



Fisheries and Oceans
Canada

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Canada

Coast Guard

Garde côtière

SAR SEAMANSHIP REFERENCE MANUAL



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FOREWORD

This SAR Seamanship Reference Manual is published under the authority of the Manager, Search and Rescue, of the Canadian Coast Guard. Funds associated for the development of this manual were provided by a generous contribution from the National SAR Secretariat's New SAR Initiatives Fund program. Without this financial contribution, the publication of this manual would not have been possible.

Purpose

To be able to perform safely and effectively, a rescue mission involves a huge amount of operational knowledge. Most of that knowledge is already available. However, in the context of small vessels, it is dispersed under a number of specialised and individually prepared courses or, under bits of documented information. In addition, the background and theory that sustains SAR operational knowledge is in many cases developed for larger ships involved in offshore rescue. Although the information is helpful, it does not always reflect the reality of small boat operations. A prime example would be first aid where all courses are developed around a movement free stable ground, which is quite different from a small bouncing boat deck.

Another issue is standardisation. Search and Rescue is essentially a humanitarian activity with the prime purpose of saving lives. In most cases, it involves the participation of number of dedicated people that may not have the same background. In order to make operations more efficient, it is paramount to have people executing operational tasks the same way. Therefore, this manual is aiming at introducing and standardising small boat operations for SAR. In fact, the purpose is to bring together under one manual all known best operational procedures and practices that usually apply to small boat involved in a SAR mission.

This manual targets two main groups of small boat rescuers. One is the Canadian Coast Guard Auxiliary and the other one is the Canadian Coast Guard Inshore Rescue Boat Program. However, other organized response units such a local Fire Department can certainly benefit from this manual. We hope that it will incorporate and standardise the current best practices employed within the Canadian Coast Guard operations community. It is intended to be the primary reference for the above noted two targeted groups, mainly for shore based boat operations and seamanship training.

The standardised methods and procedures presented in this Manual can apply to all boat operations and crew training and, Commanding Officers, Officers in Charge or Coxswains are encouraged to ensure that personnel tasked with boat crew responsibilities are trained or familiar in all methods and procedures in the Manual.

As the scope of this knowledge is quite vast, it will be under continuous review and will be updated as necessary. In addition, errors, omissions or suggestions should be forwarded to:

Manager, Search and Rescue, Canadian Coast Guard
Department of Fisheries and Oceans
200 Kent Street, Station 5041
Ottawa, Ontario, CANADA K1A 0E6

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Étienne Beaulé, First aid and technical writing consultant
 Allen Bilodeau, Project manager
 Mathieu Vachon, Project manager

TEAM SAR OTTAWA

Ron Miller
 Mike Voigt
 Steve Daoust
 François Vézina
 Johanne Clouâtre
 Brian Leblanc
 Neil Peet
 Kathy Needham

REVIEW AND CONSULTATION**CANADIAN COAST GUARD**

Kevin Tomsett
 Dave Dahlgren
 Greg Sladics
 Herman Goulet
 Charles Lever
 Stephen Sheppard
 Howard Kearley
 Mike Taber
 Deborah Bowes-Lyon
 Mark Gagnon
 Gaétan Gamelin
 Pierre Bossé
 Pierre Domingue
 Chris Moller
 Geoff Sanders
 Bill Mather

CANADIAN COAST GUARD AUXILIARY

Harry Strong
 Garry Masson
 Ed Bruce
 Rick Tolonen
 Rudolph Mulack
 Guy Poirier
 Ted Smith
 Jim Gram
 Murray Miner
 Cal Peyton
 Ed Fulawka
 Hubert Charlebois
 Duff Dwyer
 Don Limoges
 Jack Kennedy
 Don Mertes
 Marvyn Huffman
 Jim Presgrave
 Robert Petitpas
 Sylvio Lagacé
 Gilbert Léger

Jeanne Drolet
Jean Péloquin
Marie-France Lavoie
Gaétan Létourneau
Bill Fullerton
Richard Wedge
Lois Drummond
Bruce Falkins

INSHORE RESCUE BOAT (PROGRAM)

Mike Cass
Liz Brayshaw
Jen Schnarr
Danielle Dillon
Amy Birchall
Andrew Boyd
Casey Wilson
Tina Sweet
Darryl McKenzie
Marie Tremblay
Sophie-Émanuelle Genest
Nathalie Desjardins
John Johnstone
Scott Davis
Tim Church
Heather Goodwind
David Latremouille
Aaron Macknight
Chris Evers
Steven Shea
Dan Latremouille
Dana Sweeney
Steven Dickie
Gavin Moore
David Willis

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Maureen McMahon
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ABBREVIATIONS AND ACRONYMS

NOTE: The abbreviations are listed alphabetically in the first column, with the French equivalent in brackets. Bold characters indicate that the abbreviation is the same in both languages.

AMVER	Automated Mutual Assistance Vessel Rescue System
CASARA (ACRSA)	Civil Air Search and Rescue Association
CCG (GCC)	Canadian Coast Guard
CCGS (NGCC)	Canadian Coast Guard Ship
CCGA (GCAC)	Canadian Coast Guard Auxiliary
CF (FC)	Canadian Forces
CGRS (SRGC)	Coast Guard Radio Station
COSPAS	Russian for: Space system search for distressed vessels
CSA (LMMC)	Canada Shipping Act
CSS	Co-ordinator surface search
DF	Direction finder
DFO (MPO)	Department of Fisheries and Oceans
DND (MDN)	Department of National Defence
DMB	Data marker buoy
DSC (ASN)	Digital selective calling
ECAREG Canada	Eastern Canada Traffic Zone Regulations
ELT	Emergency locator transmitter
EPIRB (RLS)	Emergency position-indicating radio beacon
ETA (HPA)	Estimated time of arrival
FRC (ERS)	Fast rescue craft
F/V (B/P)	Fishing vessel
GMDSS (SMDSM)	Global Maritime Distress and Safety System
GPS	Global Positioning System
IMO (OMI)	International Maritime Organisation
Inmarsat	International Mobile Satellite Organisation
IRB (ESC)	Inshore rescue boat
kt (nd)	Knot (nautical mile per hour)
LKP	Last known position
m	Metre
MCTS (SCTM)	Marine Communications and Traffic Services Centre
MARB	Maritime assistance request broadcast
Medevac	Medical evacuation
MSI	Maritime safety information
MRSC	Maritime rescue sub-centre
M/V (N/M)	Merchant vessel or motor vessel
NM (MN)	Nautical mile
NSS (SNRS)	National Search and Rescue Secretariat
OBS (BSN)	Office of Boating Safety
OSC	On-scene co-ordinator

PIW	Person in water
PLB	Personal locator beacon
POB	Persons on board
RCC	Rescue co-ordination centre
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite-Aided Tracking
SART	Search and rescue (radar) transponder
SERABEC	Sauvetage et recherche aériens du Québec
SITREP	Situation Report
SKAD	Survival kit air droppable
SLDMB	Self-locating datum maker buoy
SMC	Search and rescue mission co-ordinator
SOLAS	International Convention of the Safety of Life at Sea
SRR	Search and rescue region
SRU	Search and rescue unit
S/V (B/V)	Sailing vessel
UTC	Co-ordinated universal time
VTS (STM)	Vessel traffic services
VHF	Very high frequency (30 to 300 MHz)

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3 PERSONAL SAFETY

3.1 GENERAL

SAR crews often have to perform their duties under extreme conditions (wind, waves, cold water, etc.). Personal safety is one of the most important issues to be aware of in order to avoid injuries. Many pieces of protective equipment are available for these conditions. This chapter will describe these pieces of equipment, their correct usage and maintenance.

Always remember, though, that safety equipment will not protect you against poor judgment. Leaders of SAR crews should always think about safety before deciding on measures to be taken.

3.2 PROTECTION IN COLD WATER

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, many victims do not even have the time to get cold. The shock of the icy waters forces them into hyperventilation. In 90% of cases, water will soon penetrate into the lungs and cause drowning. For the 10% that remain, spasms in the upper airways will prevent the entry of water into the lungs, causing “dry drowning.” These people will eventually die from suffocation.

Professionals who work on the water must be prepared for the unexpected. Wearing gear suited to the job provides a survival advantage. Remember that most drownings occur in good weather, when danger awareness is at its lowest.

To increase your chances of survival in cold water:

- Wear gear that fits;
- Clean and maintain your safety gear (keep it looking new);
- Pick the proper gear for the job.

3.2.1 Wearing gear that fits

Safety equipment that does not fit is of no use to you. There are countless stories of people struggling to survive and being hampered by exposure coveralls that are too big or a PFD floating above their head. Gear that does not fit is uncomfortable to work in and dangerous. If you are out in a boat often, get yourself one set of gear that fits and wear it.

3.2.2 Cleaning and maintaining your safety gear

Refer to section 3.3 for more information on cleaning and maintaining specific safety equipment.

3.2.3 Picking the proper gear for the job

Imagine having fallen overboard at night, and 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

that 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 come back...

Safety-conscious crewmembers organize their gear before they leave and usually leave it in a kit or equipment vest (worn over top of a PFD). The safety equipment chosen must have five essential features:

- Flotation
- Protection
- Warmth
- Ease of detection
- Mobility

3.2.3.1 Flotation

How do rescue personnel survive the first few minutes of exposure, and protect their airways from the icy salt water? Flotation will keep the head up and out of the water and reduce the physical struggle to stay afloat. A PFD or a life jacket will be essential for those dangerous first minutes in the water.

3.2.3.2 Warmth

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 1-15°C Canadian waters, hypothermia is your next concern. Without thermal protection, chances of survival after a long exposure to cold water are slim. An easy rule to remember is the rule of 50: “A 50-year-old man has a 50/50 chance of surviving for 50 minutes in 50°F (10°C) water” or “A 50-year-old man has a 50/50 chance of surviving a 50-yard (46 m) swim in 50°F (10°C) water.”

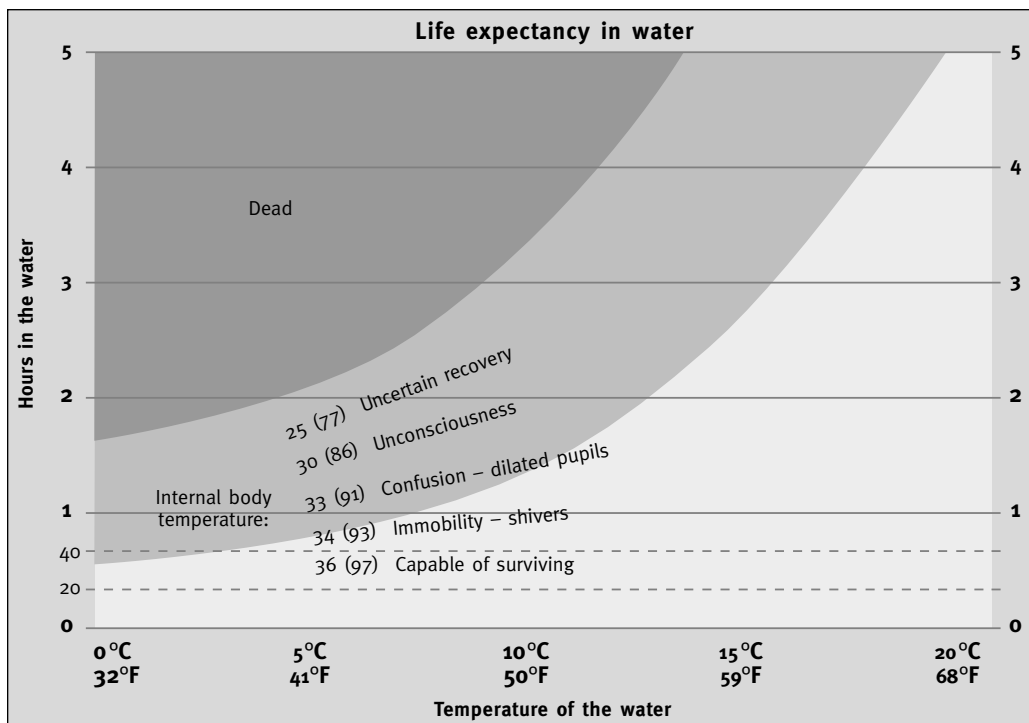


Figure 3.1: Chart of survival times as a function of water temperature (assuming no cold protection)

A multi-layer approach to thermal insulation will protect you against a chilly demise. Different materials distribute heat in different ways. Polypropylene uses heat energy to hold water away from the skin and insulates energy better than natural fibres. Wool gets wet but keeps the water suspended and keeps body heat protected. Wool stays relatively warm when wet. Cotton soaks up water like a sponge and holds it against the skin. As the water evaporates, heat energy is pulled away from your body (not a good choice).

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. A wool toque or balaclava on the head and a scarf or a polypropylene neck warmer can reduce heat loss by 25%.

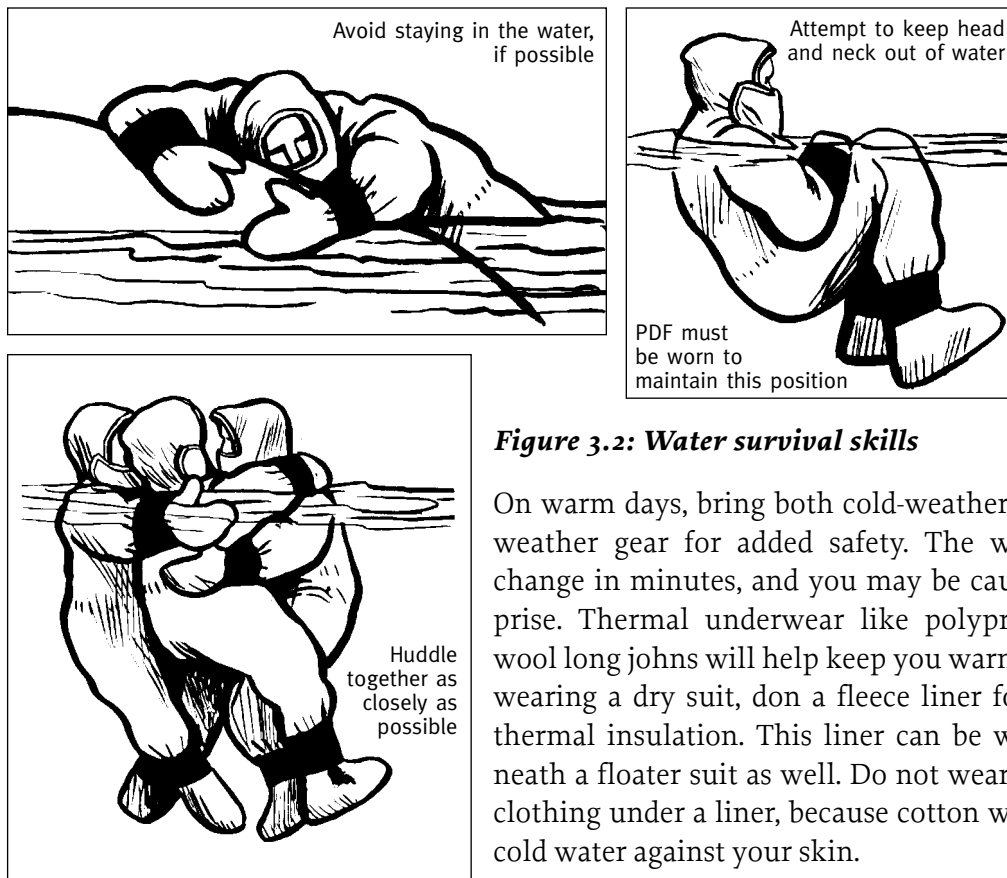


Figure 3.2: Water survival skills

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 dry suit, don a fleece 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.

There are a number of options for keeping yourself warm. The most common are anti-exposure work suits and lightweight SAR dry suits. These will be discussed in sections 3.3.2.5 and 3.3.4.

3.2.3.3 Protection

SAR vessels often operate in severe climatic 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 from 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. When there is the slightest risk that the vessel could be operating in extreme conditions, the crew must have helmets, eye protection and gloves.

Head protection is very important for survival on board any kind of Fast Rescue Craft (FRC). On board these craft, crewmembers will be exposed to strong and sometimes sudden accelerations, both horizontal (due to engines) and vertical (due to waves). Under these circumstances, the risk of head injury is high. It is imperative to wear helmets to minimize 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 minimize stress on the neck during sudden speed change.

Eye protection is vital, particularly in extended operations. The eyes are the most vulnerable and sensitive areas of the body. They are easily damaged by glare, salt and wind. Some form of ultraviolet and wind/spray protection is necessary. 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.

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

Note: When it comes to gloves and eyewear, expensive is not necessarily better.

3.2.3.4 Ease of detection

There are active and passive ways to be detected. Passive “detectability” means that no movement is required for visibility. All your gear should be brightly coloured and covered with reflective tape. If you have an automatic strobe or water-activated EPIRB (Emergency Position-Indicating Radio Beacon), these will draw attention to you. Active signaling devices require you to use them to draw attention your way. All these devices should be inside the various pockets of the equipment vest.

3.2.3.5 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 it all fits you.

3.3 PERSONAL SAFETY EQUIPMENT

3.3.1 General

Crews in custody of personal safety equipment are cautioned that the quality of maintenance and care of this equipment may be instrumental in the saving of lives, including their own. 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 master 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.

3.3.2 Buoyant Devices

3.3.2.1 General

Buoyant 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, and they must be stowed away from excess heat. SAR crews should wear some kind of buoyant device at all times when on board. Buoyant devices will not protect those who do not wear them.

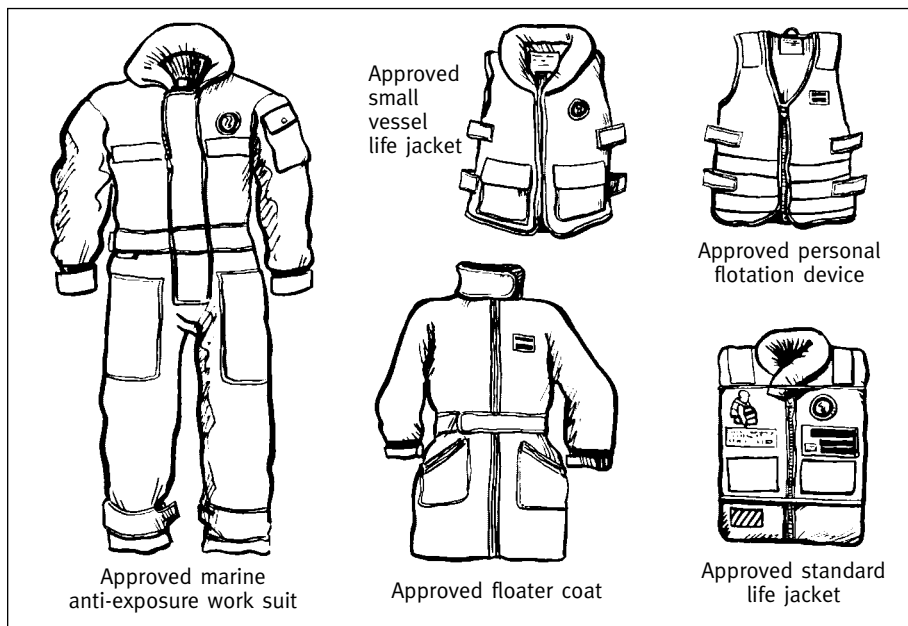


Figure 3.3: Various flotation devices

Buoyant 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 waterlogged 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.

The 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.).

A manufacturer seeking approval of life jackets and PFDs must receive approvals from the Ship Safety Branch, Transport Canada and the Underwriter's Laboratories of Canada (ULC). Life jackets are submitted to Ship Safety for initial design approval and then forwarded to ULC for testing; however, PFDs are initially submitted directly to ULC to begin testing. If the PFD meets all tested standards, it is then forwarded to Ship Safety for final approval and the issue of a certification number.

Three prototypes are required for laboratory testing; one is tested to destruction to determine suitability of material, workmanship and performance. If the tested sample meets the requirements of the relevant standard, the remaining two are stamped "Approved"; one is returned to the manufacturer for comparison with production models, and the other is retained for departmental records. A numbered certificate appears on the label of marketed items.

More than 20 models of life jackets and more than 100 different styles of PFDs, manufactured by 15 different companies, have been approved.

Recommendations on the best products available are not given because all approved models must meet the required standards. Users should purchase the most suitable for fit and comfort to satisfy the law and accommodate intended use. For example, a PFD suitable for paddling a canoe would probably be different from the device appropriate for merely sitting in a motorboat or sailboat, or for sailing. The boater should try out the device in the water to become familiar with its feel and capabilities. 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).

3.3.2.2 Standard life jackets

The approved standard life jacket is mandatory equipment on all commercial vessels subject to Ship Safety Inspection and on all small fishing vessels under 15 tonnes G.R.T. (Gross Registered Tonnage).

The standard life jacket may substitute for any other personal buoyant device permitted on pleasure craft. The life jacket is manufactured to Transport Canada Specification TP 7318. This specification contains the Coast Guard Board of Steamship Inspection Requirements

for standard life jackets, incorporating the basic 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, face and body position for an unconscious person in the water;
- effect of petroleum products; and
- colour.

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. As of July 1991, owners of older type jackets should fit a whistle, reflecting tape and light to their jackets.

The main feature of a standard life jacket is its ability to turn an unconscious person in the water from 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). SAR crews should use smaller but more comfortable PFDs.

3.3.2.3 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) not subject to inspection by Transport Canada Ship Safety. They are designed and manufactured to Canadian General Standards Board (CGSB) Specification CAN 2-65.7-M80, drawn up and maintained under the auspices of the CGSB Committee on Life Jackets. This committee consists of representatives from the boating industry, safety organizations such as the Canada Safety Council, manufacturers, distributors and various government departments.

Small vessel life jackets are designed in two styles, one-piece (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. 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. There must be no tendency for the jacket to turn a body from any other position to face-down.

As for the standard life jacket, small vessel life jackets tend to be relatively uncomfortable. PFD's remain the best alternative for SAR crews.

3.3.2.4 Personal Flotation Devices (PFDs)

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

PFDs are manufactured to CGSB Specification 65-11-M88 for adult sizes and to 65-15-M88 for children's. PFDs have less buoyancy and turning moment than life jackets. They must not have a tendency to turn the wearer face down in the water.

There are two approved types:

- Type I has inherent buoyancy capabilities due to its construction from unicellular foam or macrocellular elements.
- Type II has two buoyancy media: inherent features and inflatable capabilities. The inflatable section has an oral inflation device and a manual device consisting of a cylinder of compressed CO₂ operated by a manual trigger.

It is important that the PFDs be worn with straps and zippers fully fastened, and that the PFD be in good condition. Personal flotation devices 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.

Recently, Transport Canada approved new colours such as blue and purple for PFDs used by recreational boaters. Some of these colours are not as visible as the standard red, yellow and orange PFDs. 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.

3.3.2.5 Anti-exposure work suits

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 even 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 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 protection that a dry suit or a survival suit would. The full-exposure coveralls can severely limit swimming and movement, especially if they do not fit properly.

Suits that are damaged by small tears, broken zippers, open seams, or small burns may be repaired by sewing or patching. 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 periodically lubricated with paraffin or beeswax, which both lubricate and retard corrosion.

Flotation suits should not be dry-cleaned. Areas that become soiled may be washed with a mild soap solution, rinsed with fresh water, and then hung to dry in a ventilated area. Do not wring the suit. Do not attempt to use solvent or thinner to clean suits exposed to a substance containing acetone.

3.3.2.6 Testing the floating capability of PFDs and flotation suits

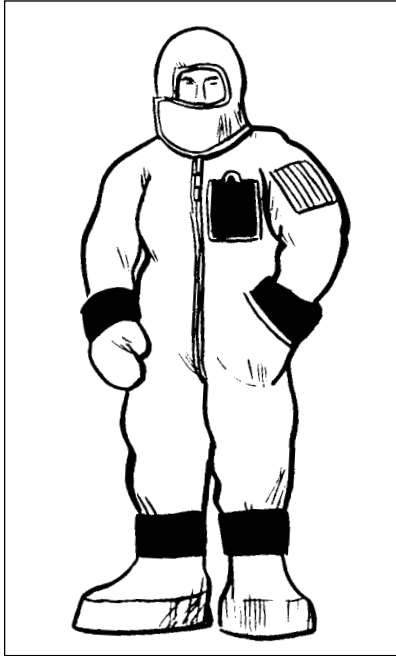
Vest pockets can be used for a wide variety of equipment, depending on the nature of work to be done. Pockets soon become full and the equipment vest becomes heavy. Fifteen pounds of buoyancy on your PFD will quickly become useless if you carry 30 pounds of equipment.

Weigh all your gear that you would wear on the heaviest day. If you are involved in enforcement, weigh the bulletproof vest with trauma plate and full gun belt. If you are a surveyor, weigh your survey vest and other necessary equipment. Rig a diving weight belt to the equivalent weight and put on your PFD. Now jump into a swimming pool and see 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 a 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.

3.3.3 Abandonment immersion suit

An abandonment immersion suit is a heavy rubber abandonment suit that is somewhat similar to a diver's dry suit. The suit provides excellent thermal protection and flotation, especially when the inflatable bladder is activated. These suits are designed as abandonment devices and should NOT be viewed as working flotation devices such as a standard life jackets or anti-exposure work suits.



These suits must be checked periodically for holes, punctures, rips, etc., and to ensure that the teeth of the suit's zipper are aligned and that the zipper works all the way up and down. The zipper should be periodically lubricated with beeswax or a bar of soap.

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 survival 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.

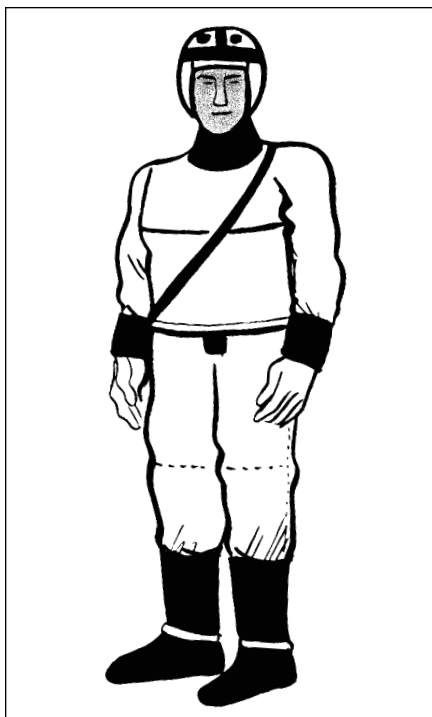
Figure 3.4: An immersion suit

An immersion suit is truly the best thing one could wish to be wearing while floating in cold water. It keeps dry and it 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.

3.3.4 Dry suits

3.3.4.1 General

The most effective way to keep warm is to stay dry. A lightweight dry suit offers the best balance of dryness and mobility in cold weather. The dry suit is ideal for extended missions in severe climactic and marine conditions. SAR dry suits are usually similar to diving dry suits, but they have no valves. Hoods are not attached and the suit is worn with a thermal liner. Wrist and neck seals can 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 dry suits also have integral work boots or soft-shoes. Dry suits are not approved as flotation devices; consequently, they must always be worn with a PFD. Dry suits can be punctured. When this occurs, the inherent buoyancy provided by the suit will be lost. This is why an approved PFD must be worn over the dry suit.



Dry suits alone do not provide adequate insulation or hypothermia protection. Thermal underwear must be worn beneath the dry suit 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.

Dry suits are among the most expensive items of personal protection for SAR crews. To perform their function of providing protection from the elements, they do require some specialized maintenance routines. With proper care and maintenance, they can fulfil their purpose for extended periods of time. Always refer to manufacturer's guidelines in order to make proper usage of the dry suit in matters such as donning and removing the suit.

Figure 3.5: A SAR lightweight dry suit

3.3.4.2 Dry suit maintenance

To prolong the life of the dry suit and ensure that it is ready for your next use, the following steps should 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. Do not use hand soap or silicone spray;
- 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 lubricants of any kind to seals.

3.3.4.3 Dry suit storage

Dry suits should be stored with the entry zipper completely open. They should be folded with the zipper on the outside and stored in a protective bag.

3.3.4.4 Repairs

Dry suits 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 dry suit 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.

3.3.4.5 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, and additional heavy underwear will provide insulation.

Cleaning routines for thermal underwear are limited to laundering after use. 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.

3.3.5 Equipment vest

Equipment vests are made of lightweight material and are designed to be worn over a PFD. The following pieces of equipment can be stored in the equipment vest:

3.3.5.1 Strobe light

A small waterproof strobe light can also 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 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.

Personal strobe lights should be worn by all individuals engaged in SAR operations in periods of low visibility. The strobe light should be activated and checked at least once every patrol. This check includes:

- a physical examination of the body, clear light cover, and switch, including protective boot cover, for damage;
- a check of the battery date for expiry (generally one year from manufacturing date);
- a check of the lanyard for security and condition of cord; and
- activation of the light to check functional operation.

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.

3.3.5.2 Personal distress flares

It is highly recommended that a minimum of three personal distress flares (type B) 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 dry suit or in a fanny pack with other items of personal safety gear.

The type B distress flare produces at least two red stars at intervals of not less than 15 seconds. The stars are projected to an altitude of not less than 90 m (300 ft.). The stars burn with a luminosity of not less than 5,000 candela for a period of not less than four seconds, and burn out before touching the sea. The type B distress signal may contain a firing device capable of throwing the stars automatically or may use a cartridge-firing device that requires loading for each star.

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 coordination and dexterity not needed for self-contained devices. Coordination 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.

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 manufacturing date on the flares to ascertain whether they are still within the four-year period of approval. If expired, replace the flares with fresh ones and dispose of the outdated flares in the manner approved for your region;
- 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 watertight. If the wrapping is not watertight, replace it with a new zip-top bag;
- Replace the flares into their designated stowage pouch or pocket.

3.3.5.3 Whistle

The whistle is a sound-signaling device that can be heard at distances greater than 300 m at sea. It is an effective and inexpensive item of personal protective equipment that has been instrumental in locating and saving many lives at sea. Yet, care and maintenance of this simple piece of equipment are often ignored.

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.

3.3.5.4 Heliograph

In addition to flares, strobe lights, and whistles, some SAR units issue an emergency-signaling mirror. The emergency signaling 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 origin. The signaling 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.

3.3.5.5 Dye marker

This device releases into the water a green dye that greatly increases visibility from the air.

3.3.5.6 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.

3.3.5.7 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 gets separated from the rest of the crew. Note that some new models are compatible with GMDSS (a useful feature).

3.3.5.8 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 and lubricate the blade once in a while with a fine layer of oil to increase resistance to corrosion.

3.3.6 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.

3.3.7 General cleaning routines for protective clothing

Salt, corrosion and grease are the main enemies of safety gear. Given time, salt can cut material like a knife, transforming a dry suit into a wet suit and a rain jacket into a well-ventilated jacket. The salt molecules penetrate the fibres while in solution and crystallize 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 and all zippers, metal buckles, and brass snaps or buttons should be protected with silicone spray or glycerin (hand soap). Keep your gear like new.

- Avoiding Human error among SAR Personnel, IMO LSR 26/5, 1994.
- Beaulé, Étienne: Module de formation Chefs d'équipe, Canadian Coast Guard, Laurentian Region, 1998.
- Bridge Resource Management – Student's Workbook, Edition 6, Sweden, SAS Flight Academy AB, 1993.
- Canadian Coast Guard Auxiliary, Central and Arctic region: Fundamentals of SAR, 1996.
- Canadian Coast Guard Auxiliary, National Guidelines Respecting Canadian Coast Guard Auxiliary Activities, 1998.
- Canadian Coast Guard, Bridge Resource Management Course, Canadian Coast Guard College, 1998.
- Canadian Coast Guard, Central & Arctic Region IRB Training Manual.
- Canadian Coast Guard, Courtesy examination manual for small craft.
- Canadian Coast Guard, Gaetan Gamelin, Mécanique préventive, Laurentian Region.
- Canadian Coast Guard, Jacky Roy & Jean-Michel Boulais, L'équipage ESC devant la loi, Laurentian Region.
- Canadian Coast Guard, Mathieu Vachon, Formation des équipages en embarcation rapide de secours, Laurentian Region, 1999.
- Canadian Coast Guard, Operational guidelines for Search and Rescue units, 1993.
- Canadian Coast Guard Regional Manual for Marine Rescue Operations, Laurentian Region, DFO 5675/1998.
- Canadian Coast Guard, René Paquet, Les effets du stress post traumatique, Laurentian Region.
- Canadian Coast Guard, Robert Jinchereau, Notes de cours, Laurentian Region.
- Canadian Coast Guard, RHIOT Manual, Pacific Region, Bamfield RHIOT Shool.
- Canadian Coast Guard, SAR Skills Training Standard, TP-9224E, 1994.
- Canadian Coast Guard: Small fishing vessel safety manual, 1993.
- Canadian Power Squadron, Pleasure Craft Operator Course, Motor and Sail, 1990.

Fisheries and Oceans Canada, Coast Guard, Maritime Search and Rescue in Canada, T 31-87/1996E.

Fisheries and Oceans Canada, Coast Guard / Transport Canada Marine Safety: Global Maritime Distress and Safety System, 1997.

Fisheries and Oceans Canada, Coast Guard, Safe Boating Guide, 2000.

International Civil Aviation Organisation and International Maritime Organisation: International Aeronautical and Maritime SAR Manual, IAMSAR Vol. I, II, III.

National Defence / Fisheries and Oceans Canada / Coast Guard: National Search and Rescue Manual, B-GA-209-001, DFO 5449, 1998.

North Pacific Vessel Owner's Association, Vessel Safety Manual, 1986

St. John Ambulance, First Aid, First on the scene, standard level, activity book, 1999.

Stanley R. Trollip, Richard S, Jensen, Human Factors for General Aviation, Englewood, Jeppesen Sanderson, 1991.

United States Coast Guard, Boat Crew Seamanship Manual, U.S. Department of transportation.

World Health Organisation, International Medical Guide, 1989.

Zodiac Hurricane Technologies, Technical Manual, 733 OB Rescue, British Columbia.