3 THE SAFE BOAT

Practically anyone who can start an engine or hoist a sail can climb aboard a boat and head out onto the water. For the well-being of everyone aboard, however, there is more to boating than that. Boating begins with safety.

Although every chapter in this book covers some aspect of safe boating, this chapter gives you the basics—how to meet legal requirements and other safety needs, and guidelines for choosing and maintaining equipment. Refer to page 74 for safety tips that even experienced boaters should review periodically. You will also be directed to other parts of the book for further reading.

For skippers and crew members alike, a safe boating course is essential. Such courses are offered in most areas, as discussed in Chapter 27.

SAFETY AWARENESS ON BOARD

Defining the roles on board

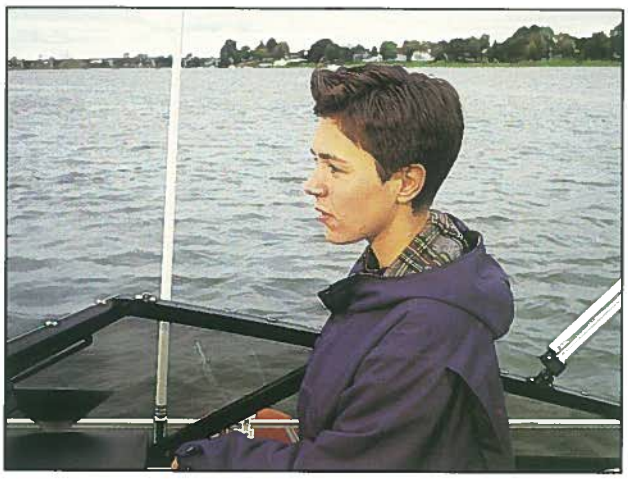
As the skipper of a boat, you are responsible for the vessel, for the safety of those on board, for others in boats nearby, and swimmers, water-skiers and anyone else who may be affected by your boat's course or its wake. This applies to all sizes of boats, on all waters and at all times. One of the challenges is accepting the responsibility without letting it detract from your enjoyment of boating.

To be an effective skipper, you must know yourself, your abilities and your limitations. You must know your job so well that you perform all tasks confidently, without having to think about the details involved. Equally important is a knowledge of your crew and your boat, and what you can reasonably expect of them in an emergency.

Good communication is key to a safe and enjoyable outing on the water, and it is essential to ensure that everyone aboard agrees to the safety rules you define for your boat. Before you leave the dock, make sure that other members of the crew know what is expected of them; they should also be acquainted with the location and proper use of all essential equipment aboard.

Remember that a boat traveling through the water can cause injury just as easily as a car moving on the highway. As skipper, you must be able to concentrate; distractions such as loud music or rowdy behavior by passengers can easily divert you from your important tasks. Maintain a safety consciousness at all times: If you establish your authority as the leader and delegate with tact, each outing or voyage is likely to be safe and fun.

Even the most experienced skipper will admit to being fooled at times by unexpected events such as changing wind or current. "Plan ahead" is one of the best pieces of advice in boating. When guests aboard have little or no boating experience, take them on a tour of the boat, pointing out danger areas such as the boom or a sheet under load. On the water, dangerous situations can develop with amazing speed, so vigilance and foresight are important—both outside and inside the boat. Devote your full attention to your boating tasks; have an answer to every threat, and a plan to take you out of every danger. Spend time assessing the types of crises with which you might have to deal, assemble the appropriate tools and equipment, and practice the procedures best suited to solving the crisis before it becomes a disaster.



At least one crew member other than the skipper should be fully capable of recovering a person who falls overboard, or of returning to port should the skipper be incapacitated.

Safety in the water

For many people, the boating experience includes swimming. You can best ensure that water activities are as safe as possible by enrolling in a water safety training class, and by following the safety guidelines below.

- Know your personal limits; avoid overextending yourself.
- Always swim with at least two other people, never alone.
- Before diving, make sure the water is deep enough and hazard-free; check for any change in tide level since last swimming. Enter the water the first time with your feet first.
- When tired or overheated, stay out of the water.
- Rely on your swimming ability for support, not on inflatable plastic toys or air mattresses.
- At all times, non-swimmers should wear personal flotation devices (PFDs, Types I, II, III or V, *pages 64 and 65*).
- Prohibit dunking and pushing, which may be dangerous.

While on board the boat, if a crew member inadvertently falls into the water, don't jump in. Use a reaching, throwing or floating assist such as a paddle, cushion, life ring (preferably a Type IV PFD) or a rescue line with a float attached. Crew overboard procedures are covered in Chapter 4.

Respecting U.S. federal requirements

Your primary safety system is your boat itself—in good repair and operable condition, and outfitted with the proper safety equipment. Although needs depend on the type of boat you use and the nature of the boating that you do, the regulations on operation and U.S. Coast Guard-approved safety equipment are mandatory for daysailers, powerboats and bluewater cruisers alike. It is your legal responsibility to carry the required equipment listed on page 62, to keep that equipment in proper working order and to operate your boat in a safe manner. Boats 12 meters (39.4 ft.) or more in length also are required to carry on board and maintain for ready reference a copy of the Inland Navigation Rules *(Chapters 6 and 7)* when on inland waters.

Satisfying Canadian requirements

In Canada, minimum required safety equipment is established by the Department of Transport (DOT), and varies with boat length. As of the preparation date for the 63rd edition of *Chapman Piloting*, proposed revisions to Canadian regulations were not yet enacted. For the most recent Canadian Coast Guard (CCG) information on safe boating and required safety equipment, call toll-free: 1-800-267-6687. (If outside Canada, call 613-990-3124 or 613-991-3105.)

U.S. COAST GUARD MINIMUM REQUIRED SAFETY EQUIPMENT

Equipment	*Class A* *Less than 16 feet (4.9 m)*	*Class 1* *16 feet to less than 26 feet (4.9-7.9 m)*	*Class 2* *26 feet to less than 40 feet (7.9-12.2 m)*	*Class 3* *40 feet to not more than 65 feet (12.2-19.8 m)*
Personal flotation devices* (see also pages 61 and 63-66)	One Type I, II, III or V** device for each person (also applies to canoes and kayaks of any length).	One Type I, II, III or V** PFD for each person on board or being towed on water skis, etc., plus one Type IV*** PFD available to be thrown.	One Type I, II, III or V** PFD for each person on board or being towed on water skis, etc. plus one Type IV available to be thrown.	
Fire extinguishers* (see also pages 72-73) ***When no fixed fire extinguishing system is installed in machinery space(s)***	At least one B-I class approved hand-portable fire extinguisher. Not required on outboard motorboats less than 26 feet (7.9 m) in length and not carrying passengers for hire if the construction of such motorboats will not permit the entrapment of flammable gases or vapors.		At least two B-I class approved hand-portable fire extinguishers, or at least one B-II class approved hand-portable fire extinguisher.	At least three B-I class approved hand-portable extinguishers, or at least one B-I class plus one B-II class approved hand-portable extinguisher.
When fixed fire extinguishing system is installed in machinery space(s)	None.		At least one B-I class approved hand-portable fire extinguisher.	At least two B-I class approved hand-portable fire extinguishers, or at least one B-II approved unit.
Ventilation (see also pages 78-81)	Boat operator is responsible for keeping the ventilation systems in operating condition, making sure openings are free of obstructions, ducts are not blocked or torn, blowers are operating properly and worn out components are replaced with equivalent equipment.			
Whistle or other sound signaling device (see also page 71)	Boats up to 12 meters (39.4 ft.): any device capable of making an "efficient sound signal."			Boats 12 to 20 meters (39.4-65.6 ft.): device meeting technical specifications of Navigation Rules, audible ½ mile.
Bell	None required if boat equipped with device capable of making an "efficient sound signal."			Boats 12 to 20 meters (39.4-65.6 ft.): bell with a mouth diameter of not less than 200 millimeters (7.9 in.).
Backfire flame arrester* (also called flame arrester, see also page 70)***	Every gasoline engine installed in a motorboat after April 25, 1940, except outboard motors, must be equipped with an acceptable means of backfire flame control. Sailboats equipped with a motor are considered "motorboats."			
Visual distress signals* (see also page 71)	All vessels used on coastal waters, the Great Lakes, territorial seas and those waters connected directly to them, up to a point where a body of water is less than two miles wide, must be equipped with visual distress signals. Vessels owned in the U.S. operating on the high seas must be equipped with visual distress signals. The following vessels are not required to carry day signals, but must carry night signals when operating from sunset to sunrise: ▪ Recreational boats less than 16 feet (4.9 m) in length. ▪ Boats participating in organized events such as races, regattas or marine parades. ▪ Open sailboats less than 26 feet (7.9 m) in length not equipped with propulsion machinery. ▪ Manually propelled boats.			
Navigation lights	Must comply with International or Inland Navigation Rules *(Chapter 7)*.			

** Must be USCG-approved*
*** Type V must be worn (except within enclosed space) to qualify as required safety equipment*
**** Type IV not required for canoes or kayaks greater than 16 feet (4.9 m) in length*
***** Must be USCG-approved or comply with SAE J-1928 or UL-1111 standards and be so marked*

In addition to the federal equipment carriage requirements for recreational vessels (*above*), the owner/operator may also be required to comply with additional regulations specific to the state in which the vessel is operated.

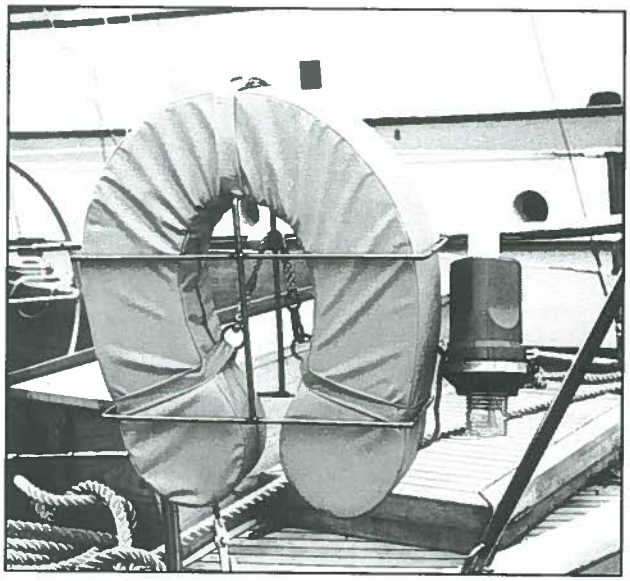
LIFESAVING EQUIPMENT

Any time anyone goes boating, there's a chance of falling overboard or the vessel sinking. A personal flotation device—a lifesaving device commonly called a PFD, or life jacket—is designed to help keep your head above water and assist you in maintaining a position that permits proper breathing.

PFDs are among the most essential safety equipment that any boater can own. Most importantly, the PFDs aboard your boat must be used. The fact is, 90 percent of deaths in boating result from drowning, and 80 percent of those drowning victims were not wearing a personal flotation device. (In fact, four of every five people killed in boating accidents in general were not wearing PFDs.) Many of these deaths were avoidable. An average adult needs additional buoyancy (the force, in pounds, that keeps you afloat) of 10 to 12 pounds (4.5-5.4 kg) in order to remain afloat. All United States Coast Guard- and Canadian Department of Transport-approved PFDs provide more than this amount of buoyancy. Personal flotation devices also offer some protection against another cause of boating accident casualties—hypothermia *(Chapter 5)*.

Children do not float well in a face-up position and tend to panic easily. Type II PFDs are best for small children; an infant vest should have built-in rollover and head-support features.

A water-skier being towed is considered on board the vessel for compliance with PFD carriage requirements. Ski belts are not USCG approved for safety. Although not required by federal law, it is advisable for a skier to wear a PFD designed to withstand the impact of hitting water at high speed. Some state laws require skiers to wear a PFD.



Horseshoe buoys, popular particularly on ocean cruising and racing sailboats, are approved throwable PFDs in the U.S., but not in Canada.

When shopping for a PFD, get the facts you need. Check the labels for U.S. Coast Guard or Canadian Department of Transport approval. Do not skimp on quality; the more easily worn life preservers and buoyant vests provide much greater protection. They are worn, rather than grasped, and so will keep an injured or exhausted person afloat.

PFDs are classified in "types" *(pages 64-65)*. Choose a model that fits the person who will be wearing it most often, and one that suits the type of boating you do. Many models are comfortable and attractive—increasing the chances of someone wearing a PFD *before* an emergency arises.

The most popular PFDs are fabric-covered Type II nearshore buoyant vests and Type III flotation aids. The fabric covering most often used is one of several types of nylon or polyester. These synthetic fabrics have a number of advantages for use in PFD construction. They are economical, durable and resistant to rot caused by microbes. They can be dyed in a wide range of colors, increasing the chances of a rescuer spotting them. They are easy for PFD manufacturers to work with. They "drape" reasonably well, and therefore are good for constructing wearable articles. The nylon fabrics used are similar to those often used in constructing jackets and camping gear.

Nylon and polyester are plastics, however, and like many plastics they can start to break down after extended exposure to the ultraviolet (UV) light in sunlight. Fabric manu-

facturers can include UV inhibitors to slow the degradation process, and dyes used to color the devices may also provide some protection. Generally, darker dyes provide more protection than light or bright dyes, such as "neon" (fluorescent) shades, but this is not always the case. Fabric-covered PFDs should ordinarily last at least several boating seasons in normal use (vacations, weekends and evenings, for example). PFDs used every day in direct sunlight will probably have to be replaced more often.

Another type of personal flotation device is the inflatable, which relies on a carbon dioxide cartridge that inflates the vest in order to provide the required buoyancy. Inflatable models are either manual (a ripcord is pulled to activate the CO_2 cartridge) or automatic, with a water-sensitive mechanism that automatically activates the CO_2 cartridge upon contact with the water. It is especially important that inflatable PFDs are USCG-approved.

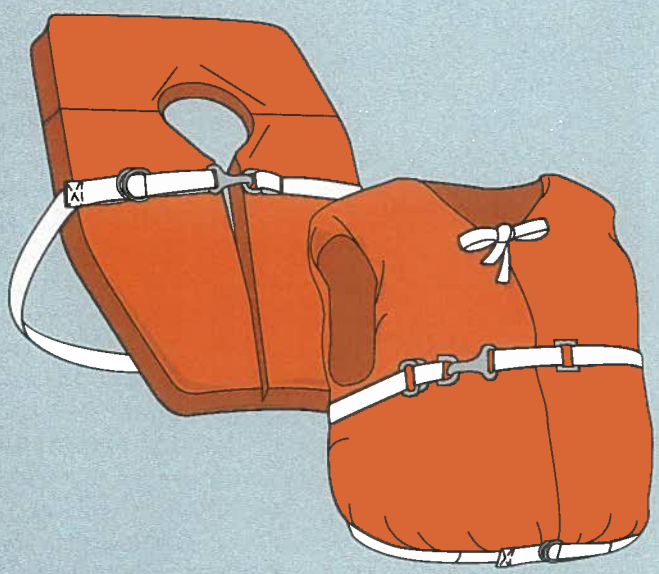
Remember that small outboard boats and sailing dinghies are more likely to capsize than larger inboard-engine boats; consequently, there is a greater possibility that occupants will find themselves in the water. Regardless of the type of boat, however, think of personal flotation devices as required operating equipment. Insist on an absolute "rule of the boat": Adult non-swimmers, all children, anyone boating alone, anyone wearing a cast, or anyone who must do a job that could result in being swept overboard must wear a PFD whenever the boat is underway. This also applies to a dinghy outing—even if only a quick row to shore. When PFDs are not being

CHOOSING PERSONAL FLOTATION DEVICES

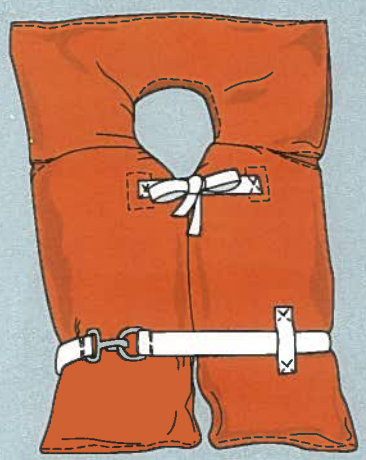
To meet U.S. Coast Guard boating requirements, you must have the proper type and number of PFDs aboard. Wearable devices must be "readily accessible," and throwable devices "immediately available." Be sure to choose this lifesaving equipment carefully. When buying PFDs, shop for a proper fit for each person aboard. Also make sure flotation devices are approved by the U.S. Coast Guard in the U.S. or, for Canadian vessels, the Department of Transport in Canada.

Try on your new personal flotation device to see if it fits comfortably snug. Then test it in shallow water or in a swimming pool to see how it performs. To check the buoyancy of your PFD in the water, relax your body and let your head tilt back. Make sure that your PFD keeps your chin above water and that you can breathe easily.

Remember, your PFD may not perform the same in swift or rough water as in calm water. The clothes you wear and items in your pockets may also change the way a PFD performs. The USCG recommends that boat owners test their PFDs at least once a year. If your mouth is not well above the water when you test it, get a new PFD or one with more buoyancy.



TYPE I
Also called an off-shore life jacket, a Type I PFD is the easiest to pull on in an emergency. It provides the most buoyancy, and is effective for all waters, especially open, rough or remote waters requiring extended survival. It is designed to turn most unconscious wearers to a face-up position. Type I is available in jacket or bib models, as shown. The adult size provides at least 22 pounds buoyancy, the child size, 11 pounds minimum.



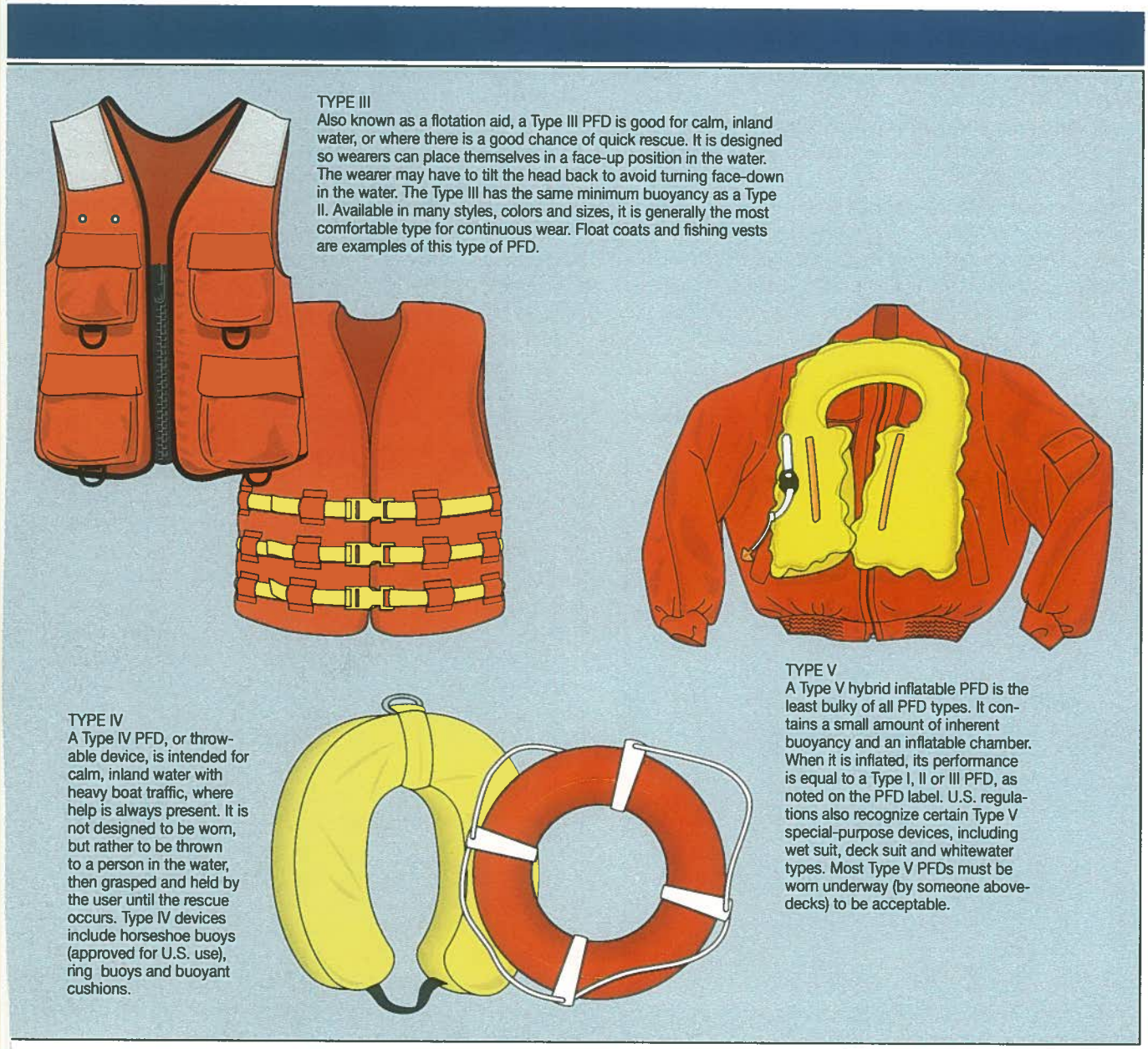
TYPE II
A Type II PFD, or near-shore buoyant vest, is intended for calm, inland water or wherever there is a good chance of quick rescue. This type will turn some unconscious wearers to a face-up position in the water. However, the turning action is not as pronounced or as effective for as many people as a Type I. An adult size provides at least 15½ pounds buoyancy; a medium child size provides 11 pounds. Infant and small child sizes each provide at least 7 pounds buoyancy.

worn, they should at least be out and readily available. For those who take pets aboard their boats, pet vests are available at most marine supply stores.

Maintaining your PFDs

PFDs aboard your boat are only useful if they are kept in operable condition. Be sure to maintain this essential equipment by following the guidelines below. It is important to remember that, like any other item of equipment on your boat, a PFD eventually gets old and worn, and therefore must be replaced.

- Check each personal flotation device's buoyancy with regular trials in shallow water. Each should hold its owner so that he or she can breathe easily.
- After use, always air-dry each flotation device thoroughly, away from any direct heat source. Then store it in a dry, well-ventilated, easily accessible place on board the boat.
- Check twice a year for mildew, leaks, insecure straps, frayed webbing, broken zippers or hardened stuffing; replace as necessary. Clean with a mild soap and running water; avoid using strong detergents or gasoline, and do not dry clean.
- Avoid kneeling on PFDs, or using them as fenders.
- Avoid contact with oil or grease, which in some cases causes kapok materials to deteriorate and lose buoyancy.
- Check PFDs that use kapok-filled bags for flotation: Make sure the kapok has not hardened and that there are no holes in the bags. Squeeze the bag and listen for an air leak. If water has entered the bag, the kapok will eventually rot. Destroy



TYPE III
Also known as a flotation aid, a Type III PFD is good for calm, inland water, or where there is a good chance of quick rescue. It is designed so wearers can place themselves in a face-up position in the water. The wearer may have to tilt the head back to avoid turning face-down in the water. The Type III has the same minimum buoyancy as a Type II. Available in many styles, colors and sizes, it is generally the most comfortable type for continuous wear. Float coats and fishing vests are examples of this type of PFD.

TYPE V
A Type V hybrid inflatable PFD is the least bulky of all PFD types. It contains a small amount of inherent buoyancy and an inflatable chamber. When it is inflated, its performance is equal to a Type I, II or III PFD, as noted on the PFD label. U.S. regulations also recognize certain Type V special-purpose devices, including wet suit, deck suit and whitewater types. Most Type V PFDs must be worn underway (by someone above-decks) to be acceptable.

TYPE IV
A Type IV PFD, or throwable device, is intended for calm, inland water with heavy boat traffic, where help is always present. It is not designed to be worn, but rather to be thrown to a person in the water, then grasped and held by the user until the rescue occurs. Type IV devices include horseshoe buoys (approved for U.S. use), ring buoys and buoyant cushions.

and replace the PFD in any of the following cases: if the kapok filling is hard, if you feel a large quantity of air coming from the bag, if the kapok is waterlogged or if the PFD smells of mildew.

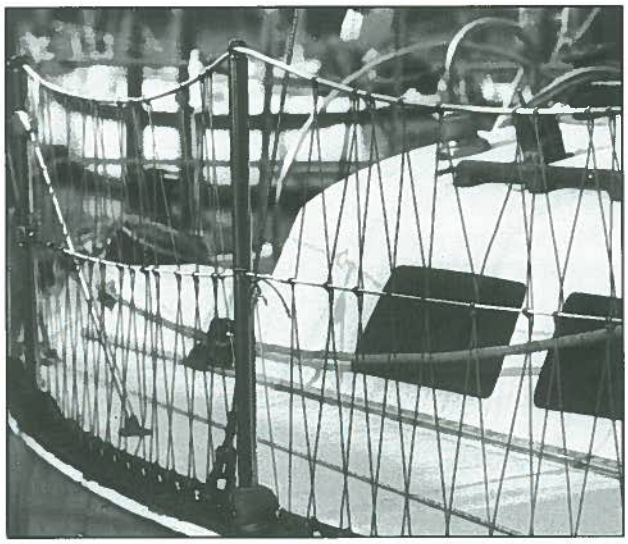
■ Check PFD covers periodically. A cover that has torn due to weakened fabric is obviously unserviceable; a weak cover could split open and allow the flotation material inside to be lost. Badly faded bright colors can also be a clue that deterioration has taken place. Compare fabric color where it is protected—under a body strap, for example—to where the fabric is exposed. A PFD with a UV-damaged fabric cover should be replaced. Another simple test is to pinch the fabric between thumb and forefinger of each hand and try to tear it. If the fabric cover can be torn this way, the PFD should definitely be destroyed and discarded.

Lifelines, safety nets and harnesses

Make sure that everyone on board follows the traditional mariner's advice: "One hand for yourself and one for the boat." No matter how seasoned your sea legs, when the weather is rough, keep your center of gravity low whenever you move about the boat. (Further ensure stability by grasping handholds, for example.)

On sailboats, lifelines serve as boundaries for the deck, particularly when children or pets are aboard. Many people reinforce those boundaries by rigging nylon netting along the lifelines, or between the hulls of catamarans or trimarans. When small children are adventurous, however, or when the boat is pitching, rolling or heeling, safety harnesses provide additional safety insurance.

A safety harness ensures that you know where your children are at all times aboard a boat.



Netting rigged along lifelines of a sailboat is an excellent safeguard against children falling overboard.

In addition to ensuring that you know a child's whereabouts at all times, a safety harness is essential in other conditions for boaters of all ages. It will keep you aboard even if you fall, and should be worn anytime you are sailing alone, whenever any crew member is on deck in heavy weather, when going on deck alone at night while underway, when going aloft or whenever you feel there is a danger that you might lose your footing.

Put on the safety harness before going on deck, and keep in mind that a safety harness is only as strong as its attachment point. The best attachment point is a jackline, or jackwire—a bow-to-stern trolleylike wire on a sailboat deck, onto which safety harness tethers are securely clipped. In the absence of a jackline, a harness should be hooked to the windward side of the boat—only onto a sturdy through-bolted fitting (a cleat, winch or stay, for example); the mast; or stainless steel eyes of a toe rail or a grab rail. Keep in mind that lifelines and stanchions cannot be relied upon to withstand a great deal of force; therefore, they are unsuitable attachment points.

When shopping for safety harnesses, choose only models designed for use aboard a boat, with reinforced nylon webbing, stainless steel hardware and a tested strength of at least 3,000 pounds. The harness should fasten at the chest, with a catch that responds only to firm, positive action for release; the USCG recommends quick-release-under-load catches and buckles. A harness should have a stainless steel snap hook at the end of a tether no longer than 6 feet. If you attach a sailing knife to the harness, in a sheath and with a lanyard, you will always have a tool handy.

Each safety harness aboard your boat should be adjusted to fit the person who will wear it, then labeled to ensure quick identification when needed in an emergency. Stow your harnesses in dry places and inspect them regularly for wear and tear, along with your other safety equipment.

Fueling the boat safely

Fueling a boat properly is an essential element of good seamanship. Whether you are planning a day's outing or an extended cruise, before starting out make sure you have enough fuel on board, and if any is needed, fill the tank safely. Practice the "one-third rule": Use one-third of your fuel going out, one-third to get back and keep one-third in reserve. Remember that although diesel fuel is non-explosive, it will burn nonetheless. Whether you use gasoline or diesel fuel, follow the step-by-step procedures below—carefully and completely—every time you fuel a boat.

Of primary importance is the condition of your fuel tanks. If you have portable fuel tanks, make sure that they are constructed of sturdy material and in good condition, that they are free of excessive corrosion and do not leak. The vents on portable tanks must be operable; the tanks themselves should have a vapor-tight, leakproof cap. Avoid excessive movement of portable tanks. Permanent fuel tanks and lines should also be free of corrosion and must not leak. Tanks must be vented to the outside of the hull. The fill pipe and plate must be located outside of closed compartments and outboard of the cockpit, and must fit tightly.

Before fueling

- Fuel before dark whenever possible, and secure your boat to the fueling dock.
- Stop engines, motors, fans and other devices that can produce a spark. If the electrical system has a master switch, turn it off. Turn off all galley fires and open flames.
- Close all ports, windows, doors and hatches so that fumes cannot blow aboard and below.
- Disembark all passengers and any crew members not needed for the fueling operation.
- Prohibit all smoking on board and near the boat.
- Make sure that an approved, well-maintained fire extinguisher is close at hand.
- When refueling an outboard, remove portable tanks from the boat and fill them on shore. Refer to Chapter 8 for more information on fueling portable tanks.

While fueling

- Guard against static sparks by keeping the nozzle or can spout in contact with the fill opening.
- Avoid spilling any gasoline.
- Avoid overfilling: Filling a tank until fuel flows from the vents is dangerous.

After fueling

- Close fill openings.
- Wipe up any spilled gasoline; dispose of wipe-up rags safely on shore.
- Open all ports, windows, doors and hatches, then turn on the bilge blower. Be sure to ventilate the boat for a minimum of four minutes.

PRE-DEPARTURE FLOAT PLAN

1 NAME AND PHONE NUMBER OF PERSON REPORTING

2 DESCRIPTION OF BOAT
Type of boat; color of hull, deck and cabin; trim; registration number; length; name of boat; make; any other distinguishing features.

3 PERSONS ABOARD
Name, age, address, telephone number of skipper and each crew member.

4 MEDICAL PROBLEMS OF ANY PERSON ABOARD

5 ENGINE TYPE
Horsepower, number of engines, fuel capacity.

6 SAFETY AND SURVIVAL EQUIPMENT
Personal flotation devices, flares, mirror, visual distress signals, flashlight, food, paddles, water supply, anchor, life raft, dinghy and EPIRB *(Chapter 24)*, any other safety or emergency equipment.

7 MARINE RADIO
Type, frequencies.

8 TRIP EXPECTATIONS
Departure points, route, destination, expected date and time of arrival. Expected date of return.

9 ANY OTHER PERTINENT INFORMATION

10 VEHICLE LICENSES
Color, make and license number of automobile and trailer (if applicable), and where they are parked.

11 SUGGESTED DATE AND TIME TO CALL COAST GUARD OR LOCAL AUTHORITY FOR SEARCH

12 TELEPHONE NUMBERS TO CALL FOR FURTHER INFORMATION OR IN CASE OF EMERGENCY

13 COMPETENCY OF PEOPLE ABOARD
Boating skills and emergency first-aid training.

Before departing on your trip, give a responsible relative or friend the information suggested in the float plan above. (Do not attempt to file your float plan with the Coast Guard, which does not have the staff to keep track of boats.) You must notify the person holding the float plan of any changes in your plans—especially in the case of late arrival.

- Sniff low down in tank and engine compartments or, if you have a detector *(page 70)*, make sure it is working properly. If you detect any odor of gasoline, do not start the engine; continue ventilation actions until the odor can no longer be detected. Check for any drips and liquid fuel.
- Be prepared to cast off lines as soon as the engine starts; get clear of the pier quickly.

Loading and capacity for U.S. boats

Loading and capacity refer to the weight of people, fuel and gear that can be safely carried. A boat's safe load in terms of people depends on a number of characteristics, including hull volume and dimension, weight of the engine and, if an outboard, how it is mounted. A boat's number of seats is not an indication of the number of people it can safely carry.

The U.S. Coast Guard safety standard covering Display of Capacity Information applies to manufacturers of monohull boats less than 20 feet in length, except sailboats, canoes, kayaks and inflatables. The standard requires:

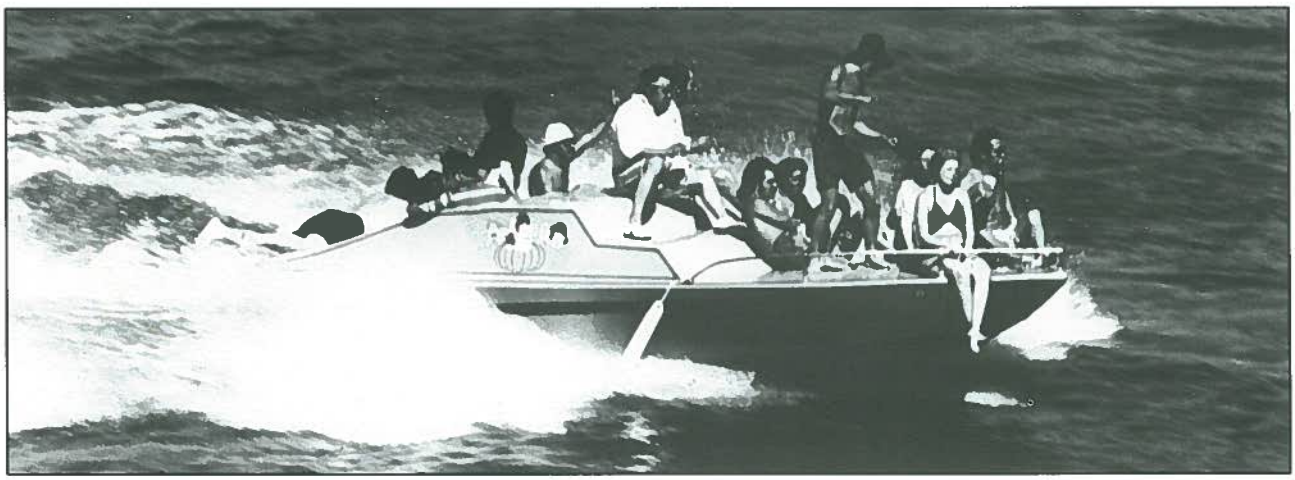
- Boats powered by outboards: the maximum persons capacity in pounds and number of persons, maximum weight capacity (persons, motor and gear) in pounds and maximum horsepower capacity.
- Boats powered by inboards and stern drives: the maximum persons capacity in pounds and number of persons, and maximum weight capacity (persons and gear).
- Manually propelled boats: the maximum persons capacity in pounds and maximum weight capacity (persons and gear).

There are also voluntary industry standards covering capacity labels for boats to which the Coast Guard regulations do not apply, e.g. some boats 20 feet or longer in length, pontoon boats, inflatables, etc. The labels are substantially the same; however, they cannot display the words "U.S. Coast Guard" because such displays would suggest compliance with the Coast Guard standard when, in fact, the standard does not apply to such boats.

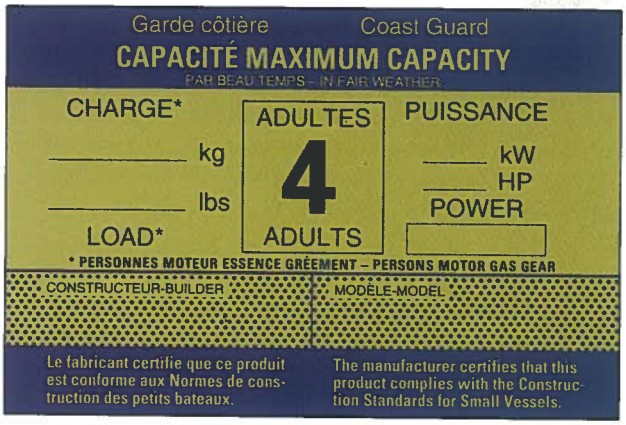
This is a capacity plate for an in-board or a stern-drive craft. Similar plates for boats with outboard motors would have additional details on the maximum horsepower that should be used.

Although it is not a violation of federal law for a boat operator to exceed the values displayed on the USCG Maximum Capacities label, there may be local consequences. Some states, for example, consider overloading or overpowering a boat beyond the values shown on the label a violation, and may cite an operator who exceeds posted limits. In addition, some insurance companies will not insure a boat that is powered with a motor larger than the maximum horsepower capacity shown on the label, and some boat manufacturers will void any applicable warranties for the same reason.

Also keep in mind that the limits defined on capacity plates apply in good to moderate weather conditions. In rough waters, keep the weight well below the limit. People represent a "live" load; moving about affects a boat quite differently than static loads like the engine or fuel tank. If your boat's capacity is fully used, or if the weather becomes rough, distribute the load evenly; keep the weight low, and avoid abrupt changes in distribution. Shift human or other weight only after stopping or slowing.



Overloading is a major cause of boating accidents and can worsen the outcome of any mishap while underway. Be sure to check the boat's capacity plate before loading.



A Canadian Capacity Plate is required for any vessel up to 6 meters (19.7 ft.) in length that is capable of being fitted with an engine.

Canadian compliance plates

In Canada, as of April 1, 1999, all new pleasure craft capable of being fitted with an engine are required to carry a compliance plate. Manufactured vessels up to 6 meters (19.7 ft.) in length are required to carry a Capacity Plate, which shows the recommended maximum load, number of people and engine power. Manufactured vessels over 6 meters (19.7 ft.) in length are required to carry a Conformity Plate, which states that the boat has been built in accordance with the Construction Standards for Small Vessels. Boats that are home-built or made by manufacturers which are no longer in business or unable to issue a plate are issued a Single Vessel Plate. Canadian plates issued before April 1, 1999 are still valid.

A Canadian compliance plate must be permanently attached in a prominent position and clearly visible.

If you are buying, building or importing a boat, you are responsible for ensuring that it has a Canadian Capacity, Conformity or Single Vessel Plate. For guidance and information, call the Office of Boating Safety's toll-free number: 1-800-267-6687.

Boarding a boat

Stepping on board a small boat, whether an outboard or dinghy, is an important basic boating skill. If you are boarding from a pier, step into the boat as close to the center as possible, keeping your body weight low. Keep lines tight or have someone steady the boat while you board. If boarding from a beach, come in over the bow.

Never jump into a small boat or step on the gunwale. If you must take a motor or other gear aboard, place it on the edge of the pier where you can easily reach it from the center of the boat. Better yet, after you have boarded the boat, have someone on the pier hand it to you.

If stepping into a light dinghy on a beach, remember that the unsupported parts of a boat out of the water are quite vulnerable. A rock could be driven through the hull by your weight all on one foot.

Using a pre-departure checklist

Another measure of good seamanship is the procedure you follow before actual departure. Whether you are in home waters or far away, make a final weather check *(Chapter 14)* close to departure time each day. Prepare your own pre-departure checklist for use each time you depart, and revise it as your boating experience grows and your activities change. Use the following guidelines to help you design a checklist suited to your specific needs. Before you depart, ensure the following:

- All safety equipment is aboard, accessible and in good working condition.
- The bilge has no fuel fumes and little or no water. (On a gasoline-powered inboard-engine boat, "sniff" the bilges for fumes and operate the blower for at least four minutes.)
- All loose gear is stowed securely. Dock lines and fenders should be stowed immediately after getting underway.
- All guests have been properly instructed in the dos and don'ts of safety and operational matters aboard.
- Engine oil levels are adequate; water level is sufficient in closed cooling systems. After starting engines, check overboard flow of cooling water.
- Fuel tanks are as full as you need. There is enough fuel aboard for your anticipated cruising, plus an adequate reserve if you must change your plans.
- A second person on board is capable of operating the boat, including the radio, in case you become disabled.

Hand gear to a person seated in a small boat; do not attempt to step aboard carrying heavy or bulky items.

INVENTORY OF COMMONLY USED SAFETY EQUIPMENT

In addition to common use on board boats, some of the safety equipment listed below (identified with an *) is also legally required by the USCG.

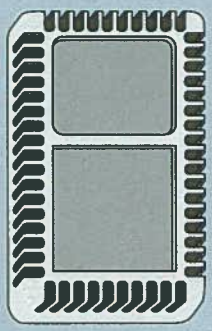
Bilge pump or bailer
Although federal regulations do not require dewatering devices—a bucket or other bailer on unpowered boats or electric bilge pumps on boats with engines—they are required by some state laws. Required or not, these items are recommended for safe boating. In Canada, even the smallest boat must have at least a bailer on hand.

Boathook
A hook on a pole is invaluable for fending off, placing lines over piles, picking up pennants of mooring buoys and recovering articles dropped over the side. When marked with rings at one-foot intervals—a mark in a different color or size should be added for the boat's draft—a boathook is useful for probing around a stranded boat in search of deeper water.

Charts and navigation publications
Essential for planning your course and navigating safely, charts and navigation publications, such as those covered in Chapter 18, should be up to date.

Compass
Desirable on almost any boat, for both emergency and regular use, a compass and plotting instruments *(Section 5)* are recommended for piloting purposes.

Detectors and alarms



A well-thought-out alarm system can alert you to a wide variety of dangers, from burglars on deck to explosive vapors trapped below.

A float switch mounted above the normal bilge-water level, for example, can signal flooding in the bilge. Other detectors indicate dangerous levels of gasoline, propane, hydrogen fumes or carbon monoxide, with sensors mounted in appropriate compartments below decks. Additional sensors can warn of low oil pressure, loss of engine coolant and fire.

For detecting burglars coming aboard, neither home nor automobile alarms are practical aboard an occupied boat; install only an alarm that is specifically designed for marine use.

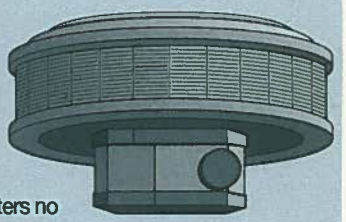
Electronic equipment
VHF radio is the basic piece of electronic safety equipment used in receiving weather reports and Coast Guard warnings, as well as in transmitting requests for assistance. Other operational safety items include electronic depth sounders, fuel vapor detectors and navigational equipment such as Loran, GPS and radar.

EPIRB (emergency position-indicating radio beacon)
This automatic radio transmitter, described in Chapter 24, should be carried on any boat operating offshore.

Fenders
Carried in appropriate sizes and numbers, fenders are useful for normal berthing, and when two boats must make fast to each other while underway or at anchor.

First-aid kit
An essential item of safety equipment, the kit *(Chapter 5)*, should be accompanied by a first-aid manual and supplemented by one or more first-aid courses.

Flame arrester*



With some minor and technical exceptions, every inboard gasoline engine must be equipped with an acceptable means of backfire flame control—or "flame arrester." Flame arresters no longer require Coast Guard approval; the USCG now accepts flame arresters complying with Underwriters Laboratories (UL) Standard 1111 or Society of Automotive Engineers (SAE) J1928. When in use flame arresters must be secured to the air intake of the carburetor with an airtight connection. Elements must be clean, and grids must be tight enough to prevent flames passing through.

Flashlight or searchlight
A searchlight—installed on larger craft, hand-held on smaller boats—serves both as a night piloting aid and as an emergency signaling device. A multicell flashlight or electric lantern can serve these functions, although sometimes less effectively.

Ground tackle
Ground tackle *(Chapter 12)* includes anchors, anchor rode (line or chain) and all the shackles and other gear used in anchoring. All ground tackle must be in good repair and operational condition and, after use, should be carefully re-stowed so that the main anchor is ready for use and auxiliary and storm anchors are readily accessible.

Lead line
A hand-held lead line is useful as a backup to the electronic depth sounder, and is particularly handy when necessary to

probe around a stranded boat in search of deeper water. A dollop of wax or hard grease is affixed to the bottom of the lead to obtain a sample of bottom consistency.

Life rafts

For everyone who cruises or fishes offshore, a rigid or inflatable life raft should be considered mandatory. Standards for life rafts—size, capacity ratings, seaworthiness, sturdiness—are set by Safety of Life at Sea (SOLAS) international conventions, and are adapted for the U.S. by the USCG. Life rafts are discussed in Chapter 4.

Lightning protection

Although lightning strikes very few North American boats per year, lightning protection aboard your boat *(Chapter 23)* could help avoid considerable damage to your boat and may save the lives of those aboard. Two types of lightning protection should be installed—one to guide the charge of a main strike safely down into the water, the other to protect electronic equipment from a damaging power surge.

Sails for heavy weather and sail rig modifications

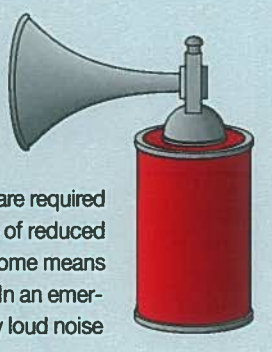
The average set of sails is designed for moderate wind and stress, and not for quick-action adjustment in heavy weather.

Jiffy (or slab) reefing uses a set of lines and blocks for quick and secure sail reduction; it is particularly useful for a single-handed sailor. A roller reefing system, often found, rotates the sail around an axis or pulls the sail down and around like an upside-down window shade. Although reefing by either of these methods is a compromise—convenience weighed against efficient sail shape—the loss of sailing efficiency is made up by the gain in sailing safety.

Storm sails, made of heavier cloth and strongly reinforced at stress points with extra-sturdy edge bindings, are designed especially to handle the extra pressure of high winds. Chapter 10 offers a detailed description of sails.

Sound signaling devices*

The *Navigation Rules (Chapter 7)* require sound signals to be made under certain circumstances, including the meeting, crossing and overtaking situations that are described in the *Rules*. All vessels, including recreational vessels, are required to sound fog signals during periods of reduced visibility; therefore, you must have some means of making an efficient sound signal. In an emergency, for example, you can use any loud noise to attract attention: If you have a loud hailer, use it, or make a megaphone from a rolled up chart, or bang on a metal pot. Vessels 12 meters (39.4 ft.) or more in length are required to carry on board a whistle (horn) for marine use and a bell.



In Canada, vessels less than 12 meters (39.4 ft.) must have aboard a means of making an efficient sound signal; longer vessels require a whistle for marine use and a bell.

Spare parts and tools

The list of tools and spare parts to be carried aboard is best developed by skippers for their own boats. Depending on the type of boat, how it is normally used, and the capabilities of the crew, the list may include items such as simple tools, plugs, cloth, screws, nails, wire, tape and other objects for making emergency repairs at sea; spare bulbs for the navigation lights and various mechanical and electrical spare parts.

Visual distress signals*

Most boats—and all boats operating in open waters (offshore and the Great Lakes)—must be equipped with visual distress signals, classified by the USCG for day use only (D), night use only (N) or combined day-and-night use (D/N). If pyrotechnic signals are used, the minimum quantity is three D and three N signals, or three D/N signals. Each device must be in serviceable condition, readily accessible and certified by the manufacturer as complying with USCG requirements. Distress flares, smoke flares and meteor rockets have expiration dates—42 months after the date of manufacture.

Remember that USCG regulations prohibit any display of visual distress signals on the water, except when assistance is required. Use emergency signals only when in distress *(Chapter 4)*, and only when help is close enough to see the signal.

In Canada, vessels over 6 meters (19.7 ft.) must carry CCG-approved flares according to the length of the vessel. USCG flares are not acceptable. CCG-approved flares show the date of manufacture rather than expiry. Flares are considered effective for 48 months from the date of manufacture.

Windshield wipers

Although windshield wipers may seem like minor equipment, they are invaluable in rainy or misty conditions. Wipers may be operated by hand or electric motor. The best choice of wiper is a sturdy commercial version used by commercial fishermen and tugboats. A "clear view" screen is an effective, but somewhat expensive, solution consisting of a circular piece of glass, motor-driven at high speed to spin the water away by centrifugal force. Some boaters use a product designed for racing-car drivers; this substance coats the windshield, forcing water and salt to bead and quickly fall off the glass.

* Legally required by U.S. Coast Guard *(page 62)*

FIREFIGHTING EQUIPMENT

USCG-approved fire extinguishers

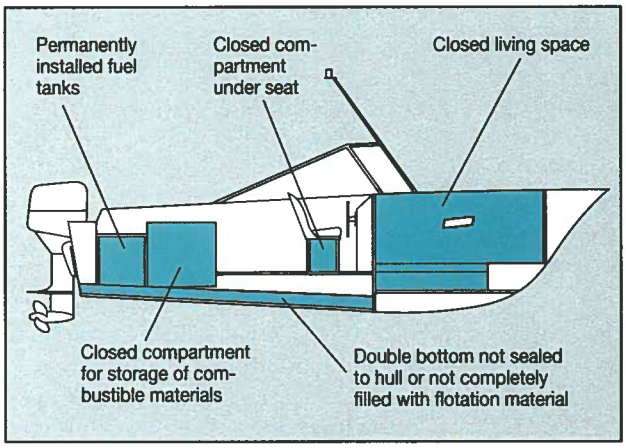
On board a boat, fire extinguishers are required if any one or more of the following conditions exist:

- Inboard engines.
- Closed compartments under thwarts and seats where portable fuel tanks may be stored.
- Double bottoms not sealed to the hull or which are not completely filled with flotation materials.
- Closed living spaces.
- Closed stowage compartments in which combustible or flammable materials are stored.
- Permanently installed fuel tanks. A portable tank can be removed from the boat for refilling without the use of tools.

Approved extinguishers are classified by a letter and number symbol. The letter indicates the type fire the unit is designed to extinguish. (Type B, commonly used on boats, is designed to extinguish fires involving flammable liquids such as gasoline, oil and grease.) The number indicates the relative size of the extinguisher (minimum extinguishing agent weight). U.S. Coast Guard-approved hand-portable and semiportable fire extinguishers bear a metal nameplate that provides the manufacturer's name and the unit's type, capacity and operating instructions.

For marine use, all required hand-portable fire extinguishers and semiportable and fixed fire extinguishing systems must be approved by the USCG or, in Canada, one of four organizations: Board of Steamship Inspection (Transport Canada), Underwriters Laboratories of Canada, British Board of Trade for marine use, or the USCG. Check each unit regularly to ensure that gauges, if any, are free and nozzles are clear. Extinguishers may contain any of the following extinguishing agents listed below. (See Chapter 4 for information on use of extinguishers.)

- Dry chemical is an agent widely used because of its convenience and relative low cost. The cylinder contains a dry chemical in powdered form, along with a propellant gas under pressure. These extinguishers tend to "pack" or "cake"; shake them periodically, and store where there is least engine vibration. Dry chemical extinguishers without gauges or indicating devices are not approved.
- Foam is a combination of water and a chemical foaming agent, and is most effective for fires involving flammable liquids—gasoline, solvents, grease, oil and some paints. Although foam will work on fires involving wood, cloth, paper, rubber and many plastics, it leaves a messy residue. It should not be used for electrical fires.
- Carbon dioxide units consist of a cylinder containing CO_2 under high pressure, a valve and a discharge nozzle at the end of a short hose or pipe on a swivel connection. This type of extinguisher is advantageous because it leaves no messy residue to clean up after use and causes no harm to the interior of engines as some other types may do. A disadvantage,

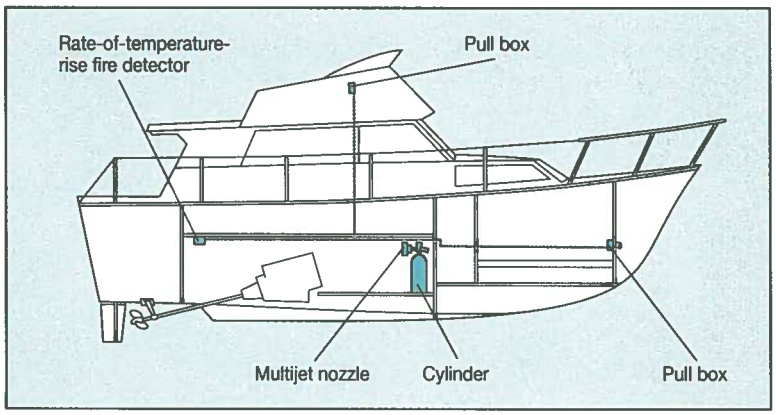


Any one or more of the enclosed spaces identified above makes carrying a fire extinguisher a legal requirement.

FIRE EXTINGUISHER CONTENTS

Class	*Foam in gals.*	*CO_2 in lbs.*	*Dry chemical in lbs.*	*Halon in lbs.*
B-I	1.25	4	2	2.5
B-II	2.5	15	10	10

Units approved for use on boats are hand-portable, B-I or B-II classification, and have the characteristics shown above.



Boats powered by inboard engines, particularly those fueled by gasoline such as the one shown at left, often are fitted with a built-in CO_2- or Halon-type fire extinguishing system. It may be activated manually, or automatically by temperature-rise sensors. A discharge indicator must be mounted at the helm station.

however, is that the state of charge can be checked only by removing and weighing the cylinder and comparing this figure with a stamped figure on or near the valve. Weigh a CO_2 unit annually; if the gross weight is reduced by more than 10 percent of the net weight, the unit is not acceptable and must be recharged. CO_2 units may be used where a fixed system installed in an engine compartment is operated either manually or automatically by heat-sensitive detectors.

■ Other liquefied gas systems include Halon 1301, a colorless and odorless gas that stops fire instantly. It is heavier than air and sinks to lower parts of the bilge. Humans can tolerate a 7 percent concentration, which is more than enough to fight fire for several minutes. Although effective, Halon is currently being phased out for environmental reasons. According to a 1987 international treaty to eliminate ozone-destroying chemicals, the use of Halon will be banned in developed countries by the year 2000. Several replacement chemicals are now available.

Until the year 2000, Halon 1301 may still be used in built-in systems activated manually or automatically; for restoring protection after use, additional tanks can be carried. Halon 1211, a closely related chemical, is used in hand-portable extinguishers. Manufacturers recommend that Halon extinguishers be weighed at least once a year.

SAFETY ASPECTS OF APPLIANCES

Several items generally found on boats are not safety equipment per se, but have definite aspects of safety about their design, installation or operation that must be considered.

Galley stoves

Stoves should be designed, manufactured and approved for marine use, and most commonly use alcohol, kerosene, electricity, liquefied petroleum gas (LPG) or compressed natural gas (CNG) fuel. Electricity is probably the safest source of heat for cooking aboard a boat, but shore power or an auxiliary generating plant is required to produce the large amounts of AC power required. Because of their inexpensive and simple nature, alcohol stoves are widely used on boats; with precautions, such installations can be quite safe. Although plain water will extinguish small alcohol fires, be aware that the fire could be spread by water.

LPG, or "propane," stoves are excellent for cooking, but can present a serious safety hazard unless installed and operated in accordance with strict rules (American Boat and Yacht Council Standard A-22 and National Fire Protection Association Standard 302). Pressure kerosene provides a high temperature source of heat, but is sometimes difficult to control. Gasoline is unsafe as stove fuel, and should never be used for cooking on a boat. The use or storage of portable stoves with attached LPG or CNG bottles is prohibited inside a boat with accommodation areas.

Fuel for alcohol and kerosene stoves may be supplied to the burners either by a gravity or a pressure system—provided fuel tanks cannot be filled while the burners are in operation, except where the supply tank is remote from burners and the filling operation will not introduce a fire hazard. A removable or accessible liquid-tight metal drop pan at least ¾ inch (1.9 cm) deep should be provided under all burners. Pressure tanks should have suitable gauges and/or relief valves.

Stoves should be permanently and securely fastened in place and adequately ventilated when in operation. All woodwork or other combustible material around a stove, including smoke stacks, must be effectively protected with non-combustible sheathing. Portable stoves must be secured while in use.

Refrigeration

On some boats, refrigeration is simply a matter of ice to keep food fresh and to cool beverages. Although this method of refrigeration offers no safety hazards, freshwater drip tends to promote dry rot and/or odor. Water from melting ice should be piped overboard—not into the bilge. A collection sump, with pump, helps make the task easier.

Many boat owners, however, opt for the convenience of mechanical refrigeration—usually an electric-motor-driven compressor. These marine units use a non-toxic and non-flammable refrigerant, non-sparking motors, safety valves on high-pressure portions of the system and construction designed to survive the rigors of marine service.

Heaters

Cabin heaters include reverse-cycle air conditioners and built-in electrical heaters, which are safe. Portable electrical heaters should be used only if secured in place while in operation. Gasoline is unsafe for fueling a boat's heaters. Likewise, portable kerosene or alcohol heaters are not recommended for two reasons: they produce carbon monoxide, and they have the fire potential of spilled fuel. Heaters using diesel fuel are acceptable, but rare. Any heater that consumes oxygen from the cabin presents a danger of asphyxiation.

Any heater discharging combustion products must be vented through a stovepipe and a Charlie Noble, a stovepipe fitting in a cabin top or deck. Many sailors favor coal-, charcoal- or wood-burning heaters for the even, dry heat they deliver, despite the mess they create and the problems of storing fuel. LPG heaters should have an automatic device to shut off fuel supply if the flame is extinguished; pilot lights should not be used.

Every heater aboard a boat must be designed specifically for marine use, and must be securely fastened whether in use or in storage. The area in which it is installed must comply with ventilation requirements. Finally, take note that any burner system that may adversely affect safety in reaction to the normal motion of the boat is not an acceptable appliance.

BOATING SAFETY CHECKLIST

Is your boat as safe as it can possibly be? If you can answer "Yes" to the following questions, chances are that the vessel is safely equipped and that you operate it safely.

✓ Do you carry legally required and other safety equipment aboard—and do you know how to use it?

✓ Before getting underway, do you review, with everyone aboard, emergency procedures and identify all safety equipment and exits (where appropriate)?

✓ If you carry a life raft aboard your boat, have you included its proper deployment as part of your routine safety training? At least one other crew member should know, for example, where the raft is located, how to inflate it quickly and to inflate it on deck rather than belowdecks or in the cockpit.

✓ Are you aware that it is illegal to operate a vessel while intoxicated? When alcohol or drugs are mixed with boating, the results can be fatal. (At least 50 percent of all boating accidents are alcohol-related.)

✓ Do you check local weather reports before departure, and keep a weather eye open during your voyage *(Chapter 14)*?

✓ Are your lifesaving equipment and fire extinguishers readily accessible at all times?

✓ Do you avoid overloading your boat with people or gear?

✓ Do you make sure you have good non-skid surfaces on deck and on the soles of shoes of everyone on board?

✓ Do you keep bilges clean and electrical contacts tight?

✓ Do you guard rigidly against any fuel system leakage?

✓ Have you requested a Coast Guard Auxiliary Courtesy Marine Examination *(page 75)* for the current year?

✓ Have you taken any safe boating courses *(Chapter 27)* or first-aid courses *(Chapter 5)*?

✓ Before departing, do you leave a Float Plan *(page 67)* so someone knows where you are boating and when you are expected to return? Do you notify the holder if plans change?

✓ Are you familiar with the waters that you will be using: tides, currents, sand bars and any other hazards you may encounter *(Sections 4 and 5)*?

✓ Do you know your personal limitations and responsibilities? Remember that exposure to sun, wind and cold water affect your ability to react.

✓ Are you aware that a sailboat mast touching a power line could electrocute you? Check your clearances while underway.

✓ If you are a non-swimmer, are you planning to learn to swim? It could save your life, or someone else's.

✓ Are you and your crew prepared for any emergencies that could occur *(Chapter 4)*?

✓ Do you know and obey the Rules of the Road *(Chapter 7)*?

✓ Do you watch, and heed, posted speeds; do you slow down in anchorages?

✓ When towing a water-skier, do you remember that two people are required in the boat: one to operate the boat and one to watch the skier?

✓ Do you know your fuel tank capacity and fuel consumption at various RPMs, and the cruising range this gives?

✓ Do you take maximum precautions when taking on fuel *(page 67)*? Do you practice the "one-third rule" by using one-third of the fuel going out and one-third to get back, keeping one-third in reserve?

✓ When anchoring, do you allow adequate scope *(Chapter 12)*? Are you far enough away from neighboring boats?

✓ If someone falls into the water, do you know what to do? Avoid jumping in; use a reaching, throwing or floating assist such as a paddle, a cushion, a Type IV PFD life ring or a rescue line with a float attached.

✓ Do you avoid relieving yourself over the side of the boat in a standing position? This is a common cause of accidents resulting in drowning.

✓ Whenever possible, do you, and those aboard your boat, remain seated while underway?

✓ Do you know that standing in a small boat raises the center of gravity, often to the point of capsizing? Standing for any reason or even changing position in a small boat can be dangerous, as is sitting on the gunwales or seat backs or in a pedestal seat while underway.

USCG AUXILIARY SAFETY REQUIREMENTS

Federal and state requirements provide for the bare necessities of boating safety equipment, and should be considered only the beginning of equipping a boat for safety. Expanding the boater's safety checklist is one important role of the U.S. Coast Guard Auxiliary, which, in most areas, offers a Courtesy Marine Examination (CME) for boats. The examination is free of charge, and a sticker is awarded to each boat that meets federal safety requirements and additional safety items established by the Auxiliary. These requirements, listed below, are in addition to, and generally more demanding than, legal requirements; they serve as an excellent safety guide for all boat owners.

Requirements for USCG Auxiliary decal

■ **Personal flotation devices** *(pages 63-66)*. Boats 16 feet or longer must have at least two wearable and one throwable personal flotation device; boats less than 16 feet in length, a minimum of two PFDs.

■ **Fire extinguishers** *(pages 72-73)*. Boats under 26 feet long, of open construction or which have a built-in fire extinguisher system, must carry an additional hand-portable extinguisher. All hand-held fire extinguishers must be mounted in a readily accessible location.

Sailboats 16 feet or more in length, even without any auxiliary power source or fuel tanks, must have at least one B-I type extinguisher.

■ **Navigation lights** *(Chapter 6)* must be fitted and in good working order. A sailboat with an auxiliary engine must be capable of separately showing the lights of either a sailboat or a powerboat; the lights must be wired so that the display can be changed from one to the other.

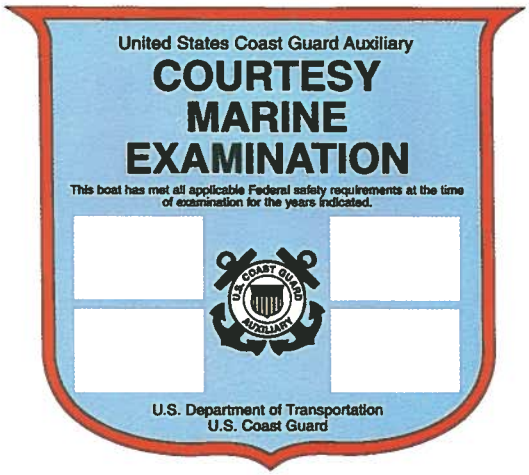
■ **Visual distress signals** *(page 71)*. Every boat must have acceptable visual distress signals even if not legally required by the USCG. On inland rivers and lakes, any device suitable for attracting attention and getting assistance may be carried to serve the purpose.

■ **Ground tackle** *(Chapter 12)*. An anchor of suitable type and weight for the particular boat, along with line of appropriate size and length, is a valuable safety item should the engine fail and the boat be in danger of drifting or being blown into hazardous waters.

■ **Bilge pump and bailer.** All boats must have a bilge pump or bailer of a suitable size, and in proper operating condition. Most common are an installed electrical pump for boats longer than about 18 feet, and a hand scoop-type bailer on smaller craft. A manual bailer is required for the Courtesy Marine Examination in addition to mechanical pumps, in case the power fails.

■ **Propulsion.** All Class A boats must carry a second means of propulsion, for example a paddle, oars or an alternative mechanical means that may require a separate battery and fuel source.

■ **Fuel systems.** Because, according to Courtesy Marine Examination requirements, there is no such thing as a portable fuel tank larger than 7 gallons, any fuel tank larger than 7 gallons must meet all requirements for permanent tanks. Portable fuel tanks (7 gallon capacity or less) must be constructed of sturdy, non-breakable material in safe condition. Tanks must be free of excessive corrosion and must not leak. Any vents must be capable of being closed; the tank must have a vapor-tight, leak-proof cap.



In most boating areas, skippers can obtain a USCG Auxiliary Courtesy Marine Examination of their boats. A boat that meets the requirements receives a basic four-year sticker with a tab for the current year; additional tabs will be added for later years. Failure to pass the CME is not reported to any authorities, nor does it carry any penalty to the owner.

All tanks must be properly secured in the boat to prevent excessive movement. Permanent fuel tanks (over 7 gallons capacity) and fuel lines must be free of excessive corrosion and must not leak. Permanent fuel tanks must be grounded. The fuel fill pipe must be securely fitted to the fuel fill plate and located outside of a closed compartment where any spilled fuel will be directed overboard. A vent terminating outboard of the hull and compartments must lead to each permanent fuel tank.

■ **Seaworthiness.** The boat must be free from fire hazards, in good overall condition, with the bilges reasonably clean and the visible hull and structures generally sound. The maximum persons capacity and maximum horsepower capacity must not be exceeded.

■ **Appliances**—galley stoves or heaters, for example—and their fuel tanks must be of a marine type, and installation must present no hazard to the craft and its occupants. Appliances must be properly secured and the system must not leak. (No odor of fuel must be detected when the system is turned on.) There must be no flammable material in the vicinity of stoves or heaters.

Adequate ventilation must be provided for appliances as well as their fuel supplies. Appliance shut-off valves must be readily accessible. Only common appliance fuels must be used. Due to their volatile nature, gasoline, naphtha and ben-

zene are prohibited for use as appliance fuels if a boat is to pass a Courtesy Marine Examination.

■ **Electrical wiring** must be in good condition and properly installed. No exposed areas or deteriorated insulation is permitted. The electrical system must be protected by fuses or manually reset circuit breakers. Switches and fuse panels must be protected from rain or spray. Batteries must be secured to prevent movement, and the terminals covered to prevent accidental arcing.

■ **Registration/documentation papers.** CME requirements are the same as the federal requirements: The owner/operator of a vessel must carry a valid Certificate of Number *(Chapter 2)* whenever the vessel is in use. The person in command of a documented vessel must have the Certificate of Documentation *(Chapter 2)* issued to that vessel on board the boat unless the Certificate is being submitted to a documentation officer.

■ **State requirements.** The owner/operator may be required to comply with additional regulations specific to the state in which the vessel is registered or operated. Therefore, the boat will be checked against the requirements of the state in which the CME is conducted.

■ **Inflatable boats.** A Courtesy Marine Examination decal is awarded to an inflatable boat that meets all requirements for a craft of its size plus some additional specifications. For example, the boat must have a minimum of three separate non-interconnected air chambers and an installed rigid transom; a strap-on outboard motor mount is not acceptable.

CME requirements for sailboats

Sailboats without mechanical power, either installed or detachable, are required to have personal flotation devices for each person on board the boat; the type of PFD varies with the size of the boat. Sailboats longer than 16 feet are eligible to become Coast Guard Auxiliary Facilities if they meet certain prescribed standards. These requirements can serve as a general guide to all owners of sailing craft as to desirable safety equipment.

Sailing craft under 26 feet in length are required to carry one B-I hand fire extinguisher, and larger boats must have on board two such units. These sailboats must meet the Courtesy Marine Examination standard of one approved lifesaving device on board for each berth, with a minimum of two such devices. In addition, such craft must meet all standards for motorboats other than those relating to propulsion machinery, fuel systems and ventilation of related compartments. This leaves in the requirements such items as an anchor with line, distress flares, and standards for galley stove installation and general electrical wiring—all matters that affect safe operation of the boat.

THE CANADIAN COAST GUARD AUXILIARY EXAMINATION

Canada has a similar Coast Guard Auxiliary examination program, administered by the Canadian Coast Guard and the Canadian Coast Guard Auxiliary. Requirements are similar to those in the U.S., although the vessel must meet CCG standards regarding the boat's mandatory safety equipment.

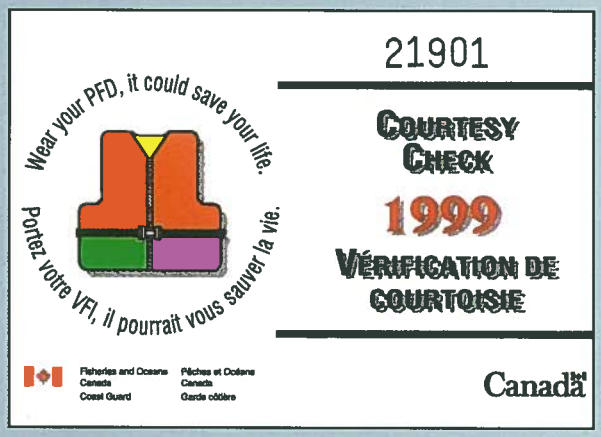
Of particular note are some of the ways in which the Canadian examination differs from its U.S. counterpart.

■ For vessels in Canada to complete the Courtesy Check (CC) inspection, the owner must have on board the vessel's license or registration papers.

■ If the boat is equipped with a radio, a radio station license is required, and the operator must have a "Restricted Radio Operator's Certificate."

■ In Canada most small vessels are "licensed" and issued a number *(Chapter 2)*. A vessel referred to as "documented" in the U.S. is referred to in Canada as a "registered" vessel. No external number appears on a registered Canadian vessel—only the name of the vessel and the port where it is registered.

According to regulations, the Courtesy Check decal "shall be issued only if the vessel and its equipment completely comply with all applicable regulations. The boater/fisherman must repair or rectify minor faults or deficiencies 'on the spot,' before the decal may be issued." The decal attests simply that, at the time of examination, the required equipment was on board and appeared to be in good working order.



In Canada, the Courtesy Check (CC) is conducted by both the CCG and its Auxiliary organization. The decal awarded to boats passing inspection is a different color each year, and should be affixed to the boat's starboard side window or housing.

BOAT AND EQUIPMENT SAFETY ORGANIZATIONS

There are many public and private organizations devoted to the promotion of boating safety. Those that are perhaps best known by boaters as sources of boating safety courses and information include the U.S. Power Squadrons, Canadian Power and Sail Squadrons, U.S. Coast Guard Auxiliary and Canadian Coast Guard Auxiliary—described in detail in Chapter 27—and the American National Red Cross, described in Chapter 5. Others, including those listed below, promote safety by establishing standards for boats and equipment, for their installation and use.

The American Boat & Yacht Council, Inc.
The ABYC is a non-profit public-service organization founded to "improve and promote the design, construction, equipage, and maintenance of small craft with reference to safety." Membership is open to both companies and individuals. The ABYC develops and publishes "Safety Standards"—recommended specifications and practices for making small boats as free from dangerous defects or deficiencies as possible. Standards are stated in terms of desired performance. They are prepared by Project Technical Committees formed as broadly based groups of recognized authorities. All technical reports and safety standards are advisory; the Council has no powers of enforcement.

The ABYC does not "approve" boats, equipment, materials or services. Some standards refer to other standards or to testing laboratories. Standards are reviewed and revised periodically, then published as supplements to the complete loose-leaf format *Standards and Recommended Practices for Small Craft*. This publication is available from the ABYC at 3069 Solomon's Island Road, Edgewater, MD 21037-1416.

The Marine Department of Underwriters Laboratories, Inc.
A not-for-profit corporation in existence since 1894, this organization has testing facilities in North Carolina. Commonly called UL, it serves industry and the boating public by conducting safety investigations and tests of marine products, by developing Marine Safety Standards and by preparing special Marine Supplements to UL Electrical Safety Standards.

The principal activity of the Marine Department is testing boating equipment for safety, a process that begins with manufacturers voluntarily submitting product samples. These are then tested for compliance with appropriate safety requirements, and evaluated for overall design and construction in relation to their use. After a product has successfully completed the evaluation and complied with all of the UL requirements, the Marine Department conducts a follow-up investigation at the factory to confirm that the manufacturer's production controls comply with UL requirements.

A device that passes all its tests is "listed" by UL and may carry both on the product and in its advertising the UL "listing mark," consisting of the Laboratories' name or symbol, as shown above, the product name, a control number and the word "Listed." The name of the device is included, with the name of the manufacturer, in the annual UL Marine Product Directory. Listing is an expression of UL's good-faith opinion that the item meets minimum applicable safety standards; listed products are re-tested periodically to ensure that they continue to meet the UL safety requirements. Keep in mind that, while UL listing is desirable in a product, it is not a guarantee of quality or performance, nor are all listed products of the same class necessarily equivalent in quality, performance or merit.

Only products commercially available are eligible for UL listing. The presence of a UL or UL-Marine label on any device means simply that a production sample has been successfully evaluated relative to safety requirements.

The label may, however, be the basis on which "authorities having jurisdiction" grant approval for use. Such authorities include individuals making judgments for their own purposes, industry people making judgments for components of original equipment installations, marine surveyors for insurance purposes and administrators of regulations making judgments required by law.

The National Fire Protection Association
Called the NFPA, the organization issues codes, standards and recommended practices for minimizing losses of life and property by fire. Activities include all aspects of the science and methods of fire protection. NFPA does not approve, inspect or certify any installations, procedures, equipment or materials, nor does it approve or evaluate testing laboratories. It does prepare, by coordinated action of committees of experts, codes and standards for the guidance of all persons in the matter of fire protection. Frequently, NFPA codes and standards are written into law or regulations by various governmental units. A good reference for boaters, the NFPA's booklet *Fire Protection Standard No. 302 for Motor Craft (Pleasure and Commercial)* is available from the NFPA, 470 Atlantic Ave., Boston, MA 02110.

Miscellaneous organizations
Other organizations that prepare design, safety and construction standards for boats and motors include the National Marine Manufacturers Association (NMMA); the American Bureau of Shipping (ABS); Society of Automotive Engineers (SAE); Lloyds of London; North German Lloyds and Veritas. Boats manufactured in any country may be built to conform to standards of any of these organizations.

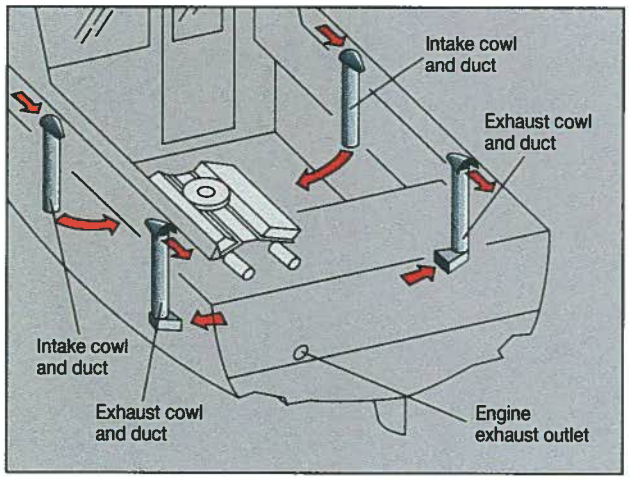
SAFE VENTILATION

Good ventilation serves several important purposes aboard a boat. Proper ventilation is required by United States Coast Guard regulations because it is essential for removing explosive vapors prior to starting a vessel's engine, particularly after fueling. Ventilation of enclosed passenger-carrying areas such as the wheelhouse or accommodation spaces is also important in preventing the accumulation of carbon monoxide—one potential cause of boating fatalities. (Regardless of whether your craft is a sailboat or powerboat, if it is equipped with a permanently installed gasoline engine, refer to the box on page 79 for specific safety information on the prevention of carbon monoxide poisoning.) Finally, from a comfort point of view, good ventilation keeps fresh air flowing through a boat's living spaces and helps control mildew in items such as bedding and upholstery.

The United States Coast Guard ventilation regulations apply to all gasoline-powered boats, including most outboards. Vessels for hire that carry more than six passengers are subject to special regulations (consult a U.S. Coast Guard Marine Safety Office for specific details). Since diesel fuel does not conform to the Coast Guard definition of "volatile" fuel, legal requirements for "natural" or "powered" ventilation systems do not apply. Bear in mind, however, that although diesel fuel does not explode, it does burn; a broken fuel line can result in a fire.

The U.S. Coast Guard regulations described below apply to gasoline-powered boats. The particular regulations which apply to a vessel depend upon the date of manufacture of the vessel. Historically, the regulations concerning ventilation began as an operator requirement. Like the early regulations which required all operators of boats to carry life preservers, operators of most gasoline-powered motorboats (with the exception of open boats) constructed after April 25, 1940, were required to equip every engine and fuel tank compartment with a natural ventilation system. Boat builders and operators could supplement the ventilation system of a vessel by installing a bilge blower; however, a bilge blower is part of a powered ventilation system. Powered ventilation was not required by regulation until 1980 when it then became part of the Coast Guard safety standard applicable to the boat builder. An "open boat" was one which met each of the following conditions:

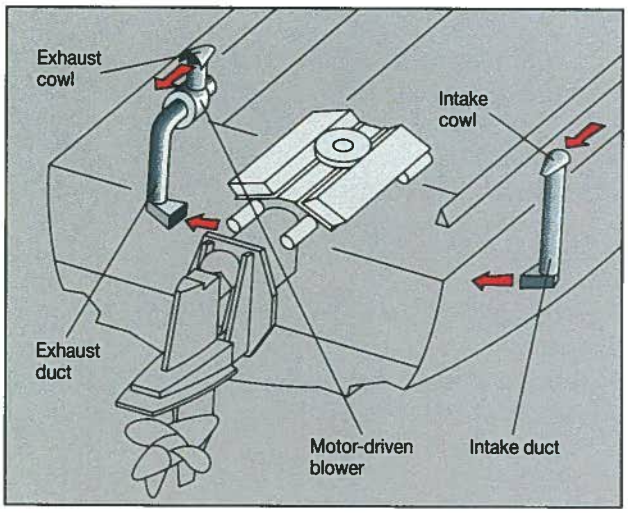
- The engine and fuel tank compartments shall have as a minimum 15 square inches of open area that is directly exposed to the atmosphere for each cubic foot of net compartment volume.
- There must be no long or narrow unventilated spaces that are accessible from such compartments in which a flame front could propagate.
- Long, narrow compartments (such as side panels), if joining engine or fuel compartments and not serving as ducts thereto, shall have at least 15 square inches of open area per cubic foot provided by frequent openings along the full length of the compartment formed.



A natural ventilation system is an arrangement of supply openings or ducts from the atmosphere (located on the exterior surface of the boat) or from a ventilated compartment or from a compartment that is open to the atmosphere.

In 1979, the United States Coast Guard revised the ventilation regulations by requiring "powered" ventilation systems on gasoline powered inboard and inboard/outdrive boats. The change was intended to lessen the possibility of fire and explosions, which were the primary cause of property damage and the second most common cause of personal injury from boating accidents.

A natural ventilation system is effective only when a boat is moving fast enough to force air through the ventilation ducts, or when the wind is at sufficient velocity and direction to blow through the ducts. It had become obvious that there was a definite need for some type of forced ventilation on boats to remove explosive and flammable gases before



A powered ventilation system consists of one or more exhaust blowers. Each intake duct for an exhaust blower must be in the lower one-third of the compartment and above the normal accumulation of bilge water.

SAFEGUARDING AGAINST CARBON MONOXIDE

Although most recreational boaters are conscious of the potential dangers on the water, the risk of carbon monoxide poisoning is one threat that is often forgotten. It is important to know the facts about this invisible killer, and to take the necessary steps to ensure safety on board.

Carbon monoxide (CO) gas is clear and odorless, and may be present even when exhaust smoke is not. Its initial toxic symptoms are deceptively similar to those of seasickness: headaches, dizziness and lack of coordination, as well as other symptoms—such as drowsiness. Moreover, the individual who experiences symptoms of carbon monoxide poisoning tends to lose any healthy fear that danger is imminent.

When carbon monoxide is inhaled, CO molecules attach to red blood cells—like oxygen molecules do in a person who is breathing clean air. The result is a lack of oxygen for the tissues with subsequent death of the tissue and, if prolonged, death of the individual.

Boaters whose craft are equipped with a permanently installed gasoline engine, gasoline powered generator, stoves, heaters or charcoal grills should be alert to the dangers of CO poisoning. They should ensure sufficient ventilation, be aware of the situations when danger is heightened, and inspect their exhaust systems frequently.

Cabin cruisers are particularly susceptible to problems involving carbon monoxide poisoning. The best way to prevent CO from migrating into passenger areas and accommodation spaces is to provide alternate sources of air. For example, leave a port in the windshield open and open a deck hatch. If you can feel a flow of air coming aft through the cabin and cockpit areas, you can reduce the chances that carbon monoxide will be pulled forward and into the boat due to backdrafting.

Backdrafting is caused by air movement over or around a boat, creating a low pressure area at the stern that can increase CO levels on the vessel. Dangerous concentrations of CO can also accumulate when a boat's engine or generator is operated while the boat is moored in a confined area such as a boathouse, next to a seawall or alongside other boats. Be aware of the effect that your vessel's exhaust may have on other vessels; likewise be aware that another vessel's equipment may affect the CO levels on your boat.

The way to prevent CO problems due to leaks from exhaust systems is with regular inspections and maintenance. Look and listen for leaks in the exhaust systems of generators and propulsion engines. Look for discoloration around joints in the system. Make sure all hose clamps in the exhaust system are secured properly. Double clamping rubber hose connections at each end will help prevent the exhaust hose from vibrating loose. Make sure engine room bulkheads are completely sealed against leaks into accommodation areas. All holes or gaps in the engine room bulkhead for plumbing, wiring and controls should be sealed.

Carbon monoxide gas detectors have reached the point that their installation should be considered by all safety-conscious recreational boaters.

In the event that a passenger or crew member displays symptoms of CO poisoning, immediately evacuate all accommodation spaces; give the affected person oxygen if it is available; contact medical help and, if the person is not breathing, perform cardiopulmonary resuscitation (CPR) *(Chapter 5)*.

the engine was started. In fact, boating accident statistics indicated that most fires and explosions occurred while the boat was "dead" in the water after fueling.

The existing regulations require both powered and natural ventilation systems to be employed in all compartments that have a permanently installed gasoline engine. Only natural ventilation systems are required for fuel tank compartments. Ventilation is not required for fuel tank compartments where the fuel tank vents to the outside of the vessel, since the accumulation of fuel vapors in the compartment is improbable. However, regulations require ignition protection of any electrical component in a compartment containing a fuel tank in order to limit the probability of an explosion in the event of gasoline leakage.

The USCG Ventilation Standard applies to manufacturers of all boats that have gasoline engines for electrical generation, mechanical power or propulsion. The standard applied to all boats built after July 31, 1980—except that manufacturers were given the option of electing to comply with the standard any time after July 31, 1978.

While the Ventilation Standard is a manufacturer requirement, operators are legally responsible for maintenance of their boats' natural and/or powered ventilation systems. This means boat owners must ensure that, when replacing any components in the ventilation system of a boat built after July 31, 1978, replaced components are similar to those that were originally installed by the boat manufacturer.

Ventilation system requirements

All vessels that were built after April 25, 1940, and that use gasoline for purposes of electrical generation, mechanical power or propulsion are required to be equipped with a ventilation system.

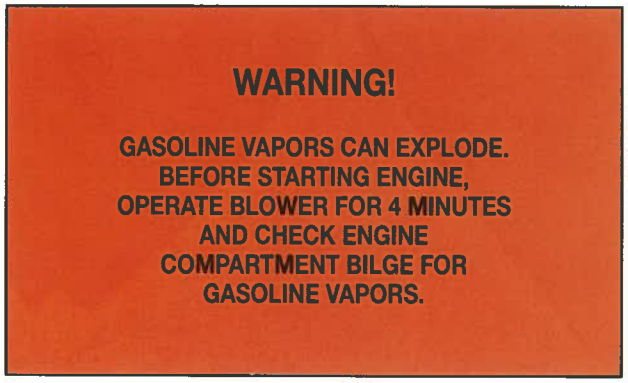
A natural ventilation system consists of at least two ventilator ducts, fitted with cowls or their equivalent:

- A minimum of one intake duct that is installed to extend from the open atmosphere to the lower portion of the bilge.
- A minimum of one exhaust duct installed so as to extend to a point at least midway to the bilge or at least below the level of the carburetor air intake.

A powered ventilation system consists of one or more exhaust blowers. Each intake duct for an exhaust blower should be in the lower one-third of the compartment and above the normal accumulation of bilge water.

Between April 25, 1940 and July 31, 1978, the regulations covering ventilation systems applied to the owner/operator. ■ **If your boat was built between April 25, 1940 and July 31, 1978,** a natural ventilation system is required for all engine and fuel tank compartments, and other spaces to which explosive or flammable gases and vapors from these compartments may flow, except compartments which are open to the atmosphere. There was no requirement for a powered ventilation system; however, some boats were equipped with a blower.

The United States Coast Guard Ventilation Standard, a manufacturer requirement, applies to all boats built on or after August 1, 1980. Some builders, however, began manufacturing boats in compliance with the Ventilation Standard as early as August 1978.



A warning label is required near each ignition switch on a boat in compliance with powered ventilation requirements in the USCG Ventilation Standard. Help prevent disaster by posting a warning label, such as the one shown here, in any unventilated space into which a crew member might attempt to put a gasoline or cleaning solvent container.

THIRTEEN STEPS TO SAFETY MAINTENANCE

Most marine safety equipment needs some sort of maintenance—ranging from regular, ongoing attention to periodic checks at weekly, monthly or annual intervals. Following the guidelines below, custom design a checklist for your particular boat, adding to it as you install or modify equipment. Make an entry in the boat's log of all inspections, tests and servicing of fire extinguishers. Not only will this record essential checks; it may prove valuable for insurance surveys or claims. Remember, just as important as periodic checks is follow-up repair. Never delay maintenance related to safety, and avoid operating a boat that has any safety defect.

1 Keep your bilge absolutely free of dirt and trash.
Check frequently and clean out as often as needed. Accumulations of dirt, sawdust, wood chips and trash in the bilge will soak up oil and fuel drippings. In addition to creating a fire hazard, this may also clog limber holes—drainage holes—and bilge pumps.

2 Inspect lifesaving equipment.
At the start and mid-point of each boating season, check the condition of lifesaving equipment; if you boat year-round, check quarterly *(pages 63-66)*. Replace below-par lifesaving devices immediately. Attempt repairs only where full effectiveness can be restored; if in doubt, ask for U.S. Coast Guard advice.

3 Check installed fire-extinguishing systems at the beginning and mid-point of each boating season, or as recommended by the manufacturer. Check portable extinguishers at least monthly.
Refer to pages 72-73 for details about maintenance.

4 Discharge a fire extinguisher periodically, even though it is not needed for fighting a fire.
In addition to good maintenance, this provides valuable practice. Discharge one of the portable units each year on a regular rotation basis—preferably in the form of a drill with all crew members participating. Away from the boat, put out an actual small fire in a metal pan or tub. When discharging a CO_2 extinguisher, always hold the nozzle by the plastic handle; never unscrew the hose from the cylinder to discharge it openly. Always discharge a dry-chemical extinguisher completely.

After an extinguisher has been removed for testing or practice discharge, have it serviced by a competent shop and reinstalled as soon as possible. Make sure that there are always enough extinguishers aboard to serve your boat's safety needs.

5 Check the engine and fuel system frequently for cleanliness and leaks. If you find any leaks, take immediate action.
Wipe up any oil or grease drippings and stop leaks as soon as possible. Do not use the boat, and—with all loads turned off so that no sparks will jump—disconnect the leads from the battery so the engine cannot be started.

6 Check the entire fuel system annually, inch by inch, including fuel lines in areas not normally visible.
When replacing fuel system components, use equivalent replacement parts—never automotive parts. If any joints or lengths of tubing or hose are worn or damaged, call a qualified mechanic without delay.

7 Maintain your boat's bilge ventilation system in top operating condition.

■ **If your boat was built on or after August 1, 1978**, it might have either (1) a natural ventilation system or (2) both a natural ventilation system and a powered ventilation system. If your boat bears a label containing the words, "This boat complies with U.S. Coast Guard safety standards," etc., you can assume that the design of your boat's ventilation system meets applicable regulations.

■ **Boats built after August 1, 1980**, which comply with the United States Coast Guard Ventilation Standard, display at each ignition switch a label which contains the information shown opposite.

Requirements for boat operators

All boat owners are responsible for keeping their boats' ventilation systems in good operating condition (regardless of the boat's date of manufacture). This means making sure that system openings are free of obstructions, that ducts are free from any blockage or damage and that all blowers are operating properly. In addition, any damaged or worn out components are replaced with equivalent equipment designed for marine use.

Elements of ventilation

Ducts, which are legally required and essential to the system, are designed for safety and long life. They should be made of non-ferrous, galvanized ferrous or of sturdy high-temperature-resistant materials. Ducts should be routed clear of, and protected from contact with, any hot engine surfaces.

Although not legally required in new boats, intake cowls normally face forward in an area of free airflow underway; exhaust cowls face aft creating a suction effect. Openings (or sets of openings) should be located with respect to each other—horizontally and vertically—in order to prevent the recirculation of fumes exhausted from a ventilated compartment. In addition, intake openings should be positioned to avoid picking up vapors from fueling operations.

8 Have a qualified professional inspect your boat's electrical system thoroughly every year, including all wiring in areas not normally visible.

Search for any cut or chafed insulation, corrosion at connections, excessive sag or strain on conductors and other visible signs of deterioration. Test leakage by opening each circuit at the main distribution panel, with all loads turned off, measuring current flow. Ideally, there should be no current flow; current of more than a few milliamperes indicates electrical leakage that should be identified and corrected without delay.

Keep in mind that connections at the boat's storage batteries need special attention. Disconnect them and, using a wire brush, remove all corrosion. Next, replace and tighten the connections, then apply a light coat of grease or other protective substance.

9 If all through-hull fittings, struts, shafts, etc. are connected electrically by an internal bonding system *(Chapter 23)*, have this wiring checked annually.

Although the skipper can make a visual check of the bonding system, an electrical expert with specialized equipment is needed for a thorough evaluation. Make especially careful checks where connections are made to the protected fitting or other metal part; connections in the bilge are subject to corrosion and development of poor contacts with high electrical resistance. If there are any signs of corrosion at points of connection between bonding wires and through-hull fittings, ask for a complete electrical test.

Remember that, in terms of possible electrolysis (stray current corrosion) damage, a bonding system with one or more poor connections may be worse than no system at all. Electrolysis causes weakening of through-hull fittings—bolts or struts and rudder posts, for example—that could result in serious safety hazards.

10 Perform an annual safety inspection of the hull and fittings below the waterline.

On wooden boats, check hull planking for physical damage and for any general deterioration from age. Check fiberglass hulls for any cracks, especially at points of high stress. Call in an expert if you find any suspicious areas.

11 If the boat is normally kept in the water, haul it out periodically for bottom cleaning and repainting.

After the boat has been hauled out, check to make sure that all through-hull fittings and their sea cocks are in good condition and operating freely; disassemble and lubricate if necessary. Include fastenings that are susceptible to damage from electrolytic action.

12 Check underwater fittings annually.

This includes shafts, propellers, rudders, struts, stuffing boxes and metal skegs. Repack stuffing boxes as often as necessary to keep them from leaking excessively, while also checking shafting for alignment and excessive wear at strut bearings. Examine propellers to see if they need truing up.

13 Choose replacement parts carefully.

Whatever parts you replace—for fuel, electrical or ventilation systems; navigation light bulbs; or anything aboard your boat—make sure you use equivalent components that are designed specifically for marine use.