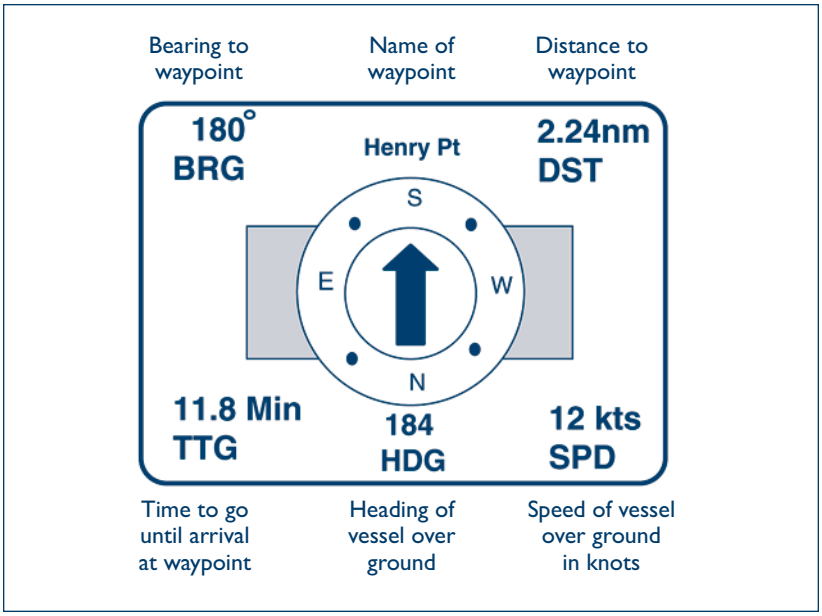
Road



Plotter

1. Compass Screen

This screen displays your course in reference to the cardinal points of the compass and an arrow will indicate the direction of your waypoint. This screen is easy to see and the large arrow in the middle makes it a useful quick reference while steering. It will give you the direction of your track over ground and this can be compared to your magnetic compass or gyrocompass heading.



GPS Drill: Accuracy and System Check

Checking the accuracy of your system is part of a routine of constant vigilance. Before getting underway and while underway, crewmembers can practice the accuracy check by following these steps:

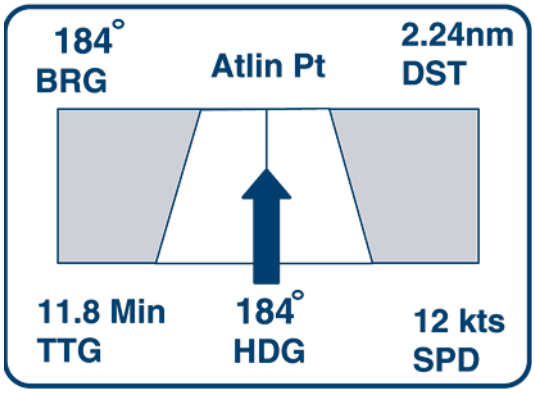
➡ *Switch to the position page and write down the position coordinates and compare those with the other position information at hand. (Radar, Compass bearings, Loran C).*

➡ *Call up the satellite page and check your position error (EPE,GQ, or HDOP). How many satellites are you tracking?*

➡ *Call up the nav set-up page and check the system's chart datum and compare that with the datum used on your chart.*

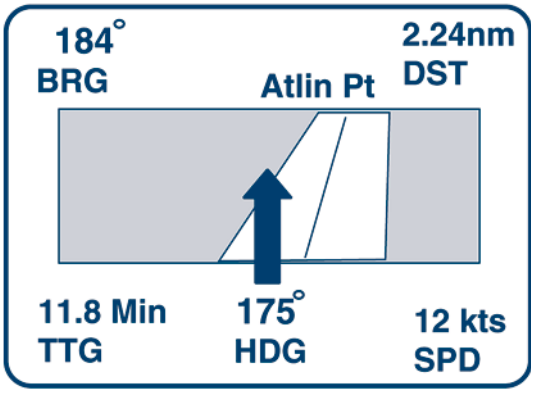
2. Road Screen

The road screen is designed to give the navigator an idea of how far the vessel has strayed off of the intended track (XTE or cross track error). The width of the road can be set to any desired value. The waypoint is indicated at the end of the road and the BRG is the course to steer to the waypoint. SPD and HDG are speed and heading calculated over the ground and the vessels movement through the water may be different. The road screen is effective in determining exactly how much you are being pushed off of your course.



Cross Track Error

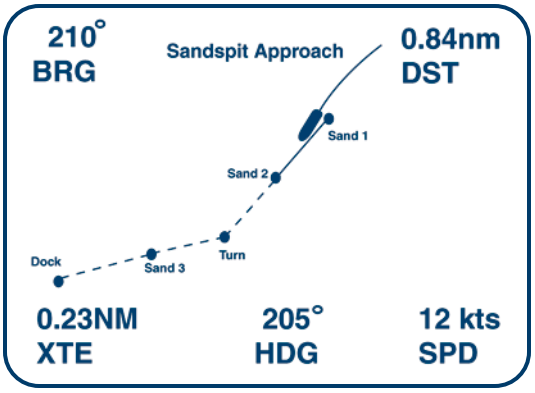
Wind, current or an unplanned course alteration can put you off of your intended track. When your vessel is being set off track, the road will move sideways and the end of the road indicates the direction in which you must steer to get back on the track to your waypoint. Not all screens have an arrow to indicate your heading but you can use this arrow to estimate a course to swing back to your track and then steer to the waypoint.



If the road width is set at 1 mile, then this vessel is 1/4 mile off of the track, and heading in the wrong direction.

3. Plotter Screen

The plotter screen is great for seeing where you have been. When following a course, searching a shoreline or running an open water search pattern, the plotter will show your path over the ground. The plotter will also display your route or string of waypoints and provide a graphical reference of where your vessel is on the route. This screen can also be helpful when estimating your cross track error and let you steer back to your intended track.



GO TO

This function allows the user to set a direct path to a position manually entered by coordinates, a plotter or a stored waypoint.

Man Overboard Board (MOB)

If someone falls over the side or you just need to mark a spot quickly and steer back to it then the MOB button will set your system to focus on that spot and provide a course to steer, distance to and time to go before you get there.

Creating a Route

Once you have waypoints in your systems memory you may wish to use them to create a route or make an entirely new route from different waypoints. When you select a string of positions and link them together the system will calculate the courses to steer between them and the distances of the legs. You can select and change the waypoint order and follow this route in either direction. Sometimes you may wish to delete or add a waypoint in a route.

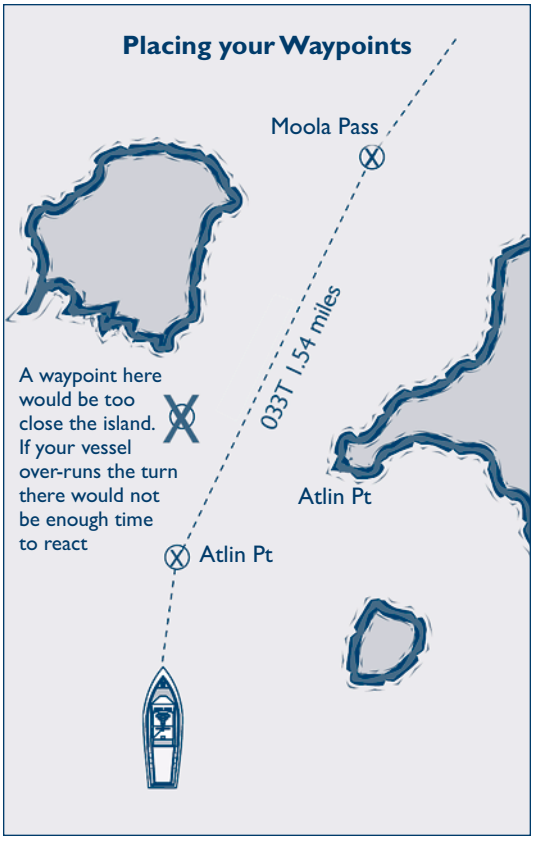
RT SANDSPIT

WPT	BRG	DST
SAND 1 SAND 2	210	1.1 NM
SAND 2 TURN	220	1.0 NM
TURN SAND 3	265	0.8 NM
SAND 3 DOCK	263	0.5 NM

Remember that the GPS will steer you directly to your waypoint regardless of obstructions

Route Planning

When you plan your routes, place the waypoints in open clear water to make sure that your course lines for the legs of your route pass through safe water. When planning turns at the beginning of the next leg, place the waypoint in a spot that will forgive position or operator errors See diagram). If you over-run your turn you do not want to find yourself up on the beach.



The waypoints are placed in clear water and named using a geographical reference not a number or a letter

GPS systems can be very accurate but not very smart:

The GPS only knows mathematical differences between coordinates on a sphere and it uses that and your position information to steer you to those points. The machine doesn't care if there are rocks, islands or continents in your way. It will quite happily steer you through the middle of these things.

GPS Drill: Routes

The buttons and menu routines can be complex when working with a GPS routes. Remembering the sequences takes time and practice.

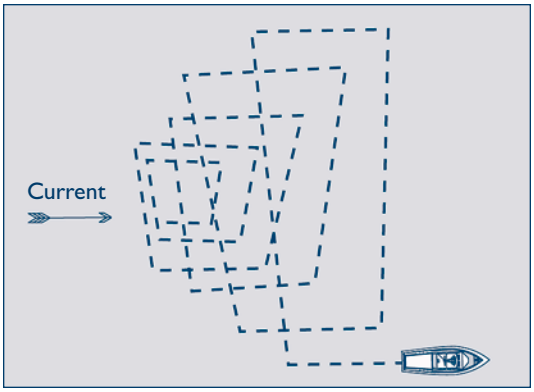
Therefore, each crewmember should sit down with the owner's manual and practice the following procedures:

- ➡ *Create and name a route*
- ➡ *Select and add previously stored waypoints into you route*
- ➡ *Enter and new waypoint and add it to your route*
- ➡ *Delete a waypoint from your route*
- ➡ *Activate and follow the route from first leg to the last*
- ➡ *Activate and return along that route (reverse route) from last leg to the first.*
- ➡ *Skip the current leg and advance to the next leg manually*

Using the GPS in searches

The GPS can be used in many ways during a search. If the JRCC provides the coordinates of a vessel in trouble or the commence search point for a search you can enter that position as a waypoint and hit the GOTO button for a direct line to that spot, provided the path is clear of dangers. In islands or along a shoreline, you can create a route with that position as the end of your last leg.

Using the GPS to run open water search patterns may not be good idea. The GPS does everything in reference to the ground and not the surface of the water. When searching for a person or object on the water you want your search pattern moving with the water surface and not staying with the ground. By using a stopwatch and timing your search legs, you will keep your pattern on the surface, and when you look at your GPS plotter your ground track will be skewed in the direction of your current. If you use the GPS to guide through the pattern the pattern will stay still while your search target may be drifting away.



Common GPS Symbols & Abbreviations

Abbreviation	Meaning
ALT	Altitude
AQR	Acquiring
BRG	Bearing to a position
DST	Distance to a position
ETA	Estimated time of arrival
EPE	Estimated position error
Ft	Feet
GQ	Geometric quality
HDG	Heading of vessel over ground
Kts	Nautical miles per hour
M	Metres
MAG	Magnetic
NM	Nautical mile
SAT	Satellite
SPD	Speed of vessel over ground
TRK	Track of vessel over ground
TRU	True
TTG	Time to go until arrival at position
WPT	Waypoint
XTE	Cross Track Error

7.6.3 Electronic Charting Systems and Chart Plotters

The electronic charting system is comprised of three components designed to fulfil each of the three basic functions of the system:

- **Input** – provided primarily by the GPS, although some systems incorporate fluxgate compasses, speedometers and depth sounders to verify information.
- **Processing** – generally this is also performed by the computers built into a GPS, but functionally this component allows for the storage of Waypoints, computes ETAs, determines relative bearings, and calculates a host of other information. Some more recent systems actually take input from a (D)GPS and process the data on a dedicated laptop computer.
- **Output** – The most common output device for charting systems is a raster display (similar to most computer displays), although LCD (Liquid Crystal Display) screens, Plasma Panels, and CRTs (Cathode Ray Tube) are also available. Sometimes output also takes the form of a servo control system such as an Auto Pilot.

Electronic Chart Display

Some basic definitions of the output displays need to be applied at this point:

Chart Plotter – a plotter which has the capability of displaying rudimentary charts;

ECDIS – (pronounced "ek dis") an Electronic Chart Display and Information System combining a GPS, computer, navigation software, and electronic charts that allow an operator to view the position of the vessel in real-time against a background chart.

Electronic Navigation Charts (ENC)s

These are electronic charts that are fully compliant with the international IHO-S-57 standard for ECDIS. These charts are electronic versions of the National Hydrographic Survey or NOAA charts, use the standard hydrographic symbols, are updated regularly, and are complete compilations of the same information contained in Notices to Mariners, List of Lights, Radio Aids to Marine Navigation and other official publications. These are very comprehensive databases in electronic form and are rarely found on Fast Response Craft, but are increasingly common aboard large commercial craft, military and Canadian Coast Guard vessels.

Vessel Icon

Different manufacturers use different icons to indicate the vessels's current GPS position. The purpose of the vessel icon is to show the operator where the electronic input thinks the vessel is situated, according to the most recent electronic data available to it. Some icons are shaped like a vessel and can orient themselves against a North Up background to indicate bearing and relative position to hazards. On some displays the icon (or a bearing line attached to the icon) becomes elongated as the vessel speeds up and gets smaller as the vessel slows down.

7.6.4 Depth Sounder

Under-rated and often overlooked as a Navigation tool by pleasure craft operators, Depth Sounders are invaluable for inshore or near-shore Search and Rescue work. Consider the altimeter in an aircraft – when coupled with a pilot's eyes and a reliable chart – an altimeter lets a pilot know exactly where he is. Depth sounders can be used in exactly the same manner – only the visual references (rocks instead of mountain tops) can sometimes disappear with a tide.

Depth Contours in Shoreline Search

The most common application of a depth sounder in SAR activities is when a vessel is called upon to perform shoreline searches. A coxswain may typically instruct a helmsman to follow a depth contour while other crewmembers are engaged in maintaining lookouts.

Cautionary Notes

Depth sounders, as with other electronics, use echo locating of radio signals to operate. Sometimes these radio signals have frequencies which are very close to the frequencies of other electronics, and the instruments may interfere with each other yielding false readings which may be assumed to be accurate. When depth sounders on small craft tend to flash on/off, their reliability becomes questionable. When this happens, there are always the old standbys: **Eyes and Chart**.

7.7 Navigation: When in doubt stop or slow down

The single most dangerous act in Search and Rescue is transiting to scene. You as a crewmember must constantly be vigilant and on watch. High-speed rescue craft require that all on board excluding victims must play an active role (lookouts) in the safe passage of the vessel. The communication between the Captain/Coxswain and the helm must be fluid, clear and regimented. If anyone is in doubt as to the safety of the vessel that person shall be able to stop the vessel for an assessment of position and direction. A prudent coxswain will realise that a vessel that moves that quickly can afford an orientation stop or two.

Navigational Aids and Common Light Combinations

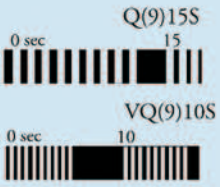
Each crewmember should be able to recognise the different buoys as well as identify the navigation lights of commercial vessels. These lights, when seen at night, can indicate the nature of the vessel's work and its ability to manoeuvre.

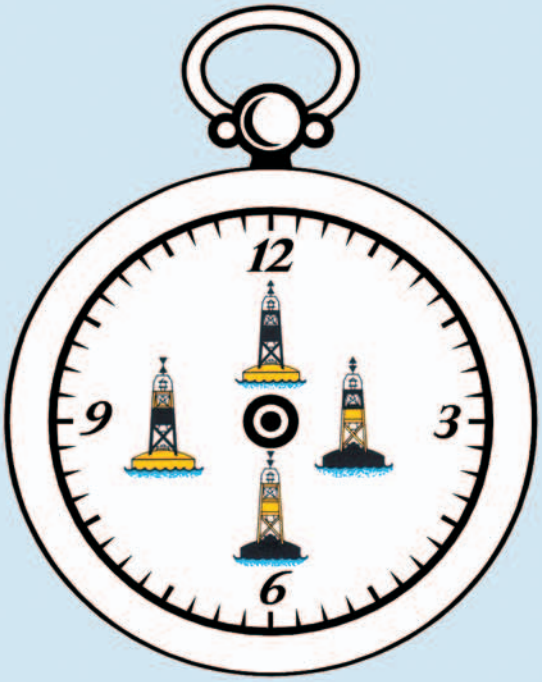
Cardinal Buoys Flash Groups

Using the clock to remember

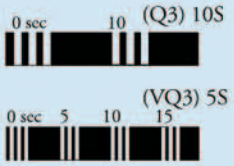
12/24 Flashes in 12 Seconds
NORTH CARDINAL

9 Flashes in 15/10 Seconds
WEST CARDINAL

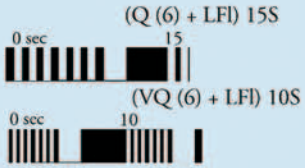




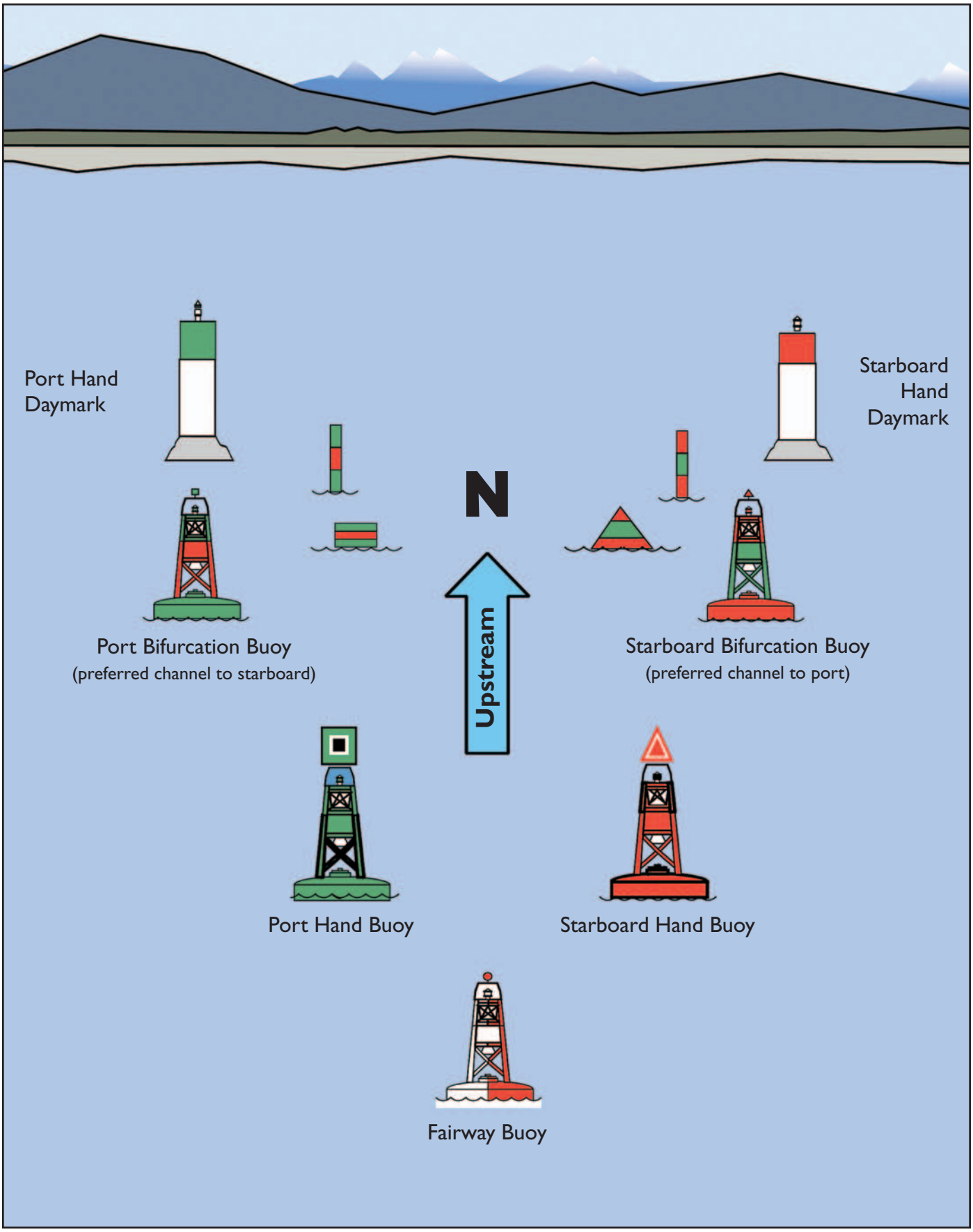
3 Flashes in 10/5 Seconds
EAST CARDINAL



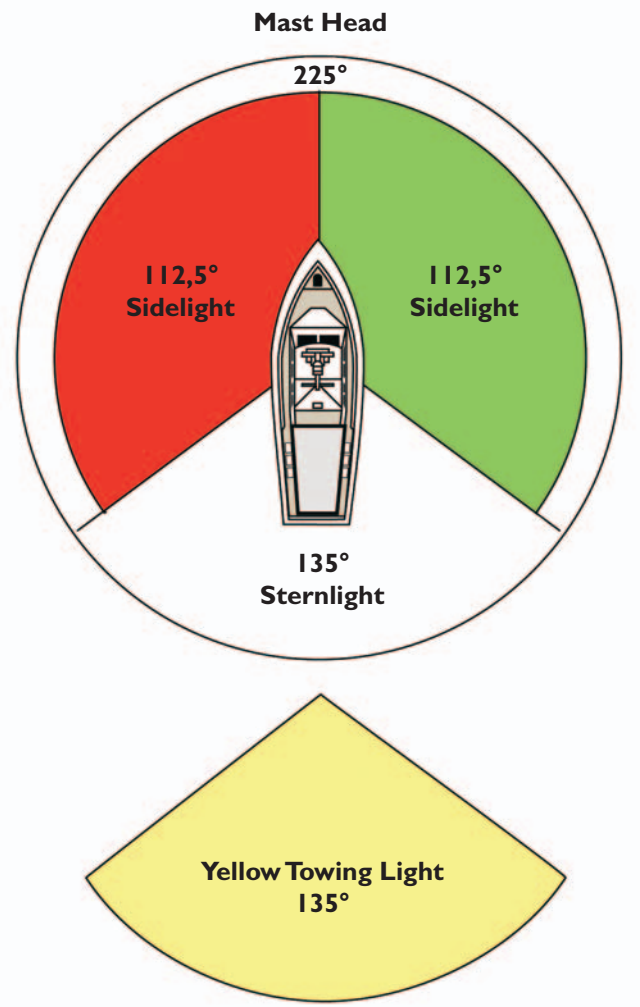
6 Flashes plus one Long 15/10 Seconds
SOUTH CARDINAL



Lateral Buoyage System IALA B



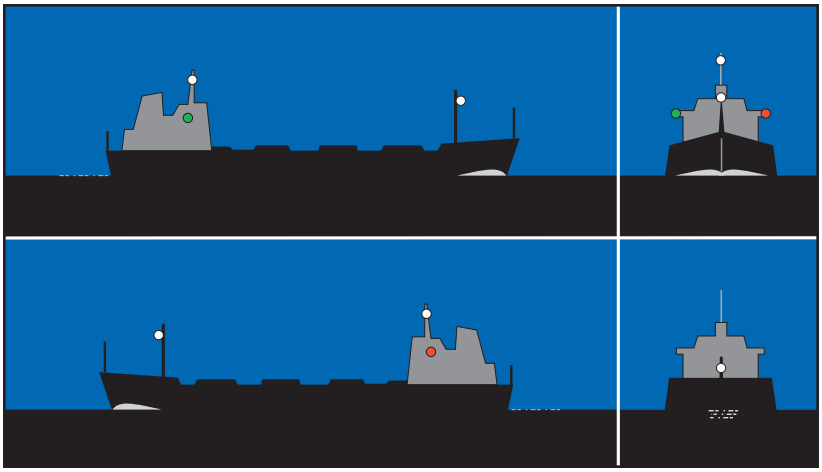
Arcs of Visibility for Navigation Lights

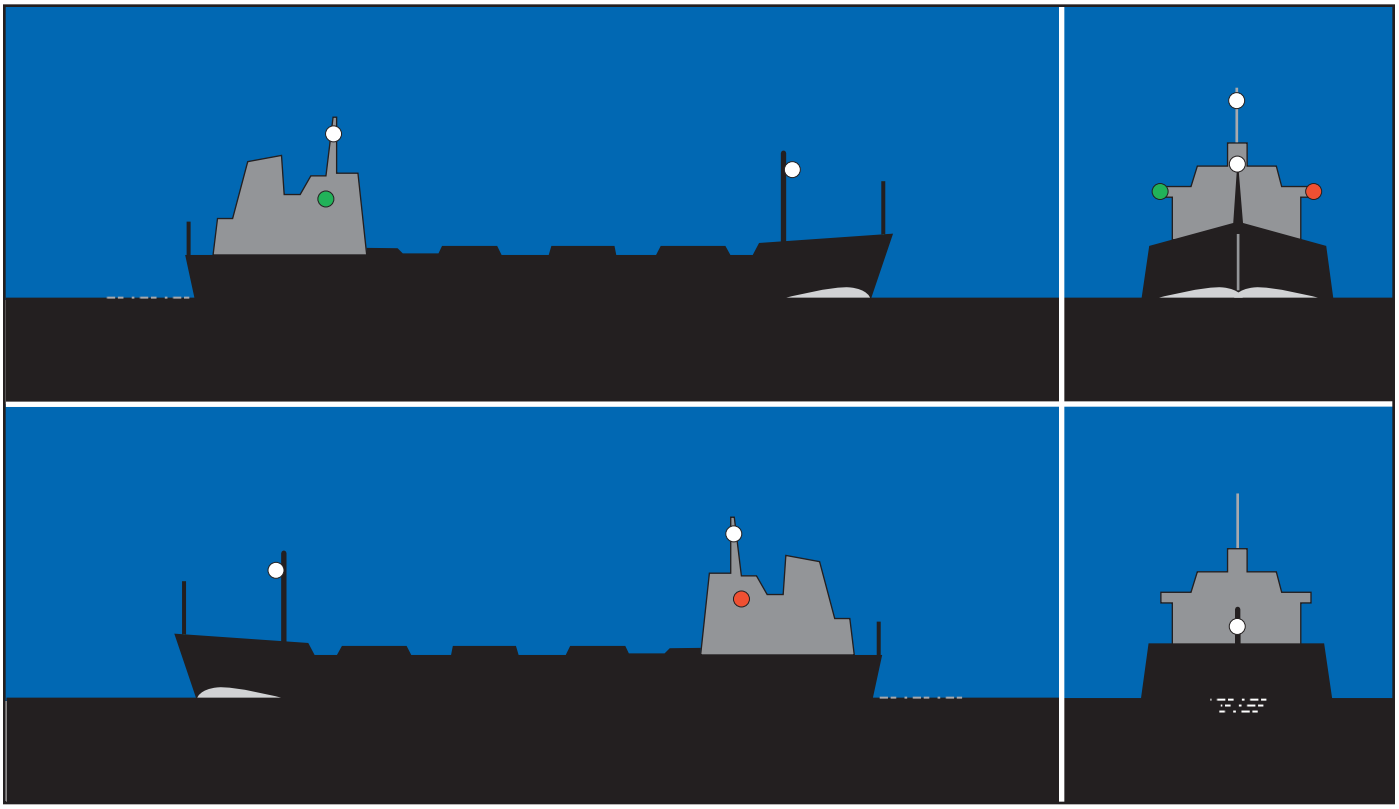


Key Diagram

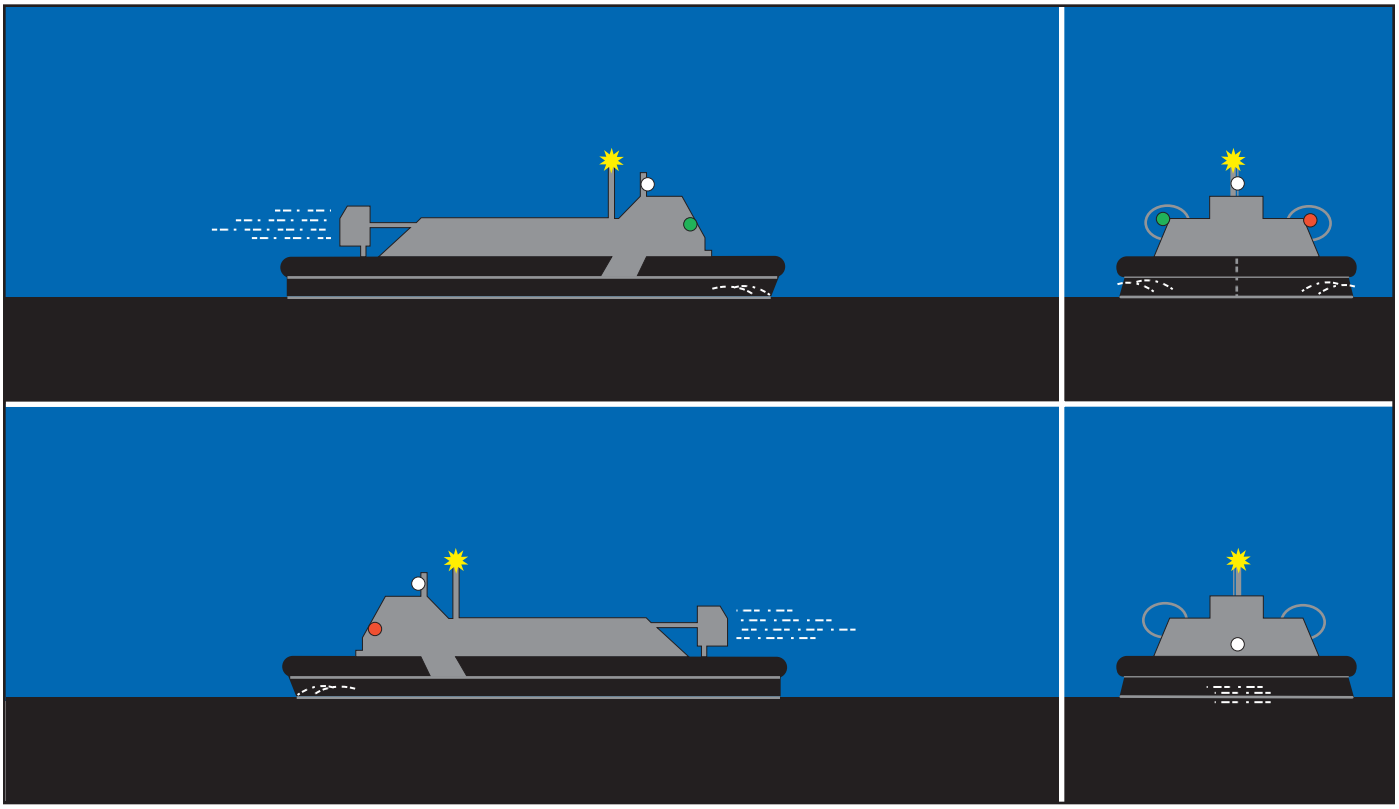
Note: For the following pages, please see beside a key diagram explaining what these pictures are showing;

- Top left - from starboard side,
- Top right - from ahead,
- Bottom right - from astern,
- Bottom left - from port side

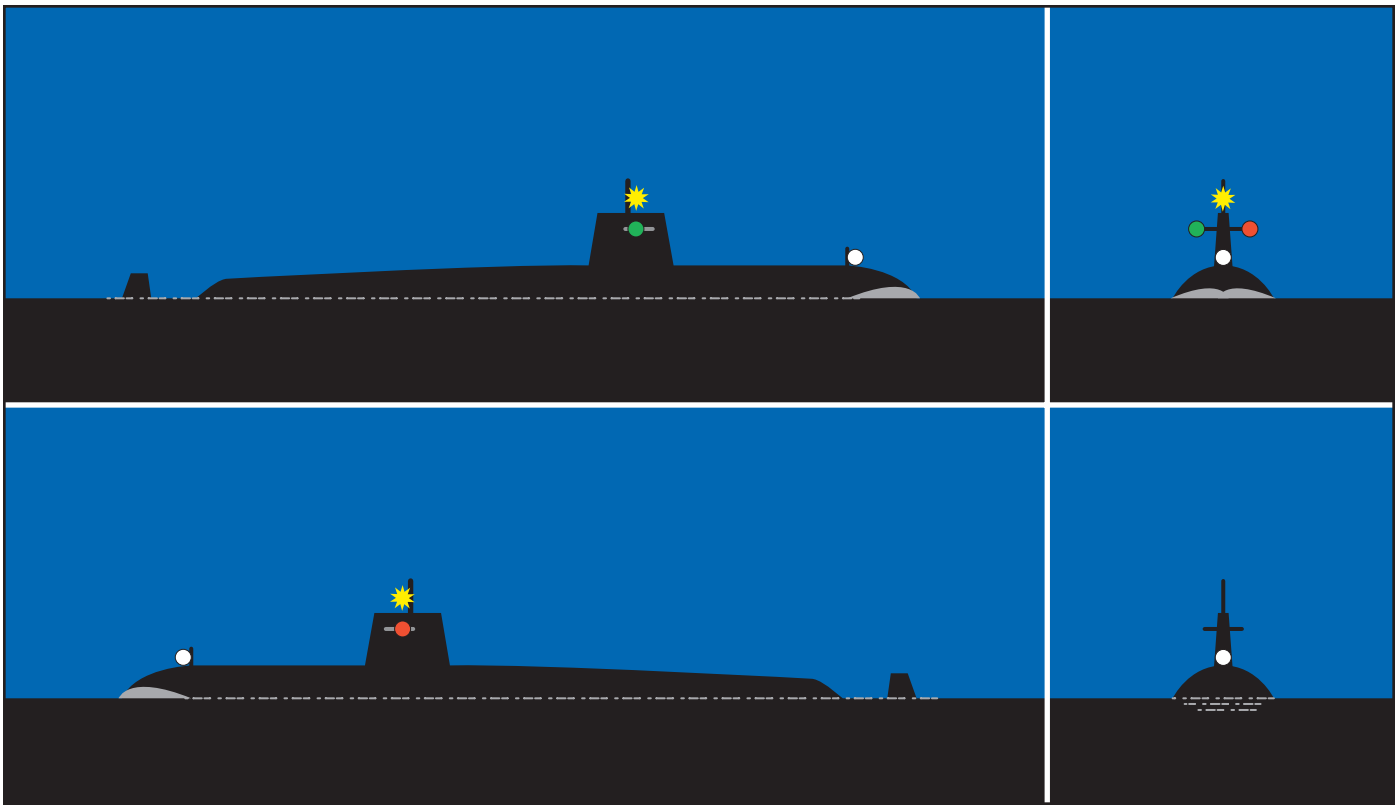




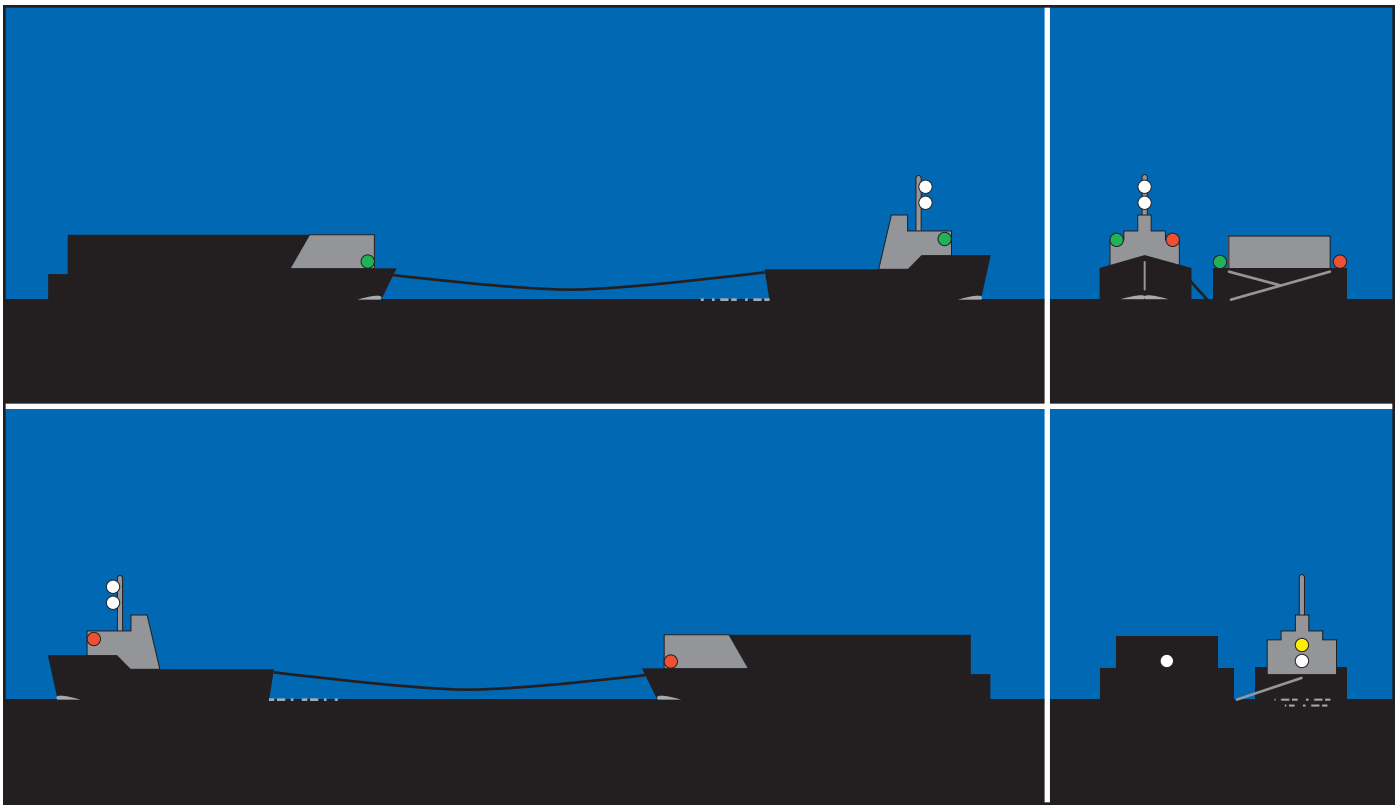
Power driven vessel, probably 50 metres or more in length, underway and making way.



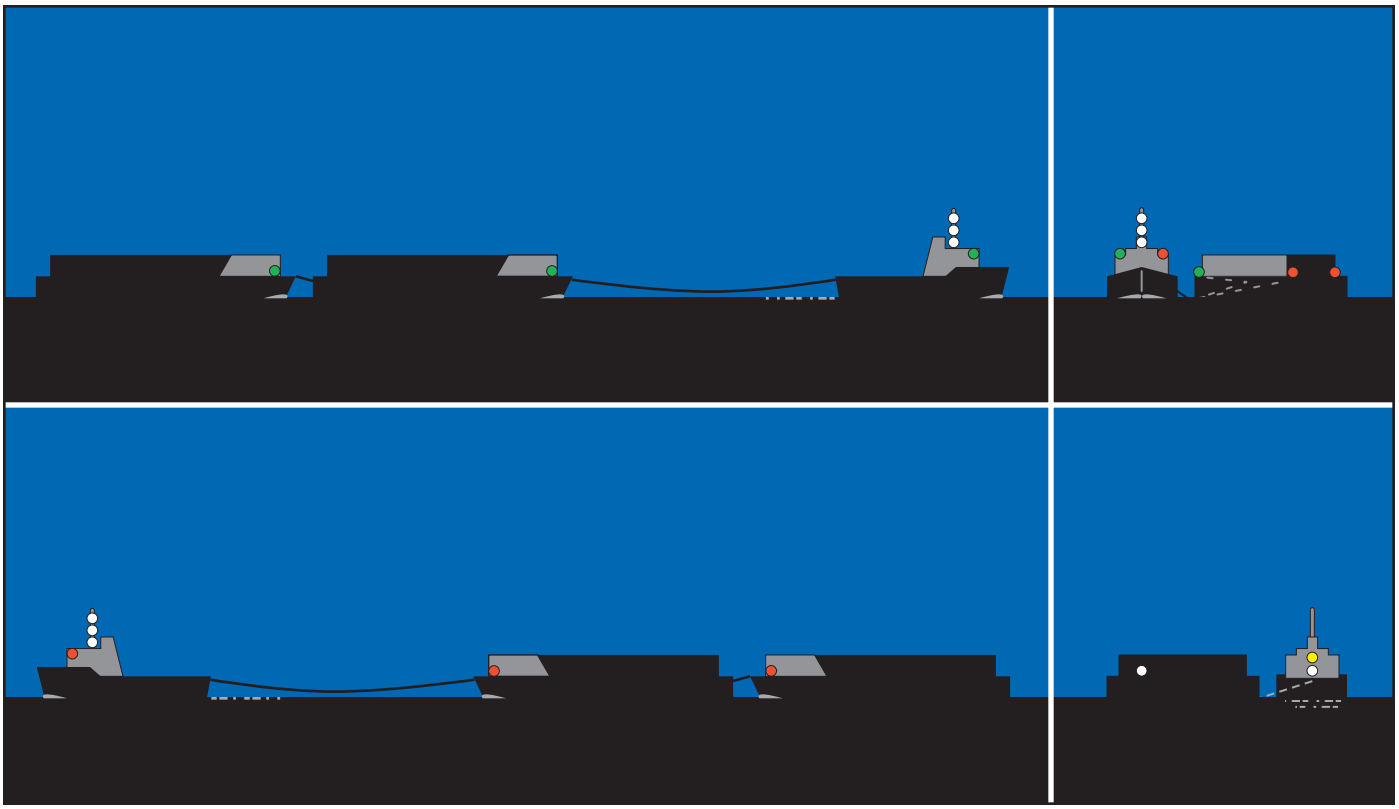
Air cushion vessel in non displacement mode, less than 50m in length, with yellow flashing light.
No flashing light when in displacement mode.



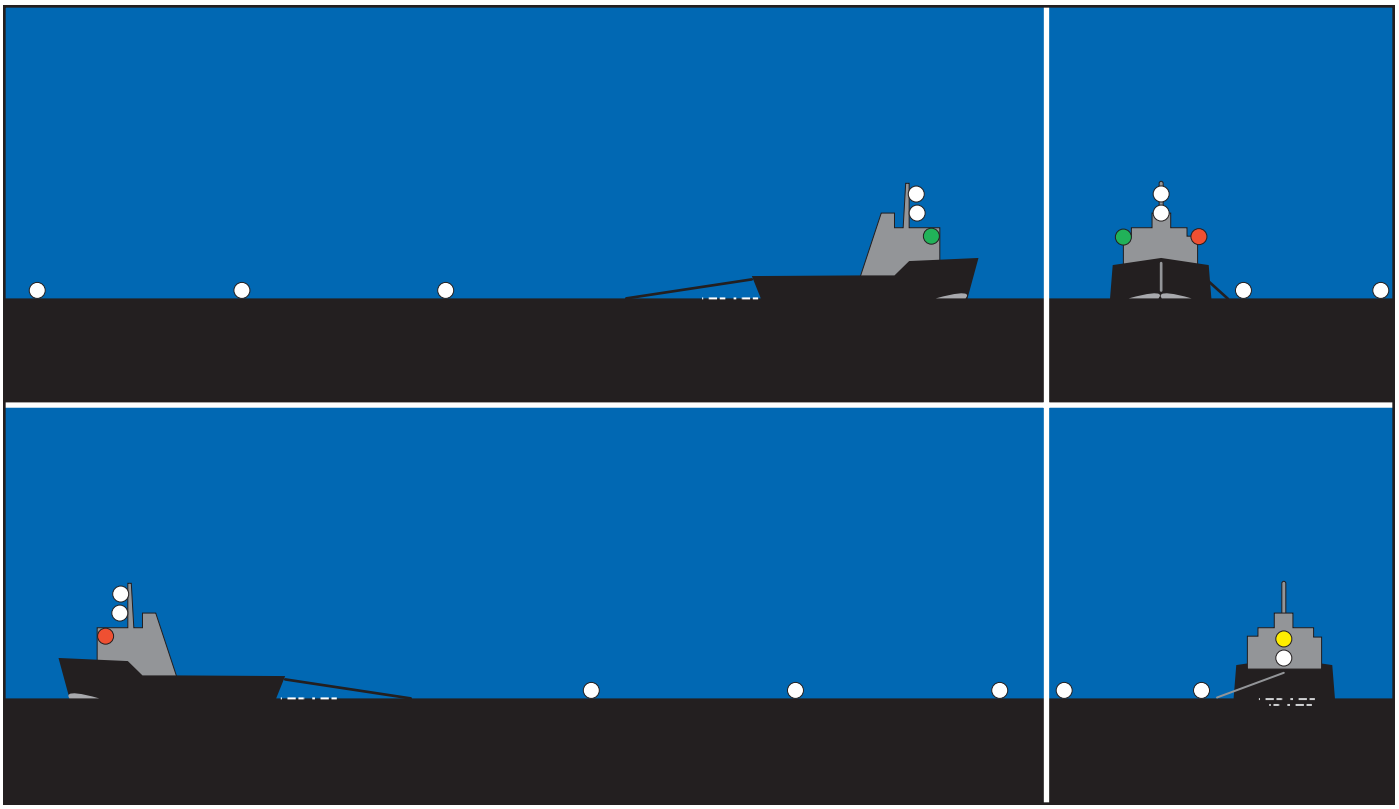
Submarine - power driven vessel, probably 50 metres or more in length, underway and making way with optional flashing yellow light.



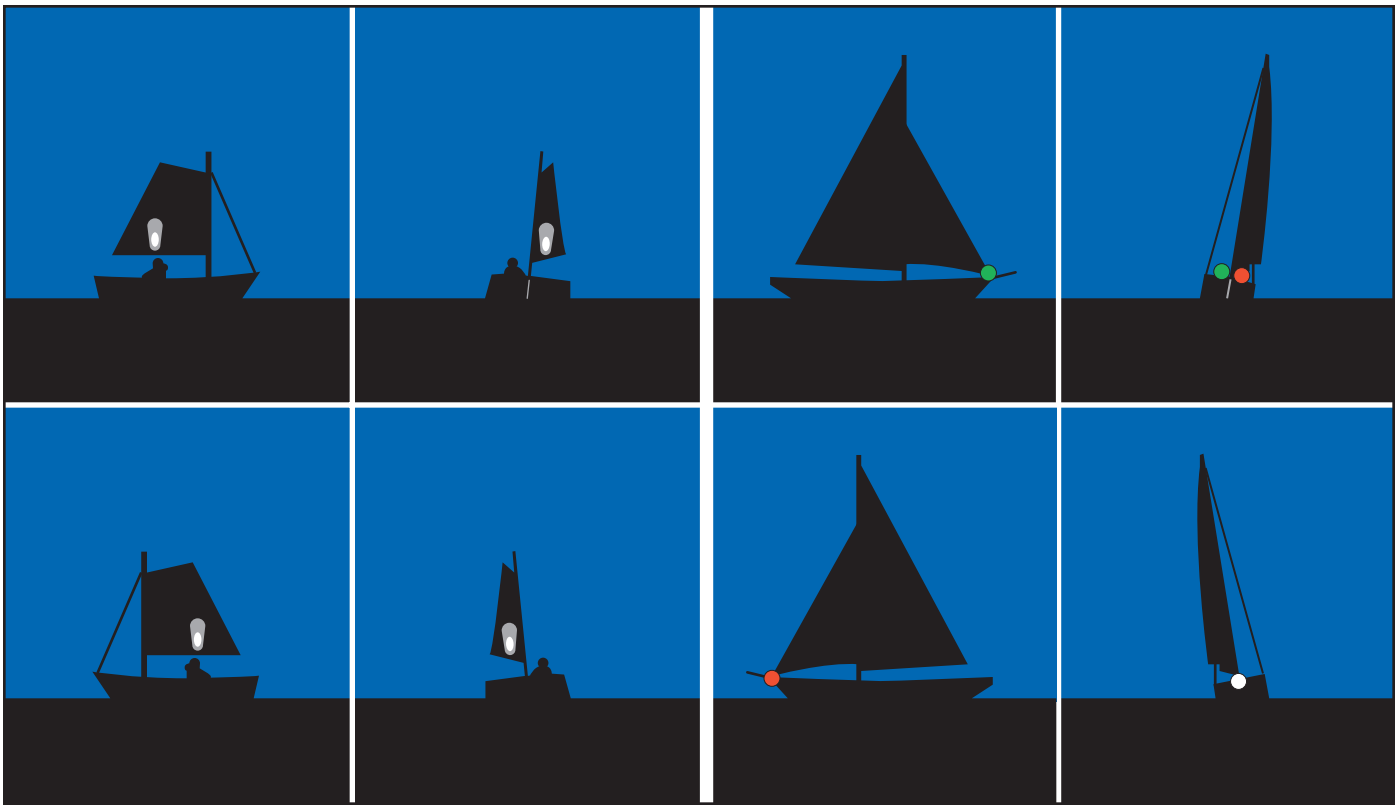
Vessel engaged in towing, where the length of tow is 200 metres or less, measured from stern of towing vessel to stern of tow, and the towing vessel is less than 50 metres in length.



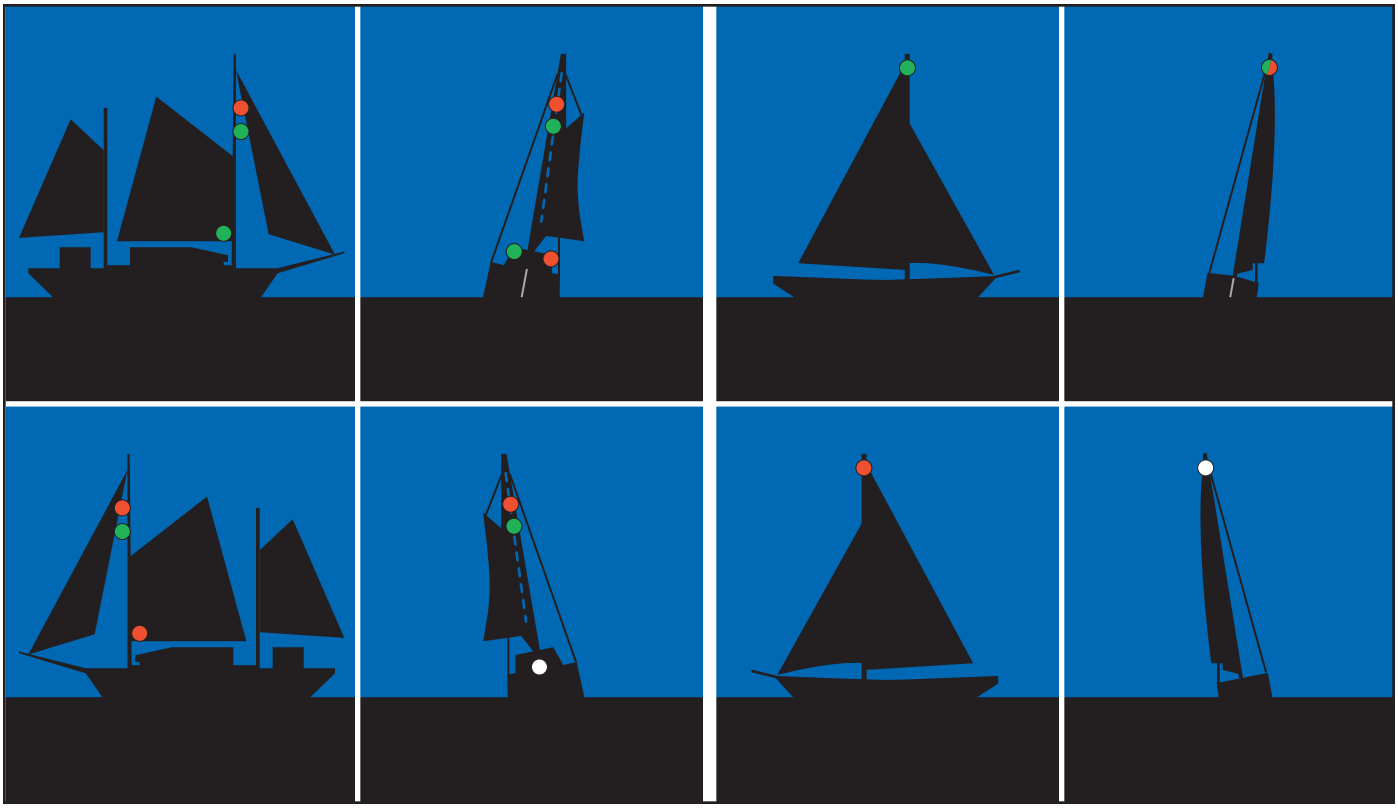
Vessel engaged in towing, where the length of tow is more than 200 metres, measured from stern of towing vessel to stern of tow, and the towing vessel is less than 50 metres in length.



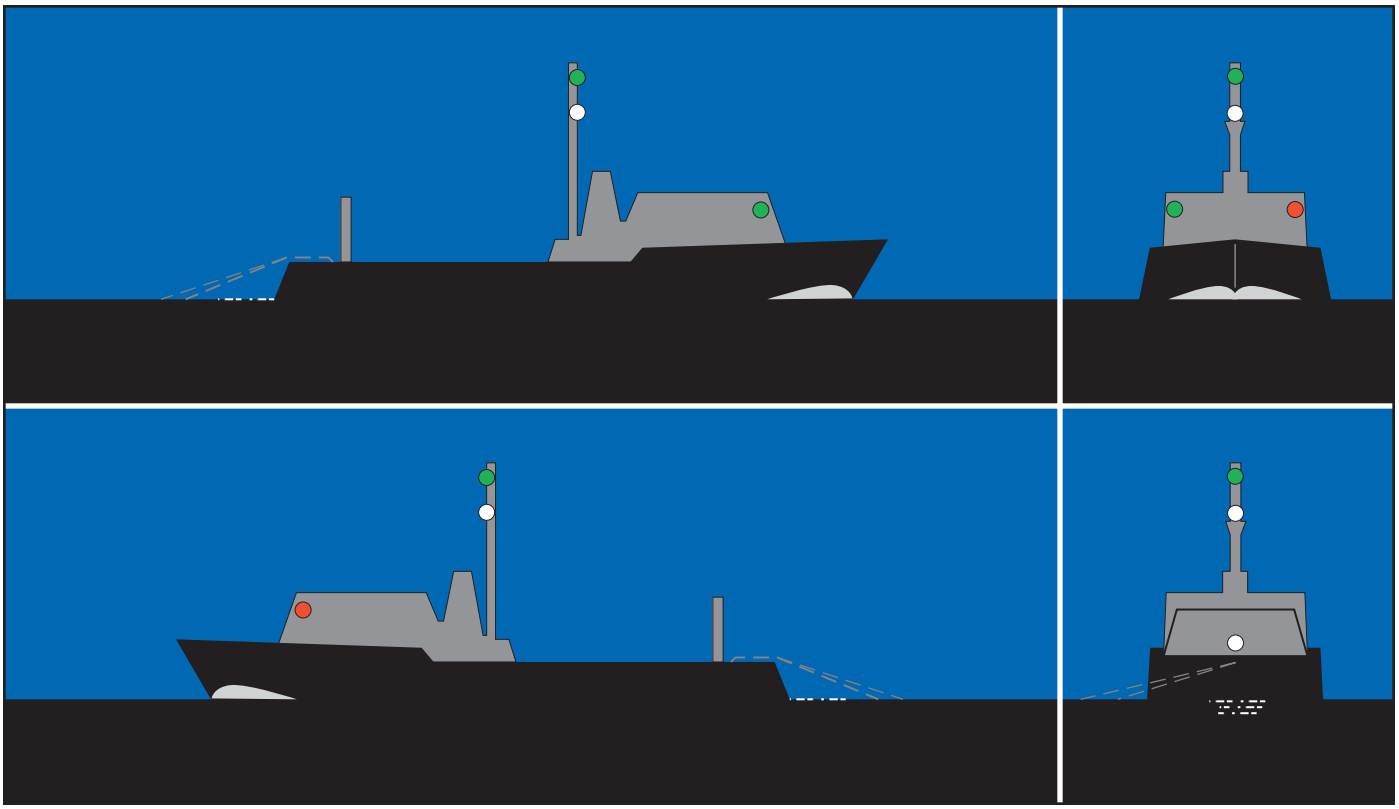
Vessel engaged in towing a log boom, where the length of tow is 200 metres or less, measured from stern of towing vessel to stern of tow,and the towing vessel is less than 50 metres in length.



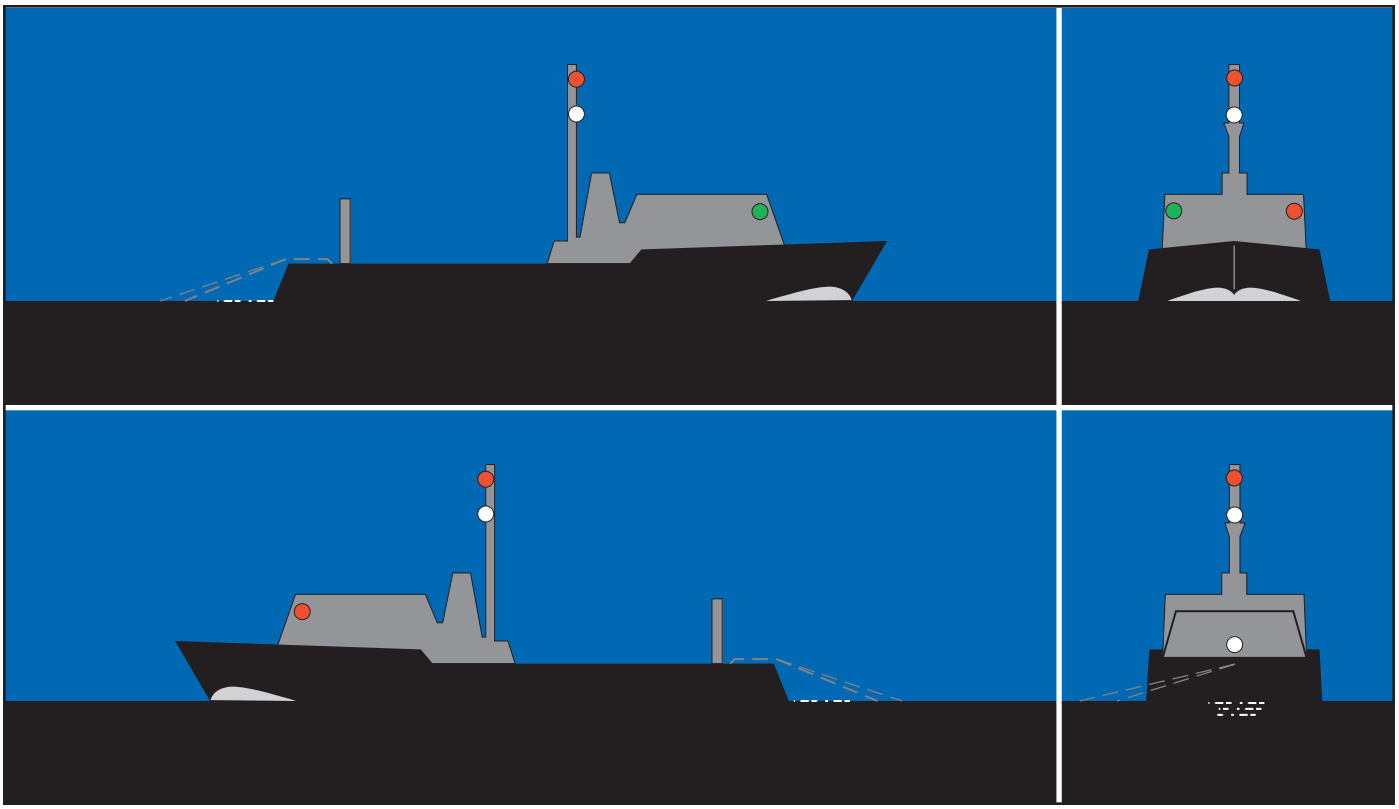
Left set / Sailing vessel under way, less than 7 metres in length.
Right set / Sailing vessel under way.



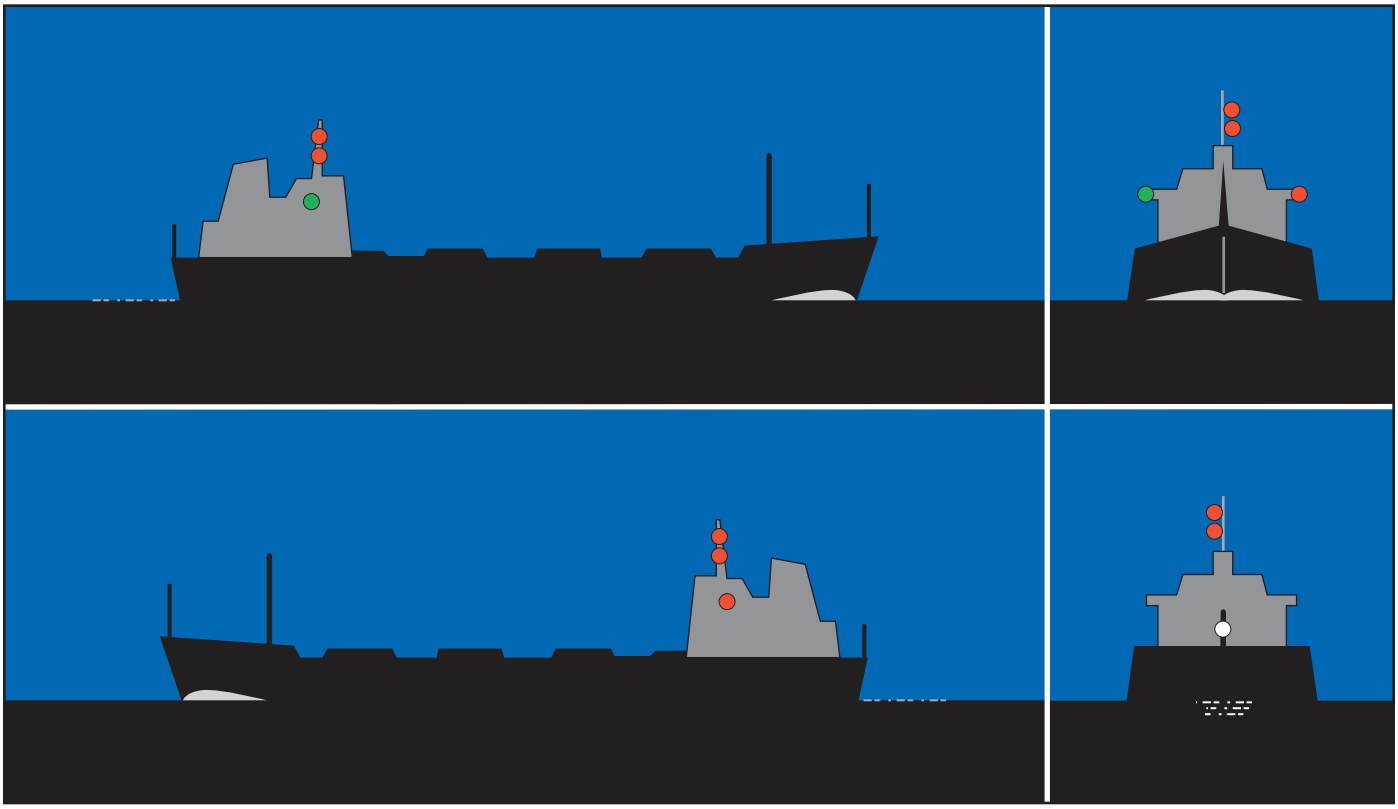
Left set / Sailing vessel under way, with optional lights.
Right set / Sailing vessel under way, less than 20 metres in length.



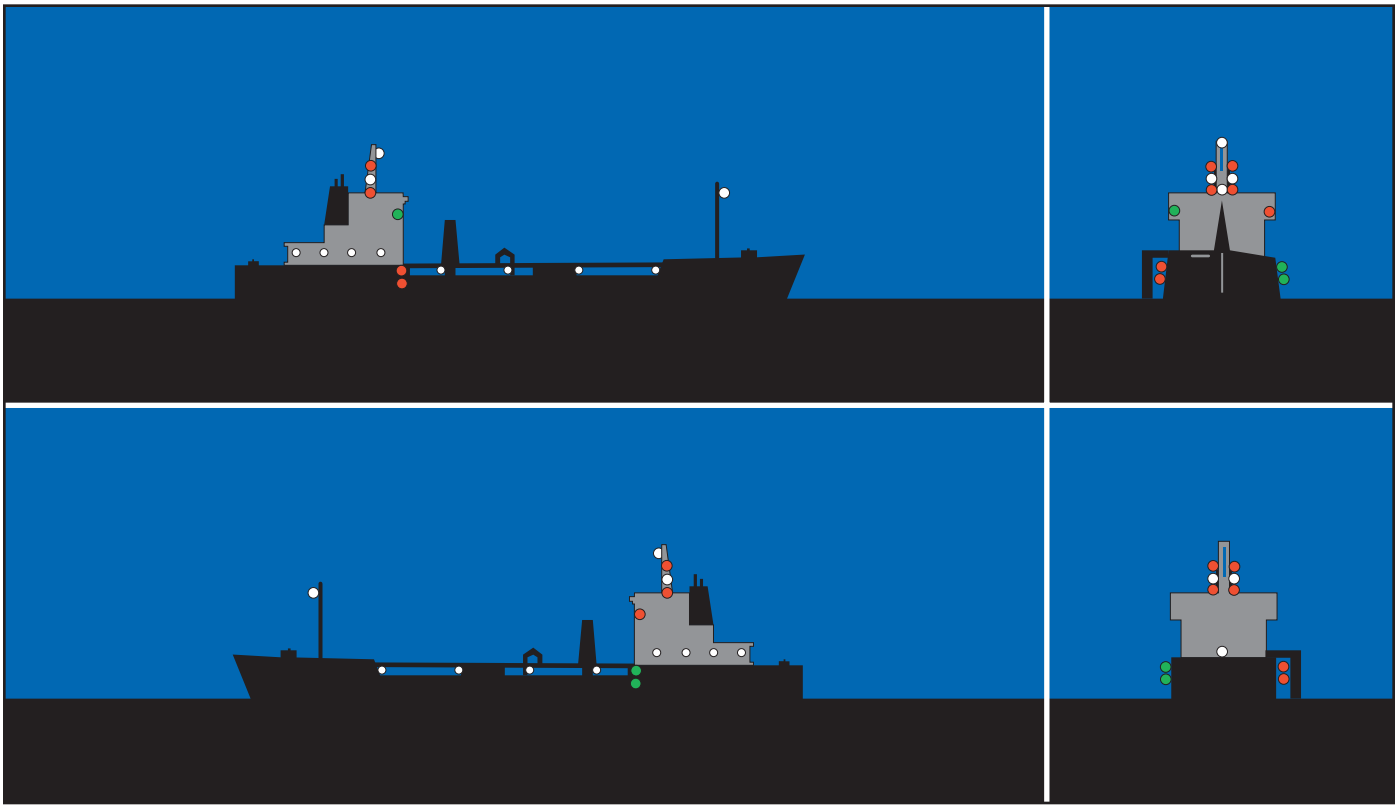
Vessel engaged in trawling, less than 50 metres in length, under way and making way.
Nets in the water.



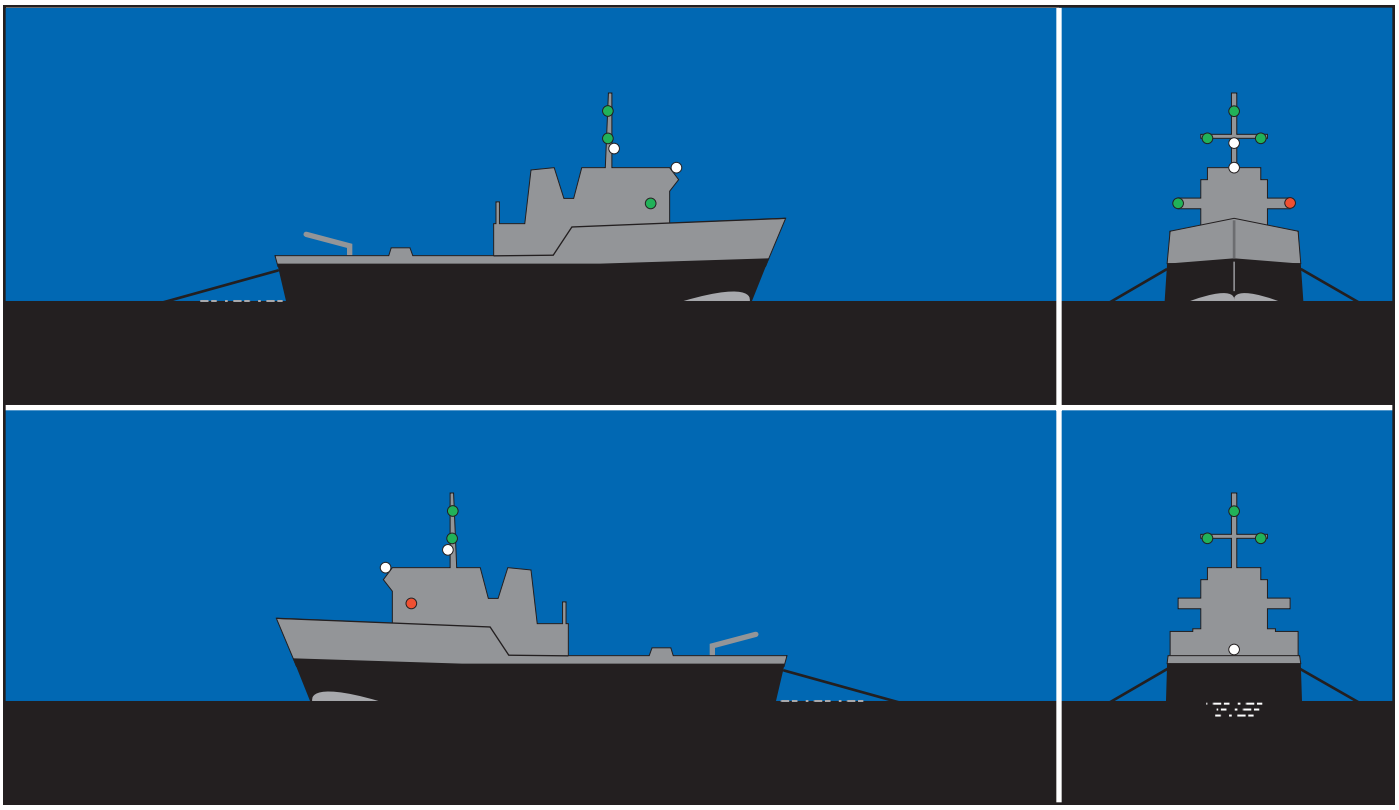
Vessel engaged in fishing, less than 50 metres in length, under way and making way.
Net in the water, but extending more than 150 metres.



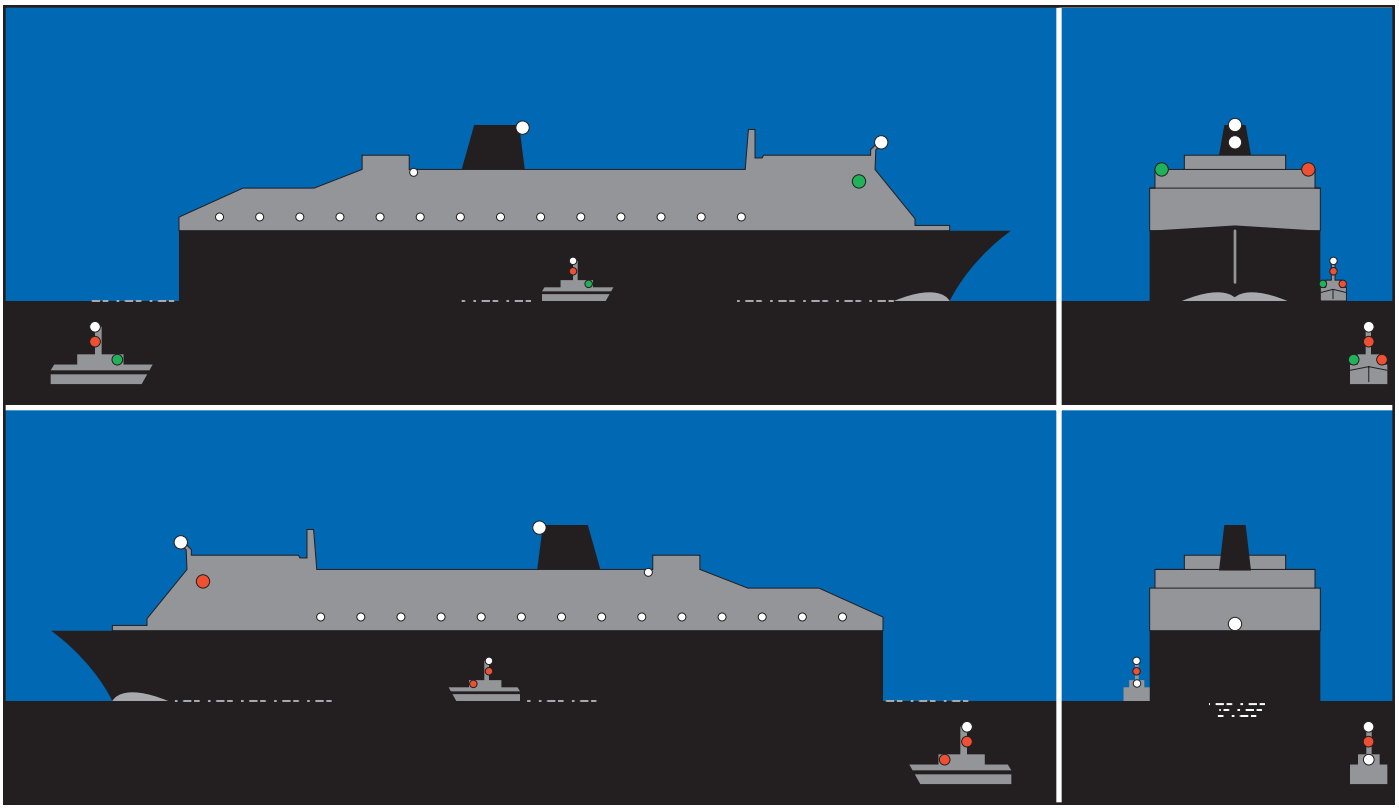
Vessel not under command, of any length, underway and making way,
When only underway, no side or stern lights.



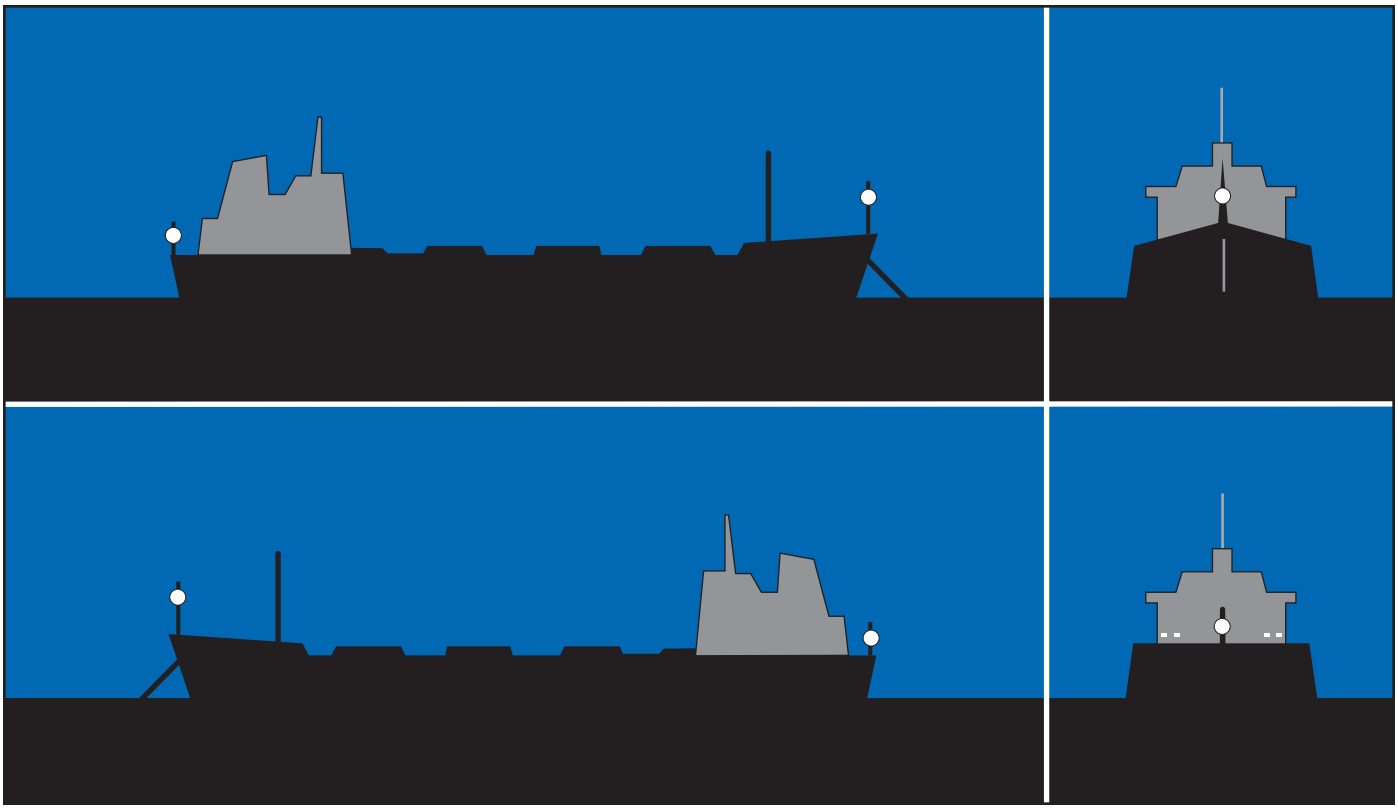
Vessel dredging and restricted in her ability to manoeuvre, probably 50 metres or greater in length, under way and making way, with obstruction on her starboard side, and safe to pass on her port side.



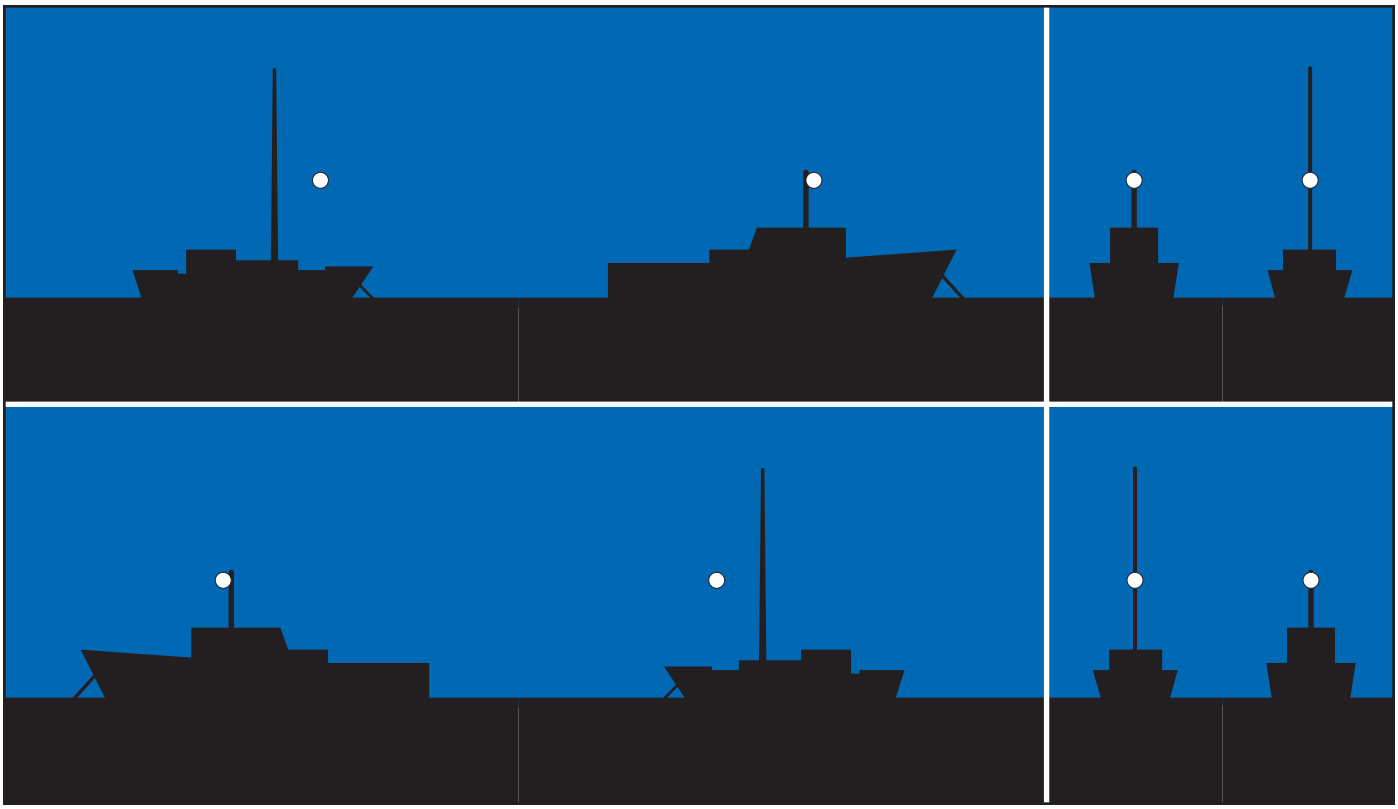
Vessel in engaged in mine clearance operations, under way and making way, probably 50 metres or greater in length.



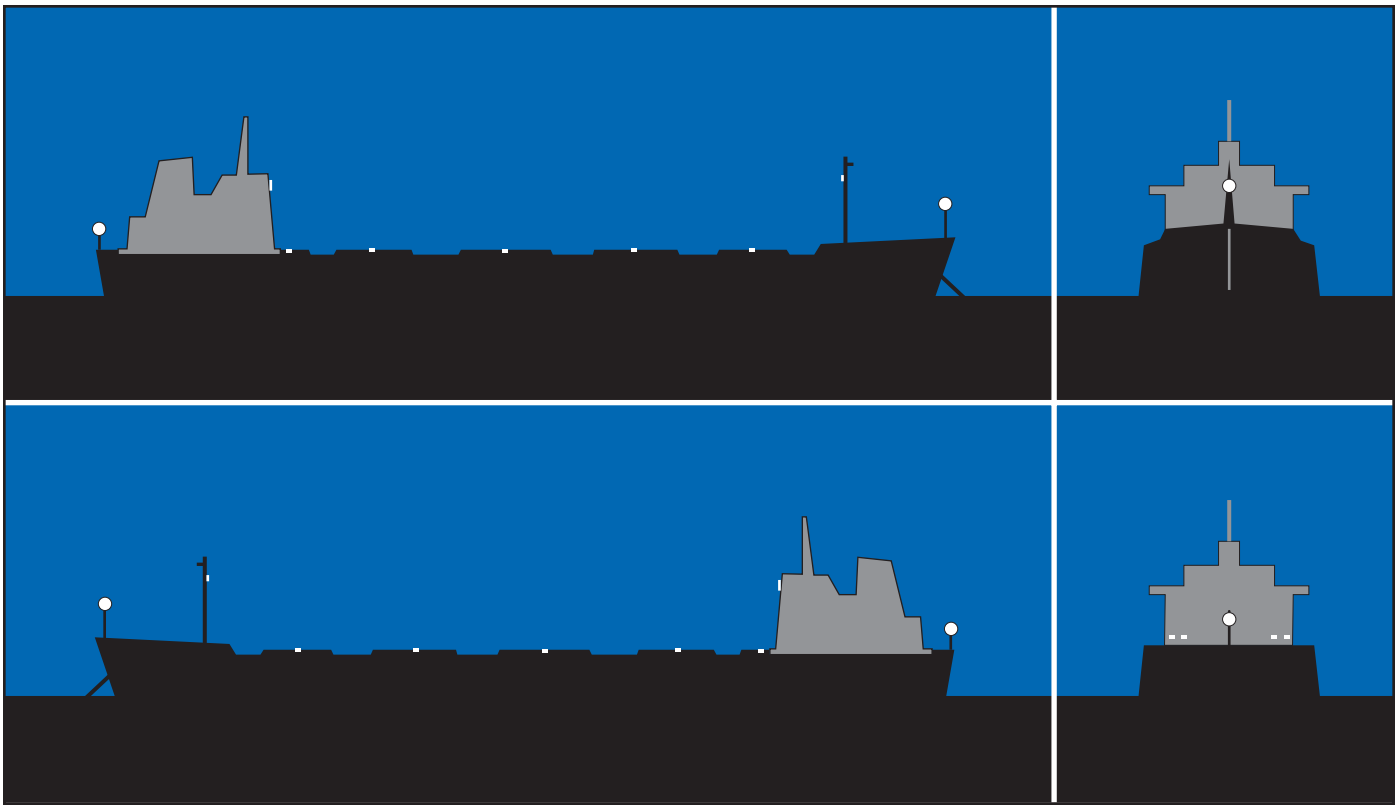
Vessel engaged on pilotage duty, underway, with power driven vessel, probably 50 metres or more in length, underway and making way.



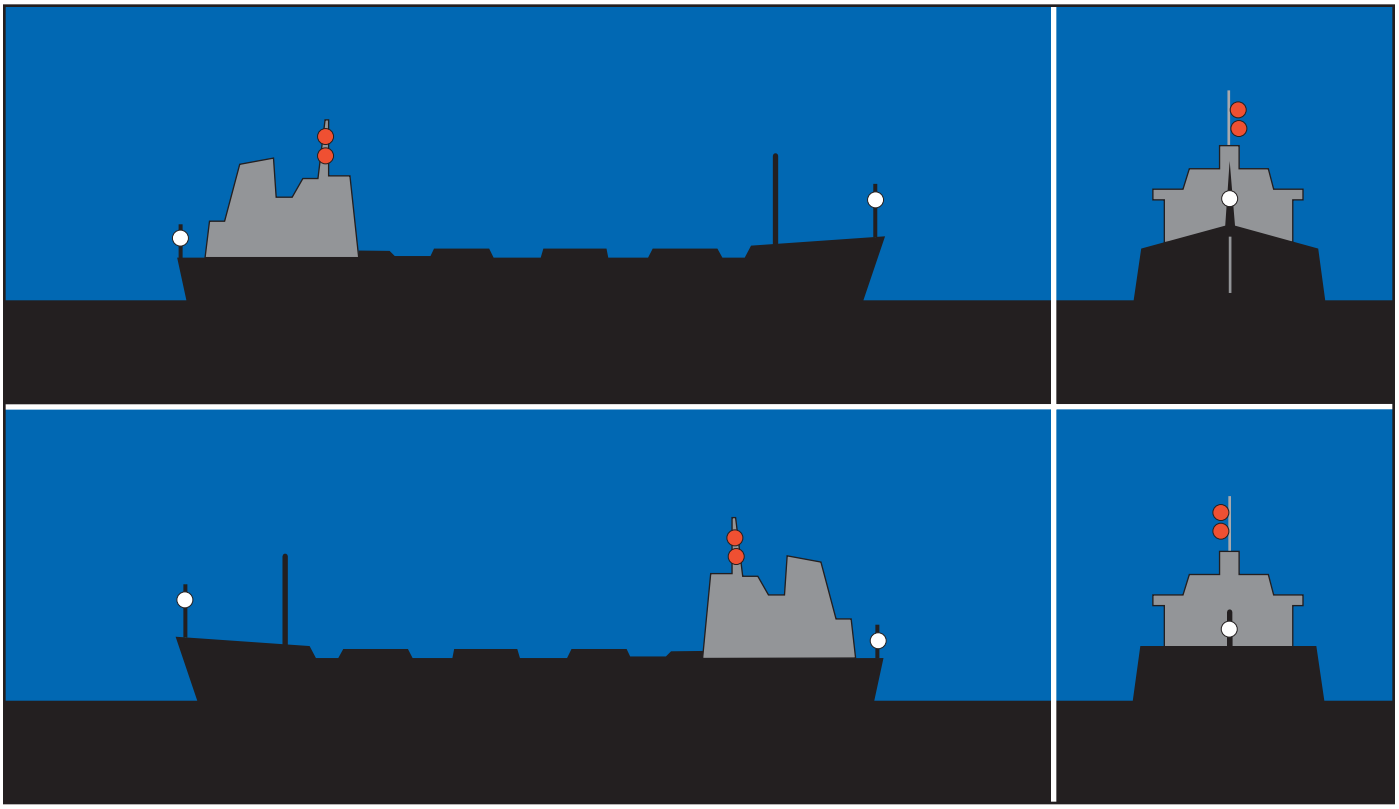
Vessel at anchor, probably 50 metres or more in length, but less than 100 metres.



Vessels at anchor, less than 50 metres in length.



Vessel at anchor, probably 100 metres or more in length. Must have illuminated deck lights.



Vessel aground, probably 50 metres or more in length, but less than 100 metres.

8

Towing

Experienced coxswains will testify that a towing situation can turn from boring and uneventful into treacherous and deadly in the space of seconds. A SAR crew may have to fly into action and react in order to save the vessel being towed or even their own rescue vessel. These situations can be simple or extremely complex and only competent and effect teamwork will lead a SAR crew through the hazards of towing.

The purpose of this chapter is to enable new CCGA crew to become familiar with the operations and communications involved in towing. As a new crewmember one should be familiar with all of the emergency procedures as well as the commands and signals of the captain/coxswain. Each crewmember should be able recognise dangers and participate in an effective response to those dangers.

Towing

Contents

Hard Aground on Harwood

Story By Daniel Reid (Canadian Coast Guard)

"Mayday…Mayday…Mayday, this is the sailing vessel Nellie (name changed). We are hard aground on Harwood Spit, Northeast Harwood Island. We have three people on board including one small child. Any vessels in the area please help!"

Torn from our seats by the urgent distress call, Tom Joyce, Traci Murphy and myself, Daniel Reid went into the familiar motions of preparing for a late-night call. As members of the Inshore Rescue Team stationed at Cortes Bay we were ready day or night to assist boaters in distress. The sound of the mayday call and the subsequent bleating of the auto-tone generated by the Coast Guard radio station at Comox had us moving with an extra sense of urgency. As Coxswain Tom Joyce started gathering further information, Murphy gathered gear relevant to a night call while I went down the hill to warm up our Zodiac Hurricane 733 and to rig spotlights for our transit southbound.

"Comox Coast Guard Radio…Coast Guard 509, channel 61 alpha…We are underway to assist the sailboat aground on Harwood spit…ETA two-zero minutes."

With a strong Northwest wind whipping us on from behind, we began the dark transit southbound towards Harwood Island. With Tom Joyce at the helm and Murphy on navigation we threaded our way in between islands and reefs, while I recorded information from Comox Coast Guard Radio and a commercial fishing vessel that had responded and was now on scene monitoring the situation.

As we rounded Mace Point on Savary Island we could make out the long flat shadow of Harwood Island ahead. We asked the fishing vessel to illuminate the stricken sailboat with their spotlight so as to guide us in. Now on scene, we alerted Comox and began our approach. Stopping about a hundred feet from the breaking surf we assessed the situation. Everything we saw was reported to the coxswain so that he could formulate an effective plan. The sailboat was hard aground on the sand bar. Heeled over on its port side, the boat rose and fell, slamming down on the bar with each breaking wave. The sails were furled and the rigging clear of the water; the vessel looked safe to approach.

Clearly outlining our duties, the coxswain laid out our plan of action.

"Dan, you get up forward and pass a messenger line and we'll get the tow-line on her. Traci you start peeling off some towline…we are going to need lots up on the foredeck so hustle. Danny, once we get in there we are only going to get one shot at this so make it quick and make it good."

With the situation assessed and our plan in place we made the transition from observing a situation gone bad, to throwing ourselves into the middle of it.

"Slack… more slack!" I hollered from the foredeck. The first attempt at passing an EZ-toss bag had been aborted when the bag was blown from my hands and I now needed to send our towline directly. Instructing the master of the stricken vessel to pass the line around a strong point and then back to me I made the throw as Tom brought us in to secure the tow. On our pitching foredeck I made fast a long bowline and shouted "Secure". With the line secured Tom threw the throttles astern and we backed out of the pounding surf. As we came into deeper water Tom called "Coming around" and smoothly swung the Zodiac around 180 degrees into the wind and the two stern drives dug in for the pull. With a roar we came tight on the towline that Murphy had made fast on the rear tow-post…and nothing happened! Slowly we felt the sand bar slowly loosen its stubborn grip on the sailboats hull and we were on our way.

"Comox…509…61…we have the sailboat in tow at this time." As we pulled away from the submerged bar we arranged to hand the tow off to the crew of the Mallard I who had arrived just in time to watch us recover the sailing vessel from their own front doorstep.

When we later came alongside the Coast Guard Cutter Mallard, Coxswain Ray Barnes said to Tom "Wow, I have never heard such clear communication on a rescue boat. We were sitting several hundred feet off and we knew absolutely everything that was happening on your boat. At first we thought that you were mad, Tom, and then we figured out that you were all just letting each other know what was going on. Good job out there."

8.0 Introduction

Towing is an operation that often includes long hours of tedious routine interspersed by short periods of intense activity and excitement. In order to reduce the risk of accidents everyone must be ready to act. The crew must be diligent and cautious because the slightest lapse in attention or effort will result in accidents and mishaps. Everyone must be alert and watching out for their teammates. Everyone must be supporting the captain/coxswain and contributing towards the successful completion of the mission.

Three Primary Positions in towing are:

1. **Line handler**
   The line handler prepares, and passes the towline. He then controls the line during the tow following the coxswain or captain's instructions.

2. **Tow Watch**
   The tow watch position must watch the tow at all times and cannot perform duties that will distract from the watch.

3. **Helm**
   The driver, usually the coxswain, must control the vessel safely during the approach and while towing.

8.1 (STOP & ASSESS) Tow Assessment and Safety

8.1.1 Towing SAP (Stop Assess Plan)

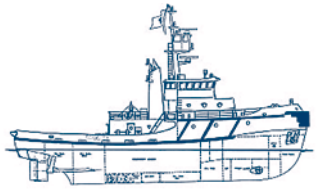
The coxswain or captain will usually completely and slowly circle the distressed vessel, and then stop the rescue vessel to discuss the results of the SAP. It is important to communicate constantly and clearly during towing operations. Remember the principles of two-way communications.

Summary of the National Guidelines for Towing

Coast Guard Auxiliary units may provide towing assistance in accordance with National SAR Program, as stated under Section 1 of this policy provided it imperilling the assisting vessel, or tow, or persons on board. If in the judgement of the JRCC/MRSC or the Commanding Officer on scene, the conditions for a distress or potential distress are not present, and if suitable commercial assistance is readily available, then the provision of a tow by Coast Guard Auxiliary resources may be denied.

Towing assistance will be provided only with the understanding that the vessel requiring assistance can be towed, with minimum risk, to the nearest appropriate safe haven or to a "rendezvous" position where the tow can be safely transferred. On arrival at the safe haven, it is not the responsibility of the Coast Guard Auxiliary unit to secure the towed vessel, however, the Commanding Officer may take such action as is necessary, having due regard to the circumstances of the case, to see the towed vessel is safely secured or anchored. Coast Guard Auxiliary units will not provide a tow to disabled vessels for the sole purpose of getting from one safe haven to another.

In non-life threatening situations, and if requested, the Coast Guard Auxiliary will aid in establishing direct communication between commercial services, other private vessels, and the operator of the disabled craft will be responsible for the cost.



8.1.2 Safety on Board Your Tow

- ⇛ Remove all personnel from the disabled vessel if the situation warrants it
- ⇛ Establish and maintain communications with the disabled vessel
- ⇛ Establish a communications schedule on a mutual working frequency
- ⇛ When underway ensure that the people on board the disabled vessel stay clear of towline
- ⇛ Keep the towline attachment point as low and as close to the centreline of the tow as possible

Visual Towing Assessment

Obvious dangers and Primary Factors to look for and be reported during the assessment are:

Vessel State

- ➜ Objects or people in the water
- ➜ Rigging or lines in the water
- ➜ Oil or fuel slick
- ➜ Is the vessel listing to one side or fore and aft (bow and stern)

***NEVER** attach the towline to lifelines, stanchions, grab rails, or ladders*

***NEVER** attach the towline to cleats or bits that are only screwed onto the disabled vessel's deck*

***NEVER** use knots to join towlines, unless there is no alternative*

Steps to Two-Way Communications

1 Look
2 Name
3 Say Message
4 Repeat
5 Confirm

- ➜ Water level on hull compared to bootline or load-lines
- ➜ General state and condition of the hull and cabin works (obvious damage or disrepair)
- ➜ Hull type, planing or displacement and estimate of hull speed
- ➜ What gear or cargo is onboard and is it stowed and secure?
- ➜ Motion (quick or slow wallowing)
- ➜ Bilge pumps and over board discharges (regular discharges?)

People on Board

- ➜ Number of people that are visible
- ➜ Ensure all are wearing safety gear or life jackets/PFDs
- ➜ Are people moving and responding normally?
- ➜ Obvious signs of deception
- ➜ Unusual actions and behaviours are normal or abnormal

Environmental Factors

- ➜ Proximity to shore
- ➜ Depth of water and land features (lee shore?)
- ➜ Visual clues on-scene current and its effect over time (1-2 minutes)
- ➜ Wind and the profile of the vessel
- ➜ Forecasted weather for duration of tow
- ➜ Wave size and character
- ➜ Visibility
- ➜ Darkness
- ➜ Stricken vessel's set and rate of drift

The interview

After any obvious dangers and primary factors have been identified the pre-towing interview will commence either by radio or by voice. If the vessel has VHF, the CCGA vessel can contact the vessel on VHF 16 and move them to a working channel that they can remain on for the duration of the tow. If they do not respond on the working channel return to VHF 16 and try another channel. The people on board should be asked the following questions and then given the following information and instructions:

Questions to Ask

1. Is everyone all right and accounted for?
2. Does anyone have injuries or need medical assistance?
3. How many people are on-board?
4. What is the nature of your problem?
5. Are you taking on any water in any part of your vessel?
6. Is your vessel stable and secure for towing?
7. Do you have a working searchlight or flashlight?
8. Are all of your hatches and watertight doors closed and dogged?
9. What is your hull speed?
10. Where do you wish to go?
11. What VHF channel are you monitoring?
12. Do you have a shaft brake?
13. What kind of securing points do you have?
14. Are you able to receive and secure a towline?

Information and Instructions to Give

1. We will tow you to (the nearest safe haven with facilities)
2. Verbal or written towing waiver given and consented (coxswain or captain will do this)
3. Please have everyone don his or her life jacket
4. Please inspect all of your vessels' void spaces, bilges and compartments for damage or water
5. Please close and secure all of your deck hat ches and watertight doors
6. Please maintain the designated radio channel and notify us if you change the channel for any reason
7. Please check in with us regularly on the designated VHF channel
8. If you cannot reach us for some reason, wave your arms up and down or signal us with a flashlight/searchlight
9. Please turn on your port and starboard lights and stern light
10. Please secure the rudder amidships or steer for our stern (coxswain /captains decision)
11. Please secure your propeller shaft if appropriate to do so
12. Are you able to secure the towline to (designated securing point) using this line and gear?

13. Prepare to take the towline. We will pass it to your bow (or designated spot)
14. Secure the line to (best securing point) and advise us when the line is tied on
15. Please ask all of your crew to stay inboard and keep their weight low
16. Life jackets will be worn at all times

8.2 (The Plan) Pre-Tow Briefing

After the assessment is complete, and all members have had a chance to point out details of the vessel and the surroundings, it is time for the coxswain/captain to ask for suggestions regarding a towing plan.

The crew can offer ideas regarding the best way to tow this vessel. After careful consideration, the coxswain/captain will brief the crew on the details of the chosen plan and the jobs given to crewmembers. Each crewmember will confirm that they understand their role and ask any clarification questions before they commence. At this point the only challenges or criticisms made by crew should be regarding an imminent danger.

Weather conditions and the distressed vessel's position to the weather will generally warrant modification of your standard approach. Through a clear briefing the basis of the towing approach has been established in everyone's mind, making those inevitable last minute modifications much less confusing.

The coxswain may communicate a few points to the crew when you decide on a final approach. When events or circumstances and factors that were assumed when you began the evolution are actually different, the towing plan should be re-evaluated. (i.e., no suitable strong point available to tow from, very poor seamanship skills on the vessel to be towed.) It's the crew's responsibility to inform the coxswain of any deviation or deficiency that they become aware of.

A coxswain that briefs the crew prior to each towing evolution will help the crew to work together and establish a mood of communication which reduces the possibility of error.

Points to consider during the Planning Stage

- ⇛ Sending situation reports (SITREPs) to the Joint Rescue Co-ordination Centre at regular intervals
- ⇛ Assign one of your crew to monitor the towline and stricken vessel at all times
- ⇛ Keep stricken vessel in step with towing vessel to prevent shock loading – catenary
- ⇛ Weather, visibility, sea conditions
- ⇛ All necessary equipment made ready before approach
- ⇛ Possibility of broaching in heavy seas (stricken vessel may have to tow a drogue)
- ⇛ Monitor the degree of roll when towing in heavy seas
- ⇛ Towing in current (watch for eddies, whirlpools, etc.) Keep towline fairly short to maintain control
- ⇛ Some line should be kept on the drum in reserve – it's easier to let towline out than to pull it in

Plan Briefing Points

- ✓ Have a Man Overboard manoeuvre practised and ready
- ✓ Set up of tow rig
- ✓ What type of approach you are going to make
- ✓ When to pass the lines
- ✓ How/who is tending the lines
- ✓ Who is working the tow bitt
- ✓ When/how to secure towline
- ✓ How much towline you might pay out
- ✓ The crew should be prepared to brief you on the following information once the towing evolution begins
- ✓ When hook-up is complete
- ✓ Number of turns on tow bitt
- ✓ The direction and strain on the line
- ✓ How well the line is feeding out; too slow or too fast?
- ✓ Amount of towline paid out

Vessels engaged in SAR should never carry less than 100 m (330 ft.) of towline.

Vessel to vessel communications

Before commencing the tow, set up a method of communication between the vessel being towed and your vessel. If VHF is available, pick a frequency and time of contact; establish with the vessel that any kind of

significant change in circumstance should be communicated immediately. If the vessel fails to respond to a regular check-in then the towing vessel must take action by reducing speed and attempting to get the people's attention.

If sufficient crew is available, placing a crewmember on-board the vessel you are towing with a portable radio is preferred for first-hand communication.

8.2.1 Towline Safety

Inspection of Towing Gear

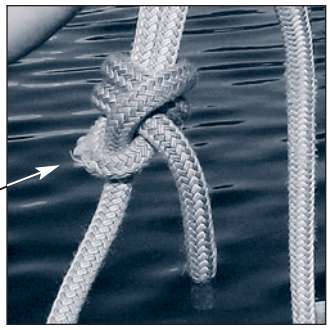
The line handler and crew shall regularly inspect the fittings and equipment used for towing. These fittings should be checked for cracks, fractures, rust, corrosion, wood rot, fibreglass core softening, or delamination. Crew should inspect surfaces that are normally hidden from view, particularly backing plates and under deck fasteners. Tow bars are subject to high vibration and may loosen or cause stress fractures around their foundations. Keep working surfaces free from paint and relieve any surface roughness. A smooth working surface reduces wear, friction and chafing on lines.

Inspection of Towlines

The towline should be clean of tar, algae or mould and be loose and flexible. If there are signs of deterioration, rot or damage then that line should be replaced immediately. Towline length, type and size will depend on the towing vessel's construction, power, size and fittings. Vessels engaged in SAR should never carry less than 100 m (330 ft.) of towline, especially if the SAR unit is required to operate in heavy weather or offshore.

The Towline can be a deadly killer and many forget how quickly things can go wrong when a line is under load. (see p. 92) The crew must ensure all gear (lines, shackles, messenger, drogues, tow bits, chafing gear, fairleads, etc.) have been checked for wear and tear.

- Never wear gloves when handling a rope towline
- Always ensure that the way is taken off the vessel while crewman is securing line to the tow post
- Always stay out of the bight, especially around tow posts
- Always stay out of the path of recoil in case the line parts
- Always use your own towline if possible
- Ensure all crew on both vessels are wearing a PFD (at minimum)
- When underway keep personnel on board both boats clear of the towline
- Attach the towline to designated strong points only. Never secure the line to stanchions, grab rails, ladders or bitts/cleats that are screwed to deck only
- Never use half hitches to secure the towline to the bit. The line will bind and have to be cut off.
- Avoid adjusting the length of the towline while underway
- Stop to adjust the towline

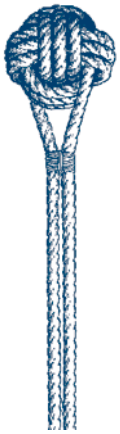


Inspect your lines before use.

(Note the frayed strands)

Heaving Lines

Steps to throwing a line



- Split the line into two coils, a throwing coil and a following coil. The throwing coil should be a small, tight coil approximately the diameter of a basketball. The throwing end should hang about 6 to 10 inches below the coil.
- With the line in front of you, place the throwing coil in your throwing hand and the following coil in the other hand.
- Wait until everyone is ready.
- Check behind you to see if you have enough space to swing.

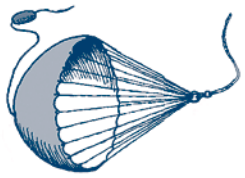
- Keep your eyes on your target and throw directly at it.
- Swing your throwing arm around (outstretched, like a discus thrower) and let the following coil fly out of your hand.

Drogue

A drogue is a device that acts in the water the way a parachute works in the air. The drogue is deployed from the stern of the towed vessel to help control the disabled vessel's motion. You must familiarise yourself with the operating characteristics and effectiveness of drogues under differing conditions. The time to learn about a drogue is before you need to deploy one. While trailing a drogue from the towed vessel is an acceptable practice, and may be useful when the disabled vessel has lost rudder control, normally it is not deployed well offshore.

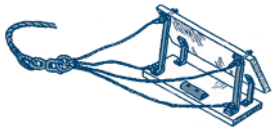
If it is necessary to tow a vessel with large swells directly on the stern, it may be more prudent to alter course or lengthen the towline rather than deploy a drogue. Drogues are typically used when the tow is shortened, for example in preparing to tow into a bar or inlet. With a short hawser and large swells on the stern, the drogue is deployed to prevent the towed vessel from running up on the stern of the towing vessel and to keep tension on the towline to help prevent the towed vessel from "surfing" down the face of a wave. The idea of a drogue is to provide backward pull on the stern of the towed vessel so that the wave will flow under the boat. It is important to match the size of the drogue to the towed vessel, its deck fittings and overall condition.

The larger, well-constructed cone drogues can exert a very large force on a boat's transom, so the towed vessels stern must be carefully examined. There are numerous types, sizes and styles of drogues commercially available. A traditional drogue is a canvas or synthetic cloth cone, with the pointed end open. Drogues of this type have a ring in the base of a cone (the leading edge) to which a four-leg bridle is attached. The other end of the bridle connects to a swivel, which in turn connects to a line made fast to the stern of the towed vessel. The towed vessel "tows" the drogue.



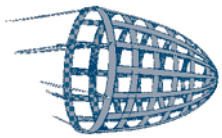
Parachute Drogue

Folding / Voss Cross



Fenger Drogue

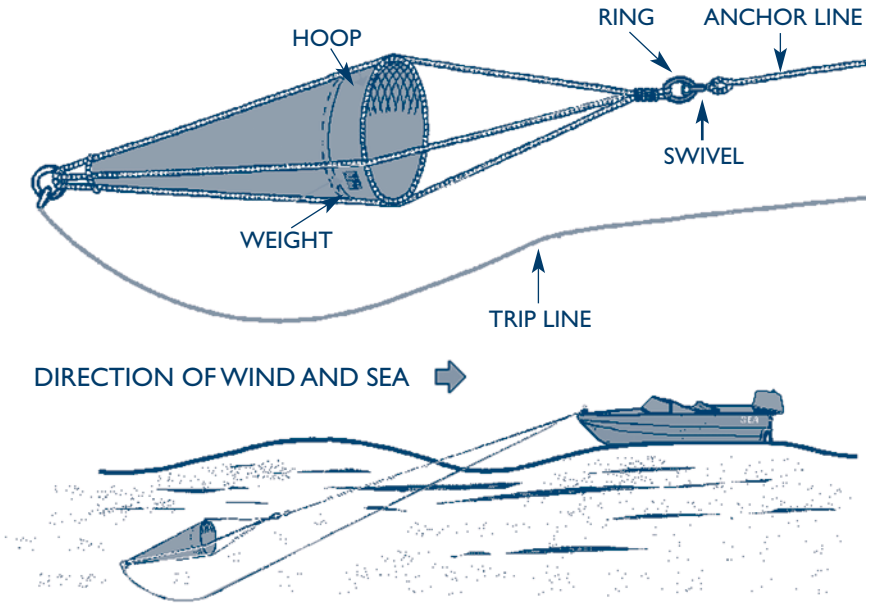
Bucket



Galerider Drogue

Line Messenger

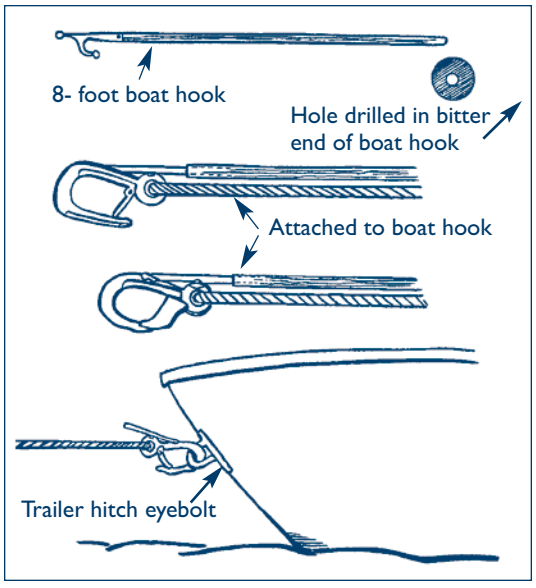
Most towlines are too heavy to cast more than a few feet. In rough weather, or if it is impossible to get close enough to throw a towline to a disabled vessel, use a messenger to reach the other vessel. A messenger is a length of line used to carry a larger line or hawser between vessels.

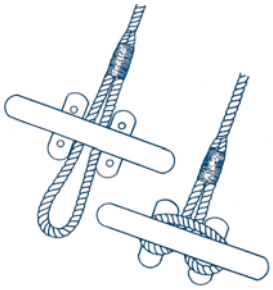


SEA ANCHOR IN A SET POSITION

Tow Assist Hook or Kicker Hook

These devices make hooking up a tow a safer procedure by reducing the time spent alongside the vessel using a positive correction method, thereby keeping crew out of harms way. It consists of a short piece of pipe or doweling with a snap hook mounted on one end. It is important to make sure that the hook or clip's Safe Working Load (SWL) designation is greater than the towline's. The snap hook is attached to a short piece of towline with an eye spliced into it. The tow assist hook snaps into the trailer eye of a planing hull vessel. The trailer eye is always the most secure point on a planing hull.





When attaching to cleats, ensure they are securely fastened.

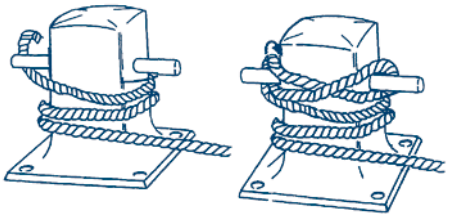
Chafing gear

Chafing gear protects towlines, bridles and pendants from wear caused by rubbing against deck edges, gunwales, bulwarks, chocks or tow bars. Tie layers of canvas or leather to the towline, bridle or wire rope at contact points to prevent chafing damage. Sections of old fire hose also work well as chafing gear. Make sure the chafing gear stays in place for the duration of the tow.

Strong Points

Towlines shall be secured only to the safest and strongest point on the vessel. The owner of the vessel can secure the towline:

- On a small planing hull, the trailer eye can be used.
- Deck cleats in fibreglass hulls can be weak, especially if they do not have doubling plates behind them.
- Anchor windlasses are usually a safe bet, but be wary of smaller ones in fibreglass hulls since they can carry away.
- Deck bollards on larger displacement hulls are safer, but check their condition.
- Do not bridle around cabins or hatch coamings.



8.3 Positions

8.3.1 Line Handler:
Set up and Passing the line

The line handler is at the greatest risk of injury in the event of an accident during the evolution. This is why the line handler must be practised and methodical in their set up and actions. The line handler should be verbalising every move he or she makes. Towing can be as boring as it is dangerous, so it is important to stay alert. The line handler is also responsible for the effective set up, inspection and readiness of the towing gear.

Towing Communications

Proper and effective communications can make or break a towing evolution. When working on deck all

conversations should be loud and assertive and the recipient should acknowledge any requests.

It is critical that the crew be versed in the Coxswain's/Captain's commands and signals. All of these commands and signals should be used and practised during towing practices and exercises.

Commands and Signals

- ⇛ Set up/ready the line
- ⇛ Prepare to pass the line
- ⇛ Stand by
- ⇛ Pass the line
- ⇛ Put on / take off another wrap
- ⇛ Slack, surge or pay out the line
- ⇛ Take in
- ⇛ Bring her alongside
- ⇛ Let her all go

Scripted example commands and signals during a tow.

Command: "Set up the towline on the starboard/port side" (coxswain's choice)

Actions

- ⇛ Repeat the order
- ⇛ Free the towing spool or break out the line
- ⇛ Inspect the line for damage
- ⇛ Fake out appropriate length for the pass off. (Ask the coxswain for the length)
- ⇛ Route the line outside of the rigging and stanchions starting at the tow bitt and working towards the pass off point
- ⇛ Attach heaving line, bridles or messengers (if using)
- ⇛ Coil appropriate length at pass off point
- ⇛ Prepare heaving line (if using one)
- ⇛ Line handler shouts when complete,"**Towline ready**"

Coxswains/Captain's command:
"Prepare to pass the line"

Actions

- ⇛ Repeat the command
- ⇛ Check the coil you are throwing or passing
- ⇛ Double-check your line path to see if anyone is in the bight
- ⇛ Check behind you and around you for snags and obstruction

- ⇛ Sturdy your footing
- ⇛ Line handler shouts to crew when ready
- ⇛ **"Stay clear of the line!"** Crew Line handler shouts to coxswain, **"Ready to pass the line!"**
- ⇛ Coxswain shouts to line handler **"Wait for my signal"** Line handler repeats back order
- ⇛ Coxswain shouts **"Pass the line please"**
- ⇛ Line handler replies **"Passing the line!"** Line handler throws line

Coxswain waits until the person on board the tow shouts, **"The line is secure on the tow"**

Coxswain shouts to line handler, **"Get ready to pay out the line"**

Actions

- ⇛ Line handler repeats order and moves back to the tow bitt and wraps the line on the bitt.
- ⇛ Line Handler controls the tension on the tow bitt and the coxswain controls throttles. The line handler pays out the line slowly until nearing the length specified.
- ⇛ The captain reduces speed and shouts **"make her fast there"** (signal for this is a fist facing palm out).
- ⇛ Line handler wraps the tow line on the bitt and secures the tail end and shouts **"tow line secure".**

Vessel is now under tow and a watch is established.

Onboard: Brief your crew on situation and what's expected.

On Tow: Establish mutual working frequency for entire tow.

When working onboard the tow one should follow the Solo operations guidelines.

8.3.2 Crewmembers On-board the Tow

Boarding a tow

Occasionally the coxswain will decide that putting a crewmember on board the vessel is best.

Here, he or she can assess the condition of anyone onboard the tow and perform the attachment of the towline to the securing points. This crewmember may remain on board to monitor the vessel while it is being towed.

Solo Operations

You should don all foul weather gear and have your crew do a personal equipment check before you go. It is critical that you are able to stay in communication with the towing vessel and that you establish commands and signals before going on board.

Anytime one crewmember is performing a task away from the vessel they are involved in solo operations. In order to carry out tasks safely and have the boat crew able to respond in case of emergencies the lone crewmember must follow some basic procedures.

Pre-Departure

- ✓ Participate in a Stop Assess Plan briefing and verify any instructions by coxswain or captain
- ✓ Establish hand signals for the following messages (see commands and signals)
- ✓ Perform a thorough personal safety equipment check before leaving,
- ✓ Test and check all SAR gear and equipment be sure to wear full drysuit or flotation coveralls
- ✓ Test and secure a portable radio to your vest or in your PFD and establish a working channel and emergency channel (VHF 16)
- ✓ Remember a flashlight day or night

Checking the Tow During Operations

When on-board the tow, a crewmember should account for all on board and make sure all are wearing life jackets. Give them boundaries and safety guidelines for tow. Then explain to the vessel operator how to steer the vessel while under tow (steer for towing vessel stern).

Commands and Signals

Waving arms up and down: *Distress or emergency, use flash lights or flares at night*

Arms in an 'O' shape above head, Thumbs up: *OK*

Circle with a flashlight: *OK in night operations*

Holding up portable radio *or microphone, or holding hand up to ear like a telephone: Check your radio and establish contact.*

Sounding Five short with the towed vessels horn: *to alert all involved of urgent situation and establish contact*

Problems to watch for:

- ➜ The people on board are acting stressed or overly concerned
- ➜ The vessel is taking on water or incurring damage
- ➜ The vessel is being towed past its hull speed (vessel settles low in the water and begins to shudder and the bow wake increases exponentially)
- ➜ Check towline securing points and stress at that point
- ➜ Check for chafing or shock loading
- ➜ Monitor action or motion of the towed vessel
- ➜ Towline becoming overloaded (line groaning and stretching)
- ➜ Routinely check all the spaces below decks and bilges for flooding or damage
- ➜ Establish communications and report findings
- ➜ Provide regular SITREPs (every 5-15 minutes depending on the situation) that include
- ➜ Log all pertinent information (photos if asked)

8.3.3 Tow Watch

The crewmember is responsible for the towing watch and is obliged to monitor the tow at all times. This crewmember cannot be responsible for any other duties that require attention to be directed away from the tow. The tow watch must have emergency line cutting tools ready to use. They should not be stowed where the person retrieving them will have to get close to the tow line.

Roles and Responsibilities

- ➜ Constantly monitor and report the stability and state of the towed vessel
- ➜ Monitor and report the safety and activities of anyone on board the towed vessel
- ➜ Monitor the line and tow bitt for signs of shock loading or excessive strain
- ➜ Monitor the motion of the vessel and towline for signs of trouble (see list next page)
- ➜ Be prepared to cut the line on the coxswain's order
- ➜ In the event of a man overboard from the tow be prepared to act as a spotter for the recovery operation
- ➜ Watch for emergency signals from the tow
- ➜ At night the tow watch will use a spotlight to illuminate the tow and towline

Signs of Trouble

The watch is looking for any of the following signs of trouble.

- Persons on board the tow indicating distress
- Amount of catenary
- Angle of towline moving way from aft to abeam (danger of girding)
- Tow moving from astern to one side
- Towed vessel veering back and forth
- Towline shock loading
- Displacement hull being pulled too fast
- Towline unravelling or fraying
- Towline groaning or overloaded
- Towed vessel settling in the water or sinking
- Securing points moving or coming loose
- Tow line steaming may show line is close to breaking

If you see any of these occurring notify the coxswain immediately. The coxswain/captain will usually adjust the speed or adjust the tow length. If the tow is endangering the CCGA vessel then the coxswain/captain may order the line cut. Do not cut it without the coxswain's order.

8.3.4 Helm

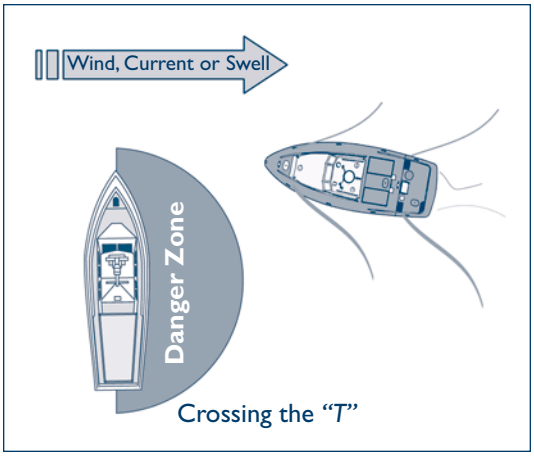
The basic underlying principle to all manoeuvring is to keep your bow heading up into the most dominant conditions. These conditions can be wind, swell, or current. The approach should be slow but with enough speed to maintain steerage way.

Approaching the Stricken Vessel

A stricken vessel presents a serious risk to the rescue vessel and everyone on board must be familiar with the danger zones around a vessel adrift. Anytime the SAR vessel is downwind or down swell from the stricken vessel there is a chance that the vessel may surge onto the rescue boat.

Crossing the "T"

This approach allows the boat coxswain to cross the bow of the stricken vessel and station keep in the "Safe Zone". Approaching into the wind, helps to maintain better control. Staying upwind of the other vessel's bow (in the Safe Zone) greatly reduces the danger.



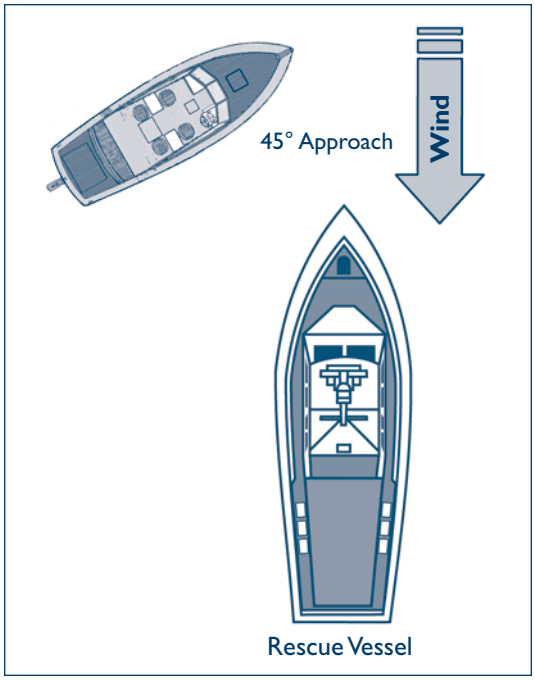
The basic underlying principle to all manoeuvring is to keep your bow heading up into the most dominant conditions.

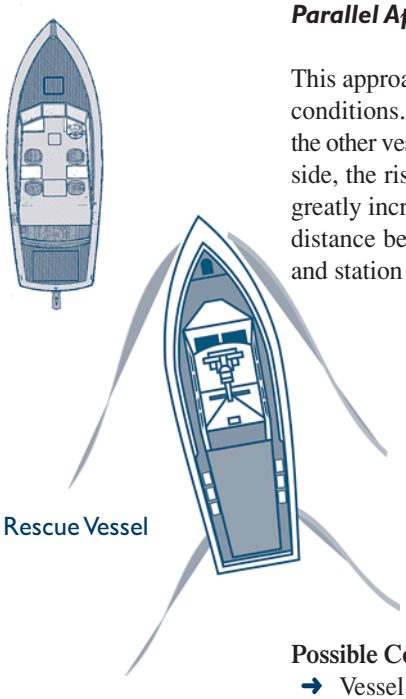
Brief your crew on what actions are expected and when to perform them. Since this approach is the safest in light or heavy weather conditions, it is the preferred method to practice all the time; that way, your crew knows what to expect. Most vessels will lay off the wind, beam-to the wind and weather. By crossing the "T" into the wind and weather, you will be able to maintain the most control when station keeping, staying in one position relative to the other vessel.

45 Degree Approach

This approach is used in calm to moderate conditions. The rescue vessel approaches the stricken vessel at a 45-degree angle. The vessel with the most leeway must be on the downwind side.

In a 45 degree approach, the rescue vessel spends much more time in the Danger Zone. Again, once the SRU passes the bow of the other vessel, the towline is thrown, and the SRU must station keep in the Safe Zone while the line is made secure.





The safety of your own vessel as the rescue vessel, and the safety of your crew are paramount.

Parallel Approach

This approach is also used only in calm to moderate conditions. The SRU approaches from the stern of the other vessel. Obviously, with the SRU lying alongside, the risk of collision with the stricken vessel is greatly increased. Care must be taken to keep a safe distance between the two vessels. Pass the towline and station keep until secured.

8.3.5 Towline length

Catenary and Control

How much towline is enough? That depends on the sea state and the direction of the tow. If the tow is proceeding through open water, consider the following:

Possible Complications

- ➜ Vessel moves out of step.
- ➜ The towed vessel may broach in heavy following seas.
- ➜ The towed vessel may roll excessively in heavy beam seas.

Without catenary, if the towline went straight back to the towed vessel, every shock load would be transmitted directly through to both vessels. Enough line must be let out to ensure that this "shock-absorbing" characteristic – catenary – is present. Generally, the more line out, the more catenary there is.

When determining towline length, as well as catenary, the vessels must be kept in step. The two vessels must rise to the crest and slide into the trough at the same time. Both go up, both go down. If this doesn't happen, there will be shock loading every time the towline goes slack and then tightens up again.

When towing a vessel in heavy following seas, as the towed vessel surfs down the face of a wave, picking up speed, it may temporarily start going faster than the towing vessel. If this happens, the towed vessel will start turning beam to the seas (broaching). To prevent this, the towed vessel may have to drag a drogue. In heavy beam seas, smaller vessels may broach, and some vessels, especially sailing vessels, may roll a lot.

Shock Loading

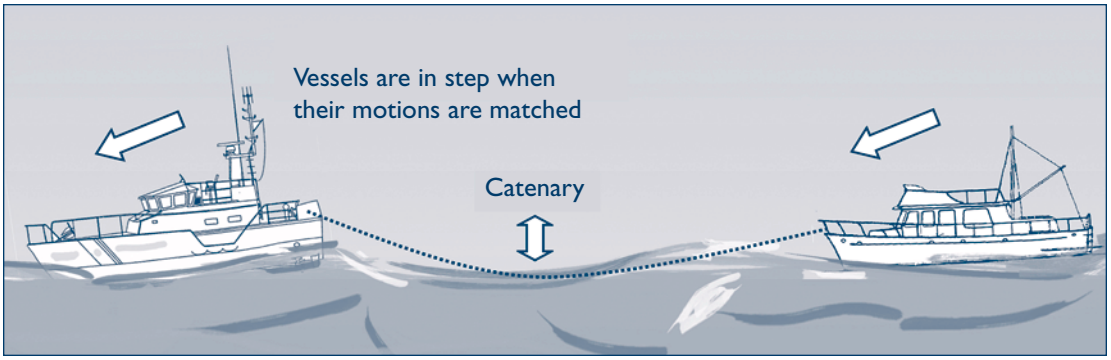
An SRU will rarely deal with only one force acting on the tow. The crew usually faces a combination of all forces, each making the situation more complex. Some individual forces are very large and relatively constant. Crews can usually deal with these forces safely, provided all towing force changes are made slowly and gradually. When forces are changing in an irregular manner, tension on the towline starts to vary instead of remaining steady. Given the potential dangers of shock loading, the tow vessel must use various techniques to prevent or counteract its effect.

Reducing Speed

Slowing down lowers frictional resistance from drag and wave resistance. Reducing these forces will lower the total towline tension. In head seas, reducing speed also reduces wave drag, spray drag and wind drag, lowering irregular towline loads. The total reduction in forces on the tow can be rather substantial. When encountering another vessel's wake in relatively calm conditions, reduce speed early enough so that the towed vessel loses momentum before encountering the wake. Slamming into a large wake will shock load the towline of a small towed vessel, and may even swamp it.

Get the vessels "In step"

Extreme stress is placed on the towline in heavy weather when the tow vessel and the towing vessel do not climb, crest or descend waves together. Vessels in step will gain and lose momentum at the same time, allowing the towing force to gradually overcome the towed vessel's loss of momentum, minimising shock loading. To get the vessels in step, lengthen the towline if possible.



Lengthen the towline

A longer towline reduces the effect of shock loading in two ways. The more line out, the greater the catenary. When tension increases, energy from shock loading is spent on "straightening out" the catenary before being transferred through the rest of the towline and fittings. The second benefit of a longer towline is more stretch length. Depending on the type of towline, another 50 ft. of towline will provide another 5 to 20 ft. more stretch as a shock load absorber. Remember to lengthen the towline enough to keep the vessels in step and minimise the shock load source. Constantly adjust towing speed to match that of the towed vessel.

8.4 Towing Log Entries

Most claims against the CCG and CCGA arise from towing incidents. Log entries provide legal documents that will serve as evidence for such claims. Note the owners' consent to tow, the weather at the time, sea conditions, reasons for the tow, general condition of the vessel to be towed including any obvious damage that pre-exists with the vessel, number of POB, any medical problems that might be a factor during the duration of the tow, and your destination. Noting this kind of information now demonstrates your diligence if some unforeseen difficulty should arise.

8.4.1 Taking notes

A good rule of thumb is to note the passage of time and significant events, position every 15 minutes, significant events, ie., shortened up, change in sea state, revised ETA.

8.4.2 JRCC SITREPS

The JRCC or MRSC will want to hear from you regularly during the tow. A SITREP may only include your position, an updated ETA, and any changes in destination. The coxswain or captain may wish to contact facilities ashore to arrange for the vessel's arrival.

8.5 Towing Alongside

An SRU will rarely deal with only one force acting on the tow.

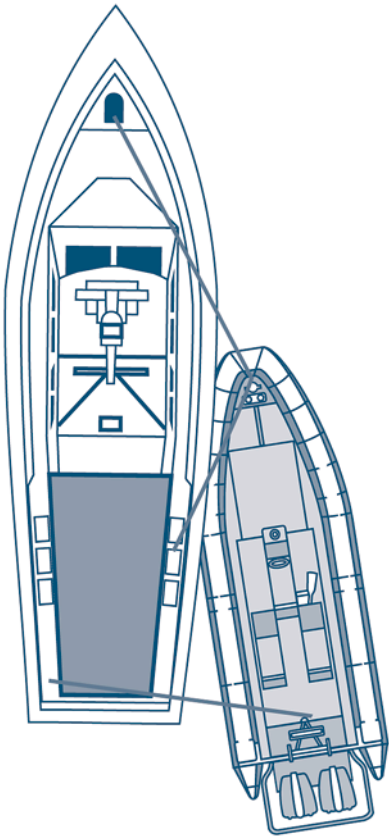
Once you've taken the vessel to where she's going, quite often you'll have to take her alongside a float or dock. You are not obliged to take the boat to its accustomed slip, but only to the nearest safe haven. Stop in a protected place with plenty of sea to disconnect and take her in tow alongside. Do not attempt to tow alongside for any great distance or in adverse sea conditions.

Method:

Brief or instruct the crew of the following:

- To which side of your boat, port or starboard, the tow will be secured
- Prepare lines and position lines in place
- Rig fenders if necessary
- Keep all lines clear of the water and away from the propellers
- Safety

Note:
When operating RHIs, to prevent damage to the tubes never tie lines to the lifelines/grablines or eye holes on the tube



The object of towing alongside is to make both vessels to act as one as much as possible. Normally three lines are connected as follows:

- The bow line is secured from your bow to the towed boat's bow and serves to hold the rescue boat's bow in
- The stern line is secured from your stern to the outboard of the disabled vessel's stern
- The tow strap (fwd spring) is secured from your stern to the towed vessel's stern. This is the line that takes the strain resulting from the towing vessels forward movement
- The spring lines when properly attached can reduce the amount of surging, which may occur between the boats.

When preparing to take a vessel alongside from a stern tow the following steps should be followed

- Advise the vessel of your intentions
- Reduce speed gradually, and keep the tow line in view and control at all times
- Be aware of any set or drift and of any obstacles and hazards
- Heave in the slack from towline as the vessels close

R Ranger Deck Log

Saturday, Nov 4th, 2001

Crew: *Anderson, Blake, Rubin*

TIME	Events and Description	Coms
2315	CGA R Ranger, Tasked by JRCC to respons to a 42-ft. power vessel	
	"Outa Luck" B/D in Nakoola Pass, Advise MCTS/JRCC, ETA 35 mins.	
	(L/L). White hull, blue house works, purple stripe on hll, red dinghy. 4 POB	
2322	CGA R Ranger departs marina and attempts to contact "Outa Luck"	VHF 16 & 16A
	on VHF 16, no answer.	
2340	abeam Nonsuch Pt.	
2350	Alongside "outa Luck", all POB OK, MCTS/JRCC advises	VHF 62A
	there is no commercial assistance available.	
0005	Owner/Operator gives verbal waiver on VHT 62A	VHF 62A
0010	Crewmember Blake on-board tow with portable. "Outa Luck"	VHF 62A
	under tow for Mercy Cove, ETA 45 mins.	
0020	Abeam Naughty Point, surge out tow to 300 ft.	
0042	Contact tow for SITREP, give JRCC SITREP	VHF 62A
0055	Shorten tow for Mercy Cove entrance. Put "Outa Luck" alongside	
0120	Vessel secure, advise JRCC and MCTS	VHF 62A L/L
V/L	"Outa Luck" 41 ft. I/O Bayliner, white hull, blue House works	4POB
	I/O 350 gas Mercruiser. Lic 19K 34789	Dist 13nm
	Red Dinghy with 6hp Johnson O/B	Time 1.4 hrs
0056	Owner/Operator (PCOC 2345766)	
	Oskar Lippots (403) 765-0989. Cell (403) 345-5673	WX pt cldy
0101	CG 509 has Spanky in tow and attempting to swing over to	W NW 25 kts
	east side of rapids to catch an eddie	Sea 3 ft.
		1 ft. chop
0145	Depart Mercy Cove RTB	VHF 62A
0235	Secure Base	VHF 62A

To secure the tow alongside, perform the steps below:

1. Lead a line from you bow head as a bowline to the vessel to be towed

2. Secure the bow line, keeping the bow of the towed vessel slightly angled in towards your bow

3. Lead another line from your bow, rigged as a spring to the vessel to be towed. Secure forward spring

4. Ensure that your stern is well aft of the towed vessel to maintain the effectiveness of your screws and rudder. A good rule of thumb is that the tow post is even or slightly aft of the vessel's stern

5. Send a stern line from your tow post to the far (outboard) side of the vessel to be towed. Secure the sternline

6. Back down slowly and take up the slack on the forward spring

7. Go ahead slowly and adjust/secure sternline

8. All lines are to be very taut at this time to enable control of the towed vessel the forward lines should be the tightest

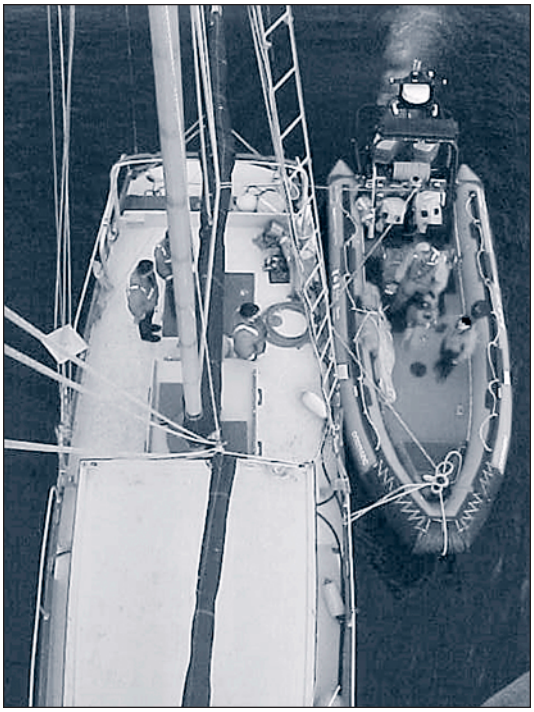
Hint: Try to pass the eye end of the line back to the towing vessel. This way the control and adjustment remains on the towing vessel.

Going astern greatly increases the vessels' swing to the side. Combining lock to lock helm movements with the appropriate engine manoeuvres makes this easier. When handling larger boats, it sometimes helps to get the other vessel to assist you in steering. If this is not possible, ensure that the other vessel's rudder is amidships. With the added weight, give yourself plenty of time to stop.

The windage of the other vessel will also increase your leeway. A lookout may be required up on the bow of the other vessel to watch for opposing traffic on the blind side, and to call out distances on your final approach. When you choose which side of the stricken vessel to tie up to, bear in mind that you want to approach the dock or float into the wind for more control. Have both vessels' mooring lines and fenders ready when you come alongside to secure to the dock or float.

Docking an alongside tow

Whenever possible for control, approach against the wind or current and dock on the protected or leeward side of the berth.



When docking with a vessel in an alongside tow follow the steps below:

1. Decrease speed as slowly as possible to maintain control of the vessel.
2. Determine the following factors:

- ➜ Wind velocity and direction
- ➜ Current velocity and direction
- ➜ Height of tide
- ➜ Type of structure, dock and location of berth
- ➜ Obstacles and obstructions around the mooring/dock
- ➜ Availability and location of personnel and deck fittings
- ➜ Which vessel will be placed alongside the dock or mooring
- ➜ Does the towed vessel have the use of its rudders(s) to assist

3. Determine the angle of approach and the side of the boat to be berthed based on the evaluation of the factors listed above.
4. One of the crew members on the towed vessel can direct and call out distances if your visibility is impaired by the towed vessels cabin or house works.

8.6 Handling a Sinking Tow

A sinking vessel being towed can pull a towing boat under

Have a method of cutting the towline close at hand

A sinking vessel being towed can pull a towing boat under unless all personnel pay close attention to what is happening during all phases of a towing operation. When a sinking boat is towed astern of the towing boat there is danger of the towed boat yawing, and capsizing the towing boat by pulling it sideways by the force exerted through the towline. This is called girding. Few sinking tows allow for time to ponder what actions are the best course to follow.

The following procedure is a guideline for responding to a sinking tow.

- ➜ Slip or release the towline and if necessary, cut the towline with a knife or axe (normally ordered by the coxswain or captain)

- ➜ If it is necessary to cut the tow line , the cut is to be made at the closest point to the towing bollard as possible to prevent whip back of the tow line.

9

Search

This chapter will reinforce the value of meticulous habit and thoroughness in searching. Only through constant practice and refinement will a search team settle into truly effective methods. A new crewmember will learn to concentrate on the tasks involved in searching, spotting and manoeuvring through search patterns. The CCGA crew will learn to take these tasks one step at a time and never cut corners.

Search

Contents

Harvey Stops and Listens

January 13th, 1998 Bella Bella, British Columbia

"Mayday, Mayday this is the RED FIR **X** We are in Deer Passage and we are going down."

"Red Fir Ten this is Prince Rupert Coast Guard Radio. How many on board your vessel?"

"The Red Fir Ten, Red Fir Ten, this is Prince Rupert Coast Guard Radio. How many on board your vessel?" There was no answer.

The thirty-five foot tug boat had just pulled away from the fuel dock at Bella Bella and was steaming north into a four foot chop. The water was running down the fore deck and draining into an opening just aft of the wheelhouse. The crew of three failed to notice the rising water level in the lazarette. Twenty minutes later the tug began to settle and list to starboard. It was clear that she was sinking and sinking fast. As the wheelhouse filled with water the captain called out a mayday on the radio before he was pulled under when the wheelhouse slipped beneath the waves. Jason Dornan and his girlfriend Arlene managed to escape the vessel as it sank. Arlene began to swim for shore while Jason clung to a half-full propane bottle. Soon the SAR aircraft from 442 Squadron (Rescue 310 Labrador Helicopter and the Buffalo fixed wing search plane) both flew over, but they did not see him. Jason thought he was saved when the Department of Fisheries Zodiac approached at high speed, but it passed by.

There was a knock on the door and someone announced, "Hey Harvey, the RED FIR **X** went down in Deer Passage and the Coast Guard is looking for them." Harvey Humchitt got up from his meeting and left. He stopped by his house and picked up some food, blankets and a sleeping bag. He knew the crew of the RED FIR **X** and he could not just sit at home and listen to radio so he phoned rescue centre, started up his boat and departed Bella Bella.

About fifteen minutes later he arrived on scene. The sun was setting soon and Harvey knew that time was running out for the tug crew. The DFO Rigid Hull Inflatable was doing a shoreline search of the west side of the passage. Harvey spotted an oil slick at the east end of Troop Narrows. He went over to investigate the slick and shut down his engines to listen. There was a faint cry for help. Harvey turned his head and saw a bump in the water about ¾ of a mile from the slick. As Harvey approached the object he saw Jason holding on to the propane bottle. Harvey said:

"Jason don't let go of that can until I get ahold of you."

Harvey pulled Jason aboard and Jason told Harvey about Arlene. Harvey looked around the beach and saw Arlene lying on the shoreline. She got up and waved.

9.0 Introduction

Years of experience on the water have taught old mariners like Harvey that it pays to take your time and go through the steps if you want to find someone. The most effective searching is done through diligent methodology. The only way to be diligent and methodical is to take the time to prepare yourself and your vessel to handle all contingencies. An experienced coxswain or captain takes the time to brief the crew, discuss the roles of the vessel in this search and share all the information known. Thus the crew becomes actively involved in the solution to the problem. Your unit is not effective until all the minds on board your vessel are focused on the success of your mission. The one time you decide to skip a bay or not bother finishing the last legs of your search pattern is the time that you will miss the survivors you are searching for.

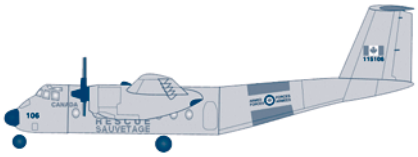
One of the greatest enemies to an effective search is preconceived ideas and assumptions as to where the search subject is. Start searching before you get to the defined search area just in case the position was slightly out. If you are assigned an area to search then you must cover it 100%. As soon as you depart from the JRCC search action plan the SAR system fails.

Search activities constitute a small percentage of annual SAR incidents. When CCGA members are called upon to participate in search activities they will most likely join or be joined by other vessels. In some cases, however, you may have to search alone. If you are involved in a major search, there is a good possibility that a Coast Guard SAR Unit or other government vessel will be appointed to lead the operation as On-Scene Commander (OSC). You will then receive your search instructions from the OSC. In situations where such a vessel is not available, you may have to direct your own search activities and/or those of other participating vessels.

9.1 Stage One: Awareness

9.1.1 Who answers the call for help?

When someone asks for help this message can be received in many ways. Coming from a vessel, the call is usually over a VHF radio or cell phone. The Coast Radio Stations (MCTS) will usually hear the radio call first and pass this message on to JRCC. If the call is over the phone the 911 system will re-route the call to JRCC as a marine case. Most searches start with an overdue (O/D) vessel or person being reported over the phone by concerned family members. JRCC will gather as much information as possible about the incicent. Once the resources have been selected, a search action plan is formed.



The most effective searching is done through diligent methodology

9.1.2 Canadian SAR System Responds

JRCC or MRSC gathers information on the case and uses its authority to task vessels; the vessel or vessels to be tasked are alerted by a variety of means including: radio, telephone, pager, or other emergency alert system. If alerted by telephone, a resource is normally given available information. If alerted by other means, vessels normally contact the JRCC by telephone. When ready to depart, the vessel informs JRCC/MRSC of their Estimated Time of Arrival (ETA) and situation report through the radio station. At this point the Coast Radio Station (MCTS) may have further information and instructions from JRCC and will indicate whether the tasking is to proceed. In some instances the CCGA vessel will already be on the water when it is alerted. In these cases the Coast Guard Radio Station (MCTS) would call the vessel on VHF channel 16 and switch to a designated working channel. On the working channel MCTS will pass on instructions about the incident and ask for an ETA. If tasked, the vessel will proceed and transmit regular SITREPs as necessary or as requested by the Joint Rescue Centre.

Communication Setup

1. MCTS will indicate which radio channel is to be used and the frequency of SITREPs they prefer

2. In emergency or special circumstances, you may request MCTS to connect you directly to JRCC/MRSC through a duplex channel. This involves the MCTS setting up a radiotelephone connection through a landline to JRCC/MRSC.

Note:
If you ovehear a distress call that goes unanswered after a period of time then you should relay that message to an MCTS station.

9.2 Stage Two: Initial Actions

9.2.1 Search Action Plan Message from JRCC

The search action plan message may be abbreviated depending on mission complexity, but usually contains the following information:

- ➜ Distressed vessel's last known position (LKP)
- ➜ Nature of distress and severity or urgency
- ➜ Weather (actual on scene & forecasted)
- ➜ Other SRUs tasked

SMEAC from JRCC

Situation:

- Brief description of incident, position, and time
- Number of persons on board (POB)
- Weather forecast and period for forecast
- SRUs on scene
- Primary/secondary search targets, including amount and type of survival equipment

Mission

- Search area: area, size, corner points, other

Execution:

- By columns: area, SRU, parent agency, pattern
- Creep direction, commence search point (CSP), and altitude

Administration

- OSC collects on scene weather reports from SRUs
- Who collates information, and resolves discrepancies prior to reports to SMC
- Parent activity report to SMC at end of day's operations: sorties, hours flown, area(s) searched, and coverage factor(s)
- OSC reports to SMC

Communications / Co-ordination:

- Control channels, primary and secondary
- On scene channels, primary and secondary
- Monitor channels
- SAR vessel's aerobeacon and IFF identification
- Press channels
- OSC designated
- On scene time for units
- Track spacing/coverage factor desired
- OSC instructions (including DMB instructions)
- Air space reservations
- Aircraft safety comments
- Parent agency relief instructions
- Authorisation for non-SAR aircraft in the area
- Distressed vessel's characteristics
- Time on scene of first SRU

9.2.2 SAR detectives

Finding people takes detective work. That work can be done on the water or on the phone. During searches you should stop and speak to vessels in the area or interview witnesses to an event. You must be thorough and methodical in your questioning and recording of information. All information shall be passed on to JRCC.

Solve the case on the phone

In some small communities JRCC often does not have the local knowledge or resources to investigate the case thoroughly. This is where an auxiliary unit can help. After checking in with JRCC, the auxiliary unit may offer to check out some areas and people locally. If JRCC thinks this is a good idea then you can devise a contact list and start investigating. Many times JRCC will already have made calls to the family or relatives and need your unit on the water. If the missing person/persons are known in the community then an auxiliary unit can call the relatives, friends and witnesses to gather more information about the case. Remember you are acting as an agent for JRCC not on your own. All information gathered must be passed on to JRCC before you make your next move.

Overdue Vessels

If requested by JRCC:

- Contact marina managers or wharfingers to see if the missing vessel has been in the area. If so, find out when they were there, when they left, and where they were going. (Boaters change their plans and forget to tell anyone, but may have mentioned alternate plans).
- Check every vessel carefully for licence number, description, and name. Remember that there is no time limit on a search. The vessel description may not always be accurate. Check each boat closely. There have been cases where the search has been for a pleasure craft, and the boat turned out to be a sailing vessel or a fishing boat.
- Check the parking lot for the missing person's vehicle (assuming they have one). If the vehicle is still there, the person may not have returned yet. If the vehicle is not there, then the person may have returned, yet not told anyone. Relay this information to the CGRS by radio to JRCC via land line.
- Check all of the marina and floats. The missing party may have returned and tied up at a dif-

ferent spot.

⇒ If there are other people around on the floats, tell them who you are and what you are doing. You may receive unexpected information concerning the whereabouts of the missing vessel.

9.2.3 Preparing Yourself to Search

You must be physically and mentally prepared to search for indefinite periods of time. CCGA vessels have searched for many hours only stopping for replenishment and refuelling, and if necessary a change of crew. You can review the spotting and scanning procedures before you go as well as checking your personal safety gear.

Before you step on the vessel ask yourself:

Are you ready to search for extended periods of time?

- ➜ Am I dressed warmly?
- ➜ Do I need a change of clothes?
- ➜ Do I need to contact my family and advise them?
- ➜ Do I have medications that I need?
- ➜ Do I have a toothbrush or a comb?
- ➜ Do I have snacks or water available?
- ➜ Do I have contact lenses if so do I have spare glasses and sunglasses?
- ➜ Do I have personal flashlight and notebook?
- ➜ Do I have necessary phone numbers and resource lists?
- ➜ Has my crew written everyone's names on the unit status board on shore so people know who is on board the vessel?

9.2.4 Pre- Departure Briefing

Your coxswain will take some time during the team preparation to brief the crew and share the details of the case. If you know the information then you can be one of minds working to solve the mystery. By getting the entire crew involved each crewmember gets a personal stake in the success of the search.

9.2.5 Preparing Your Vessel for Searching

Pre-departure inspection

Once you are prepared you must ready the vessel. One crewmember can read out the items on the pre-departure list and the other can inspect the critical gear. The vessel should not depart until this pre-departure inspection is complete.

A few minutes of prep can save time and embarrassment on scene.

Note:
A searcher should be aware of their fatigue level.

Search Communications review and check

The radio watch can check in with the Coast Guard Radio Station and verify the designated search channels as well as announcing the departure (see Initial Departure message, Chapter 4).

On Scene Commander (OSC)

The selection of an On-Scene Commander (OSC) and/or a Coordinater of Surface Search (CSS) is based on the experience of the individual, the capability and type of vessel.

The OSC is usually the Captain of a SAR vessel or aircraft. On occasions, another vessel may be designated as CSS. If the Joint Rescue Co-ordination Centre has not designated an OSC, and your vessel is on-scene with other vessels, you may be assigned the CSS position. The duties of a CSS may be transferred to another vessel, but frequent transfer is not recommended since it inevitably leads to confusion. Consult with JRCC before transferring this function.

9.3 Stage Three: Searching

9.3.1 Making the Search Action Plan Happen

The captain/coxswain will ensure all are aware of their duties and ready to carry them out.

First On scene

As your vessel nears the search area the coxswain/captain will slow down to search speed and everyone will start to look for objects in the water. Here the search plan can be reviewed and any comments or concerns by the crew and spotters can be addressed. The captain will ensure all are aware of their duties and ready to carry them out.

9.3.2 Datum and LKP

Datum: is defined as the most probable location of the search object for a given time corrected for total drift.

Normally provided by JRCC, datum is the starting point for most searches. To find datum, the Last Known Position (LKP) of the search object is corrected for the drift it would experience in a given time period. In other words, JRCC uses object drift formulas and computers programmed with local current and tide information to estimate where the search subject will most likely be by the time you arrive.

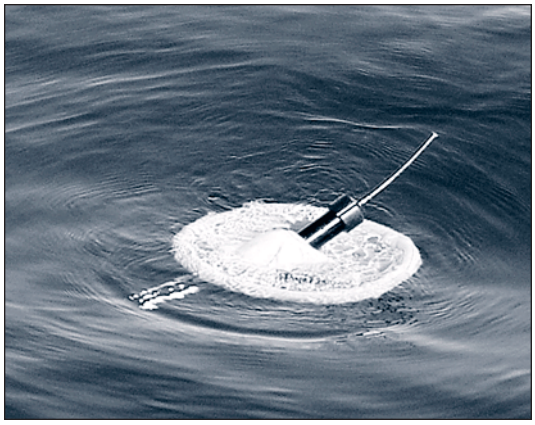
Commence Search Point

Confirm the search action plan and everyone's roles

If searching for a person in the water, one of the first steps upon arriving at commence search point is stopping the vessel to look and listen. JRCC needs the real wind and current information from the scene and it will be your job to supply that data. The Datum Marker Buoy (DMB) is the tool that JRCC uses to gather this information. With a large search, sometimes JRCC will assign a vessel to simply stay by the DMB and relay its position constantly. The JRCC can ask that the DMB be deployed anywhere in the search area. Your next actions may well determine your success in finding the target.

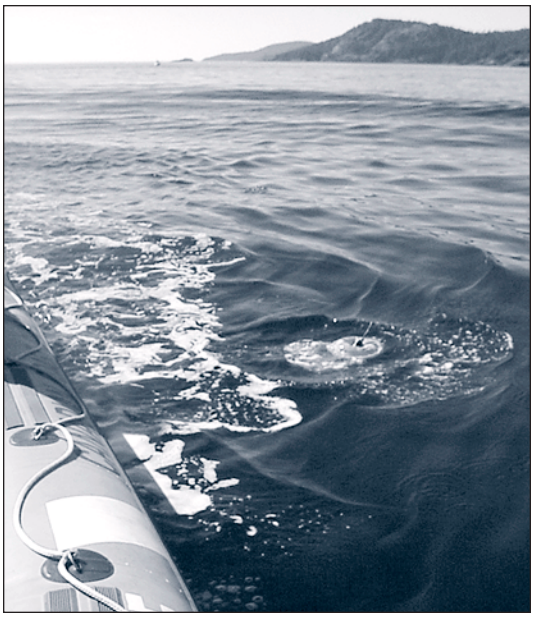
Tips for successful searches

1. Search actively when approaching, and at the commencement point of the search
2. Remind your crew to stop and shut down the engines, if practical, while the spotters look and listen
3. At datum, the coxswain may ask that the datum marker buoy (DMB) be deployed and the time and position be recorded. JRCC will be advised that the DMB is in the water and given its time and position
4. Confirm the search action plan and everyone's roles
5. If starting an open water pattern, draw the search pattern on the chart table or console and keep track of the progress



DMB Deployment Steps

- ➡ Prior to arriving on-scene, confirm with the Joint Rescue Coordination Centre that a DMB is required
- ➡ Inform JRCC/OSC immediately after a DMB is deployed, including time, location and frequency (if electronic)
- ➡ Provide regular DMB position updates to JRCC



9.3.3 Target Profile

Target Information

Before arrival at the search area, the coxswain of the search vessel should brief all lookouts as to the nature of possible targets and a review of all of the information known. A search for an overdue vessel can progress into a search for many things, the lookout should understand the types of situations the craft may have encountered, and the targets that may result from those situations.

Stop and Listen

Excerpt taken from the statement of a survivor of a capsized vessel.

" The search vessel slowed down and dropped a pole in the water just 50 feet from me. I screamed, waved and blew my whistle but they could not hear me over the wind and their engines. They talked for a minute and then drove off. I shivered in the icy waters for another hour before I was spotted by a helicopter…"

Whistles and voices will carry past a person's sighting distance. It is important that a search vessel stops and listens upon arrival at the commence search point and regularly during the search.

When a possible rescue craft is sighted or heard, survivors will usually grab the closest signalling device available. Lookouts should also be alert for shouts, screams, or whistles from the survivors, as they may see the rescue craft before it sees them. If a single distressed vessel has foundered prior to the arrival of rescue units, the most probable search objects will be lifeboats, rafts, debris, oil, and people in the water.

Person(s) in the Water

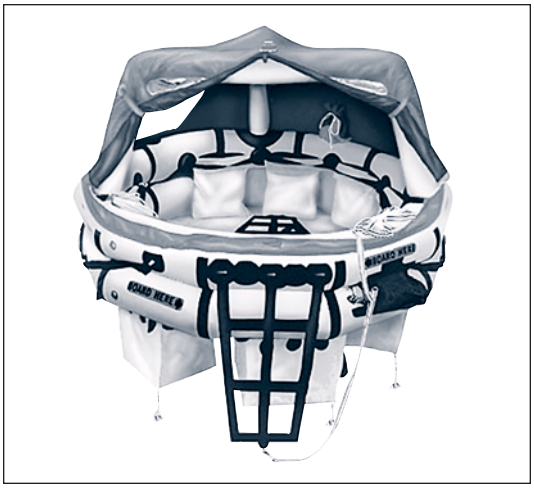
On a perfectly calm day in clear conditions a person in the water can disappear from a spotter's sight at as little as 100 metres. Locating a person in the water can be a difficult task due to sea state, weather conditions, time of day, and most importantly whether the person is wearing a flotation device. If the person is not wearing a flotation device, in most instances all that will be visible is the head. If they are wearing a flotation device, the head and shoulders will probably be visible. Be on the lookout for floating debris - the missing person(s) may be clinging to it.

Life Rafts and Lifeboats

These targets are designed for high visibility and easier to detect. Lifeboats from large vessels are usually equipped with ample pyrotechnic and visual aids, and may even carry emergency radios. Many of these vessels have power and/or sail propulsion. If more than one boat has been launched, they might be grouped or tied together to make them an easier visual target. Dinghies or rafts from small craft usually have a limited supply of visual detection aids, and in many cases, do not carry any at all.

Target Information Sheet

Size: _____
Colour: _____
Name: _____
Numbers: _____
Profile: _____
Type: _____



On a perfectly calm day in clear conditions a person in the water can disappear from a spotter's sight at as little as 100 metres.

9.3.4 Look to find

A marine distress often involves a vessel still afloat but in need of some assistance. In good weather and sea conditions, larger vessels are normally good visual and radar targets. Small surface vessels are usually more difficult to detect either by visual or electronic means. The best detection aid during good visibility periods is an alert spotter.

The probability of detection of even large vessels in rough seas is greatly over-estimated by many searchers. In some cases, large vessels are not detected until the SRU is close. Small craft are usually extremely difficult to detect under such conditions. In many instances, search aircraft have flown directly overhead without sighting them. At night, if the disabled vessel has the ability to turn on lights, the probability of detection is increased. When searching for a distressed vessel by radar, identification of the target may be hampered by adverse sea conditions, which interfere with radar reception. When searching, lookouts should be alert for pyrotechnics, lights, smoke, or visual signals of any type or colour.

The scene of a major incident is usually marked with considerable debris. Persons in the water are often found in the area of the debris clinging to floating objects.

You may obtain valuable clues to its whereabouts by asking the vessel operator what he can see in the way of prominent landmasses, navigation aids, other vessels, or aircraft. By asking the operator to determine the bearings of such objects, one may be able to cross-reference his observations with your charts, and thus considerably reduce the search area.

One may also ask what depth of water the vessel is in to ascertain a fathom line to follow for search purposes. In darkness you may request the distressed vessel to fire a flare or to use some other type of illumination for you to observe (such as a searchlight). If such equipment is not available to the distressed vessel, you may use your own flares so that the distressed vessel can give you a reciprocal bearing. Whenever flares are used to obtain bearings or for illumination purposes, JRCC must be advised.

9.3.5 Searching at Night

CAUTION:
NVGs will narrow your field of vision, and adversely effect night vision. Do not attempt to operate a vessel or conduct searches by NVGs alone.

Searching at night is a very demanding task and the darkness and uncertainty of sightings increase fatigue. The spotter must use their eyes, ears and nose to give a survivor every chance. Crewmembers must also remember that their first duty is to the safety of the vessel and they are not simply a spotter but a lookout.

Night Vision Goggles

Night vision goggles (NVGs) help spotters to pick out tiny objects in the dark. They work by magnifying existing ambient light. Ambient light is the total light available from many sources such as the stars, moon, city lights or all of these sources. Many NVGs are the binocular style and to be used correctly they require several adjustments.

Adjusting Your Goggles

- ➜ Hold the unit up to your eyes
- ➜ Adjust to match your eye width, by moving the controls for the right or left
- ➜ Adjust for individual eye focus

NVGs work best in cold, dry air. The effectiveness of the NVGs is reduced by reflected or light from snow, rain, drizzle, fog or even small invisible moisture particles. Direct intense light, from your navigation lights or other vessels close by, can reduce night vision goggles' usefulness. Under some conditions, it is necessary to stop and extinguish all lights in order to utilise NVGs. When working near lit shorelines, try to position the rescue vessel with the shore lights behind you when you are looking at the search area.

Searching Under Parachute Flares

Parachute flares may increase the chance of detecting search objects. This form of illumination has good potential when searching for objects that are located in well-defined search areas on flat land or at sea. Parachute flares are normally dropped from fixed-wing aircraft that are flying above and ahead of the searchers. In this type of search, vessels and helicopters are the most effective SAR Units.

Disoriented or Lost Vessels at Night

Vessels can easily become disoriented when travelling at night. Remember that vessel operators who are in distress are often disoriented. Be prepared to ask the type of questions, which will assist you in determining the correct position of the distressed vessel. If they are wise enough to ask for help early, they will prevent grounding, or colliding with another vessel/object. This can involve anything from a full-scale search, to merely asking a vessel to determine what their heading, course and speed was *before* they got lost.

- ➜ Ask the vessel to relay the relative bearings of passing ships, aircraft, prominent landmarks, and the depth of the water in the area
- ➜ Ask the vessel to flash navigation or search lights, use their sound signals to help identify their location; and fire flares if necessary
- ➜ If VHF radio communications have been established, Vessel Traffic Services (VTS) may assist with their Direction Finding (DF) equipment, or by providing the positions of unidentified radar targets

Locating lost vessels requires the keen detective skills and local knowledge of the CGA crews. It includes piecing together all of the information and clues as to determine the correct location of the dis-

tressed vessel. It usually boils down to asking the right questions on the radio or telephone.

9.3.6 The Use of Spotters

Spotter Versus Lookout

The Collision Regulations require that the vessel keep a lookout at all times. That lookout is concerned with safety of the ship and prevention of collisions.

Spotting Procedures

The more spotters you have, the greater the chance of detecting the search object. Normally, CCGA Units must make do with three spotters and a helmsman. If possible, use reserve personnel to rotate with spotters on duty, and to provide support (i.e. hot drinks, light snacks, conversation, navigation, or perhaps to prepare equipment to be used later in the mission).

The training, practice and experience of your spotters are also important factors. Military tests show that trained spotters are less subject to fatigue. The chances of detection improve if spotters are familiar with the appearance of objects in the water, such as people in lifejackets, lifebuoys, liferafts, and people swimming.

Spotting Position

The best spotting positions depend on the size and layout of the vessel. For the average vessel, if there are sufficient crew, place one spotter on each side, scanning forward and to the side. If possible, position one spotter looking aft.

Spotter Fatigue

Long searches cause crew/spotter fatigue. Fatigue occurs more rapidly under adverse sea conditions and low visibility. Frequent rotation of lookouts helps postpone the onset of fatigue. If replacements are not available on the vessel, shift lookouts from one side of the vessel to the other at 30-minute intervals.

Keep spotters warm and comfortable. With well-trained spotters and favourable conditions, efficiency can be maintained for 2 hours. After that, performance falls off drastically

When searching from within the wheelhouse or cabin, ensure that all windows are clear (inside and out) prior to departure. This prevents false sightings and constant re-focusing of the eyes when scanning across smudges or cracks in the windows. Dirty glass will also reduce the passage of light, so a dim light may not be seen when looking through it.

Sunglasses should be used when scanning up-sun, and are recommended for continuous use during searches in bright daylight, or high-glare conditions. Sunglasses that filter rays from the infrared and ultra-violet spectrum provide proper eye protection.

Binoculars should not be used for scanning. Once an object has been located, binoculars may be used to identify it. Binoculars should be kept clean and readily available to the spotter. Cup the eyepieces of binoculars with fingers to prevent eye injury.

It is normal for a person to require 30 minutes or more to become fully adapted to night vision. Therefore, avoid glare and reflection on board in order to preserve night vision. Illumination inside the wheelhouse should be red in colour, and should be kept to a minimum.

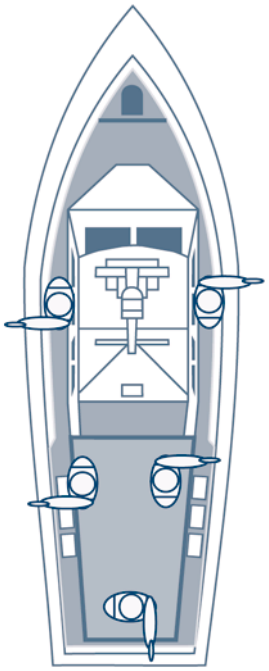
Rotate positions every half-hour, increasing frequency during poor or dull weather, to maintain your vessel as an effective search resource.

Maintain eye contact with any sighting. Attention should be attracted through a pre-arranged method of reporting – by hailing, intercom, or other means. At no time should eye contact be lost with the sighted object.

Scanning Technique

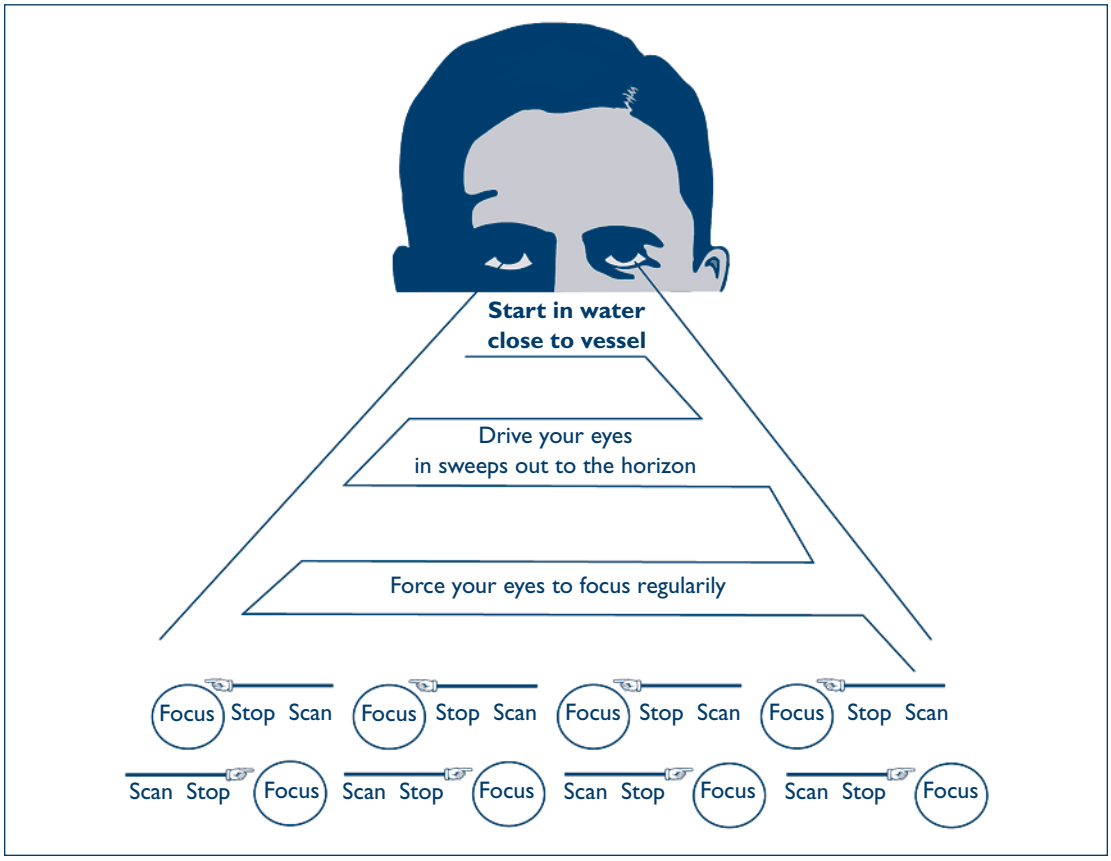
Active search requires conscious effort. It is sometimes compared to doing push-ups with your eyes. A spotter must search the sector by starting a sweep near the vessel, working your way out in a series of parallel lines to the edge of the search sector. When the sweep has been completed, a five to ten second rest can be taken followed by another search of the sector.

With the eyes focused straight ahead, the spotter should move his/her head to search the assigned area. Searching an area using eyes alone, without any head movement, can lead to an overexertion of the eye muscles, causing early fatigue.



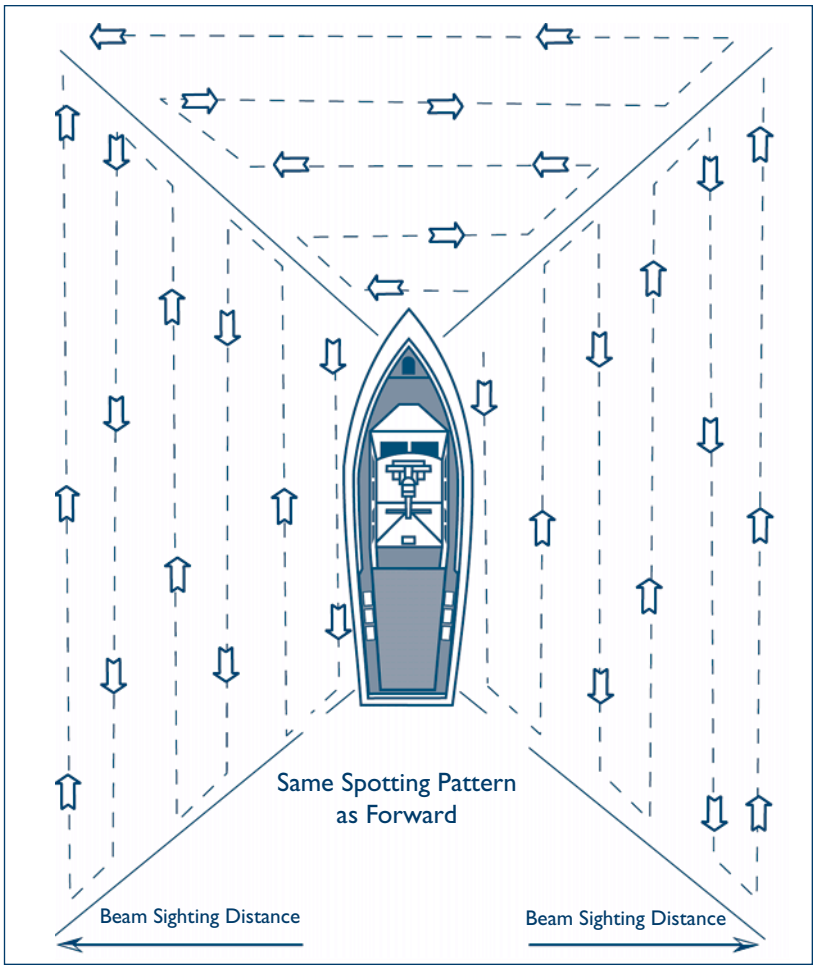
Spotters in their assigned sections

There should be absolutely no smoking. Tests have shown that smoking seriously hampers night vision.



The sequence of **SCAN–FOCUS–SCAN** should be performed in 10° to 15° segments, allowing your eyes to register objects within an 8° radius around the focused position. If you scan continuously without focusing, or focus beyond the 15° limit, your efficiency is reduced.

The retinal cells in the periphery of your vision are more sensitive to points of light than the cells in your middle focus area. You will find, when searching at night, that weak lights are detectable at the edge of sight, but not ahead. Focusing slightly higher than the horizon helps with detection.



9.3.7 Recognising a distress

Most important to your operations are the distress signals that you may see or hear. In some situations you may be the only link between the vessel in distress and the SAR system. Knowing the distress signals and knowing how to respond to them is of paramount importance for anyone involved in maritime search and rescue

Pyrotechnics

The following are some pyrotechnic emergency signals you may encounter:

- gun or explosive signal fired at about one minute intervals;
- red or orange flare fired one at a time in short intervals;
- rocket parachute showing a red light;
- orange smoke;
- any flames on a vessel.

Flag hoists

Flag hoists are a quick method of emergency signalling, but can only be used in the daytime.

These are some of the best known examples:

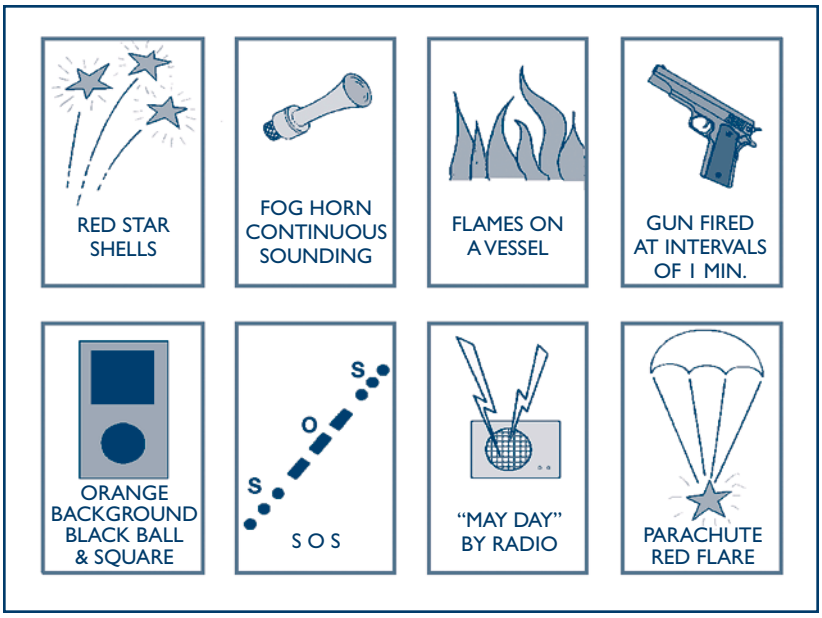
- a square flag with a ball, or ball-shaped object above or below the flag;
- an orange flag with a black ball and black square on it;
- November Charlie (N/C) flag.

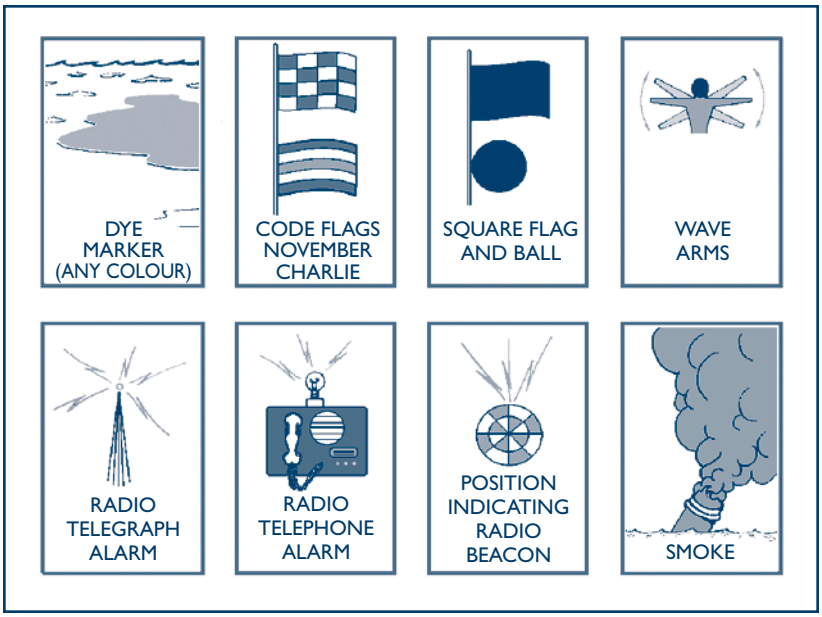
Hand signals

Possibly the oldest form of signalling is hand signals, but like other methods of visual communication, the signals are not standardised and can be easily misunderstood. Crew members must be constantly alert for hand signals being sent by other mariners that are not standard distress signals, but that may be attempts to indicate an emergency situation.

These three standard hand signals are used as distress signals:

- slowly raising and lowering an outstretched arm
- signalling with an oar raised in the vertical position
- holding a life jacket aloft





Light signals

- The Morse code symbols "SOS" (Save Our Souls) transmitted by a flashing light may be used to communicate distress.

Possibly the oldest form of signalling is hand signals

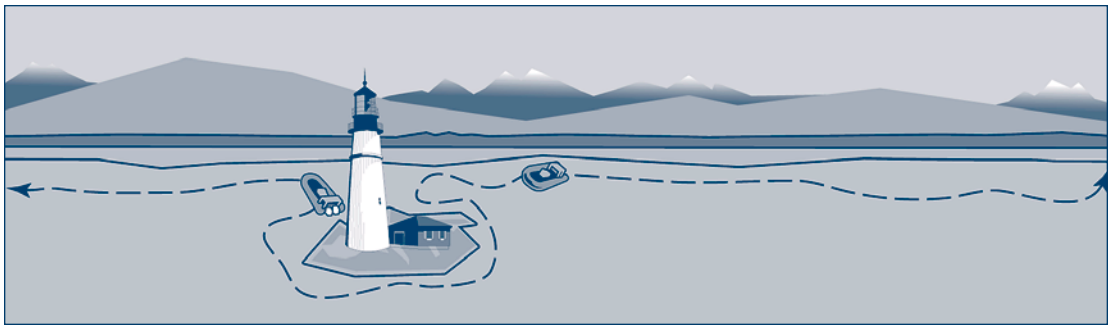
S ··· O – – – S ···

Strobe lights

Strobe lights (possibly attached to a personal flotation device) can also be used. Distress strobe lights will usually emit 50-70 flashes per minute.

9.3.8 Shoreline Searches

Vessels engaged in shoreline searches must be aware of navigational constraints and any limitations imposed by sea conditions.



This pattern is used primarily for situations in which it is probable that survivors and/or debris have washed ashore. It should be used in conjunction with any pattern, which nears a shoreline (particularly a lee shore).In general, rigid hull inflatables commonly get this assignment. Their shallow draft and tilting engines allow them to land if necessary. They allow crews to check in behind trees, logs and rocks for even the smallest bits of debris. Spotters should also scan the shoreline aft to check bays, which run parallel to the shoreline, as well as up the slope of the shore, looking for discarded lifejackets, wet drag mark up otherwise dry rocks.

Searchers using this pattern should exercise caution in navigation to avoid running aground on shoals, reefs, or bars.

Vessels engaged in shoreline searches must be aware of navigational constraints and any limitations imposed by sea conditions. Spotters should consider the possibility of survivors clinging to navigational aids such as buoys, or to rocks off shore. Survivors may make their way to any dry land they drift close enough to see. Survivors may also anchor their boat or raft, or tie it to an offshore navigational aid if they drift into shallow water but still cannot see land or believe they cannot make it to shore unaided.

9.3.9 Search Patterns

Occasionally a Canadian Coast Guard Auxiliary vessel will be required to perform an open water search pattern. When arriving on scene at a search datum JRCC may ask your vessel to commence an open water search pattern.

Terms used to describe search patterns:

- **Commence search point:** Position where the SRU begins the first leg of the search.
- **Search leg:** One of a number of successive tracks run by the SRU.
- **Cross leg:** Tracks that connect search legs.
- **Track space:** Distance between adjacent search legs.
- **Major axis:** Longest side of a rectangular search area.
- **Minor axis:** Short side of a rectangular search area.
- **Creep direction:** Direction of advance of SRU within search area.
- **Beam sighting distance:** Lateral distance searched on both sides of SRU (1/2 trackspacing and normally less than maximum detection range).

Track spacing

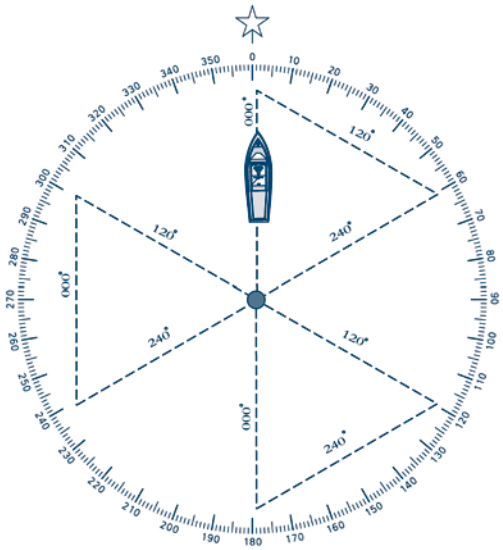
This is the distance between adjacent search legs. Track spacing can be controlled by the search planner and is based on detection capability. The more difficult the object is to detect, the closer the track spacing should be. Track spacing will normally be provided by JRCC.

Track spacing is a function of sweep width and the desired coverage factor. Sweep width is obtained from tables, which have been compiled from tests conducted on the detectability of search objects under various conditions. It is used to find the optimum track spacing and hence coverage of the search area. Sweep width is affected by:

- Size and type of the search object
- Sea conditions
- Flotsam
- Glassy water, and windblown spray
- Search craft speed
- Type of search craft
- Search altitude for aircraft
- Search crew fatigue

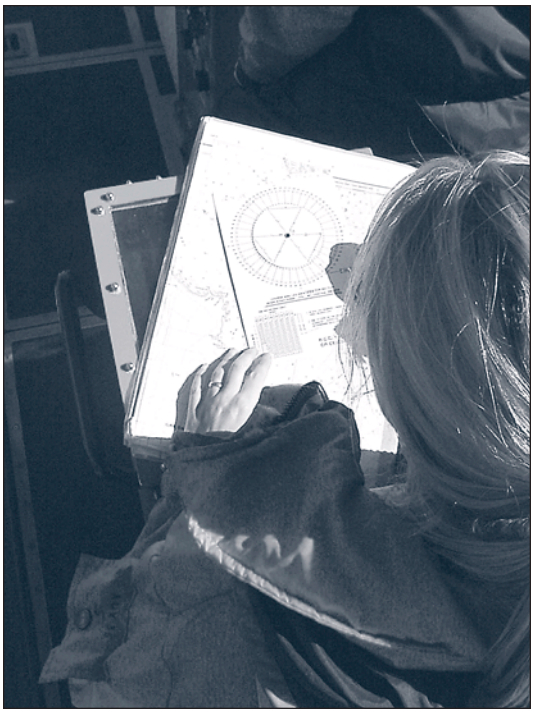
Since this calculation is completed prior to the search actually getting underway it is important that the SRU master advise JRCC, once on scene, of the prevailing conditions thereby enabling the search planner to verify his/her calculation.

Sector Search – Victor Sierra (VS)



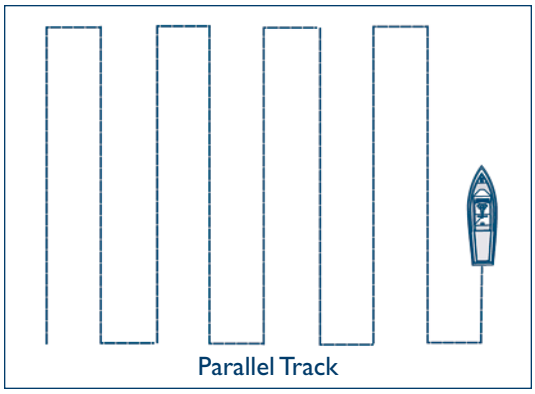
Sector Search

The sector pattern is used when the datum is established with a high degree of confidence and when the target is small (such as a person in the water). The SRU repeatedly passes through the datum. The pattern resembles the spokes of a wheelwith the centre of the wheel at datum. One must calculate an appropriate track space and search speed as well as be able to measure elapsed time. When starting, the Datum Marker Buoy is placed at the datum (and reported to JRCC) and the search began with the initial course being in the direction of the drift or magnetic north.



Parallel Track – Papa Sierra (PS)

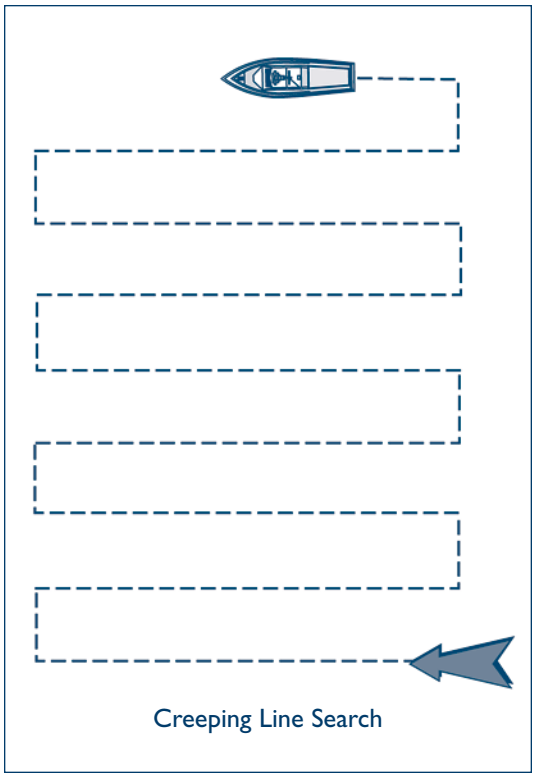
The parallel track pattern is used for general areas of probability where no precise datum is available. It can be used by a single vessel or several vessels to locate targets of all sizes.



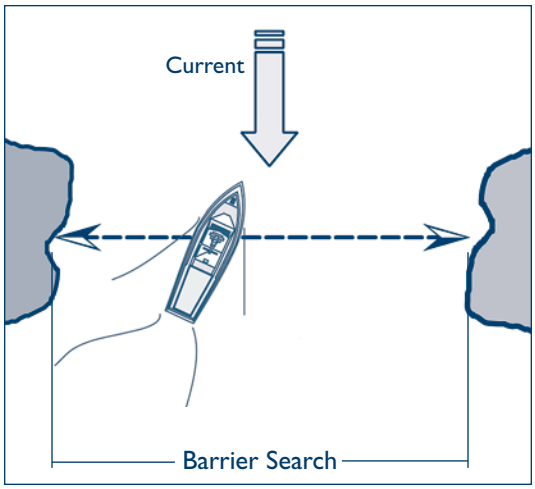
Parallel Track

Creeping Line – Charlie Sierra (CS)

The creeping line pattern is similar to the parallel track pattern and is used in similar circumstances. The legs however, are much shorter than in a parallel track search, making the creeping line more effective in areas of drift or current such as those experienced in narrow bays or channels. In these cases, run the legs cross-current and progress against the flow. Use this pattern where the search object is believed to be in one end of the search area.



Creeping Line Search

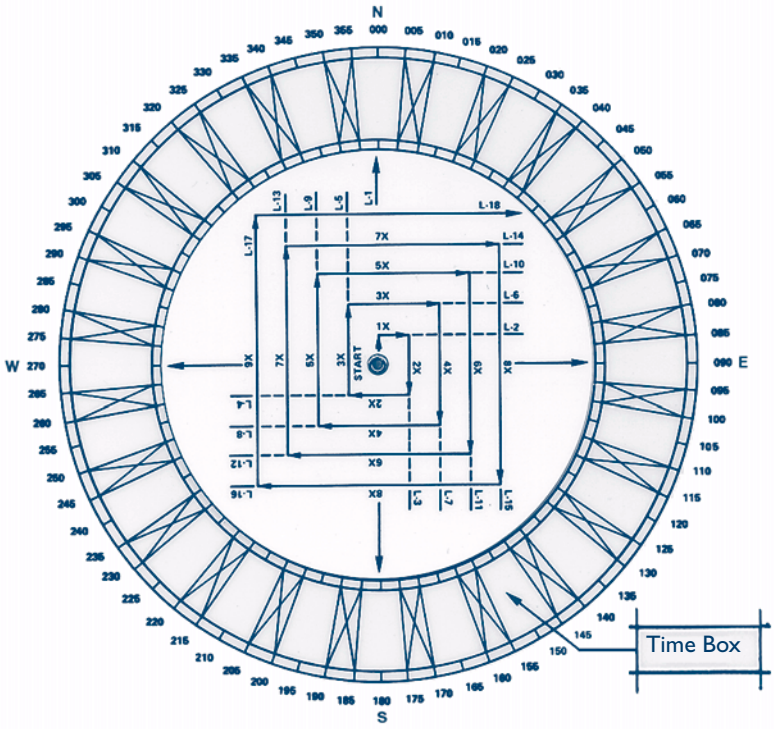


Barrier Search – Bravo Sierra (BS)

The barrier search pattern is used in search areas where strong currents are experienced. The purpose of the barrier search is to detect a search object that is being swept down current. The barrier is usually set downstream of the projected datum. It is the only pattern that uses fixed geographical points of reference. In order to conduct a barrier search, keep position against the current by employing diagonal sweeps upstream.

Expanding Square Search (SS)

An Expanding Square search is used when there is a relatively precise datum, i.e. time of distress and on-scene time of SAR unit very short, and total drift or drift state of search object very small. First, the Datum Marker Buoy is set afloat at the datum (and position reported to JRCC). The track spacing is determined from what is being searched for, and the search speed is set (usually between 5 and 10 knots, when searching for persons in the water). Careful notes should be kept on this search, of what length legs have already be completed in which direction.



COURSE AND LEG IDENTIFIER FOR EXPANDING SQUARE PATTERN – (SS)

Expanding Square Search Computation Table

Track/ Space	1 kts	2 kts	4 kts	5 kts	6 kts	9 kts	10 kts	12 kts
0.5	30:00	15:00	7:30	6:00	5:00	3:20	3:00	2:30
1.0	60:00	30:00	15:00	12:00	10:00	6:40	6:00	5:00
1.5	90:00	45:00	22:30	18:00	15:00	10:00	9:00	7:30
2.0		60:00	30:00	24:00	20:00	13:20	12:00	10:00
2.5		75:00	37:30	30:00	25:00	16:40	15:00	12:30
3.0		90:00	45:00	36:00	30:00	22:00	18:00	15:00

9.3.10 Drifting with the Datum

Since it is very difficult to measure distance at sea (particularly at night), elapsed time is used to determine the length of each leg of a search pattern.

One has to remember that search patterns are scribed out on the surface of the ocean and not on the earth. If the water is moving then so is your pattern. Electronic navigation aids such as GPS give a marine navigational position in reference to the bottom of the ocean not the surface. As you manoeuvre your vessel through the shape of an expanding square or the triangles of a sector search remember that every leg of your pattern is being twisted and distorted by the effects of wind and current. This is why search patterns using GPS and radar can force your boat to go to the wrong place. When getting a pattern assigned by JRCC ask if they would like an electronic search over ground or a surface search that drifts with the datum marker.

9.3.11 Driving the pattern

A minimum of three crewmembers are required to have a vessel to perform a successful search pattern. Even with three crewmembers the vessel may drive the pattern but the spotter effectiveness will be limited, because each crewmember is busy managing the vessel around the search pattern.

Positions for a stopwatch pattern

Helm:

The person at the helm must practice the manoeuvring of the vessel through the turns and legs of the search patterns. A real search is not the time to learn how to do this.

The driver must be able to perform the following tasks:

- Keep a lookout ahead for objects and dangers to the vessel
- Use the vessels wake trail to estimate the turn angle and bring the vessel around to 90° turns and 120° turns without the use of the compass (which may be spinning)

Use the compass to sight a landmark for the next heading and use that landmark to swing the vessel to the new heading

- Use the compass to steady the vessel on the new course after the compass stops spinning
- Adjust the throttles during the turns to maintain a constant search speed

Timer:

The person on the stopwatch will perform the following tasks:

- Draw the pattern and brief the Helm and Navigation watch of the action plan
- Calculate the compass courses of the search legs and record them
- Calculate the times of the search legs and record them
- Set up the stopwatch to count down the leg times
- Give the helm a five-second warning for the next turn and the compass course for the new search leg

- Cross off the pattern legs as they are completed
- Keep eyes up and search your sector

Navigation Watch and Speed Control:

The person on the navigation watch will perform the following tasks:

- Perform all regular Navigation Watch duties
- Watch the vessel's course and speed
- Relay the speed to the helm
- Watch the radar for contacts
- Keep a lookout for dangers to the vessel

Extra spotters should search their assigned sectors

9.3.12 Finding Things

Flotsam and Jetsam

Objects that have drifted free of wreckage and items that have been thrown overboard are hard to distinguish

Objects that have drifted free of wreckage (flotsam) and items that have been thrown overboard (jetsam) are hard to distinguish. That is why when you are searching, everything that you sight or find is evidence until you have definitely ruled it out. Any items such as life jackets, pillows, fuel tanks, bottles, paddles etc. are treated as flotsam and reported to JRCC immediately. The crew must record the positions of all suspicious objects and include this information with the SITREP.

Abandoned Vessels

When coming across a vessel adrift, treat it as though there might be a person or persons on board. Survivors may be in the water, a raft or in a dinghy close by.

Use your detective skills to find the clues:

- Is the vessel full of fishing gear, with lines out?
- If vessel has an engine check the position of the throttle and gear lever
- Check the fuel level in the gas tank
- Check the temperature of the engine exhaust
- Check the vessel's mooring lines: are they coiled neatly in the vessel or is the bowline hanging out and broken?
- Where are the paddles: stowed or missing?

Always advise JRCC of the position and circumstances of a vessel adrift, along with a complete description of the vessel, contents, markings, weather on scene, and indications of time since occupied.

9.4 Other Search Units

When dealing with other SAR resources it is important that you keep track of the communications and unit tasks. Many different agencies can be involved in a large-scale search and it is beneficial to be aware of the other units capabilities.

When dealing with other SAR resources it is important that you keep track of the communications and unit tasks.

Surface Vessels

Surface vessels are used for searching, and for their ability to execute a rescue or stabilise a marine incident under a wide range of conditions. Surface vessels can be divided into two broad categories: boats and ships.

Boats

- Small vessels make limited search platforms because of the spotter's low height of eye and the movement of the vessel in rough conditions
- Rescue boats are usually deployed for fast, short-range rescues in sheltered waters, and searches in shallow or confined waters
- Often an open-boat design, providing crew and survivors with limited protection from the elements

Ships

- Superior to small vessel because of the height of eye advantage
- Offer more protection from the elements
- Capable of operating away from their home port for days or weeks
- Can provide greater level of care to survivors

Canadian Navy / Department of National Defence (DND)

The bridges of warships make good search resources because they have many spotters and constant relief. Their radar is superior to that of other ships. Navy ships are fast, manoeuvrable, high endurance vessels that also pack the communications capable of controlling both aircraft and vessels on-scene. Naval vessels also make excellent rescue ships, since they can get to the rescue scene quickly, using their helicopters and rigid hull inflatables (RHIs) to rescue and transport survivors.

Royal Canadian Mounted Police (RCMP)

The RCMP have several high-speed catamarans in the Pacific Region, each providing a solid platform for search and rescue operations. Local detachments also have small boats capable of aiding in a search. RCMP members have good local knowledge and their vessels are generally capable of participating in inshore SAR, but should be cautioned against proceeding in adverse weather conditions.

Fishing Vessels

Fishing vessels generally make good rescue platforms. A fisher's local knowledge makes them an invaluable resource, especially during inshore searches.

Weather is the biggest factor for these vessels, particularly with the smaller inshore boats.

Pleasure Craft

Pleasure craft can make good search vessels, but care must be taken in their tasking. Most pleasure craft owners have little nautical training, and probably no SAR training, so when they are tasked to assist, you must make certain that they can complete the tasking safely.

Weather is a primary concern for these vessels. Every effort should be made to avoid tasking pleasure craft in adverse weather conditions.

Other Local Resources

Other local marine SAR resources may be available. Consult with local fire and police departments, commercial operators and organised volunteer groups concerning their search and rescue plans.

Aircraft

- Most suitable platform for conducting a search. Their speed and search height allow them to effectively cover large areas
- Good SAR aircraft have a relatively quick transit/cruising speed, and a slower speed for searching (100-150 kts). Faster aircraft can still be used for conducting electronic searches, or for sweeping large oceanic search areas
- Helicopters are excellent SAR aircraft. They have fairly limited range, when compared to fixed wing aircraft, so their strength is in the rescue, rather than in the search
- When properly equipped, helicopters are excellent platforms for conducting coastal "crawls" (day or night)

Primary Air Resources

Each Search and Rescue Region has dedicated SAR air resources provided by a Department of National Defence Cormorant helicopter offering the following capabilities:

Searching

- Visual detection day
- Visual detection night (illumination flares, lights)
- Electronic Direction Finding
- Visibility (time-of-day, lighting, mist, haze, smoke)
- Weather endurance
- Range
- Low search speed

9.5 Example of Log Entries During a Search

Abbreviated Excerpts taken from search log, Coast Guard Ship ***Gordon Reid***

CCGS Gordon Reid
SAR Events Log

May 16th Year 1995	JRCC W95-0560 14-foot skiff found overturned 34 year old male missing
1423	Mayday Relay vessel "Go Getter" advises man missing from skiff, Kumealon Inlet area 53 43.6' N 129 49.6 W
1428	Coast Guard Ship Gordon Reid, and GR 1 (733) , CCGS Point Henry, USCG Helo 6022, all tasked
1442	GR1,GR and Point Henry all underway ETA 1 Hour other vessels underway
1507	VAJ (Prince Rupert Coast Guard Radio) co-ordinates channels and advises vessels on scene of search plan.
1543	JRCC advises Gordon Reid to Commence (BS) pattern search at Pitt Point Point Henry is tasked to interview reporting party on board "Go Getter"
1552	Point Henry advises subject has been missing for five hours last seen 1115 hrs. and was not wearing a PFD or warm clothing. The skiff was found overturned in open water at 1400hrs
1616	All areas 2nm from LKP have been searched by units Shoreline search Kumealon bay complete and nothing found. Search Area expanding
1644	A/C 6022 completes shoreline and open-water patterns
1708	Helo R456 arrives on scene and commences open water search
1724	Commercial Diver searches bottom near LKP and negative results Reporting vessel feels that survival chances are minimal
1737	JRCC advises most areas have been covered twice shoreline search commencing for third time
1839	RCMP advised and on route
1927	JRCC advises all units stand down negative results (search time 5.1 hours)

WX:	GR1 Crew
SS: calm	Kelly
Wind: 15kt NW	Armstrong
Sky: clear	Smith

10

Rescue

This chapter sets out to ground CCGA crewmembers in concepts of co-ordinated effort and teamwork and lead them away from notions of heroics and risk taking. Effective marine rescue is always a team effort and successful team efforts are born from continuous training along with practised communication.

Rescue

Contents

Valerie & Brothers II

Written by Neil Peet (Supervisor of Marine SAR Programs CCG)

Ten Canadian Coast Guard Auxiliarists from Harbour Breton, Newfoundland and Labrador received the Canadian Coast Guard (CCG) Commissioner's Commendation for their lifesaving efforts during SAR Mission # 00-042: F/V Valerie & Brothers II, aground with 4 persons onboard (POB), 18 March 2000.

On 18 March 2000, at approximately 0745 (L), the Maritime Rescue Sub Center (MRSC) St. John's received notification through Placentia Marine Communications and Traffic Services (MCTS) that the Fishing Vessel (F/V) "Valerie & Brothers II" was aground in Wreck Cove, Fortune Bay with 4 POB.

The F/V "Valerie & Brothers II", in the company of another fishing vessel, had returned to Wreck Cove on Friday, 17 March at 1630 (L) from the fishing grounds. When the weather deteriorated later in the evening, both fishing vessels broke their moorings and were in danger of being lost. Four individuals boarded the two boats in an effort to save them. In spite of their efforts, one of the vessels became swamped and was lost. With all four persons now onboard the "Valerie & Brothers II", her engines also failed and she began to drive ashore.

Upon grounding in Wreck Cove, three of the occupants of the "Valerie & Brothers II" were able to evacuate to a nearby cabin for shelter. The fourth individual, Russel Cox, owner of the F/V "Valerie & Brothers II" who sustained injuries in the effort to save his boat, was unable to climb the slippery rocks to safety and was forced to remain with the stricken vessel. At the time of the incident, the weather was reported to be North East winds, 35 to 45 knots, heavy seas, with reduced visibility in heavy snow and freezing spray.

In addition to tasking several primary SAR Air and Maritime Resources and two vessels of opportunity, the MRSC tasked the following Canadian Coast Guard Auxiliary (CCGA) resources to this distress incident:

- CCGA V/L "Trina & Sons", under the command of Wesley Snook Sr.;
- CCGA V/L "Jane & Brothers", under the command of Reuben Rose Jr.; and,
- CCGA V/L "Stephen & Jayde", under the command of Arthur Pierce.

In spite of the severe weather at the time, all three vessels accepted the tasking and departed the small fishing community of Harbour Breton, Fortune Bay by 0815 (L).

After approximately 1 hour on task, the CCGA V/L "Jane and Brothers" stood down from the incident due to the severe ice accumulation on the vessel. The "Trina & Sons" and the "Stephen & Jayde" being larger vessels, were able to press on through the storm tossed seas and arrived on scene at 1030 (L).

Upon their arrival, it became evident to the Masters of the "Trina & Sons" and the "Stephen & Jayde" that the now holed and swamped F/V " Valerie & Brothers II" could not be towed from the rocks to safety. As well, due to the shallow water and heavy sea conditions, the larger fishing vessels could not be used to effect a rescue of the injured and now severely hypothermic man, still onboard the "Valerie & Brothers II".

After a quick scene assessment, it was decided that the small lifeboat from the "Trina & Sons" would be floated to the "Valerie & Brothers II" to evacuate the injured man.

To assist in the rescue, two crewmembers from the "Stephen & Jayde" had transferred to the "Trina & Sons". Once in position, the small lifeboat from the "Trina & Sons" was launched and boarded by Mr. Art Pierce and Mr. Rod Pierce. While Wesley Snook Sr. held the "Trina & Sons" stern to the heavy wind and seas, his crewmembers, Wesley Snook Jr., Gary Snook Sr. and Tim Stoodley, slacked the boat to the beach by way of a lifeline.

Once alongside the "Valerie & Brothers II", the injured man, Mr. Russel Cox, was evacuated to the beach by Art Pierce and Rod Pierce. It should be noted that due to his injuries and the effects of hypothermia, Mr. Cox was unable to walk or help himself.

Mr. Cox was assisted to an alternate location where all three men then re-boarded the lifeboat and were hauled to safety by the crew of the "Trina and Sons".

Once all three men were safely onboard the "Trina & Sons", Mr. Cox was taken below deck where all of his clothing had to be cut away as they had frozen to his body. Mr. Cox was then treated for hypothermia by the crew of the "Trina and Sons" and evacuated to hospital in Harbour Breton.

Mr. Cox had spent a total of five hours in the water and in his opinion and the opinion of the receiving physician in Harbour Breton, was very near death at the time of his rescue.

10.0 Introduction

In this age of mass media and live action video a glamorised view of search and rescue has distorted the reality of our work. This has given would be rescuers some dangerous ideas. On television the rescues, even the live action ones, always work out. The networks will show rescuers taking unwarranted risks and being successful in their dangerous heroic rescue attempts. The reality is, if you make a habit out of risking your life during rescue operations you will end up dead. Dead rescuers are not effective or popular. There is no room for heroics only well planned co-operative actions.

The priorities of a Canadian Coast Guard Auxiliary vessel are simple:

1. Safety of the Auxiliary vessel's crew
2. Safety of the Auxiliary vessel
3. Safety of the people in need of assistance

Do not put yourself or your vessel in unwarranted risk under any circumstances.

10.1 Stop Assess Plan

Panic and poor judgement kill rescuers as well as victims. When faced with unusual circumstances in adverse conditions, proper assessment is the key to survival. A few moments standing away from the action observing and communicating with your team will enable you to formulate a plan based on what you see and hear. This will save countless minutes in fumbling, re-planning or winging it. These few minutes may prevent a serious accident or save a life. In extreme conditions this allows time for the team and team leader to act calmly and not be prisoners of their adrenaline. Rarely, are you faced with the typical Hollywood scenario where we only have seconds to act, or all is lost. Yet many times a scene will contain hidden or subtle dangers that are missed at first glance. There is always enough time to assess and plan.

10.1.1 SAP is a team communication process

Whenever a small team confronts an unknown situation we are compelled to get involved and help quickly. This sense of drama and urgency can draw bystanders as well as rescue professionals into situations before they are ready to deal with them. The dramatic "just in time" rescues we hear about are very misleading. Very rarely does a situation warrant instant action upon arrival. There is usually always time to gather your thoughts. What is needed is a tool to get rescuers in the habit of going through three essential steps before they leap into an unknown situation.

Stop Stop outside of the event zone (100 feet in most marine situations).

Assess Everybody observes, being careful to only discuss his or her observations and not plans.

Plan Everybody gets input on the plan but the leader has the last say. The leader assigns tasks and clarifies each team member's role. When everyone acknowledges the plan, the team can approach.

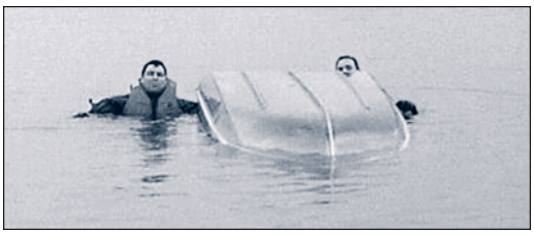
Use of SAP must always be considered when confronted with new information during a rescue, such as prior to entry into an enclosed space on the vessel. There may not be an atmosphere that will support life in that space, and the unwary crewman may become a casualty. This can be made worse by seeing an unconscious casualty lying in that space.

10.2 Rescue and Recovery

Do not put yourself or your vessel in unwarranted risk under any circumstances.

Recovering people from the water is the single most important task in rescue operations. A well thought and planned approach is critical to the overall success of the operation. If dealing with more than one person in the water, rescue centre and other search units should be notified that you are commencing rescue operations. Before you start, communicate the number of people you can see and the exact location of the survivors.

The crew of the CCGA vessel should be aware of the driver's/captain's intentions as to the means and



method planned for extracting people from the water. Any equipment necessary to bring people aboard should be prepared prior to arrival. If the person is not conscious, it may be necessary to place a crewman forward with a boathook to guide the survivor to the vessel's recovery area (i.e., swim grid, boarding ladder, dinghy, etc.)

10.2.1 Person in the Water

Recovering someone from the water is a dangerous manoeuvre. The best way to prevent injury and accident is to practice this evolution repeatedly. Everyone should be familiar with all the positions so that the vessel is ready to respond efficiently.

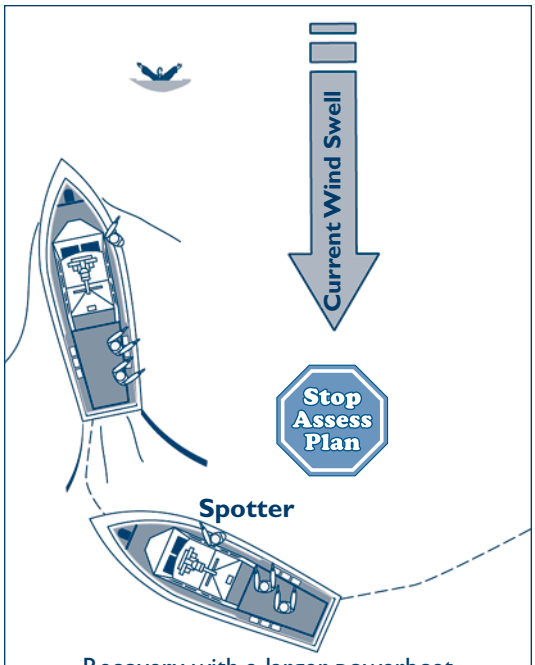
Once someone in the water is spotted, the helm position must quickly assess the prevailing conditions in order to set the vessel up for a successful recovery. If the crew takes their time in planning and preparing then the recovery will be successful.

The team shall consider the following:

- ✓ Wind
- ✓ Current
- ✓ The vessels configuration
- ✓ The method of recovery that will be used

Vessel Approach

Do not manoeuvre the vessel while close to the person in the water



Recovery with a larger powerboat

Bow into the Dominant Force

For effective control, the bow of the vessel normally will be head into the prevailing dominant forces being wind, current or swell. One of these will have the most effect on your vessel.

Stop the vessel well clear and take the time to notice any details or surprises. Communicate with the crew and confirm that everyone is ready to perform his or her task. This SAP need only be a few seconds but those seconds will save time when everyone works together effectively to recover the person. When approaching overturned sailing vessels and/or fishing vessels, watch for trailing lines. Approach from downwind, as lines drag upwind. The spotter must maintain verbal contact with the person in the water. This will enable you to assess the person's level of consciousness as well as reassure them.

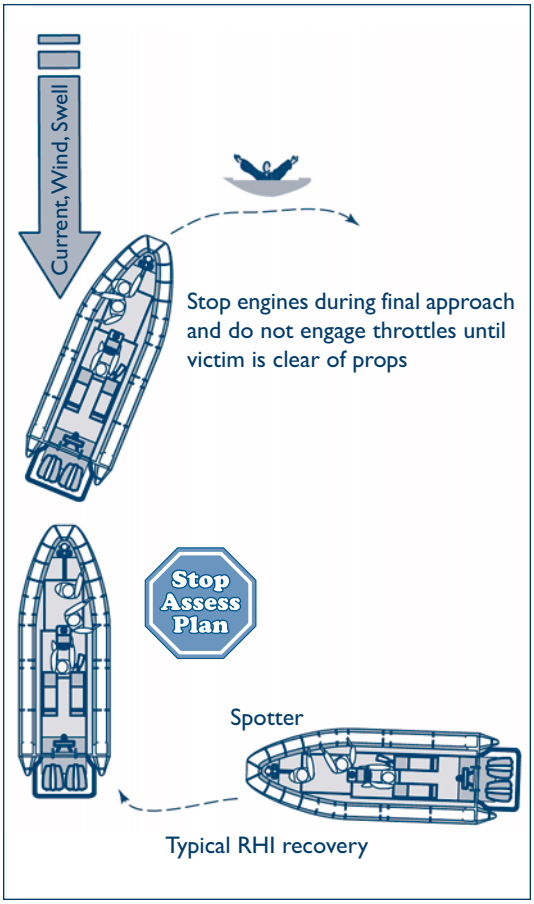
Final Approach

Once the SAP is completed, the final approach should start 2-3 boat lengths downwind from the victim (further away if wind and sea conditions dictate) to ensure that the bow is kept up into the wind. If the driver can't see the victim, the engines go into neutral. If the vessel is not close enough to recover the person, wait until the person in the water is clear of your stern and go around again for a full approach. The crewmember responsible for sighting and calling distances must remember to continue indicating position even after the victim disappears from sight under the bow. This keeps the coxswain informed of the status of the rescue. Get a hold on the victim as quickly as possible because the boat will drift downwind rapidly. The person pointing must keep his/her eyes on the victim, even if it is necessary for the vessel to make another approach.

Six steps to a typical recovery

1. Appoint one crewmember to keep sight of the person in the water, and have them point and wave their arm towards the person when they have the victim in sight. If they have momentarily lost sight of the person, they should hold their arm out straight in the direction of the last sighting.
2. Keep your bow into the wind, with the person in the water ahead of you.
3. Stop Assess and Plan when you are 2-3 boat lengths away, establish communication.
4. Go slowly on final approach. It's better to take your time and succeed the first time, than to have to go around again.
5. Put throttles into neutral when the way of the vessel will bring the vessel slowly alongside the person. Do not touch the throttles until the person is onboard, or well past and clear of the engines.

6. Use the appropriate retrieval method. Be careful during this recovery as persons in distress have pulled would-be rescuers into the water. Keep your centre of gravity inside of the boat.



Typical RHI recovery

With the person alongside, assess what is the best means to bring the person on board. Persons who have been in the cold water a long time will have lost muscle strength and grip, may be incapable of helping themselves, and may be hypothermic.

Water Extraction Techniques

Handling Your Victim

Getting a person aboard is much more difficult than many expect.

Keep the victim on the upwind side of the vessel.

- ➜ When recovering the victim, move him/her gently; severe hypothermia can quickly become cardiac arrest with rough handling.
- ➜ Support the victim's head at all times.
- ➜ Talk to the person and reassure him/her. Always assume that the victim can hear you.
- ➜ Keep the victim on the upwind side of the vessel. This will allow the victim's feet to act as a drogue, reducing the friction and effort required to pull him/her up over the side. If the victim is on the downwind side, the feet are pushed under the hull, this increases the effort required to lift.
- ➜ If the victim has been in the water for any length of time, they must be brought into the boat, carefully and as near horizontal as possible to prevent cold blood, in the extremities, suddenly returning to the heart. Parbuckling is the prefered method for this.
- ➜ Once aboard, place the victim in the position of most comfort and as protected from the elements as possible.
- ➜ Treat for hypothermia and administer first aid as necessary.

Parbuckling

This technique works best with RHIs but can be used on vessels with low freeboard and round hull shape (tumble home), in calm conditions. Parbuckling is an old sailor's trick, originally used to roll barrels up the side of ships. Rescuers can apply the same technique to gently recover people horizontally out of the water.

- ➜ Start with the person floating on his/her back.
- ➜ Attach two lines to the lifelines, one opposite the person's knees, and one opposite the midpoint between the person's shoulder and elbow. If you have to make a choice, attach closer to the elbow to prevent the line slipping up around the person's neck.
- ➜ The aft crewmember controls the victim alongside, while the forward crewmember passes his/her line under the victim at the aforementioned midpoint and back up the outboard side.
- ➜ The forward crewmember controls the person, while the aft crewmember passes his/her line under the knees and back up the outboard side.
- ➜ The crewmember at the head controls the lift. The crewmember at the head is not necessarily the coxswain, but should be the person with the best first aid qualification.

- ➜ Reassure the person and continually communicate with the other crewmember if you are the person controlling the lift.
- ➜ Give a three count, then start pulling.
- ➜ The person will be carried through one complete rotation, and end up face-up lying on top of the cap rail or sponson.
- ➜ Crewmembers involved in the lift should keep their knees and lower legs against the sponson to help stop the victim's progress.
- ➜ Gently lower victim down to the deck.

Crewmembers involved in the lift should keep their knees and lower legs against the side to help stop the victim's progress

Reassure your victim

WARNING

***Do not** place a crewmember into the water to help with the recovery, due to the extra time required to recover the second person and the risk of injury to your own crew*

Debrief Survivors

Once the survivors have been located, brought on board, and any necessary medical check up and attention rendered, the SAR crew should, where possible, question them regarding the circumstances of the incident, and the possibility of other survivors.

Information obtained from survivors must be immediately relayed to JRCC or the On Scene Commander (OSC). When questioning the survivors, speak in a calm, clear and reassuring voice. Let them know that the information they provide will help with the search.

Ask simple questions and don't suggest answers:

- ⇛ How many people were onboard?
- ⇛ Is anyone missing?
- ⇛ Do you know where any missing person may be?
- ⇛ Do you have any pre-existing medical problems that we should know about (i.e. heart problems, diabetes, etc.)?

Treat all cold water immersion victims for hypothermia. If the victim is suffering from severe hypothermia, call JRCC and request a MEDEVAC then proceed to shore immediately to obtain proper medical treatment for the victim.

One Person Lift Using a Short Piece of Line (for vessels with low freeboard)

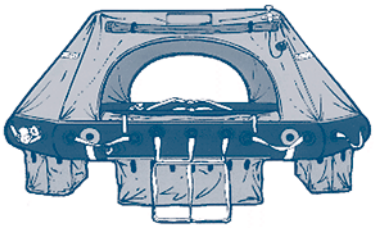
- ➜ Call out to reassure the person
- ➜ Throw one end of the line to the victim and ask he or she to grab hold of it
- ➜ Pull the victim towards the side of the vessel while explaining what you are about to do
- ➜ Clear a space on the deck on which to lay the victim
- ➜ Loop the line under the victims arms and around their chest, the two ends meeting in the middle of the chest
- ➜ Hold the line with both hands at their chest and ask the victim if they are ready
- ➜ Bob them up and down in the water three times (not in over their head) and on the third count, pull the victim up and across the rail
- ➜ Rotate the victim onto their back as you haul them on-board, then lie the victim down gently on the deck face up

Two Person Line Lift for vessels with low freeboard

- ➜ The forward crewmember gains control of the person and then places a short piece of line under his/her arms.
- ➜ The forward crewmember controls the lift as well as reassuring the victim throughout the process.
- ➜ Each of the two crew members should have one knee up on the rail or gunwale.

- Both crew members hold the line with both hands, as close to the person's chest as possible.
- Count to three and pull straight up until the person's hips are at the top of the rail, then continue the pulling motion as the forward crewmember controls the heads.
- The aft crewmember grabs the feet.
- Together with the aft crewmember, pivot the person so that he/she is head towards the bow.
- Slowly lower the victim gently onto the deck.

10.2.2 Recovery From Various Survival Craft

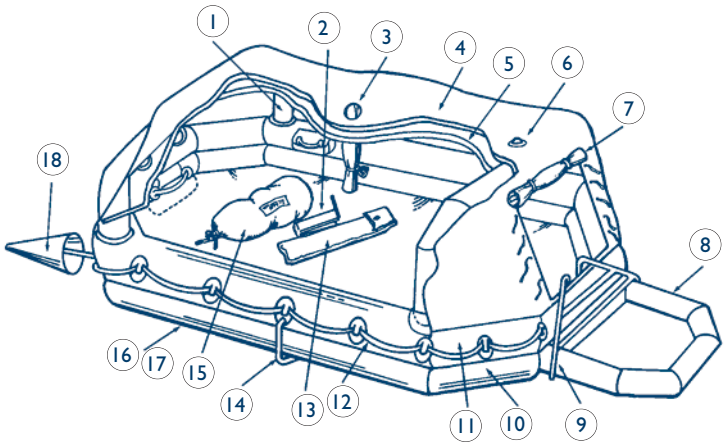


Rescue from survival craft may involve dealing with liferafts, open lifeboats, enclosed lifeboats, or any of a number of types of survival capsules. The physical condition of the survivors and the physical characteristics of the survival craft may complicate rescue and transfer of personnel. Modern totally enclosed liferafts are designed to provide the best survival platform, but as they ride on top of the waves, the occupants may well be suffering from severe seasickness and be very unsteady on their feet. Other survival craft such as open lifeboats, totally enclosed lifeboats, rescue capsules are very buoyant by nature of their construction and have an extremely lively motion at sea. Many of the enclosed survival craft are very buoyant by nature of their construction and have an extremely lively motion at sea. Each situation requires careful evaluation before approaching the survival craft to determine whether immediate removal of personnel is safe or your vessel may be required to wait until the weather/sea conditions improve.

There have been cases of survivors found safe in a survival craft only to be accidentally rammed in heavy seas by their would-be rescue ship trying to manoeuvre alongside.

Modern enclosed survival craft can safely and effectively maintain survivors in relative protection for long periods of time. In some cases, there is no need for immediate removal of personnel from the craft. Some survival craft are self-righting with all hatches sealed and all personnel strapped into their seats. These boats are capable of operating at full capacity and at six knots for a period of 24 hours. Boats for tanker vessels will have a self-contained breathing air supply together with water spray coverage for the exposed hull, and can operate in fire or a toxic atmosphere safely for a period of ten minutes. The hatches on these craft are very small in order to accommodate both the self-righting and fire survivability features. However, the small hatches also make transfer of personnel difficult. Transfer of injured or sick personnel may be extremely dangerous even in a moderate sea.

1. Canopy Arch
2. Pump
3. Rain Catcher with Tie-Down line
4. Exterior Canopy
5. Inner Canopy
6. Outside Light (Recognition)
7. Canopy Closure
8. Boarding Ramp
9. Boarding Handles
10. Hull Tube
11. Gunwale Tube
12. Life Line
13. Paddle Bag
14. Righting Line
15. Equipment Container
16. Hull CO_2 Bottle
17. Gunwale CO_2 Bottle
18. Sea Anchor



10.2.3 Person trapped under a vessel

WARNING

The first rule for the rescue team is NEVER enter an overturned hull under any circumstances.

When people are trapped underneath an overturned vessel it presents a very dangerous and unstable scene for the rescuers to deal with. The first rule for the rescue team is never enter an overturned hull under any circumstances.

A CCGA team can be most effective when trying to stabilise the scene and recover any survivors that are in the water around the area. The CCGA vessel should approach the vessel slowly, to prevent wave action that could possibly break a sealed air pocket. Once alongside, try to determine if anyone is trapped inside the vessel, and if so, their probable location in the vessel. The crew should communicate with the survivors through the hull of the vessel by tapping on it and shouting. Keeping the people advised throughout the rescue on what steps are being taken to rescue them will reassure them.

There are a number of things that can be done to stabilise the vessel and prevent it from being upset and sinking. The CCGA vessel can request a "Securité" broadcast that notifies vessels in the area to reduce speed and wash when passing. The CCGA vessel may also hold the vessel in a sheltered area or tow it carefully to shore.

Management of the scene

- Contact JRCC and request that divers and someone familiar with the internal structure of the craft be provided.
- Stabilise the hull with flotation bags, other boats tied alongside, or with heavy shipboard lifting tackle. Place vessels on either side and carefully pass a line under the capsized vessel. Do not attempt to right the vessel at this stage.
- Inject air under the vessel (preferably clear air from diving tanks or a diving compressor). This will help keep the boat afloat and may provide more breathing air to trapped victims. Be watchful that adding air to air pocket(s) does not decrease stability of overturned vessel, causing the uncontrolled righting and subsequent sinking of the vessel.
- Attach a line and marker to the hull to mark the position in case the vessel sinks.
- If someone familiar with the internal structures of the boat arrives, consider having him/her coach the survivors on how to escape, and advise the divers on how to enter the vessel.
- Once the divers have arrived on scene, they should be fully briefed and provided with any required assistance.
- If it is necessary to tow the vessel, always tow very slowly to prevent breaking any air seals.

10.2.4 Recovering from shore

Shorelines and vessels do not mix. Surf and rocks are extremely dangerous to rescue vessels.

In calm conditions some small vessels are able to beach or get close to rocks and recover people from shore.

When conditions are rough, attempting to recover someone from the beach or from shallow water can be a fatal mistake for your team. An inexperienced coxswain/captain operating too close to rocks and surf may have his/her rescue vessel and its crew, pounded to pieces in minutes. Helicopters are very effective in these situations and are not in danger of being capsized by surf and will be a more suitable resource in this situation. Whenever attempting to recover from shore:

Stop and Assess

With the vessel in a safe position the crew can assess the elements and feature of the scene. The coxswain will ask the crew to report what they see.

In order to assess the wave and water behaviour the team should observe it carefully for a period to witness the range of wave and water motion.

The team can assess the shoreline and identify potential sites for taking people off of the shoreline.

Helicopters are the better choice for getting patients ashore

The coxswain will ask the team for suggestions regarding a plan of action. Once the coxswain has considered the plan, he or she will describe the plan and assign tasks to the crewmembers. The crewmembers will confirm their roles and then the coxswain will review the commands and signals for the tasks and emergency contingencies.

Commands and Signals to be established

- ✓ Distance measurements
- ✓ A sign or command to indicate to the survivor to board the vessel
- ✓ Sea watch person's warning of large incoming sea
- ✓ Coxswain's warning of a violent manoeuvre
- ✓ Coxswain's warning of pulling vessel away

Some common plan tasks:

- ⇛ Contact the people on shore and advise them of your plan and expectations
- ⇛ One crewmember should be assigned to look to seaward and watch the oncoming seas and swell.
- ⇛ One crewmember should go to the bow to communicate with and recover the people

Floating in a Liferaft or Lifebuoy

Some vessels engaged in SAR may carry a liferaft. The liferaft can be used to conduct the safe transfer of persons to and from a shore. Before launching the liferaft, the SRU should be positioned to take advantage of wind and current to drift the raft into the beach. If the situation will not allow the raft to drift in on its own, a messenger line may be sent ashore by line-throwing gun, heaving line, or floating in with a smaller object. The raft will have to be inflated and have adequate line attached to send it in to the beach. Depending on the circumstances, the coxswain may want to send a crewmember in the liferaft to assist the survivors. If a crewmember does board the raft, he must be dressed in full protective clothing including hypothermia protection (drysuit or immersion suit and a helmet).

Transferring personnel from a liferaft to a rescue vessel can be very difficult, particularly in less than calm sea conditions. The liferaft will experience constantly varying motion from the soft bottom and soft floor as well as a constantly changing movement of the whole raft, making safe movement of personnel difficult.

Alternatively a lifebuoy, with a line (and light at night) attached to the rescue vessel, can be floated ashore to the victim, to aid their recovery.

10.2.5 Recovery of non-survivors

Many persons still die at sea and unfortunately, bodies are not always recovered during the initial search operation. When the conditions permit, drowning victims may refloat after a period of submersion. Vessels engaged in SAR can be dispatched to assist in recovering dead bodies. When doing so, it is essential to follow proper procedures to avoid contamination and to facilitate legal issues.

When recovering a body, follow these guidelines:

- ➜ If possible and practical, have a police officer on board during body recoveries. Ensure that police officers and morgue personnel will be waiting for you at the delivery point. (If no officer is present, obtain authority before moving the body.)
- ➜ Wear protective gear (goggles, masks and long rubber gloves) before approaching the body.
- ➜ Manipulate the cadaver with plastic boat hooks.
- ➜ If you have a camera, take a photograph of the body's position and state before attempting recovery.
- ➜ Prepare a body bag (the thick black or green canvas bags are better than the thin white bags, which may break.)
- ➜ If the body is badly decomposed then a parbuckling method may be preferred. Try to avoid grabbing limbs and lifting the entire weight of the body.
- ➜ Keep in mind that this is a very emotional time for the family of the victim. In this regard, the body needs to be treated with the utmost respect and dignity.
- ➜ Communications must be conducted with the proper discretion when reporting bodies, and preferably by mobile phone if possible.

After the operation, wash everything that came in contact with the body with soap and disinfect with a solution of water and bleach (1/4 cup of bleach per gallon of fresh tap water). Used rubber gloves should be replaced.

Submerged Victims

Recovery of submerged victims may be quite difficult and hazardous for the untrained rescuer. Under no circumstances should any untrained rescuer, including certified scuba divers, attempt to enter the water to recover a submerged victim. Statistics show that untrained rescuers attempting such recoveries often die or get injured in the process. Submerged victims quite often have very little chance of survival.

It is not advisable to risk the life of a crewmember to rescue someone that may already be dead. In those situations, the only rescue actions available to you are those that can be performed from the deck of your vessel.

Using sonar to find a body

Take your time with the initial assessment after recovery

10.3 Treatment, Transport and Transfer of Survivors

10.3.1 Patient management for marine specific accidents

Near Drowning

Drowning is defined as death from suffocation due to submersion. The major causes of drowning include the following:

- ⇛ exhaustion in the water
- ⇛ loss of control and being swept into water that is too deep
- ⇛ loss of support (such as a boat that has sunk)
- ⇛ becoming trapped or entangled while in the water
- ⇛ hypothermia
- ⇛ trauma
- ⇛ having a diving accident

Factors to consider in cold water submersion survival

The following general guidelines are applicable as an indication of potential survival conditions:

- ➜ The colder the water, the better. The less warmth there is in the body, the less oxygen is needed to maintain metabolism
- ➜ Moving water cools faster than standing water. This factor must be added to the balance when ambient air and water temperature and time of year are considered in calculating survival chances
- ➜ Water depth usually correlates with temperature. Temperature drops as you descend
- ➜ Smaller objects lose heat faster than larger objects. (e.g. children)
- ➜ Cleaner water makes for an easier recovery. Contaminants or biological growths ingested into the lungs frequently cause massive infections following pulmonary injuries after the initial immersion incident
- ➜ The less the victim struggles in the water, the better. If the victim submerges with a minimum of struggling, his or her bloodstream and lungs retain more oxygen for cellular maintenance

Diving Accidents

A diving accident can require the assistance of the CCGA stationed in the area.

If you are alerted for a diving accident in your area, consider these actions:

- ➜ A decompression chamber is normally necessary. It is JRCC/MRSC's responsibility to find out where the closest decompression chamber in your area is located. Plan your best evacuation harbour accordingly
- ➜ Bear in mind that a helicopter might be the best means of evacuation
- ➜ Make sure that all detailed information concerning the patient's accident travels with him or her

Pressure is the main problem for diving emergencies. To understand how these injuries can occur, it is important to understand the effects of varying pressure on the human body. Here is a synopsis of the effect of pressure on air-filled body cavities and on inspired gas properties.

The effect of pressure on an air-filled cavity can be easily explained with the example of a balloon. When a balloon is taken to the bottom of a pool, the volume of that balloon decreases during descent.

When the balloon is brought back to the surface, its original volume is restored. This phenomenon is caused by pressure. As the pressure increases during descent, the air inside the balloon gets compressed and the balloon shrinks. When pressure is decreased on the way back up, the air expands (or is decompressed), and the balloon expands.

Now imagine what would happen if someone was to put additional air into the balloon to restore its original volume at the bottom of the pool. Nothing would happen as long as the balloon remains at the bottom of the pool. If the balloon is brought back to the surface, however, it will expand to well past its original size and possibly even burst.

This simple phenomenon explains most diving injuries. All air-filled body cavities can be compared to the balloon. On the way down, the volume of air in these cavities decreases. If the air-filled cavity is rigid (sinuses for example), additional air will be drawn into the cavity, or it will collapse. This phenomenon is called "equilibration." Failure to equilibrate generally causes severe pain and will discourage any diver from going down. On the way back up, the pressure in the rigid air-filled cavity will increase. If equilibration does not occur again, the pressure may build to the point where the cavity may "explode." In other words, the air will force its way out of the cavity. For soft cavities (such as the lungs or digestive tract), things are less dramatic. The elasticity of these cavities will prevent immediate damage. Ruptures can still occur if the pressure is diminished too quickly (i.e., the ascent is too fast).

The amount of gas that can be dissolved in liquids increases as the pressure increases. Another model will be used to explain this fact. When you observe an unopened bottle of champagne, you do not see any bubbles. This is simply because all the gas is dissolved into the precious liquid. When you remove the cork, air flows out of the bottle, the pressure around the liquid rapidly decreases and bubbles begin to form. At this lower pressure, the liquid cannot hold that much gas, so the excess must leave the liquid. You have probably noticed that bubble formation can be prevented if the cork is removed slowly. Conversely, you can increase bubble formation by rapidly removing the cork.

All this applies to a diver. When a diver goes down. pressure is increased, and an increased amount of gas can be absorbed into the diver's body (this is the unopened bottle situation). If the diver observes the dive tables and the ascent rates, significant bubbles will not form. If the diver does not observe the tables, bubbles may form. Formation of bubbles in the tissues and the blood stream can cause decompression sickness and gaseous embolism, two life-threatening situations.

Decompression

Pressure is the main problem for diving emergencies.

This section on diving physiology could not be complete without a few words on decompression. Divers accumulate gas (mostly nitrogen) in their tissues when they are at depth (because of the increased pressure and gas density). The accumulation of gas is a function of time. The longer a diver spends at a given depth, the more gas he or she will accumulate in the tissues. Gas accumulation is also a function of depth (or pressure). The deeper you go, the faster the accumulation. At some point, if a diver stays too deep for too long, he or she will not be able to get back to the surface without stopping along the way to allow the excess gas to leave the tissues. These stops are called "decompression stops." The "no-decompression limit" is the maximum time a diver can spend at a given depth without decompression stops. Information on no-decompression limits and decompression stops is found in diving tables. Failure to perform required decompression and rapid ascent rates are the most common causes of decompression sickness and air embolism. To minimise risk of injury. prudent divers will conduct the deepest part of their dives at the beginning. They will then ascend slowly and perform decompression (if required) until they surface.

The longer a diver spends at a given depth, the more gas he or she will accumulate in the tissues.

Failure to perform required decompression and rapid ascent rates are the most common causes of decompression sickness and air embolisms.

Minor Cavity Barotrauma

All air-filled body compartments or cavities have the potential to suffer from the pressure variations that occur in diving. The most common problems are:

- ⇛ Ear barotrauma
- ⇛ Sinus barotrauma
- ⇛ Tooth barotrauma
- ⇛ Digestive system barotrauma

Air Embolism

Air embolism can occur when a diver holds his or her breath during ascent. As the pressure decreases, lung volume increases. At a certain point, lung damage occurs and air is forced into the circulatory system. The air bubbles can then obstruct small blood vessels and deprive certain areas of the body of blood and oxygen. In the coronary arteries, this will cause the equivalent of a heart attack. In the brain, it will cause the equivalent of a stroke. Air embolism is a serious, life-threatening condition that requires the patient get immediate transport to a decompression chamber.

Signs and symptoms of air embolism are:

- ⇛ blotching (mottling of the skin)
- ⇛ froth (often pink or bloody) at the nose and mouth

- ⇛ dyspnea (shortness of breath) and cough
- ⇛ symptoms of a heart attack
- ⇛ symptoms of a stroke
- ⇛ dizziness, nausea, vomiting
- ⇛ difficulty in speaking
- ⇛ blurred vision
- ⇛ paralysis
- ⇛ decreased level of consciousness or even coma

Decompression sickness (DCS) and bends

Decompression sickness usually occurs when a diver does not observe the dive tables and ascent rates. When this occurs, bubbles can form within the diver's body (the "champagne effect" described above). Depending on their location, the bubbles may cause several problems. In joints, bubbles usually cause pain (known as bends). When bubbles occur within the central nervous system, paralysis can occur. In the circulatory system, the bubbles may block small blood vessels and thus alter blood supply to certain areas. DCS is a life-threatening condition that requires immediate medical attention. The victim should thus be transported quickly to a recompression chamber. Signs and symptoms of DCS may occur hours after the dive.

Even if a casualty appears dead, basic life support should be started and maintained

Never give up!

- ⇛ sharp pain felt in joints or abdomen
- ⇛ signs and symptoms of air embolism
- ⇛ altered level of consciousness
- ⇛ paralysis
- ⇛ visual disturbances
- ⇛ difficulty walking
- ⇛ speech disturbances
- ⇛ convulsions
- ⇛ bowel and bladder problems
- ⇛ numbness/dizziness
- ⇛ weakness
- ⇛ extreme fatigue
- ⇛ headache
- ⇛ nausea

DCS is usually classified as Type I or Type II. Type I refers to skin bends, fatigue or pain involving joints or muscles. Type II includes neurological and cardio respiratory symptoms.

Treatment

All diving injuries are treated the same way. Here are the priorities:

- ✓ Remove the diver from the water
- ✓ Determine the nature of the problem
- ✓ Organise transport to a recompression chamber (if required)
- ✓ Support vital functions (CPR if needed) and administer the highest possible percentage of oxygen
- ✓ Perform a secondary survey and treat all other injuries

Dive Equipment

Divers may be very bulky and heavy due to the equipment they carry. Getting a diver on board may not be an easy task for anyone who does not know how to remove some of the equipment. The weights on the weight belt or on the Buoyancy Control Device will need to be removed, the Buoyancy Control Device itself and the tank must be removed, and the mask and snorkel must be removed. All equipment removed should be preserved for future examination.

Hypothermia

First and foremost, the casualty must be treated very gently. A reduced body core temperature increases stress on the heart. Rough handling may cause further stress and cause the heart to beat erratically or even stop. If the casualty is unconscious, assess airway and breathing. If no breathing is detected, begin rescue breathing using mouth to mask method (with oxygen if available, and if you are trained for its use). Check the carotid pulse. Severe hypothermia will make detecting a pulse very difficult. Great care must be taken to determine whether a pulse is present; take extra time to make sure (up to 2 minutes). Administering chest compressions over a weakly beating heart may cause erratic heartbeat (ventricular fibrillation) or full cardiac arrest. Rescuers should take at least two minutes to look for a pulse before starting chest compressions.

If the casualty cannot be immediately moved to shelter, wrap them in space blankets or tarps to slow down heat loss due to evaporation. Once you have moved the casualty to shelter, remove all wet cloth-

ing, wrap him or her in warm blankets and apply chemical heat packs to the high heat-loss areas such as the groin. armpits. chest. head and neck. If an Inhalation Warming Unit (Res-Q-Air) is available, a trained rescuer should apply it. If casualty is fully conscious, warm sweet drinks without caffeine or alcohol may be given. Do not put casualty into a hot bath or shower and do not rub the extremities to warm them up. Casualty must be transported to a medical care facility as soon as possible.

Note: Even if a casualty appears dead, basic life support should be started and maintained. The sudden exposure to cold can help to preserve the body, and this person may have a chance of recovery. Never give up!

Re-warming the patient

The underlying principle to remember is that cold, acidotic blood contaminated with the harmful by-products of metabolism without oxygen permeates the cooled body's periphery. When a large amount of this blood is allowed to circulate rapidly toward the heart and other organs, it can cause complications as serious as cardiac arrest. This afterdrop phenomenon will occur in any hypothermic patient as circulation increases. The goal is to slow and not aid its progression.

Most formerly-practised suggestions for treating the hypothermic patient such as wrapping him or her in warmed blankets, or immersing the torso in a warm bath, were more harmful than helpful because the overall effect of such procedures was to actually speed afterdrop. Research has indicated that re-warming from the inside out is less harmful to the patient. One simple and apparently efficient all-round method is warm, moist oxygen inhalation. Since the lungs jacket the heart, warming them will in turn warm the heart, thereby protecting it best from afterdrop.

10.3.2 Transport

Once the victim is carefully positioned, you may proceed toward the casualty reception point. Transit time should be used to complete a secondary survey and to treat the non life- threatening injuries of casualties needing quick transport (unstable victims). Try also to periodically re-evaluate vital signs (level of consciousness, breathing and pulse). Be aware that this assessment may become a difficult task due to noise and vibrations (especially at high speed). Confirm with JRCC/MRSC that an ambulance is waiting for you at the designated evacuation point. As for the transit from the scene to the evacuation point, use the quickest route. Try to write your observations and actions on the relevant form to inform paramedics and physicians of what happened and what was done. For less urgent situations, transit time can be used to complete emergency treatments and to complete the written patient care form.

Transit speed should be fast but safe

Transit speed should be fast but safe. Transit speed will depend on several factors, including sea state and the casualty's condition. The nature of the emergency care that you must provide will also have an influence on transit speed. For example, it might be impossible to perform CPR adequately if you are going at 35 knots in 6 ft. seas! Transit speed should thus be a compromise between the need for quick transport and the necessity of keeping the casualty alive during transit. Under no circumstances should your speed prevent the administration of life-preserving emergency treatment.

10.3.3 Transfer to or from another vessel

Where a patient has to be transferred from one vessel to another, great care should be taken to protect the patient during the transfer. The patient should be preferably in a stretcher fitted with flotation, or else wearing flotation, and stretchers fitted with a safety line. Try and fit some blankets under the patient as insulation and cushioning. Try to position the patient within the craft to minimise the effects of motion - the after end is generally better in a planing vessel. The layout of your particular vessel will dictate possible positions.

Research has indicated that re-warming from the inside out is less harmful to the patient.

DO NOT delay transport for the secondary assessment unless the victim can be classified as "stable."

***DO NOT** delay transport for the secondary assessment unless the victim can be classified as "stable."*

Preparing the SAR Unit for Transfer

- Ensure that persons on both vessels are wearing lifejackets or PFDs
- Clearly explain the transfer procedure to the crew and the people on board the stricken vessel
- Designate one person to communicate with people on the distressed vessel, and caution others from causing confusion by calling out other instructions
- Rig fenders on both craft, if required
- If lines must be rigged, ensure that only slip lines are used.

Approaching a Distressed Vessel for Transfer

- If the distressed vessel is substantially larger than the rescue craft, the hull may provide a lee for the transfer. In this situation, accept lines thrown by the distressed vessel
- If the vessel is on fire, approach from the windward side
- Beware of lines in the water, or flotsam in the wake of a sinking craft

Transfer

If conditions permit, place the rescue craft alongside the distressed vessel and secure using slip lines from the rescue craft, and be prepared to cast off quickly if necessary. If conditions do not permit securing to the distressed vessel, try a "touch and go" with instruction on when to transfer given by a designated crew member.

10.3.4 Transfer to Medical Care

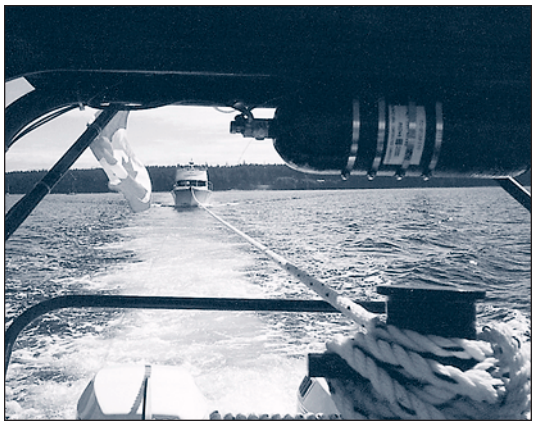
A thorough report on the patient's condition and treatments given should be given to the ambulance crew when the casualty is handed over. This may be done orally, but any recorded information such as patient care forms should accompany the patient. Any of the casualty's personal effects such as purses, glasses etc. should be noted before they are entrusted to the ambulance crew. Also, first aid equipment that goes with the patient (e.g., stretchers) should be noted and arrangements made for its return.

Notes on treatment of the patient on the vessel can be written on the back of the crew members rubber gloves in ball point pen or sharpie, and handed to the ambulance personnel.

10.4 Saving a vessel

The first priority is always the people followed by the vessel or property. However, many times the best way to save the people is to save the vessel. Each team should apply the basic principles of ensuring a safe transit to the scene and conducting a full SAP assessment when on scene.

When conducting rescue or salvage situations the plan may vary but the basic crew responsibilities and positions do not change.



When weather permits we save the people and the vessel

Helm

In situations like snatching a vessel from close to shore, an experienced helmsman is recommended. The coxswain or captain may be at the wheel.

The helm's basic responsibilities are:

- ⇛ Safe manoeuvring of the vessel through the various evolutions
- ⇛ Be prepared to take action in case of crew overboard
- ⇛ Lookout ahead for traffic, obstacles, objects in the water
- ⇛ Search spotting duties for the forward sector in a search
- ⇛ Control and monitoring of the speed, throttles, engine warnings, electronics, power and signalling/horn (smaller vessels 20m and under)
- ⇛ Monitoring the depth
- ⇛ Observing the SAR operations and watching for hazards
- ⇛ Anticipating and warning the crew of coming manoeuvres

Radio/Communication Watch

- ⇛ Relaying messages and instructions from JRCC/MRSC to vessel coxswain/captain and crew
- ⇛ Logging all communication and actions relevant to the vessel or the mission
- ⇛ Establishing contact with the vessel and conducting an assessment interview (see Towing, Chapter 8). In the event of imminent danger to the vessel the questions may be shortened to

"Is everyone safe and accounted for? Are you prepared to take our line, etc.?"

- ⇛ Regularly checking and testing the status and function of the radio/radios
- ⇛ Stopping the vessel if overhearing a distress signal or the spoken words **MAY DAY**
- ⇛ Notifying the coxswain if over hearing **PAN PAN, Securité**, or a relevant broadcast/radio traffic
- ⇛ Answering and communicating all vessel business
- ⇛ Sending a regular SITREP to JRCC via Coast Radio Station

Positions for Salvage Operations

This position requires one or two crewmembers that perform the tasks that are specific to the vessel in need. These operations can include:

- ➡ Salvage pump and suction hose
- ➡ Damage control gear set up
- ➡ Heaving lines and messengers (see Towing Chapter 8, line handling section)
- ➡ Towline set up and handling (see Towing Chapter 8, line handling section)
- ➡ First aid gear and stretchers
- ➡ Boarding a tow (see Chapter 8)

10.4.1 Assessing a Vessel's Stability

Vessels that are overloaded, damaged or have taken on water may be unstable and therefore extremely dangerous. It is important to assess the stability of any vessel that you are assisting. Some vessels that appear stable are not and some vessels that appear dangerous may be okay. You must be able to recognise the telltale signs of a vessel in trouble and stay off of that vessel. This assessment can be done during your SAP.

Reserve buoyancy

The sealed intact part of a vessel's hull above the waterline but below the superstructure offers something called reserve buoyancy. This is your vessel's insurance policy against adverse conditions and accidents. If a vessel is overloaded or has taken on water it may lose its reserve buoyancy and intact stability along with it. The best clue that a vessel has lost its reserve buoyancy is the waterline. Most vessels have a waterline or bootline painted on the hull. If this line is well below the water then the vessel is said to have no freeboard (distance from the water to the level of the main deck). With no freeboard and the main deck awash or close to underwater this vessel will not have enough reserve buoyancy to handle any seas or swells.

Watertight integrity and Down flooding

A vessel can have lots of reserve buoyancy but if her hatches, portholes and doors are not secure then she is at risk of down flooding in heavy weather (taking water into the hull). All vessels being assisted should be asked to secure all watertight closures if possible before rescue attempts can begin. Down flooding causes a vessel to lose her stability and may eventually roll over.

Vessels that are overloaded, damaged or have taken on water may be unstable and therefore extremely dangerous.

Free Surface and Load Shift

Water or fuel on board a vessel can cause trouble if it is allowed to travel across a free surface (a distance without breaks). This is why it is best to have fuel and water tanks either empty or full because liquid moving in these tanks reduces stability when it sloshes back and forth. Cargo should be kept low in the vessel and not allowed to shift in the rolling seas. Cargo or weight unevenly distributed on the vessel can cause the vessel to list (tilt to one side and stay there). Listing is another sign of reduced stability.

Water or fuel on board a vessel can cause trouble if it is allowed to travel across a free surface

Signs of Trouble

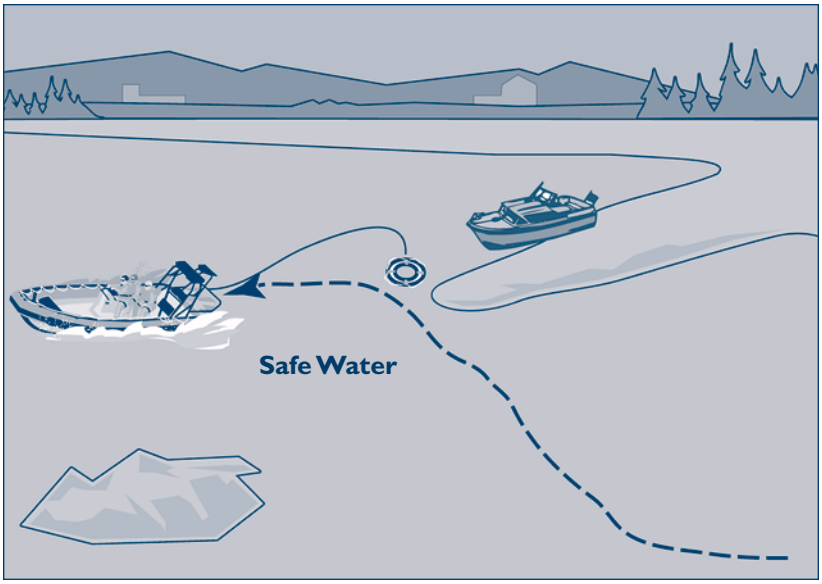
As you approach a vessel in trouble you should look for the following signs of reduced stability:

- ➡ Slow sluggish roll that hangs before returning upright
- ➡ Listing to one side or the other
- ➡ Low freeboard and a waterline (bootline) deep under the water
- ➡ Water in the bilges (more than a few inches)
- ➡ Cargo or loads high on the deck
- ➡ Cargo that has shifted
- ➡ (Loll) Lying on her side and flopping from side to side without wanting to sit upright

10.4.2 Rescue of a vessel drifting onto a lee shore

Remember, SAP equals one attempt and one success

When recovering a vessel that is drifting into danger the crew of the SRU may have to act quickly to get the vessel free of the surf or rocks. This does not mean that the SAP protocol can be skipped. This situation can be very dangerous and a proper assessment shall be made before any actions are carried out. Remember, SAP equals one attempt and one success. No SAP means a few botched attempts and possible failure.



Floating a messenger line

Stop and Assess

With the vessel in a safe position the crew can assess the elements and feature of the scene. The coxswain will ask the crew to report what they see. In order to assess the waves and water behaviour the team should observe it carefully.

The team can assess the vessel and occupants and identify potential complications or sites for attaching to the vessel.

Plan

The coxswain will ask the team for suggestions regarding a plan of action. Once the coxswain has considered the plan, he or she will describe the plan and assign tasks to the crewmembers. The crewmembers will confirm their roles and then the coxswain will review the commands and signals for the tasks and emergency contingencies.

Commands and Signals to be established

- ✓ Set up/ready the line
- ✓ Prepare to pass the line
- ✓ Stand by
- ✓ Pass the line
- ✓ Put on/take off another wrap.
- ✓ Slack, surge or pay out the line
- ✓ Take in
- ✓ Bring her alongside
- ✓ Let her all go
- ✓ Distance measurements
- ✓ A sign or command to indicate to a survivor to stay still
- ✓ Sea watch person's warning of large incoming sea
- ✓ Coxswains warning of a violent manoeuvre
- ✓ Coxswains warning of pulling vessel away

Some common planning tasks:

En route, advise the vessel operator to have everyone aboard don life jackets and to drop anchor. (There have been cases involving vessels drifting ashore in which a ready and available anchor was not used. People may forget that they have an anchor for use in just such an emergency.) The SRU crew shall ready all required towing equipment for arrival on scene. Bear in mind that the seas on scene may be agitated (e.g., secure towline to prevent the possibility of fouling screws). The coxswain or captain will usually approach the disabled vessel in an arc from seaward, keeping the SRU to windward of the disabled vessel. The path of the arc should bring the stem of the SRU across the beam of the disabled vessel. At this point the line should be passed, but at no time should the SRU lose headway or be allowed to drift toward the shore. When the line is secured. the SRU should start towing immediately to slowly pull the distressed vessel out of danger. Once the disabled vessel is clear of the lee shore danger, the towline should be checked and adjusted as necessary to carry on with the tow. If water depth or sea conditions are such as to endanger the SRU, the towline should be passed by floating down to the casualty or firing a line from a line-throwing apparatus.

10.4.3 Damage Control

Damage control is a challenge that requires ingenuity and experience due to the range and circumstances.

Wood plugs and wedges

Plugs and wedges should be used from inside when the hole is accessible; it could be very hazardous to try to plug a hole from outside the hull. Wrapping a piece of cloth around wood plugs or wedges will increase their efficiency.

10.4.4 Righting or Towing Capsized Vessels

One must make absolutely certain that all people from a distressed vessel are accounted for before beginning any procedure to right the vessel. Survivors may be trapped inside the overturned hull.

When assisting a capsized vessel:

- ✓ Recover all PIW immediately
- ✓ Check all recovered PIW for injury and/or hypothermia
- ✓ If anyone is injured or hypothermic, organise transport toward shore and have another unit (if possible) take care of the boat. If no one can deal with the boat, leave it there and notify MCTS
- ✓ Have towing waiver signed and prepare to right the vessel
- ✓ Discuss the procedure with the boat operator(s)
- ✓ Assign tasks to everyone and proceed

Damage control is a challenge that requires ingenuity and experience due to the range and circumstances.

Crewmembers should never go below decks or into areas where they may be trapped

Many vessels are best left to wait for the tide

Stop and Assess

With the vessel in a safe position the crew can assess the elements and features of the scene. The coxswain will ask the crew to report what they see or "detail" the scene. In order to assess the seas and current the team should observe the signs carefully.

10.4.5 Assisting Grounded Vessels

When the vessel is slightly aground (bow into the bottom and the stern afloat), a straight pull off is the simplest and most effective method of assistance. The straight pull is conducted as follows:

It is important to know when your efforts will cause more harm than good.

Vessel State

- Vessel size, rigging, and type
- Vessel stability and/or obvious damage to hull and waterline
- liferaft or survival suits available
- Vessel's securing points and rigging tackle (lines, wire and anchor)
- Vessel's safety equipment and dewatering capability
- Leaking fuel or risk to environment
- Can the vessel wait for the tide to rise

In most circumstances it is better to wait for the tide than to pull a vessel off of a rock or a beach.

Environment

- Tide tables
- Current on scene
- Wind
- Anchoring spots and securing points on the shoreline
- Rocks and shore
- Depth of water around the vessel
- Weather forecast

People

- Number of people on board
- All people accounted for
- Injuries or problems
- PFDs and safety equipment
- Do they have an evacuation plan?
- Waiver

Plan

The coxswain will ask the team for suggestions regarding a plan of action. Once the coxswain has considered the plan, he or she will describe the plan and assign tasks to the crewmembers. The crewmembers will confirm their roles and then the coxswain will review the commands and signals for the tasks and emergency contingencies.

Commands and signals

- Distance measurements
- A sign or command to indicate a survivor to stay still
- Sea watch person's warning of large incoming sea
- Coxswains warning of a violent manoeuvre
- Coxswains warning of pulling vessel away

Some possible plans

- Ascertain current, and plan to use it to your advantage.
- Ensure that anchors have been laid out to seaward to prevent the vessel from being driven further aground.
- If hull damage exists, determine the location and extent. If the boat is beached, have a beach party from your unit visually inspect and evaluate the condition of the vessel (if possible). Ensure the vessel's interior hull is free of sand, water and leaks. Be sure that it is not leaking pollutants into the sea. If the vessel is holed, temporary repairs will be required to reduce leakage to a minimum. If the vessel has a wooden hull ascertain whether any seams have worked open. Effect temporary repairs if possible.
- Hand the towline directly to the vessel. If you must use a messenger line, the hand-thrown heaving line is preferred. Another method to transfer this line is by using a buoyed, floating line. This must be done cautiously in order to avoid fouling your propellers with the line and putting your own vessel aground. The line should not be floated straight down to the vessel. Pay it out parallel to the shore. Position your vessel upstream from the grounded vessel, and pay out the messenger until the end is near the shore. Turn about and manoeuvre past the stranded vessel, paying out the messenger as you go.
- Instruct the disabled vessel on securing the towline, and then clearing personnel from the deck area.
- Go out into clear water and drop the anchor, after you clear the beach or shoal.
- After the towline is secured and the crew clear of the danger area on deck, go ahead slowly, weighing anchor and paying out the towline to maintain a generous catenary. This requires preplanning and flawless crew communication and co-ordination.
- Commence pulling so that optimum force can be applied at maximum high water. The strand-

ed vessel can best be pulled off in the direction opposite to that in which it ran aground.

10.4.6 Fire fighting

Vessels on Fire at Sea

When attending a fire at sea, your first priority is to extricate, stabilise, and evacuate any victims.

Fires should only be fought:

- ⇛ To save lives (i.e., victims trapped inside a burning vessel)
- ⇛ To prevent danger to bystanders

Prepare your vessel to act

The coxswain/captain will contact the JRCC when on scene while the crew make preparations to extricate and stabilise survivors. Any readily flammable materials (portable spare fuel tanks, convertible tops, tarps, etc.) will have to be moved from the deck area. Prepare your fire fighting equipment (extinguishers, pumps, and fire axes). Remember that gasoline tanks, as well as pressurized containers such as propane tanks, divers' bottles, CO_2 extinguishers, and aerosol containers can all explode in the heat of intense fire.

When approaching a vessel on fire:

Stop and Assess

Survey the scene from upwind to determine the location of any survivors; if you don't see survivors onboard, shut down your engines and listen for survivors. Remember, if there is any significant wind, survivors in the water will generally be found upwind of the burning vessel. The captain and crew can point out the characteristics of the fire and identify any flammable hazards. By asking survivors or the coast radio station, try to determine whether or not there are any explosive items on board (propane tanks, compressed air, etc.)

Remember, if there is any significant wind, survivors in the water will generally be found upwind of the burning vessel.

Plan

Once all the details of the scene have been declared then the coxswain/captain can ask for planning input. The crew will suggest plans, and approaches. After careful consideration, the coxswain will describe the plan and assign the tasks along with any emergency procedures. Each crewmember will repeat the tasks and confirm their roles. The coxswain will review any signals and commands before commencing the approach. The coxswain will then describe the plan and assign tasks as necessary.

Some plans would include actions such as:

1. If there are indications that survivors may be in the water, then immediately start a suitable search pattern.

2. Recovering victims from a burning vessel by moving in with protective fog and pulling them off the boat.

3. If the fire is too intense or there is danger from propane tanks, and the victims are wearining lifejackets, get them to jump into the water and swim to a postion where you can safely pick them up.

4. If everyone is recovered, then stand off and keep other vessels clear.

CGA vessels are not equipped nor the crews trained to fight fires at sea.
DO NOT board a vessel on fire.

10.5 Helicopter Operations

10.5.1 Hoist Operations

If survivors require immediate medical attention, a MEDEVAC may be conducted by a Canadian Forces or US Coast Guard helicopter.

A new Cormorant helicopter (left) beside an old Labrador helicopter

Safety and Hoist Operations

Do not touch the winch wire or the man descending on it until after it has touched down

This position requires one or two crewmembers that prepare the vessel for hoist operations. These operations can include:

- ➜ Clearing and securing the decks
- ➜ Notify the aircraft of any dangers or hazards
- ➜ Patient set-up (if MEDEVAC)
- ➜ Ensuring that the patient is protected from the severe effects of helicopter "downwash." If your rescue craft allows, keep the patient in a warm, well-lit area to facilitate a medical assessment by the SARTECH
- ➜ Prepare fire fighting gear and PFDs checked and ready
- ➜ Prepare lighting and signals (if any)
- ➜ First aid gear and stretchers
- ➜ Avoid focusing light beams directly on the helicopter.

Only essential crewmembers should be on deck during the hoist operation. PFDs must be worn. Helmets and eye protection should be worn, if available.

Do not touch the winch wire or the man descending on it until after it has touched down.

The patient's medical history, log of his/her vital signs and any first aid treatment provided should be listed and given to the SARTECHs, along with the patient's personal effects.

Positions for hoisting:

The helm's basic responsibilities are:

- ⇛ Safe manoeuvring of the vessel through the various evolutions
- ⇛ Manoeuvring the vessel in the event of an emergency with the SAR tech or aircraft
- ⇛ Lookout ahead for traffic, obstacles, objects in the water
- ⇛ Control and monitoring of the speed, throttles, engine warnings, electronics, power and signalling/horn (smaller vessels 20m and under)
- ⇛ Anticipating and warning the crew and helicopter of up and coming manoeuvres

Establish your communications before commencing

Radio/Communication Watch

- ⇛ Establishing contact with the helicopter and recording the instructions given by the pilot for the hoist operations
- ⇛ Identify lift area on the rescue vessel and the method of approach
- ⇛ Relaying messages and instructions from helicopter to vessel coxswain/captain and crew
- ⇛ Relaying the helm instructions to the helmsman
- ⇛ Reviewing emergency procedures with the crew
- ⇛ Listening for communications during the hoist
- ⇛ Establish hand signals if required by aircrew
- ⇛ Logging all communication and actions relevant to the vessel or the mission
- ⇛ Notifying the coxswain if overhearing **PAN PAN, Securité, or a relevant broadcast / radio traffic.**

10.5.2 Air drops

Survival Kit Air Dropable (SKAD)

DND SAR aircraft carry air dropable survival kits that consist of two 10-person liferafts and two survival containers. These kits are referred to as SKADs, and can be dropped either to persons in the water, or to persons wishing to abandon their vessel, but who do not have liferafts. The following deployment procedure is used. When the Department of National Defence SAR aircraft arrive, they will make several passes at approximately 300 to 500 feet to check wind drift.

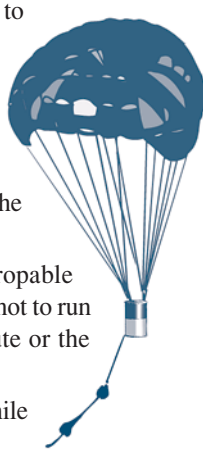
The aircraft will probably drop several smoke canisters to check wind speed and direction, and also to mark the target. Depending on the rate of drift of the target, the air crew will try to lay the kit in a line, either upwind or downwind. All the components of the SKAD are linked by 280 feet of floating poly line. The intent is to allow the target to make contact with this line so that the components may be hauled in. **Do not cut the line**. The rafts inflate in the air once jettisoned out of the SAR aircraft.

If you are operating near a SKAD (i.e. trying to recover survivors from one), be extremely careful not to become entangled in the recovery line. Do not attempt to retrieve components of the kits.

Air Dropable Pump

In the event that a distressed vessel requires emergency pumping assistance to stay afloat, SAR aircraft can either lower a portable pump by hoist, or drop it by parachute. They may also drop it to a rescue vessel for transfer purposes. The following procedure applies to parachute drops:

- The aircraft will make several low passes, dropping smoke canisters to check wind drift direction, and to mark the target
- The pump will be dropped to windward of the target. The air crew will attempt to bracket the target with a 600 foot recovery line that is attached to the pump at one end and to a drogue at the other
- When recovering an air dropable pump, you must be careful not to run afoul of either the parachute or the recovery line
- Do not open the canister while it is still in the water



SAR crews must be familiar with other unit's emergency proceedures.

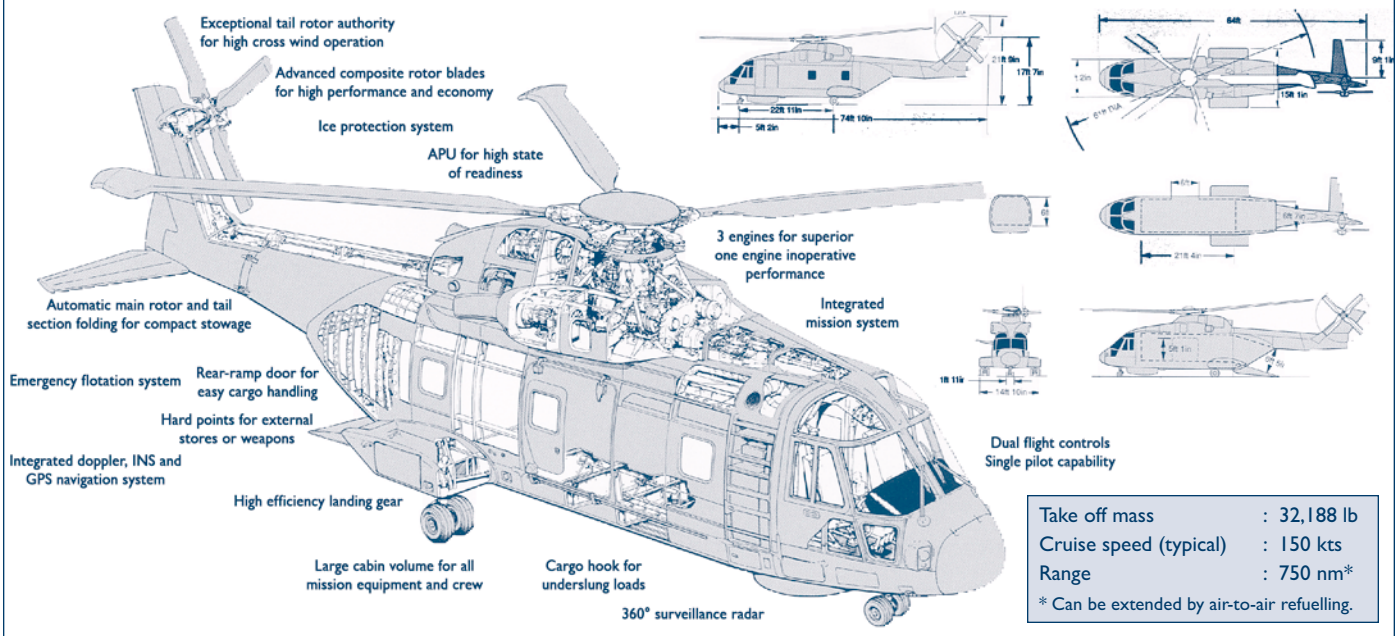
10.5.3 Aircraft Emergencies

Aircraft Engine Failure

In the event of aircraft engine failure, the aircraft will break away to the nearest safe area. If a person is on the hoist at this time, the aircraft commander will sever the hoist cable and drop the person into the sea, simultaneously making a decision as to whether to land the aircraft itself in the sea. If such a landing is made, the first priority for the surface vessel crew is to manoeuvre the vessel to avoid damage or injury from the helicopter rotors while picking up the person cut free from the hoist, and assisting the rest of the crew of the aircraft as required.

Entering the Aircraft

The aircraft crew will abandon the craft utilising an on-board inflatable raft for flotation. When approaching the aircraft, wait until the rotors stop turning. When alongside the aircraft, look for guidance from the crew or obvious markings indicating an emergency exit. If the exit is partially submerged do not open it unless you are prepared to flood the aircraft. Most DND helicopters have a door that is best used in ditchings; use of this door should retain the watertight integrity of the aircraft, which may be lost if other emergency entrances are opened. However, if necessary, either the emergency exit door, or the escape window panels may be released by means of external pull tapes. Either the pilot's or co-pilot's side windows in the cockpit may be released by first pressing the button on the side window's external handle to activate the spring-loaded emergency release handle. Turn this handle to release the side window.



Canadian Forces EH-101 Cormorant Search and Rescue Helicopter

10.6 Boarding a Vessel

Never cross the bow of an oncoming vessel!

Occasionally during search and rescue operations a SAR vessel must come alongside a vessel underway and transfer gear, people, and/or patients. Some vessels such as tugs, cruise ships in confined waters or vessel in heavy chop must maintain some steerage way in order to be a stable platform for transfer. Rigid Hull Inflatables are best suited for this operation because of the tubes. But other vessels can do this with careful preparation and a smooth hand at the wheel.

Boarding a vessel underway is not a task to be taken lightly. Only an experienced coxswain backed up by an experienced crew should perform this manoeuvre.

Critical Dangers

The greatest dangers in this operation exist when the rescue vessel gets too close to the bow or loses power and is caught by the stern wave. This can result in a person falling overboard or the vessel broaching. The waves of different hull designs can vary. If the two waves are close together this can make the approach difficult and other options should be explored (e.g. do not approach).

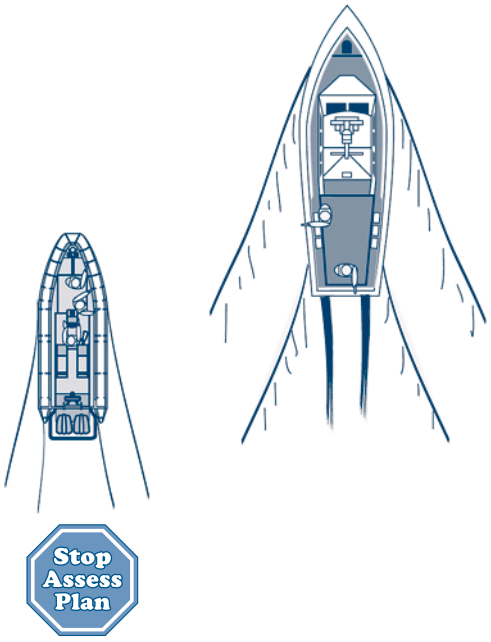
The coxswain will avoid getting too close to the bow or over top of the bow wake when close alongside. This can throw you into the bows. **Never cross the bow of an oncoming vessel**! The stern of the target vessel presents a danger, especially when it is moving fast. A large wake can be dangerous. If the propellers ventilate in the white water and lose thrust, your boat can be turned broadside to the wake and capsized. This can only occur if the stern wave is particularly steep. If you are coming alongside a large vessel, watch out for overboard discharges and any gear slung out the side of the vessel.

10.6.1 Stop and Assess (Pacing)

When pacing the target vessel, approach from behind on one side, while allowing for plenty of sea room. Move over the two wakes and move up alongside the vessel approximately twenty metres away. Carefully match the throttles so that the target vessel is not gaining or losing on your station. From this position the crew can perform a Stop Assess and Plan, the stop means to keep a relative station at a constant safe distance from the vessel. Often this position puts your vessel just ahead of the other's bow wake. Maintain this distance while the throttles are matched. The coxswain should be carefully watching the target vessel's wake for grade.

Some things to note during the Assessment SAP:

- ⇛ Wake properties
- ⇛ Hull and deck shape
- ⇛ Obstructions: overboard discharge, jagged ends or gear hanging
- ⇛ Rail breaks and hand holds
- ⇛ Vessel's heading is a clear path
- ⇛ Number of people on board and their behaviour
- ⇛ Vessel's handling behaviour and steady course line



Maintain station alongside vessel in order to complete a SAP

After the visual assessment the vessel must be contacted by VHF or verbally. The Rescue vessel will ask for permission to board and announce the side on which they are boarding. The driver of the vessel will be given instructions to maintain speed or adjust speed accordingly. The coxswain will also brief the operator of the target vessel on what action to take in the event of an emergency (MOB).

10.6.2 Plan

Once the crew has declared all the scene features then the coxswain will call for planning input. The crew will suggest plans and then the coxswain will describe the plan and assign the tasks along with any emergency procedures. Each crewmember will repeat the tasks and confirm their roles. The coxswain will review any signals and commands before commencing the approach.

Suggested Signals and Commands

- ⇛ Board the vessel
- ⇛ Stand by
- ⇛ Hold on (we are getting out of here)
- ⇛ Initiate radio or verbal communications
- ⇛ MOB

10.6.3 Approaching to Board

- ➡ Maintain the 20-metre distance and drop back over the bow wave so you are between the two wakes
- ➡ Work up between the wakes towards the boat.
- ➡ Slowly ferry in towards the after quarter of the target vessel while keeping your vessel parallel (use short strokes of the wheel and move sideways)
- ➡ Once inside the bow wake and a couple of feet away, stop and match the speed. Be aware of the wake current effect. You will feel a repelling force that will suddenly turn to a suction just before you make contact
- ➡ Softly steer the bow into the gunwale of the target vessel (beware of sharp edges and rough surfaces on the target vessel)
- ➡ As the bow touches the gunwale add helm and power to the outside engine to keep it there
- ➡ While alongside keep using the throttles to maintain the position on the side of the vessel

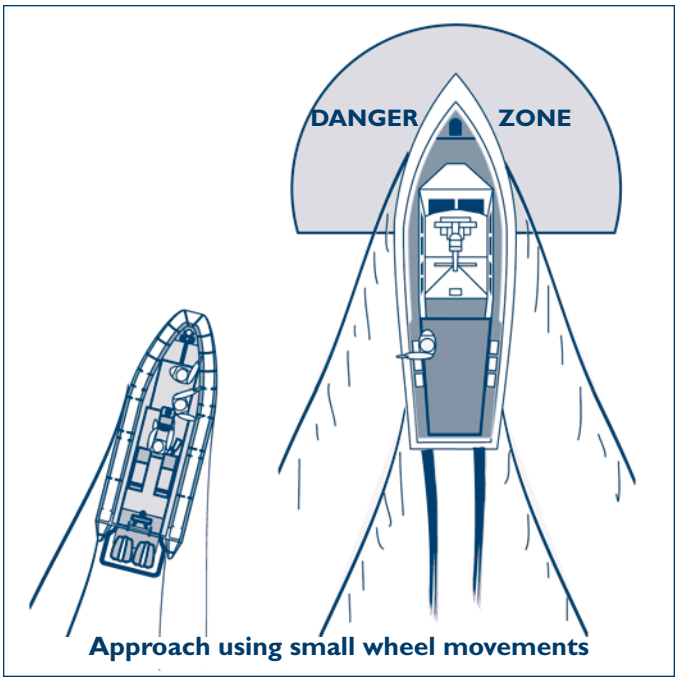
10.6.4 Boarding

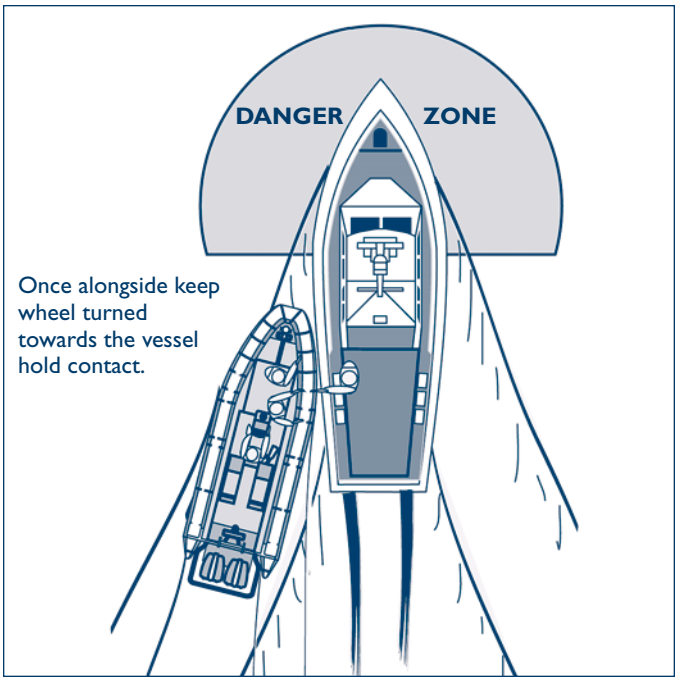
The helm is responsible and will signal the boarding party to board when it is safe to do so. When boarding, people should move quickly on to the vessel and not hesitate once they have stepped off the SRU. The helm or lookout will keep a lookout for seas or objects approaching. If a big sea does come through, stop people from passing on or off the target vessel and beware of any sharp edges as the your vessel's fenders or tubes rub against the hull.

10.6.5 Departing

When ready to pull away from the target vessel check behind you and your vessel path to ensure there is no traffic or obstructions. The driver should straighten out the wheel and add power to move the bow away. Do not turn away sharply until you have broken contact with the vessel. Then give a turn of the wheel and accelerate way from the vessel sideways.

Stay well clear of the bow! (danger zone)





10.7 Seaplanes

Occasionally the vessel involved as casualty is a sea plane. This can involve making a landing on water, because they have run out of fuel, or have lost power. In calm water they can make a controlled landing, but in any wind this may end up as a crash.

If you are called to a seaplane on the water, which is afloat normally, approach carefully (assuming the engines are not working) avoiding causing any damage to the wings, tail or floats, and take instructions from the pilot as to best way to set up a tow. A towing waiver is required. One method suggested of towing a seaplane is to take the tow rope around all the struts where they attach to the float and then back forward to secure as a large bowline knot.

It is likely that if there are passengers on board, that he request they disembark into the rescue boat. It has been known for the rescue boat to bring out fuel to allow the plane to have some fuel in her tanks to make the take off and short trip to safety.

For a seaplane crash, as already mentioned for helicopters above, you are looking for fuel on the water. If the floats stay intact, the aircraft may be upside down below the surface with the floats supporting the weight of the aircraft. As with a capsized boat, the primary task will be look for survivors.

10.8 Log Entries

In addition to the usual deck entries, the following information should be added to your vessel log during a search and rescue mission:

- Ship's name
- Names of SAR crew
- Time tasked by JRCC or Coast Guard Radio
- Time of departure
- Time and brief content of SAR radio communications
- ETA on-scene
- Actual time of arrival on-scene
- Description of search objects
- Type of search pattern and areas searched
- On-scene weather report
- Information on the distressed vessel
- Time of stand down
- Time of arrival at home base or port
- JRCC incident number

An accurate and complete log will assist during operations, by making information easier to recall and transfer (e.g. during crew hand-over).

- Name, address and phone number of owner and/or operator;
- Number and names of persons on board (POB)
- Vessel name
- Vessel description, make and model, engine type
- Vessel license or registry number

An example of a CCGA Vessel's Log is on the next page.

WX:
SS: 2m WIND: 15-20 kts SKY: pt cldy

CREW:
Allison, Brady, Corchoran

TIME HEURE	ACTIONS AND RADIO MESSAGES SENT/RECEIVED MESSAGE RADIO TRANSMIS/REÇUS	COM
1020	To VAS for JRCC dep base Pt. Grey area training 2 hrs.	
	Total Crew 3//Rgr	BH 04A
1100	To VAS secured Cowards Cove monitoring 16/04A	BH 04A
1118	Frm VAS report of swimmer off Pt. Atkinson, can you Check	
	and advise//Rgr underway ETA 6 mins//Rgr	BH 04A
1123	Mayday Relay VAS 24 ft PC on fire Ferguson Pt. 3 POB	
	Observed abandoning//Rgr ETA 8 mins proceeding//Rgr //	
	and we transiting Pt Atkinson, no swimmer sited//Rgr	BH 16
1130	To VAS Mayday on scene see 2 Persons water no site of third beginning	
	recovery//Rgr CGC Osprey enroute// Rgr have in site 1 mile south//Rgr	BH 04A
1131	Frm Osprey: Mayday copied ur last, recover people water We commence	
	vicinity search//Rgr alongside casualty one	BH 04A
1134	To Osprey/VAS: Mayday 2 casualties aboard, adult males. Injury	
	assessments slight, treating for cold. Advise 3rd Person female,	
	brown hair light blue T shirt.//Rgr Put casualties aboard Osprey,	
	join up for parallel track// Rgr //VAS checks pass to JRCC	BH 04A
1135	Frm Osprey To VAS Auxiliary 06: Mayday 2 males aboard Osprey	
	CCG Osprey Auxiliary 06 commencing parallel track, track East west	
	cable track space, creeping north//VAS Rgr Aux 06 checks	BH 04A
1141	To Osprey Mayday Target 030 degrees relative distance 200 feet.	
	Proceeding//Rgr we see your target//rgr	BH 04A
1143	To Osprey Mayday Casualty aboard, hypothermic//Rgr	
	We come alongside, transfer Osprey//Rgr	BH 04A
1146	To VAS from CGC Osprey: 3 casualties aboard, we transport Kitsilano base,	
	request EHS. Vancouver Fire boat 3 attacking Vessel afire,	
	Auxiliary 06 to stand by fire boat//VAS Rgr Auxiliary 06 checks	BH 04A
1148	Frm VAS: Mayday. PC afire Seelonce fini.	BH 16
1151	To VAS: Stood down from fireboat, vessel extinguished. Commercial assist	
	will take undertow. Incident nr?// Rgr POO-1832//R we return Pt. Grey.	BH 04A

Glossary of Nautical Terms & References

A

Abaft – In a direction towards the stern.

Abeam – On the beam; a direction at right angles to the keel.

Aboard – In or on board the vessel.

Afloat – A vessel totally supported by water and off the bottom.

Aft – At or towards the stern.

Ahead – In the direction of the vessel's head or bow.

Aid to Navigation – A device or object, external to the vessel, located to assist in safe navigation. It may be natural, a man-made structure or object.

Air Accident – A SAR Incident where the original vehicle of transportation of the persons involved was an airborne vehicle, regardless of where the vehicle came to rest.

Amidships – In the middle of the ship, whether longitudinally or laterally.

Anchor – A device designed to hold a ship in any desired location temporarily by attaching it to the sea bed by means of a length of line or chain.

Apparent Wind – The direction of the wind as it appears on board. It differs from the true wind direction and speed, due to the vessel's motion.

Assistance – Aid provided by the SAR system in response to a non-distress incident.

Astern – In the direction of the stern; opposite to ahead. The movement of a ship going backwards.

Athwartship – From one side of the ship to the other at right angles to the keel.

B

Ballast – Weight added to the ship's bottom to provide stability and trim.

Batten-down – To close all deck openings.

Beacon – A distinctive artificial structure erected as an aid to navigation.

Beam – The maximum width of a vessel.

Bearing – The direction in which an object lies with respect to the reference direction.

Bearing, Collision – A set of bearings taken on a converging vessel in order to determine if a danger of collision exists.

Bearing, Compass – A bearing relative to the Ship's Compass North.

Bearing, Magnetic – A bearing relative to the Magnetic North.

Bearing, Relative – A bearing relative to the ship's heading or bow of the vessel.

Bearing, Ring – A ring fitted over a compass and equipped with sighting lines for observing compass bearings.

Bearing, True – A bearing relative to True North.

Beating – The procedure of sailing or running to windward with alternate tacks across the wind.

Belay – To make fast a rope on a cleat by taking turns.

Bifurcation Buoy – A buoy that marks where a channel divides.

Bitt – A fitting or post for securing, usually on deck.

Bollard – A vertical piece of timber or iron ashore, to which a vessel may be moored.

Boot line – A narrow line painted on the hull of pleasure vessels to mark the normal draft line.

Bow – The forepart of a vessel where the sides of the hull curve to meet the stem.

Bowline – A knot tied to the end of the line to form a loop that will not slip.

Bridle – Two lengths of line, or a single length in bight, which are secured to the end of the towline (generally by a shackle), the ends of which are secured to two strong points on the tow.

Broach – An uncontrollable turn broadside to the sea when running with the wind on the quarter.

Broad on the Beam – A direction at right angles to the keel. At 90 degrees, port or starboard, from the ship's head.

Broad on the Bow – A direction at approximately 45 degrees, port or starboard, from the ship's head.

Broad on the Quarter – A direction at approximately 135 degrees, port or starboard, from the ship's head.

Buoy – A floating mark anchored to the bottom, used as an aid to navigation.

Burdened – The vessel with the responsibility to give way to another vessel.

C

Cabin – A space inside a vessel, accommodation or shelter.

Camber – The vertical curvature of a deck as seen in cross section.

Can Buoy – A cylindrical buoy floating end-up.

Capsize – To overturn a vessel by rolling.

Cardinal Buoy – An aid to navigation that indicates the cardinal direction toward safe water.

Cardinal Points – The four main points of the compass – North, South, East, West.

Cast Off – The operation of letting go a cable or line that secures a vessel to a buoy, dock or other ship, to permit it to get underway.

Casualty Reception Point (CRP) – A terminal located near a medical facility, capable of treating a large number of injured.

Catenary – The vertical curve of the towline, the deeper the curve the more the catenary.

Centre of Gravity – The point through which the force of gravity produced by the vessel's mass can be considered to act.

Chart – A "map" of the sea area showing any coastal lines and used specifically for nautical navigation.

Chine – The line described by the meeting of the bottom and the side of the boat.

Chock – A fitting to allow a line to pass through. A block or wedge to prevent movement of equipment.

Cleat – A fitting with two arms or horns to which a line may be made fast.

Close-aboard – Beside, close to, alongside.

Clove Hitch – A knot used for fastening to a post or a rail.

Coaming – The raised border above the deck around a hatch or cockpit.

Companionway – A stairway from one deck to another.

Compass – An instrument for determining horizontal direction.

Compass Error – The angular difference between True North and Compass North.

Compass North – The direction of North as indicated by the compass.

Compensation – The adjusting of a compass so as to remove or reduce deviation.

Con – To steer a boat by direct observation of landmarks.

Conical Buoy – A cone-shaped buoy, floating with the point up.

Co-ordinated SAR system – The facilities, equipment and procedures established in each Search and Rescue Region to co-ordinate the response to SAR incidents.

Correcting – The conversion of courses or bearings from compass to magnetic to true.

Course – The intended horizontal direction of travel, measured in degrees clockwise from reference North.

Coxswain – The person in charge of a small vessel.

Cross-Track Error – The distance away from the planned track. Used in reference to electronic navigation systems.

Current – The horizontal movement of water.

D

Datum – A reference level from which depths and heights are measured. The probable location of a search object or person, corrected for drift, at any specified time.

Datum Marker Buoy (DMB) – A small buoy, often fitted with a transmitter, that is deployed at the datum position.

Dead Ahead – Directly ahead.

Dead Astern – Directly astern.

Deadhead – A log or heavy timber floating nearly vertical with little of its bulk visible above the surface of the water.

Dead Reckoning – The process of determining a vessel's position using only knowledge of a point of departure, vessel's speed, elapsed time and course steered.

Deck – The horizontal platforms in ships separating compartments one above the other.

Deck Log – A book in which the conduct of the vessel is recorded.

Degree – A unit of angular measure of being 1/360 of one complete revolution.

Deviation – The angular difference between Compass North and Magnetic North.

Dinghy – A small, open, unballasted boat propelled by oars, sail or outboard motor; a ship's small boat.

Disabled – A term describing a craft that has lost all means of propulsion or steering for any reason, and which is in need of assistance.

Discharge Current – The water expelled by the propeller.

Displacement – The weight of the volume of water displaced by a floating vessel.

Displacement Hull – A hull that is supported solely by buoyancy at any speed.

Distress – A SAR incident wherein there is reasonable certainty that one or more individuals are threatened by grave and imminent danger, and require immediate assistance.

Docking – The procedure for coming alongside and securing to a wharf or jetty.

Downwind – To leeward, the direction in which the wind is blowing.

D.R. – Abbreviation for Dead Reckoning.

Draft – The measurement from the waterline to deepest point of the vessel, i.e. The minimum depth of water required to float a vessel.

Drift – (1) The speed of a current. (2) The distance a vessel is moved by a current. (3) To move idly without propulsion by sail or engine.

E

Ebb – A tidal flow towards the sea.

Equator – The great circle whose plane is perpendicular to the polar axis, midway between the poles.

E.T.A. – Abbreviation for Estimated Time of Arrival.

F

Fairway Buoy – A buoy that marks landfall, the entrance to a channel, or the centre of a channel.

Fall Off – The movement when a ship is steered or blown off course to leeward.

Fathom – A unit of measure equal to six feet. Used to describe depth of water, or length of rope or line.

Fender – A device hung over the side of a vessel to protect the hull from other vessels, docks or objects.

Fetch – The distance over water which the wind has blown uninterrupted.

Figure-of-Eight Knot – A stopper knot shaped like a figure of eight.

Fix – A relatively accurate position determined without reference to any former position.

Flare – (1) A signal device to indicate distress. (2) The external concave curve of the bow of a ship.

Float Plan – The recording of the itinerary of a cruise that is filed with someone reliable ashore (also known as a Sail Plan).

Flood – A current associated with a rising tide.

Fore-and-Aft – From towards the bow to towards the stern in a ship.

Forward – A directional term indicating at, or towards the bow.

Founder – To fill with water and sink.

Freeboard – The vertical distance from the water to the deck level, usually stated for the point of least freeboard.

G

Girted – A dangerous condition whereby the towline becomes near to, or at right angles to a vessel, causing a transverse pulling moment and the potential for loss of stability and capsize.

Give Way – To yield the right of way to another vessel.

Great Circle – A circle inscribed on the earth's surface whose plane passes through the earth's centre.

Ground – To touch the bottom or shore.

Ground Tackle – A collective term used to embrace all of the gear used for anchoring, or for securing a navigation buoy to the bottom.

Gunwale – The upper edge of the hull.

Gyro Compass – A directional instrument that indicates Gyro North, which can be very close to True North.

H

Half Hitch – The simplest knot, usually part of another knot.

Halyard – A rope used for hoisting sails, spars or flags.

Hard Chine – A chine with a sharp angle to it.

Hatch – An opening in the deck for access to the interior.

Head – (1) The bow of the ship. (2) Upper corner of the triangular sail. (3) Upper edge of a rectangular sail. (4) A shipboard toilet.

Heading – The direction in which the ship's head is pointed.

Headway – Movement through the water in a forward motion.

Heel – The lean of a boat due to external forces.

Helm – A vessel's steering apparatus. The angle of the rudder on course; used in sailing in lee-helm or weather-helm.

Hull – The body of a vessel from the keel to the deck line.

Hull Speed – The maximum speed at which a displacement hull can be driven.

Humanitarian Incident – An incident not directly related to an Air or Marine SAR incident, that requires the provision of assistance by SAR resources to save life or relieve human suffering, including medevacs, transport of human organs, or medical supplies and search for missing persons.

Hypothermia – A condition in which the core temperature of the human body drops to a dangerous level.

I – J – K

In Step – Keeping the tow a proper distance behind your boat in relation to the sea/swell patterns so that your vessel and the tow ride over the seas in the same relative position, eg. wave crest to wave crest.

Joint Rescue Co-ordination Centre – A unit responsible for promoting efficient organisation of SAR service, and for co-ordinating the conduct of SAR operations within a Search and Rescue Region.

Keel – On a sailing vessel, an underwater member designed to resist lateral movement.
The principal fore-and-aft-line member of a framed hull; the hull's backbone.

Kellet – (Sentinel) A heavy weight attached in the length of the anchor rope to reduce the angle of pull on the anchor.

Knockdown – The state of a sailing vessel that is heeled over with her sails in the water.

Knot – (1) A unit of speed equal to one nautical mile per hour. (2) The tucks and loops in a line used to fasten it to an object or to itself.

L

Latitude – The angular distance of a point on the surface of the Earth North or South of the Equator as measured at the centre of the Earth.

Lee Side – The side opposite to the direction from which the wind blows.

Leeward – Away from the wind.

Leeway – The lateral motion of a vessel to leeward under the influence of the wind.

Life Line – A line strung around the deck to provide a handhold in heavy weather.

Lighthouse – A major light built as a manmade aid to navigation; may be manned or unmanned.

Limber Holes – Drainage holes through a frame or floor timber at the bottom of the bilge.

Line of Position (LOP) – A line on the chart along which the vessel is known to lie, abbreviated as LOP.

List – The tilting of a vessel to one side or another due to loading, flooding or cargo shift.

Locker – A cupboard, chest or cabinet.

Log – A device that measures distance traveled through the water, from which speed can be calculated. A book in which the conduct of a boat is recorded. To record an event in the logbook (log it).

Long Splice – A joining splice that joins two lines as one, that does not increase the diameter of the line.

Longitude – The angular distance East or West of the prime meridian of a point on the surface of the Earth as measured at the polar axis.

Lubber's Line – The reference line of a compass.

M

Magnetic – Having to do with the Earth's magnetic field.

Magnetic Compass – A directional instrument actuated by the Earth's magnetic field.

Magnetic North – The North direction indicated by a magnetic compass.

Magnetic Pole – One of the two geographic areas, North or South, where the Earth's magnetic field enters and leaves the Earth vertically.

Marine incident – A SAR Incident where the original vehicle of transportation of the person(s) involved was a vessel, including air cushion vehicles operating over water.

Marline spike – (1) An adjective applied to seamanship embracing the art and shaping and working the ropes.
(2) A pointed tool used for working with ropes.

Mayday – The spoken radiotelephone distress signal.

Medevac – The urgent evacuation of a patient in circumstances other than a marine or air incident, for the purpose of saving life and relieving or preventing human suffering. Includes evacuation of a person from a vessel for medical reasons.

Mercator Projection – The most common type of chart projection used for navigational charts.

Meridian – An imaginary line joining the Earth's poles. The prime meridian is the one that passes through Greenwich, England and represents zero longitude.

Messenger Line – A length of light line which can be cast, propelled or floated considerably further than the towline, and which can be used to transfer the towline to the tow.

Minute – (1) Time – 1/60th of an hour.
(2) An angle – 1/60th of a degree.

Mooring Buoy – A permanently anchored buoy to which a vessel can secure without using her anchors.

Multi-tasked Resources – Resources that are formally funded and allocated for emergency SAR use in addition to their normal activities. When used in SAR, they are referred to as PRIMARY SAR RESOURCES.

N

Nautical Mile – A unit of distance being 1852 metres (6076.6 feet). This is equivalent to the length of arc of one minute of latitude on any great circle.

Notices to Mariners – A government publication issued regularly that contains all corrections and additions to chart information relating to navigable waters.

O

On Scene Commander (OSC) – The commander of a search and rescue unit (vessel or aircraft) designated to coordinate surface and air operations within a specified area.

Operator – The person in effective charge and control of the vessel and who is responsible for the vessel.

Other SAR Resources – Resources other than primary or secondary, which from time to time participate in SAR activities when required. Includes civilian volunteers and Federal Government-funded resources.

P

Parallel of Latitude – An imaginary circle on the surface of the Earth parallel to the plane of the Equator.

Parent Unit – The ship, office, or operations centre that has tasked you to your mission, and is responsible for you.

Pelorus – The navigation instrument used for taking visual bearings, having a card and an arc rotating sight bar with two sighting vanes.

PFD – Abbreviation for Personal Flotation Device.

Pillar Buoy – A very large structural buoy that may have a light, bell or whistle.

Pitch – (1) The theoretical distance a propeller would move ahead in one revolution. (2) The up and down motion of the bow and stern of a vessel due to the action of the sea.

Pitchpole – To overturn a vessel end over end.

Planing or Hydroplaning – A method by which a hull skims over the surface of the water.

Planing Hull – A hull of such a shape as to be capable of planing.

Pleasure Craft – A boat, a ship, a vessel, or any other description of water craft that is used exclusively for pleasure and does not carry passengers or goods for hire, reward, remuneration or any object of profit.

Plot – To draw lines on a chart indicating bearings, courses and positions.

Point – (1) To sail more closely to the wind. (2) 11 1/4 degrees of a compass rose.

Polyconic – A chart projection normally used on harbour charts.

Pooped – Vessel is pooped by a sea breaking over the stern as the vessel runs before the wind.

Port – The left hand side of the vessel when facing forward.

Primary SAR Resources – Aircraft or vessels operated and equipped specifically for Search and Rescue, and manned with SAR-trained crews. Primary SAR resources are under the direct operational control of the SRR Commander for SAR tasking.

Privileged – The vessel having the right-of-way.

Propeller – (Screw, Wheel) A device which, when rotated, will propel a vessel.

Pulpit – A raised railing at the bow or stern to prevent crew from falling overboard.

Q

Quarter – The after part of a ship's side. The stern "corners" of a vessel.

R

Radiotelephone – A communication system wherein the voice is transmitted via radio waves.

Rafted – Several vessels or barges tied together side by side, which may be anchored, being towed or inboard vessel may be tied alongside.

Range – (1) Two aids to navigation which, when seen to be in line, establishes a line of position (LOP). (2) The difference in depth between high and low tides.

Reaching – Sailing with the wind approximately on the beam.

Reef – 1. One large rock out crop, or several rock outcrops close to the surface of the water. 2. (vb) The process of reducing the area of a sail carried, when strong winds arrive.

Reef Knot – A joining knot.

Rescue Co-ordination – The function of integrating the efforts of SAR facilities and resources to achieve concerted and harmonised resolution of SAR incidents in an effective and efficient manner.

Rescue Specialist – Specially-trained rescue personnel who are a key part of a SAR crew.

Relative Wind – The direction and velocity of the wind as observed from a moving vessel.

Reverse – Go astern.

Rigging – An inclusive term for all the wires and ropes used to support masts and to control spars and sails.

Rode – The line joining a vessel to its anchor.

RPM – Abbreviation for Revolutions Per Minute, normally referring to the propeller or engine.

Rudder – The underwater portion of the steering mechanism.

Rules of the Road – Slang name for the International Regulations for Preventing Collision at Sea (Collision Regulations).

Running Fix – A position determined by the use of bearings that have an appreciable time difference in between them.

S

SAR Incident – A reported incident that requires a response by the SAR system.

SAR Mission – The task assigned to a SAR Unit by a JRCC/CSS/CAS in response to a SAR incident. A SAR MISSION commences with formal tasking by JRCC/CSS/CAS and is normally defined in scope and time.

SAR Operation – When the response to a distress incident requires the utilisation of more than one resource and/or numerous SAR missions are anticipated during the execution of the incident, it is considered a SAR operation.

SAR Resource – A resource tasked or directed by a JRCC to respond to a search and rescue incident.

SAR Tech – A Canadian Air Force crewmember with specific SAR training, operating with DND SAR aircraft.

Scale – As applied to a chart, the ratio of the distance on the chart to the distance on the Earth's surface (e.g. 1/80,000 means one unit on the chart represents 80,000 units on the Earth's surface).

Scope – The ratio of the length of anchor rode to the depth of water; both lengths are referenced to the chock where the rode leaves the vessel.

Screw – See Propeller.

Searchmaster (SM) – An individual who has been appointed by a Search and Rescue Region Commander to co-ordinate and direct a specific SAR operation.

Search and Rescue (SAR) – Search and rescue is the search for and provision of aid to persons, ships or other craft that are, or are feared to be, in distress or immediate danger.

Search and Rescue Region (SRR) – A specified geographical area in which SAR operations are coordinated and controlled by a designated Joint Rescue Coordination Centre.

Search and Rescue Unit (SRU) – A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of search and rescue operations.

Secondary SAR resources – Aircraft or vessels operated and equipped for other than Search and Rescue, but which can be expected to respond (when available) to SAR tasking. Includes multi-tasked government resources.

Secure – To make fast (tie up).

Semi-Displacement Hull – A hull that performs partly as a displacement hull and partly as a planing hull.

Set – (1) The direction in which a current flows. (2) To dig an anchor firmly into the bottom.

Sheer – (1) A wide swing off course. (2) The shape of the deckline as seen from a point on the beam.

Sheet Bend – A knot used principally for joining two ropes of unequal size.

Shoal – A shallow area in a body of water.

Shock Loading – The resistance caused by intermittent or varying forces of waves, or sea conditions encountered by the boat in tow, which cause heavy stress on deck fittings and the towing rig.

Short Splice – A joining splice between two pieces of line that has a larger diameter than the line.

Skeg – A projection under the propeller.

Skipper – (slang) The person in command of a vessel.

Slack – The interval of minimum horizontal tidal movement (minimum current).

Small Stuff – Cordage of less than 1/4 inch diameter.

Soft Chine – A rounded chine.

Soundings – Measurements of the depths of water.

Spar Buoy – An anchored floating spar used as an aid to navigation.

Spotters – Personnel aboard a SAR unit who are carrying out a visual search

Spring Line – A mooring line running either aft from the forward end, or forward from the after end, to prevent movement of a vessel fore and aft.

Stability – The property of a vessel to right herself after heeling.

Stand – The interval of zero vertical water motion at the turn of the tide.

Stand/Stood Down – SAR Unit is notified by JRCC or OSC to discontinue its involvement with an incident.

Stand On – To maintain course and speed. The stand on vessel is the one that has the right-of-way.

Standing Rigging – The fixed and permanent rigging on a mast such as shrouds and stays.

Starboard – The right hand side of the vessel when facing forward.

Steer – To direct the course of a vessel by the use of the wheel or tiller.

Steerage Way – Movement through the water fast enough to enable the vessel to respond to the rudder.

Stem – The foremost member of a vessel forming the bow and joining the keel at its lower level.

Stern – The after part of a vessel.

Sternway – The backward motion of a vessel.

Strip Chart – A large-scale chart designed principally for pleasure craft and printed in long, narrow form, covering waterways such as canals or rivers. Latitude and longitude lines are not necessarily parallel to the chart outline borders.

Strut – An outboard support for a propeller shaft.

Swamp – To fill a boat with water.

Swell – A condition of the sea resulting from a previous or distant storm or high wind.

T

Take Way Off – To halt the movement of that vessel through the water.

Thrust – Force applied by the propeller when rotated.

Tidal Current – Current due to tidal action.

Tidal Rip – A confused, tumbling surface condition, caused by tidal currents flowing over underwater ridges.

Tide – The vertical rise and fall of water caused by the gravitational pull of the Sun and Moon.

Tiller – A handle attached to the upper end of the rudderpost.

Topsides – The sides of a vessel, between the waterline and the sheer.

Towing Drogue – An object, deployed from the stern of the vessel in tow to create an aft pull that slows, stabilizes and reduces the towed vessels tendency to overtake the towline.

Track – A boat's intended path over the Earth's surface.

Transit – A line that intersects two points of land.

Transom – The transverse part of a hull closing off the stern of the vessel.

Trim – (1) The set of the sail. (2) The fore and aft or athwartships attitude of a vessel with respect to her waterline. (3) To adjust the set of the sails. (4) To alter the fore and aft or athwartships attitude of the vessel.

True North – The direction of the North Geographical Pole.

True North Pole – The position at which the Earth's axis intersects the surface in the Northern Hemisphere. (North Geographical Pole)

True Wind – The direction and velocity of the wind as observed from a stationary point.

U

Underway – A vessel when not at anchor, aground or made fast to shore.

Undocking – The manoeuvre to leave a dock or wharf.

V

Variation – The angular difference between Magnetic North and True North.

W

Wake – The V shaped disturbed area of water around and behind a moving vessel, which is set into motion by the passage of that vessel.

Wash – The loose or broken water left behind a pleasure craft as it moves along, also includes the water thrown aft by the propeller.

Wheel – The propeller steering wheel.

Whipping – A wrapping of small stuff applied to the end of the line to prevent unlaying.

Wind Direction – The direction from which the wind blows.

Windward – Towards the wind.

X – Y – Z

Yaw – To swing off course, as in a following sea.

REFERENCES

- Boating in Canada Practical Piloting and Seamanship (1967)
- Boating Safety Guide 2000
- Bridge Procedures Guide (International Chamber Of Shipping)
- Chapman Piloting – Seamanship and Small Boat Handling 62nd Edition (Elbert S. Maloney; 1996)
- Canadian Forces CFCD 105 Seamanship Rigging and Procedures Manual (1993)
- CCG Aids to Navigation (2001)
- CCG Courtesy Exam Manual (1999)
- CCG Radio Aids to Navigation (2000)
- CCG RHIOT Manual (Pacific Region)
- CCGA SAR Reference Manual (1988) (Pacific Region)
- Chart #1 (Canadian Hydrographics)
- Coastal SAR Manual (Pacific Region)
- Dangerous Waters, (Keith Keller)
- Dutton's Navigation and Piloting (Elbert S. Maloney)
- GPS Handbook and Primer (CCG 2000)
- GPS Instant Navigation (Kevin Monahan and Don Douglas)
- High Seas High Risk (Pat Norris)
- IAMSAR Volume 2 & 3 (International Civil Aviation Organization and Maritime Organization)
- National SAR and Seamanship Manual (CCG National)
- National SAR Manual (Dept. of National Defense and Dept. Of Fisheries and Oceans)
- One Minute Guide to the Nautical Rules of the Road (Charlie Wing)
- Guide to Prevention of Collisions at Sea (DA Moore)
- Oxford Companion to the Sea (Peter Kemp)
- RNLI Boat and Crew Manual (2001)
- Seamanship Techniques (DJ House)
- Small Craft Training Manual (Pacific Region)
- The Annapolis Book of Seamanship (John Rousmaniere 1999)
- The Wheel House Companion (Captain Scott)
- USCG Boat Crew Seamanship Manual (US Dept. of Transportation)

REGULATIONS

Boating Restriction Regulations

- CCG Pacific ISM crewmember Checklist
- CCGA National Performance Objectives
- Collision Regulations
- Canada Shipping Act
- Tackle Regulations