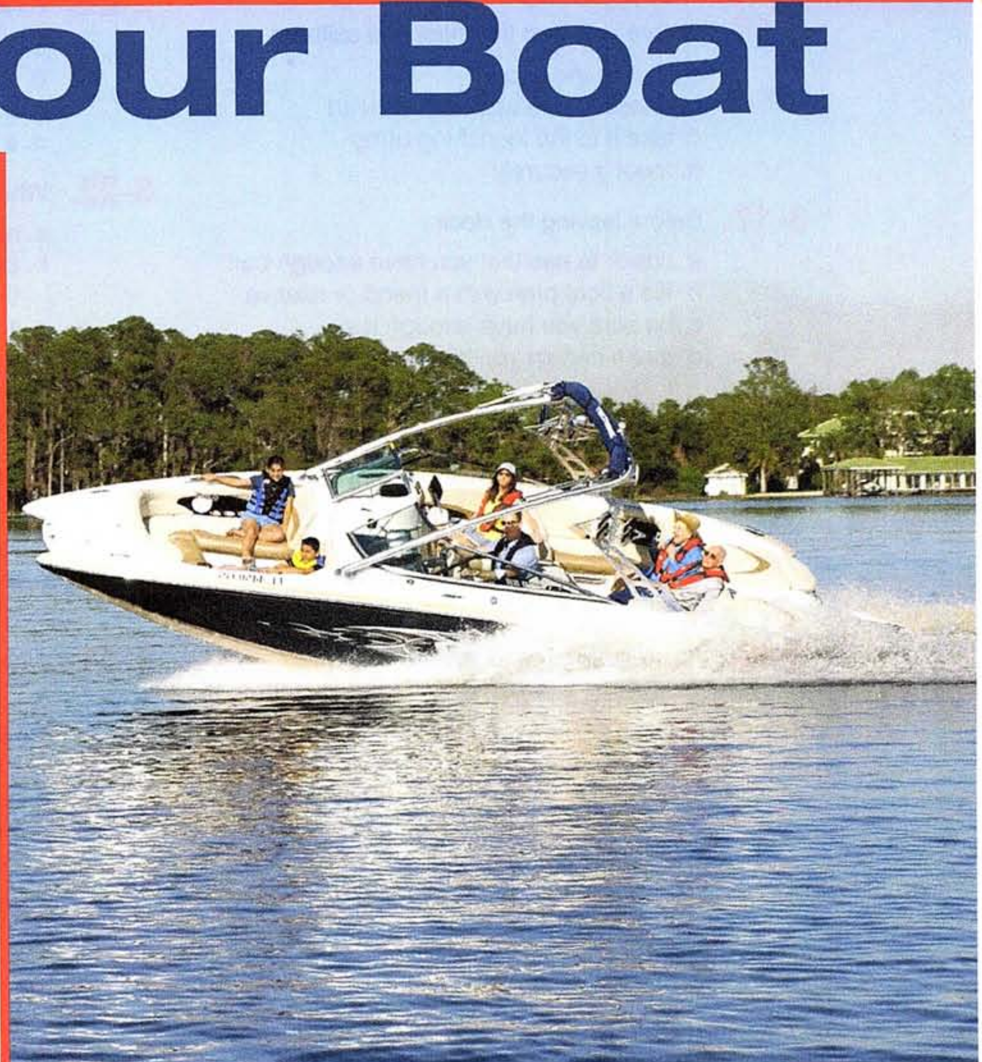
chapter 4

Handling Your Boat

The objectives of this chapter are to describe:

- The principles of handling a boat.
- Safety precautions for handling a boat.
- The One-Third Rule for fuel, and why it is important to follow.
- Precautions for fueling your boat.
- What to do if you find gasoline in your bilge.
- The fundamentals of propeller selection and operation.
- How your boat steers and turns.
- The fundamentals of trim adjustment for outboards and stern drives.
- How to load your boat safely.
- Safe conduct in a small boat.
- How to retrieve an overboard person.
- The importance of pretrip routine checks.
- How to depart from and return to a pier or mooring.
- Your responsibility for damage you may cause others.
- Characteristics and limitations of anchors.
- How to anchor safely.
- Safety practices for towing a skier.
- How to handle your boat in adverse weather and seas.



(COURTESY U. S. COAST GUARD)

HANDLING A POWERBOAT is a skill that comes through practice and experience. You will find that each boat handles differently, depending on its weight, hull shape, type of power, and load. Even two boats that look the same may handle differently, and it's up to you to learn the unique characteristics of your boat.

Leave with a Full Fuel Tank

Refuel whenever possible. This policy will help guard against running out of fuel and will reduce condensation that can occur when a partially empty tank cools, causing the water vapor in the air to condense. Filling the tank eliminates this possibility.

It's a horrible feeling to look at an empty fuel gauge after your motor sputters and quits. While leaving with a full tank is one way to safeguard against this, another is to follow the One-Third Rule, which says that you should use one-third of your fuel on your trip out, save another third for the trip back, and keep one-third in reserve. If this seems overly cautious, remember that the return trip may take more fuel than you expect. When you go out, the wind and waves may be calm or from astern, or you may be going downriver or with a tidal current. But when you turn around, you may find yourself headed into the wind, waves, current, or all three, in which case your return progress will be slower and your fuel consumption higher. The One-Third Rule can save you from a lot of inconvenience or even serious trouble in unexpected emergencies or heavy weather.

✓ FUELING SAFETY CHECKLIST

PRIOR TO FUELING

- ❑ Turn off all engines.
- ❑ Close all doors, hatches, and ports.
- ❑ Turn off all electrical equipment.
- ❑ Extinguish all open flames.
- ❑ Turn off galley stove and heaters.
- ❑ Don't smoke.
- ❑ Instruct crew and passengers on safe practices. (Consider having passengers go ashore during refueling.)

AFTER FUELING

- ❑ Open doors, hatches, and ports.
- ❑ On gas-powered boats, operate blowers for at least 4 to 5 minutes.
- ❑ Clean up all fuel spills.
- ❑ Check all compartments by sniffing for fuel fumes.
- ❑ Have a fire extinguisher at hand for engine start.

Fueling Your Boat

With a few simple precautions, fueling a boat's gas tank is a safe task.

Know What You Are Doing!

When fueling, it pays to know what you are doing. For example, people have pumped gasoline into water tanks and even into fishing rod holders. Both of these errors, on occasion, have resulted in explosions and serious injuries. Be certain that you are pumping gas into your gas tank and not into your bilge.

The law requires electrical parts in an enclosed engine space to be ignition-protected. This means that the parts will not produce sparks that can ignite gasoline fumes. Unfortunately, rebuilt or replaced parts may not be ignition-protected. You may, for example, inadvertently replace a marine alternator with one built for an automobile.

Keep Fumes Out!

Gasoline vapors are much heavier than air and flow to the lowest spot on your boat. Avoid trapping them, since there are many sources of sparks and flames aboard a boat that can ignite such fumes.

Close all cabin doors, hatches, and ports before fueling. This will help keep gasoline vapors from

TIP ***Reserve Fuel Tank Management***

The reserve fuel tank should always be full. It should only be drawn on in an emergency (when the regular tanks are dry), so be sure that the reserve fuel switch hasn't been turned on inadvertently. You should "test" the reserve supply periodically by checking for contaminants in the fuel and running the engine from the reserve tank for a short time.

TIP ***Monitor Your Fuel Reserves***

Unlike our highways, our waterways are not lined with gas stations every few miles or so. Boaters need to pay careful attention to fuel management. In addition to leaving with a full tank, you should check the amount of fuel on board periodically and change your plans if fuel consumption appears to be significantly greater than originally estimated. Know your boat's approximate fuel consumption rates at various speeds. Not all boats and tanks are equipped with fuel gauges. For example, many PWC do not have fuel gauges. Instead, they have reserve tanks. When the engine quits from fuel starvation, the operator needs to switch to the reserve tank and refuel as soon as possible.

entering your boat. Also, turn off all electrical devices such as ventilating fans, radios, bilge pumps, navigational devices, generators, and lights. Extinguish all open flames, turn off the galley stove, and don't smoke.

To be on the safe side, operate your blower for at least 4 to 5 minutes after fueling. Then, before starting your engine, check all compartments and engine spaces for gas fumes by sniffing. If you have a problem smelling odors, get an electronic fume detector. Bear in mind, though, that an electronic device is not always as sensitive as your nose.

The need to thoroughly air out your bilge and other compartments after fueling cannot be overemphasized. It is possible for trapped gasoline vapors to be so rich that a spark will cause an explosion. When you open a hatch, port, or door, or when your vessel begins to move, you may introduce enough air to make the vapors combustible. Many vessels have exploded and caught fire after leaving a fueling dock.

Built-In Tanks

The filler pipe for the gasoline tank should be located so spills do not enter your boat and become dangerous. Clean up any spill that does occur immediately and get the dirty rags off your boat right away. Spills should be avoided both for the dangers they pose and for environmental protection (Figure 4-1). Any spill that makes a sheen on the water is a violation of federal pollution laws. When you see one, report it immediately to the nearest Coast Guard station or facility. You can also report a spill to the National Response Center in Washington, D.C., by calling 1-800-424-8802.

Your boat's fuel filler pipe should be connected (grounded) to your boat's electrical grounding system (Figure 4-2). Gasoline passing through the hose line from a pump can generate static electricity, and a spark between the hose nozzle and the filler pipe might then cause an explosion. To prevent this, always keep the hose nozzle in contact with the metal of the fuel filler pipe.

Fuel Tank Vents

A built-in fuel tank must be vented outside your boat's hull (Figure 4-3). This provides an outlet for gasoline vapors and air so you can fill your tank. It also allows air to enter the tank as you use the gasoline. Without a vent, you could not draw gas from the tank without collapsing it.

Figure **4-1.** Refueling at the marine dock. Note the use of an absorbent pad to prevent spills. (PHOTO BY BOB DENNIS)

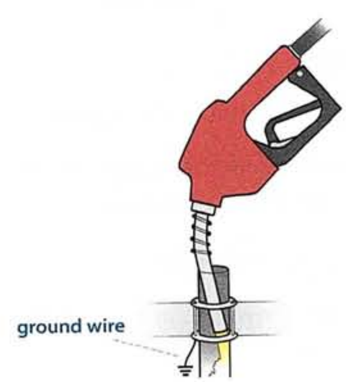


Figure **4-2.** When refueling, keep the nozzle in contact with the filler pipe to prevent static electricity buildup.

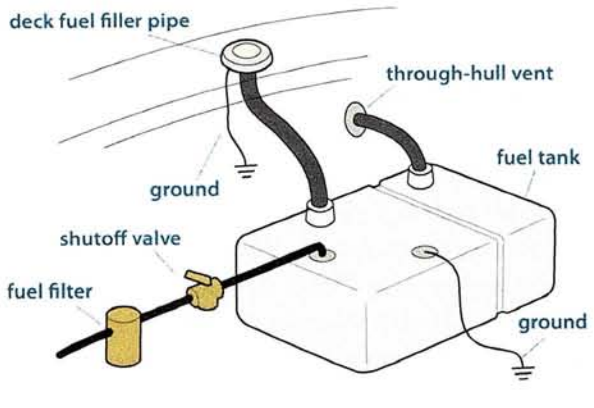


Figure **4-3.** The fuel filler deck plate and the tank's air vent must be located outside the hull's enclosed spaces so that fumes do not accumulate in the bilge.

Vents are covered with a wire mesh that may become clogged from corrosion, insect nests, etc. When this happens, poor engine performance results.

Unfortunately, both the filler pipe and the vent can cause environmental problems. If you overfill your tank, some of the fuel may spurt out of the filler pipe and into the water, and some may leak out of the vent. You can avoid either of these sources of environmental pollution by knowing the capacity of your fuel tank and never filling it to more than 95% of capacity.

There are also devices available that collect fuel spilling from the fuel vent outlet. They attach with a suction cup and can be removed easily.

If you completely fill the tank and then leave your boat in the sun, the fuel will expand and some will leak out of the vent. Any fuel spill, no matter how small or how it occurs, is illegal and can result in a fine from a state regulatory agency or the U.S. Environmental Protection Agency (EPA).

The EPA statute on oil spills is unambiguous. Note in what follows that the term "general rule" gives the EPA leeway to impose even higher penalties under special conditions such as not cooperating with the responsible official:

"If your recreational vessel discharges oil into the navigable waters or adjoining shorelines (or what is referred to as the 'exclusive economic zone') of the U.S., then, as a general rule, you are liable for all oil removal costs and certain specified damages resulting from that discharge up to $500,000 or $600 per gross ton, whichever amount is greater."

If a spill occurs and you are in federal waters, it is your responsibility to report it immediately to the Coast Guard. For more information on oil spill liability or compensation questions, contact the National Pollution Funds Center at 202-493-6999, or visit www.uscg.mil/hq/npfc.

Gasoline in Your Bilge

If you find raw gasoline in your bilge, don't operate anything electrical and don't disconnect your battery. Turn off all power by using the enclosed, marine-type battery switch. (If you have an open, "knife" switch, do not use it!) A marine-type battery switch is ignition-protected and should not produce a spark.

If a sizable bilge spill occurs at a gas dock, call the fire department. You can clean up small amounts of spilled gasoline with a sponge and a plastic bucket. Put the bucket and the sponge ashore. After that, leave the boat open until you can no longer smell fumes. Then use your blower for at least 4 minutes.

When you don't know where raw gasoline in your bilge has come from, look for its source. But do it after you have cleaned up the mess and before you try to start your engine. A leaking fuel line, for example, could be an invitation to disaster.

Portable Tanks

Remove portable tanks from your boat before filling them. When filling a portable tank, keep the hose nozzle in contact with the tank to reduce the chance of sparking from static electricity.

Your Boat's Propeller

Most recreational powerboats use propellers, with jet-drive boats being the principal exception. When viewed from aft, most props turn in a clockwise direction when the boat is moving forward, and are thus said to be right-handed (Figure 4-4). Left-handed propellers also exist, particularly on *twin-screw* boats (boats with two engines driving two propellers), where pairing a left-handed prop with a right-handed one cancels the unwanted side thrust of each and makes the boat efficient and well-mannered (Figure 4-5).

Propeller Characteristics

In addition to the direction it spins, a propeller is described by its diameter and pitch, the number of its blades, and the material used to make it.

Propeller Diameter

The diameter of the circle described by a propeller's blade tips when they spin is the propeller's diameter. The bigger the diameter, the more shaft power a propeller can absorb and the more thrust it will deliver, up to a point. Most powerboats get greater efficiency from a larger propeller, though this is not true of high-speed powerboats (faster than 35 knots or so), in which the drag created by a large propeller becomes excessive.

Propeller Pitch

Propeller blades fasten to their hubs at angles (Figure 4-6). Thus, as a blade spins, its leading edge is canted forward. The degree of cant, or twist, determines the pitch of the propeller. Looked at another way, ***pitch*** is the distance the propeller would screw itself forward into the water in one rotation if there were no slippage (Figure 4-7). A propeller with a pitch of 10 inches would, in the absence of slippage, screw itself forward 10 inches through the water with each complete revolution.

Although a propeller does not work like a wood screw, you can think of it as one to understand what is meant by pitch. The pitch of a wood screw is the distance it penetrates the wood with each complete turn.

Unlike a wood screw, however, a propeller slips when turning in water. ***Slip*** is the difference between the distance the propeller moves forward in one turn and the distance it would move if it were in a solid medium.

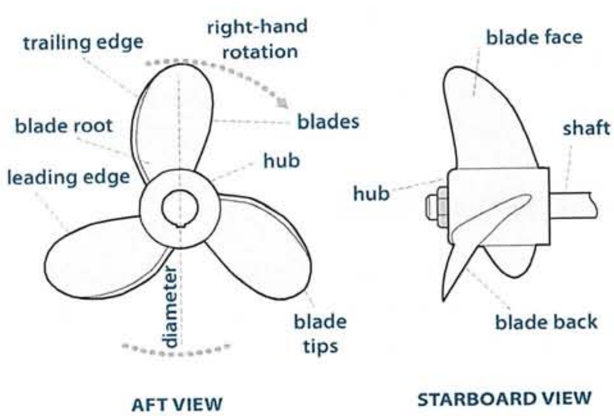


Figure **4-4.** Propeller anatomy.

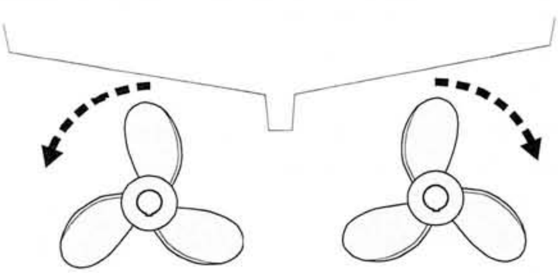


Figure **4-5.** In a twin-screw installation, the starboard propeller is typically right-handed, and the port prop is left-handed. With this configuration, the two props cancel each other's unwanted side thrust.

Figure **4-6.** **Left to right:** A three-bladed propeller for an inboard engine. (COURTESY MICHIGAN WHEEL) A three-bladed sterndrive or outboard propeller. (COURTESY JOHNSON) A four-bladed prop can deliver less vibration and more blade area in a given diameter than a two- or three-bladed propeller, though with some loss of efficiency. (COURTESY BOMBARDIER RECREATIONAL PRODUCTS)

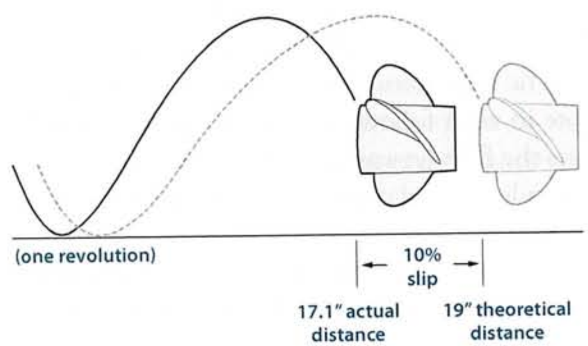


Figure **4-7.** Propeller pitch and slip. A prop with a pitch of 19 inches would move the boat forward 19 inches with each complete revolution were it not for slip. With 10% slip, as here, each revolution moves the boat forward 17.1 inches. (COURTESY MACH PERFORMANCE INC.)

Propeller Size

A propeller's size is described by its diameter and pitch. A 14 x 12 prop, for example, has a diameter of 14 inches and a pitch of 12 inches. The size markings on a propeller hub are not standardized, however, and may include only the manufacturer's part number. You may have to contact the manufacturer to determine a propeller's characteristics. Propellers used on inboards are usually well marked.

Propeller Safeguards

Most drive mechanisms include one or more parts that are designed to fail under stress before the propeller itself or some other equally expensive part is severely damaged. In a small outboard motor this function is served by a ***shear pin***, which is a soft metal pin that looks like a nail without a head. One end of the pin fits into a hole in the propeller shaft and the other end slips into a matching hole on the inside face of the propeller hub, thus transmitting the shaft torque to the propeller. When the propeller hits an object that keeps it from turning, however, the pin shears, thus decoupling the propeller from the still-turning driveshaft. If you're lucky, this will happen before you damage either the propeller or its shaft.

Replacing a shear pin is relatively easy unless the boat is in deep water. If the motor is small enough, you can dismount it to change the pin. In shallow water, you can pull the boat ashore or get in the water to replace the pin. Usually, all you have to do is remove a cotter pin and a nut, and the propeller will slide off its shaft. After you replace the pin, put the propeller back on the shaft, tighten the nut, and replace the cotter pin.

Unfortunately, a pin will sometimes shear even without the propeller hitting anything. Normal engine operation in forward or reverse puts a strain on the pin, and eventually, through metal fatigue, it will fail. *If your propeller uses a shear pin, never leave home without a spare and the tools to install it.*

Larger outboard motors have propellers held in place by the friction of a slip hub, which is designed to release, or spin, when the prop hits an object, thus minimizing damage to the prop or the shaft. The hub of a spun propeller can be replaced at a propeller repair shop.

You may be able to use a spun prop to return home. If you proceed very slowly, there may be enough remaining friction to turn the propeller.

It's a good idea to take a spare propeller with you, since when you spin a hub, you may need to replace the propeller to get home. Also, when you hit a rock or some other hard object, the propeller may be damaged before the hub spins. A badly damaged prop vibrates excessively and should be replaced before you damage your motor or its driveshaft.

Cavitation

Cavitation refers to the bubbles of partial vacuum that may appear around the blades of a propeller that is spinning at excessive speed or under an excessive load. A propeller that is too small or carries too much pitch for its application is susceptible to cavitation, which will cause vibrations similar to those of unbalanced blades and can eventually pit and destroy the blades. Boats with properly sized engines and propellers will usually experience cavitation only under very high engine speeds. If your propeller is cavitating, be sure it has a large enough diameter for its application and that its pitch is not excessive. There are also special blade designs that will reduce cavitation with some compromise in efficiency.

Note that the flat side of a propeller blade faces toward the bow and is the suction surface when the boat is moving forward, whereas the cupped, after surface is the pressure surface. Cavitation occurs when the propeller is moving so fast that water cannot move into the suction side of the blade, producing a partial vacuum.

Ventilation

When a propeller is too close to the water surface, it sucks air down into the blades; this ***ventilation*** can lead to vibration and a loss of thrust. If the propeller can't be lowered, there are special blade designs that will reduce ventilation (Figure 4-8).

Selecting Your Propeller

The propeller must be the right size for your boat if it is to operate efficiently. Too large a propeller will result in a large amount of slippage. If it is too small, it will lose energy through cavitation.

The selection of a propeller is a complex decision. Most boat dealers and propeller retailers have access to a computer analysis service that can recommend a propeller based on input information about the boat, the engine, and the intended use. If you suspect a propeller issue, remember, too, that marine growth on your boat's hull will slow down your engine and boat. Before you change propellers, get advice from a reliable dealer.

Steering

Steering a boat is quite different from steering an automobile. When you turn a car's steering wheel, the front wheels turn the front of the car, and the rest of the car follows. When you turn a boat's wheel, on the other hand, you're turning either the propeller(s) of an outboard or stern-drive boat or the rudder(s) of an inboard boat, so that the turn is initiated from the stern of the boat (Figures 4-9 and 4-10) rather than its bow.

When you turn the wheel to the right, the stern moves to port, which causes the bow to move to starboard, and the boat turns on its ***pivot point***, which is located about one-third of the way back from the forward end of the waterline.

The result is that even as your bow is swinging toward the direction you want to go, your stern is swinging to the other side of your previous track, and by a wider amount.

A boat turns differently from a car in another respect too. A car doesn't skid around a turn unless it's going too fast for the road conditions, but a boat always slides somewhat sideways through a turn. This is the inevitable result of the momentum the boat still carries from its previous track and the fact that it operates on a fluid surface, not a hard one. The tendency can be controlled with proper speed and steering, and it can be anticipated and compensated for—sometimes even turned to advantage—but it can't be eliminated. The net result of these factors is that your stern will swing to port when you're turning to starboard, and vice versa. The way a boat pivots is not particularly important in open water, but alongside a pier or another boat it becomes critical. If you operate your boat like a car while in "close quarters," you will drive its stern into the pier or another boat (Figure 4-11).

While the ability to direct the propeller thrust

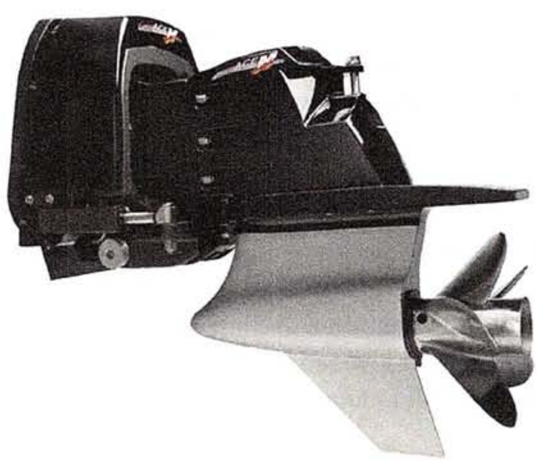


Figure **4-8.** This stern-drive lower unit shows an antiventilation plate just above the prop and a small rudder below it. The rudder conveys some steerage to the boat even when the engine is not in gear. Note the five-bladed prop, permitting more power and smoother operation from a small-diameter prop, albeit with some loss of efficiency. (COURTESY MERCURY MARINE)

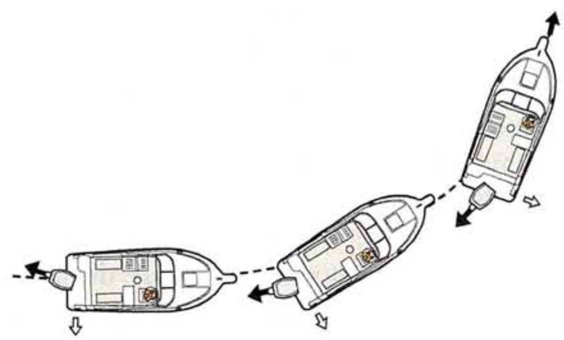


Figure **4-9.** The directed thrust of an outboard or stern drive in forward gear moves the stern of the boat into a turn.

Figure **4-10.** A turning boat pivots about a point a third of the way back from the bow.

gives an outboard or a stern-drive boat a lot of maneuverability, it is also possible to turn too sharply, causing the boat to turn over or *capsize*.

Steering a personal watercraft (PWC) or other jet-drive boat is considerably different, and is discussed below in the Jet Drives section.

Stopping

Boats also differ from cars in that they have no brakes. Boats slow gradually when you remove power and will eventually stop, but they don't respond the way a car responds to its brake pedal. In an emergency, you can stop your boat's forward motion quickly by slamming the engine from forward to reverse, but most boaters avoid doing this in ordinary circumstances, as it stresses the gears and shafts of a motor. Preferably, when going from forward to reverse or vice versa, you first shift to neutral. Then, when the engine has slowed to idle speed, you can again shift gears.

If you have a choice when docking, you should choose to dock with your boat facing *into* the wind or current (whichever is the more significant factor). That way the wind or current (or both) will help you slow down instead of speeding you up, and you'll be able to adjust your engine throttle in forward gear so that your boat moves very slowly ahead while maintaining steerageway, permitting a smooth, gentle landing.

Steering with a Single Inboard Engine

A boat with a single inboard engine requires special care when maneuvering. The engine is forward of the boat's stern and transmits its torque to the propeller through a long, rigid shaft. Because of this, you cannot direct the prop's thrust from side to side as you can with a stern drive or an outboard. Instead, steering is done by means of a rudder.

A *rudder* is a blade attached to a rotating shaft (the *rudderpost*) that extends down into the water beneath the boat's stern. In most inboard-powered boats, the rudder is directly behind the propeller. It is controlled by a tiller (rarely) or by a wheel (usually) that turns the rudderpost via a mechanical or hydraulic linkage. When the boat is moving ahead, turning the rudder left or right causes it to deflect the water discharged from the propeller and streaming past the boat, which pushes the stern in the direction opposite the deflection (Figure 4-12). If you turn the wheel right, for example, the rudder turns right, which forces the stern to the left and the bow to the right (Figure 4-13).

Inboard-powered boats, in general, operate more efficiently and more economically than outboards and stern drives. (This is not true at high speeds—say, more than 30 knots—at which point the drag of an inboard boat's rudder, propeller shaft, and other running gear makes it less efficient than

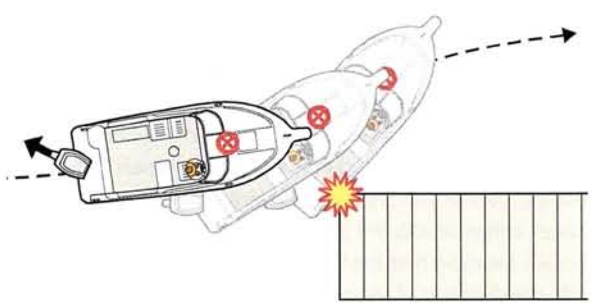


Figure **4-11.** In tight quarters, turning away from an obstacle may actually induce your boat's stern to swing into the very thing you are trying to avoid.

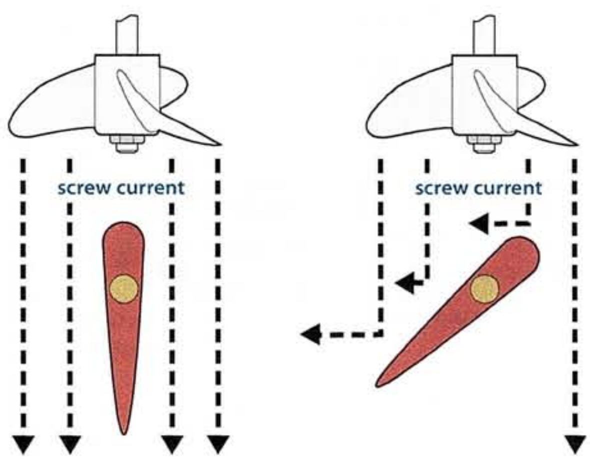


Figure **4-12.** The steering forces in play aboard a single-engine inboard boat. When the engine is in forward gear, the propeller discharge (i.e., the screw current) washes over the rudder blade, making the rudder more effective. When the engine is reversed, the screw current no longer impinges on the rudder, which is therefore less effective in reverse gear than in forward.

an outboard or stern drive.) As long as an inboard boat is moving, its rudder will exert directional control even when the engine is out of gear, though that control is reduced when no prop wash impinges on the rudder. Because outboard and stern-drive boats have no rudder except the small fin at the bottom of the lower unit, they do not respond well to the wheel when the engine is in neutral. Also, since an inboard engine is mounted farther forward, inboard boats usually ride on a level keel, whether on or off plane. This level attitude, plus the presence of a rudder, makes them good choices for waterskiing. They are less easily pulled one way or the other by a skier.

Nevertheless, because inboard engines are limited mainly to larger yachts and commercial craft, we won't devote much space to them here. Later in this chapter we'll focus more on outboard and stern-drive engines, since these are what most "weekend" boats use.

Twin Screws

Outboard, inboard, and stern-drive boats may have two engines, and sometimes (but not commonly) even more. Twin engines confer greater reliability, since it is unlikely that both engines will fail at the same time (especially if each engine has its own fuel tank), but the best reason for installing twin engines is improved maneuverability.

Turning with Twin Screws

With twin screws, the starboard propeller is usually right-handed, and the port prop is left-handed. When you increase the power on the starboard prop while going ahead, the boat will turn to port in a large arc. Conversely, increasing power on the port prop causes the boat to turn to starboard. You can, if need be, steer a twin engine boat by its

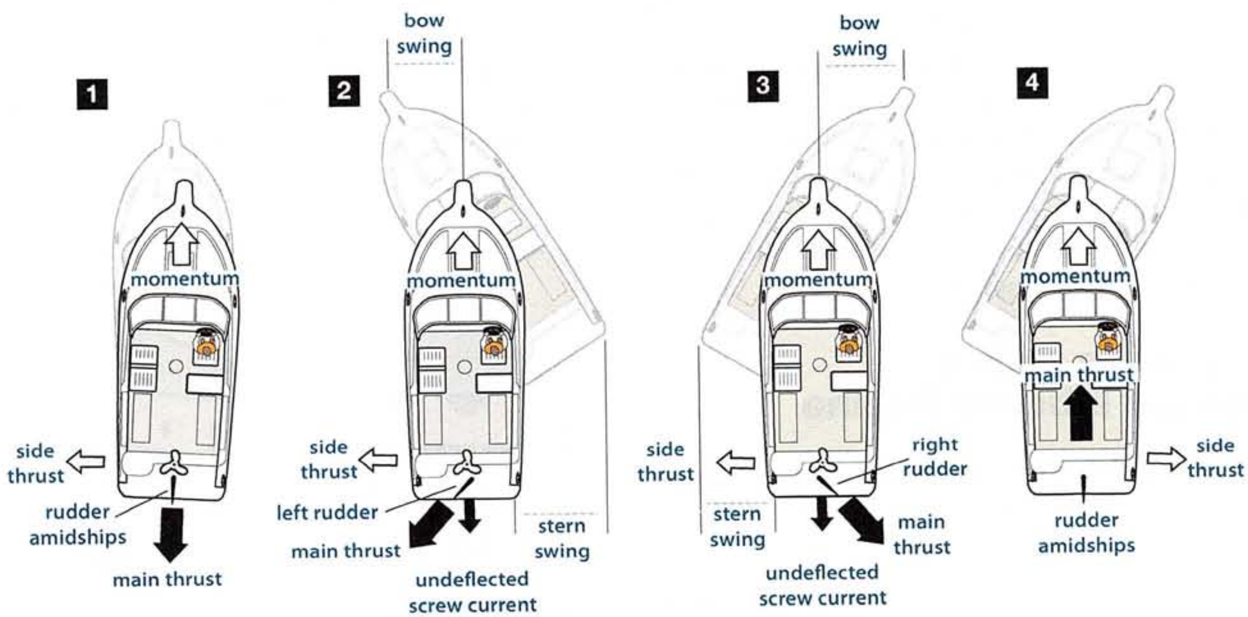


Figure **4-13.** The turning characteristics of a single-engine inboard boat with a right-handed propeller. When you power ahead with the rudder amidships, the side thrust from the prop will tend to push the stern to starboard **(1)**. This phenomenon is known as prop walk, and must be counteracted with slight right rudder in order to keep the boat moving in a straight line. When you apply left rudder, the rudder deflects the water through which the boat is traveling as well as the discharge current from the propeller to the left, which causes the stern to swing right **(2)**. The boat's natural prop walk enhances this left turn. When you apply right rudder, the rudder forces the stern to the left but is partially counteracted by prop walk, meaning that the boat will take longer to turn right than to turn left **(3)**. When you reverse the engine with the rudder amidships, the direction of prop walk is reversed and the stern swings to port **(4)**. In this illustration the engine has just been reversed and the boat is still moving ahead, but the stern would be swinging the same way even if the boat were actually backing, unless counteracted by rudder action. When driving a single-engine inboard, you must anticipate these factors and turn them to advantage—for example, by approaching a dock port-side-to so that reversing the engine will cause your stern to swing toward rather than away from the dock.

throttles alone, leaving the steering wheel centered (Figure 4-14).

Tighter turns can be made by going ahead on one engine and reversing the other (Figure 4-15). Going forward on the starboard engine and reversing the port engine, for example, causes your boat to turn sharply to port, but don't attempt this when you have much ***headway***, or forward motion through the water, because doing so might induce a capsize. With adequate throttle management, your boat can be made to turn without going forward or backward—essentially spinning on a dime (Figure 4-16). This can be a huge advantage in a narrow channel or while docking.

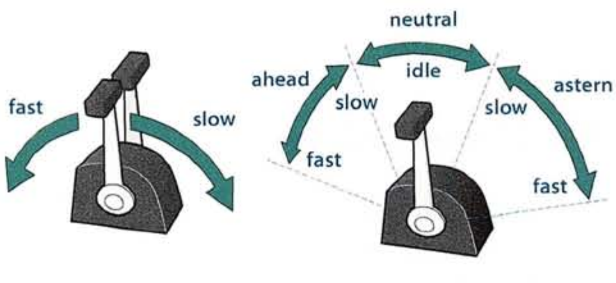


Figure **4-14.** Some boats have separate controls for the gearshift and throttle (left), whereas on others these are combined into a single lever (right), which limits you to a shorter throttle range but is perfectly adequate on most boats.

Twin versus Single Engines

Twin engines do have disadvantages, the biggest of which is initial cost. The average cost of twin engines is about double the cost of a single large engine. In addition, twin engines require more expensive and complex control systems. Furthermore, they add weight to your boat. Twin engines are about 50% heavier than a single large engine of equivalent horsepower.

Twin screws also cause additional underwater drag and thus greater fuel consumption, using one-third to one-half more fuel than a single large engine. When the twin engines are outboards or stern drives, they place additional weight at the boat's stern, adversely affecting the boat's attitude in the water.

Engine Reliability

The old argument that twin engines offer greater reliability is less compelling than it used to be thanks to the greater reliability of newer outboards. Modern outboard motors are highly dependable as well as highly efficient. Four-stroke outboard engines are, in effect, automobile engines stood on end, and are just as reliable as the engines that

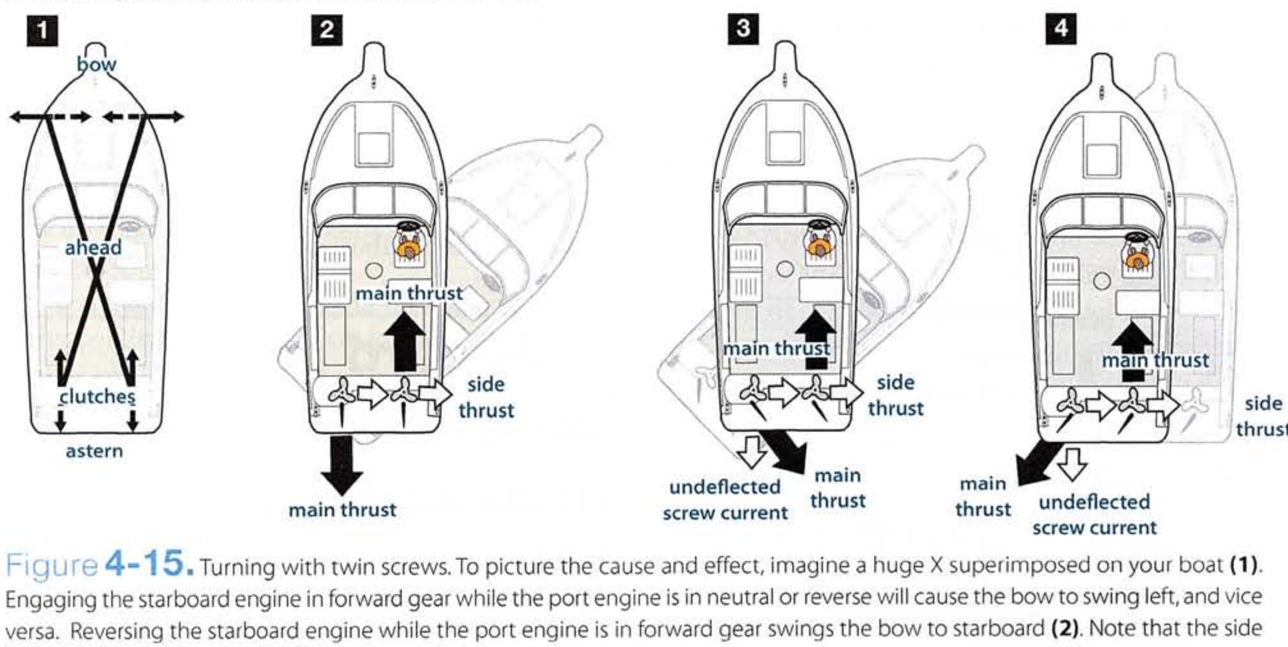


Figure **4-15.** Turning with twin screws. To picture the cause and effect, imagine a huge X superimposed on your boat **(1)**. Engaging the starboard engine in forward gear while the port engine is in neutral or reverse will cause the bow to swing left, and vice versa. Reversing the starboard engine while the port engine is in forward gear swings the bow to starboard **(2)**. Note that the side thrust from the right-handed starboard prop in reverse will accentuate this turn, as will the side thrust from the left-handed port prop in forward gear. The turn can be made even sharper by bringing the rudders into play **(3)**. Here the rudders are countering the turning action of the engines and prop walk **(4)**. The result, if you experiment, is a dynamic balance in which the boat will actually "walk" sideways—a pretty clever way of sidling into a berth.

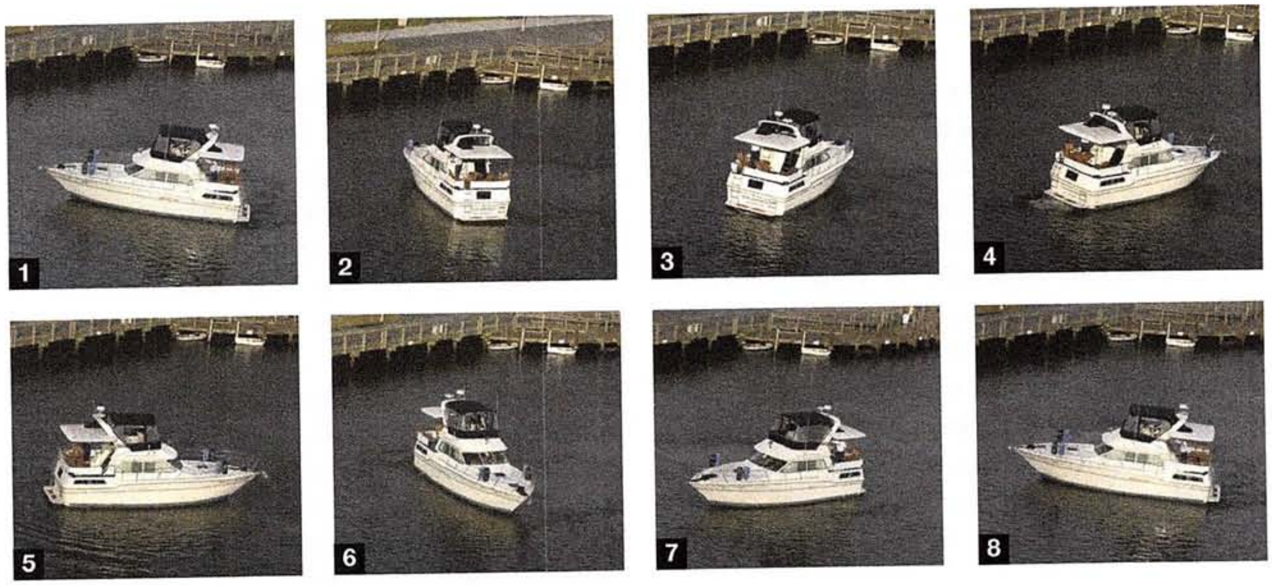


Figure **4-16.** In this series of photographs, a twin-screw boat turns in its own length. (REPRODUCED WITH PERMISSION FROM *GETTING STARTED IN POWERBOATING* BY BOB ARMSTRONG)

power our cars. Modern two-strokes, too, are dependable and efficient thanks to technological developments over the past 10 years. Newer models feature electronic fuel injection and electronically metered lubricating oil. Many have dual carburetion, and most have solid-state electronic ignition for each cylinder. Should one carburetor or one cylinder's ignition system fail, you can usually get home. If you run out of gas, however, or if the black box computer module fails, or if you should blow a powerhead, you are out of luck.

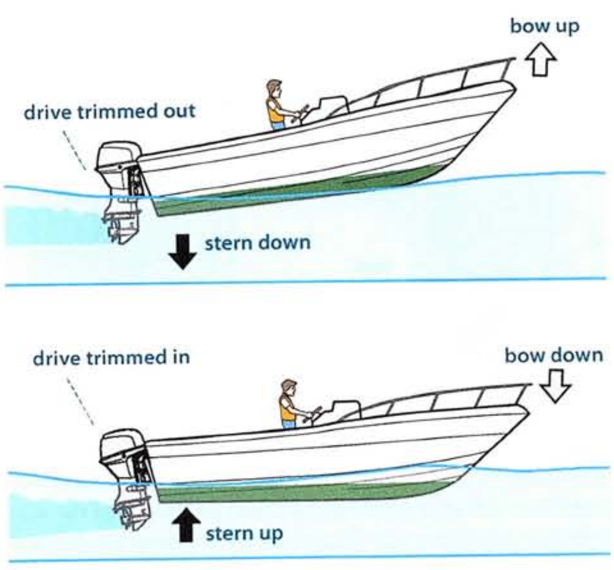


Figure **4-17.** The effect of outboard motor tilt adjustment on the trim of a boat.

Auxiliary Motors

A small auxiliary outboard motor can protect you in case of engine failure. Mount it on a spring-loaded bracket on your boat's transom and then when needed, lower it into the water. It is important to care for your auxiliary motor faithfully if you want it to be ready for an emergency. If you use your boat for fishing, this smaller motor will come in handy for trolling as well, which will ensure that it gets some use.

The auxiliary motor will probably need its own gasoline source. The gasoline in this tank should either be stabilized by using a gasoline additive or changed at least every 6 months, as old gasoline can gum up the carburetor.

Outboard and Stern-Drive Installation and Tilt Adjustment

If your boat has an outboard motor of 25 horsepower or more, it is probably permanently installed on your boat's transom. Of course, all stern-drive engines are permanently installed.

Installing a Small Outboard

If you have a portable outboard motor, you will probably take it off at home and store it to prevent theft. Reinstalling it is a simple task. When you mount the motor, be certain that its center is on the boat's centerline. It is not unusual for clamps to loosen over time; if they do, the motor may fall off. Chaining and locking prevents this and is also a good security precaution.

Tilt Adjustment

Outboard engines and stern-drive lower units tilt up for trailering and can be trimmed up or down while the boat is underway in order to fine-tune the plane of the propeller thrust, which will alter the boat's trim (Figures 4-17 and 4-18). Stern drives and larger outboards usually have hydraulic tilting mechanisms, while small outboards are adjusted manually. For best performance, the thrust of the propeller should be horizontal when the boat is at its most efficient operating angle. Tilting the motor or outdrive so the propeller is farther forward is called tucking it in, or lowering it; this will direct the propeller discharge below the horizontal plane, forcing the boat's stern up and its bow down. Tilting the motor or outdrive farther aft is called raising it, which tends to lower the stern and raise the bow.

When the propeller is too close to the transom, it lifts your boat's stern too high and causes the bow to plow into the water. When the prop is tilted too far back, it forces the stern down too far and the bow up too high. Boats operate inefficiently with improper thrust angles.

You may need to adjust the tilt angle to match water conditions. In calm, smooth water, raise the prop slightly for a faster and more fuel-efficient ride. In this position, a smaller amount of the boat's hull surface is in contact with the water. In rough water, you may want to lower the prop to bring the bow down and give a smoother ride. When the bow is up in choppy water, you get excessive pounding. But don't tilt it so far forward that the boat plows into waves.

Underway, when the propeller becomes fouled with weeds, it is possible to stop an outboard or stern-drive engine, raise the motor or the outdrive, and remove the obstruction. If your motor begins

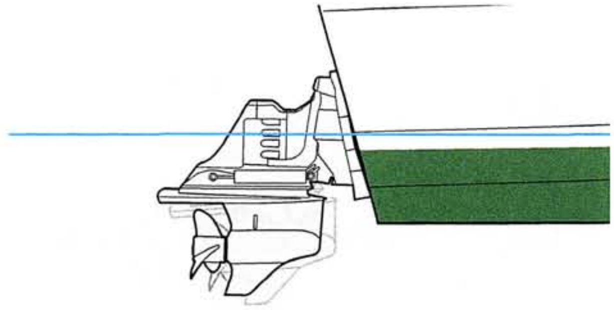


Figure **4-18.** Tilt adjustment on a stern-drive lower unit.

to run hot, stop the boat and raise the motor or the outdrive. Weeds or discarded plastic may have clogged the water intake. Don't forget to lower the motor or outdrive before restarting your engine.

You can also raise your motor or outdrive to clear shoals or to run in shallow water. Be careful, though. Keep the water intake below the surface of the water, or you may damage the engine. When the propeller cavitates, lower it farther into the water.

Some people believe that the best way to cross shallow water is to partially raise the outdrive or outboard and pass over the shallows on a plane at high speed. This is risky and probably not the best procedure. The safest approach is to keep the boat as high in the water as possible by partially raising the propellers and proceeding at a very slow speed. Paradoxically, the worst way to cross a shoal is at a moderate speed. When a planing or semidisplacement hull starts slowly and gradually gains speed, it goes through a transition phase during which it is trying to go on a plane but has not yet developed sufficient hydrodynamic lift to do so. The stern sinks lower and lower during this transition before the boat develops enough speed to climb its own bow wave and reach a plane. Then, and only then, will the stern rise. Therefore, traveling over a shoal at a moderate speed, with your boat's stern squatting deep in the water, is the worst choice.

Jet Drives

Jet-drive boats less than 16 feet long are often called personal watercraft (PWC), but there are larger jet-drive boats as well. A jet-drive propulsion package includes an inboard engine(s) but no propeller(s). Instead, the engine operates a powerful

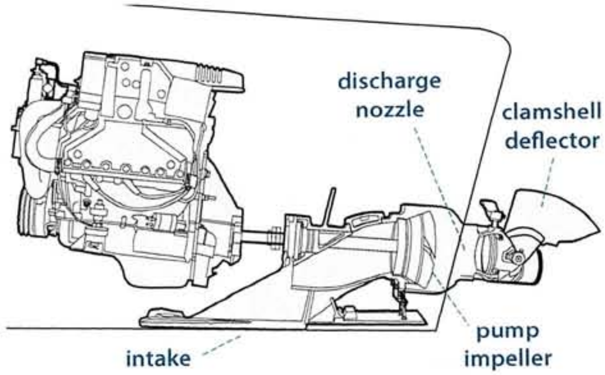


Figure **4-19.** A jet-drive propulsion unit.

WARNING **OPERATING PWC IN REVERSE** *Some PWC are equipped with a reverse gear. This is intended to be used for low-speed maneuvering, not for emergency stopping. Consult the owner's manual for your PWC.*

PWC SAFETY

Man-Overboard Safety with PWC

Riders frequently fall off personal watercraft. Therefore, PWC operators should know how to swim and how to reboard their craft. When reboarding a PWC, swim to the rear and place both hands on the gunwale. Pull yourself up on the footrest deck (boarding pad) and kneel. Move forward to the seat and sit astride. Reattach the kill-switch lanyard if your PWC is equipped with this feature. If the PWC has capsized, follow the righting directions provided in the owner's manual and on warning placards mounted on the PWC. If capsized, many (but not all) models should only be righted by rotating in a clockwise direction when viewed from aft. Righting the craft in the wrong direction can cause water to enter the engine and damage it.

PWC Off-Throttle Steering

With jet-drive propulsion, there is little or no steering capability when the throttle is off or at idle. Turning the handlebars changes the angle of the water exiting the jet drive, but there is no directional thrust unless there is power to the pump. Riders unfamiliar with this phenomenon, called off-throttle steering, can get into accidents. This can happen in a possible collision situation when a novice rider's intuition is to close down the throttle (to avoid high rates of closure) and steer away to avoid the collision. Without throttle there is no steering, and the PWC continues in its original direction, resulting in a collision. It is necessary to make a controlled-speed turn to avoid danger.

water pump (Figure 4-19) that sucks in and ejects water at high speed and volume through a special nozzle. This forceful ejection of water powers the boat, and the nozzle turns to one side or the other to steer the boat. These boats can travel at very high speeds.

An important jet-drive feature is its rapid response to acceleration, stopping, or turning. To stop some jet-drive boats, a barrier called a clamshell is lowered into the discharge stream, which deflects the stream of water forward. These vessels can stop very quickly if reversed with high power. All jet-driven vessels have poor maneuverability at low speeds, however, and this is especially important in tight spaces.

Since jet-drive boats, including PWC, steer by turning their jet nozzles, they do not have rudders. This means they must have pump power to have steering control. If you throttle back or shut off a PWC's engine, or have a power failure during a turn, you lose steering control. The PWC will not continue to turn, but will instead continue forward in the direction it was traveling before the loss of power. This causes many PWC accidents. For example, if the PWC is close to a pier or another vessel when power is reduced, it may crash into the pier or vessel.

Jet drives do not have gearboxes (i.e., transmissions). The pump impeller turns in the same direction when the vessel is going ahead or astern, and it is the lowering of the clamshell deflector that reverses the discharge stream. Thus, you can shift directly from full ahead to full astern without straining the engine. Just be sure to warn your passengers before you do this!

Jet drives are popular for watersports, since their propeller-free engines are safer to operate around swimmers and skiers. The impeller is housed inside the nozzle and thus does not represent a major hazard to swimmers. Jet-drive boats can also run in shallow water without fear of damaging a prop. They may suck up mud, sand, or debris, however, which will damage their impellers.

The engine of a jet-propelled boat is mounted amidships or farther astern. The boat's pivot point is about 14 to 20 inches forward of the engine, which makes sharp turns possible. These boats can reverse their courses in less distance than their lengths.

Loading Your Boat

Most monohulled powerboats less than 20 feet long must have capacity plates, which (as discussed in Chapter 2) displays the maximum load a boat should carry.

When loading your boat, distribute weight evenly, forward and aft and ***athwartships*** (side to side). The more weight you put into a boat, the deeper it will sink into the water, reducing its freeboard, and the less freeboard a boat has, the greater its tendency to swamp or capsize. An overloaded or improperly loaded boat is unstable and dangerous.

Passengers are often unaware of the need to balance the load forward, aft, and athwartships. Too many may seat themselves forward, causing the boat to plow through the water. Some may seat themselves on a gunwale, causing the boat to ***list*** to one side, and passengers who perch on the transom may cause the boat to be stern-heavy. All of these conditions can make the vessel difficult to handle, and most of these seating positions are also violations of the law. The skipper should place the passengers so as to be safely inboard and to trim the craft.

Whether you should carry the maximum weight shown on the capacity plate depends on several factors. First, consider the sea state or water conditions. When you expect rough water, carry less weight. A heavily laden boat will ***ship water*** more easily than one riding higher in the water. When a boat ships water, water comes in over the gunwales or the transom. Once this happens, conditions become dangerous quickly, because the water in the bilge is so heavy and because it flows to the low side, accentuating the boat's roll and pitch.

Second, as you load the boat, consider the activity you expect to engage in underway. When fishing, someone will want to stand. Standing in a small boat is dangerous and becomes more so in choppy water or when the boat is heavily laden. Standing in a boat raises its ***center of gravity***—the point where its mass is centered—thus increasing the chances of falling overboard or capsizing.

Learning and practicing the techniques for reboarding a small boat from the water and for recovering a person overboard are absolutely crucial. Reenter a small boat by climbing over its bow or its stern, since attempting to climb over its side may cause it to swamp or capsize. Practice reducing your boat's speed and coming about to recover a person in the water, because you never know when you will need to do it. We'll return to man overboard procedures later in this chapter.

Falling overboard is even more dangerous in cold water, which carries with it the danger of hypothermia and cold shock even after a short period of immersion. Hypothermia occurs whenever a person's body loses large amounts of heat and is unable to maintain its core temperature. Immersion in cold water or exposure to strong, cold winds, especially when you are wet or under the influence of drugs or alcohol, greatly increases the chance of hypothermia.

The best approach to hypothermia is to prevent it by taking steps to see that you do not fall overboard. If you do fall overboard, get back in the boat and out of the wind as soon as possible. Eating a good meal provides energy reserves you can draw on when you're exposed to extreme cold. Wear warm clothing and avoid long periods in cold winds.

Another factor to consider when deciding how many guests to invite on board is the weight of the equipment, fuel, tools, food, and other gear you're carrying. The more gear you have on board, the less capacity you'll have for carrying passengers.

Even when you have loaded your boat correctly, you may have problems under adverse conditions. Running too fast in choppy water can buffet a boat excessively, causing damage and increasing the possibility that you will lose control. Hitting a wave too fast or turning very hard can also cause a boat to capsize.

Getting Started

Before getting underway, always check the weather and review your vessel's systems and gear, using your checklist. Make sure your boat's registration is aboard.

Before Starting Your Engine

BRIEF YOUR GUESTS. Your guests should be familiar with your boat and its safety equipment. Show them how to start and stop the engine and how to operate the radio. Passengers need to be informed of the location of flares and first-aid kits, anchor-

Getting Underway

ing procedures, rough-weather procedures, line handling, and emergency boat operations.

Also, show them where the fire extinguishers are kept and how to operate them. While you are orienting your guests, let them know that no trash is to be thrown overboard.

GET A WEATHER CHECK. Before you cast off, get an up-to-date marine weather forecast and be guided by it. When stormy weather or rough water is predicted, you may want to cancel your trip. Always load the boat according to the weather conditions you expect to meet.

The most readily accessible and accurate forecasts are those given by the National Weather Service (NWS), a division of the National Oceanic and Atmospheric Administration (NOAA). You can get these on your VHF-FM radio, where they are broadcast on a continuous basis and updated as new information is received. Listen to them from time to time as you cruise to see if there have been adverse developments. These predictions are also available online at www.nws.noaa.gov, and local newspapers and radio and television broadcasters develop their own forecasts from NOAA data.

EMERGENCY NEEDS. Preparing for an emergency is essential, considering how isolated the boat may be from all services. When you leave, the day may be warm and sunny, and you may plan to be back well before sundown. But trouble can develop, so be prepared for it. Number one on your list should be a reserve supply of drinking water. Include warm clothes, too, as it can get cold on the water after sundown. It's also a good idea to have a warm blanket or two aboard, and insect repellent.

Sunscreen is a requirement, too. On the water, direct and reflected sunlight can combine to give you a bad sunburn, which can be further exacerbated when a strong breeze sensitizes the skin.

Take your PFDs (life jackets) out of the locker and put them where they are readily accessible. Before you leave the dock, make sure each person is assigned a PFD that fits and knows how to put it on. Better still, have everyone wear a PFD at all times. It is always difficult to don a PFD in the water, and in cold water it may be impossible. In many places, the law requires nonswimmers and persons under a certain age to wear a PFD.

THROTTLE AND STEERING. Take the time to check your throttle, gearshift lever, and steering mechanisms. This is especially important when using your boat in salt water, since these mechanisms can corrode and freeze.

OTHER EQUIPMENT. Have you brought all the equipment on board that you will need? This includes electronic equipment such as global positioning system (GPS), radar, and a portable depth finder, if you have them. If you removed your radio, did you remember to install it again? Do you have your anchor and enough line? In an emergency you may have to anchor in deeper water than you had originally planned.

Do you have your whistle or horn aboard? Is it in working condition? Permanently installed horns may corrode, and when they do, they no longer work.

You should also have a heaving line and a boathook available. A ***heaving line***, which is a light line weighted at one end, is useful when you need to throw a line to another vessel or to a person on the pier should you have trouble docking. The ***boathook*** can aid in mooring and docking as well as in retrieving objects dropped in the water.

CHECK YOUR GAS, OIL, AND LIGHTS. Check the fuel supply to determine if it's sufficient, and remember the One-Third Rule of fuel management. It is rare to start a trip in stormy weather, but bad weather may develop, and the fuel requirements to get home may become high. This is the worst time to run out of fuel. When you have a stern-drive or inboard engine, check its oil level. If you have an outboard motor that automatically mixes oil with the gasoline, check to see that this oil reservoir is full.

Following this, check all lights, including the running lights. You never know when you will encounter rain or fog, or when an unexpected situation will keep you out late. Should the lights not be working properly, fix them before you go.

Starting Your Engine

Check enclosed spaces, including the cabin and engine compartment, for gas fumes. Even when you don't smell fumes, run your blower for 4 to 5 minutes before starting your engine. (It is not necessary to vent fumes from a diesel engine, since those fumes are much less combustible.) You are ready now to start your engine.

After you start your engine, allow time for it to warm up. This will prevent stalling as you shift

Figure **4-20.** The telltale cooling water streams coming from these idling outboard motors show that the cooling water flow is normal. (PHOTO BY BOB DENNIS)

into gear to leave the pier. Avoid excessive idling, however, since the engine's lubrication is usually poorest while idling.

While waiting, check the telltale of your outboard motor to confirm cooling water flow. The *telltale* (also called the tracer) is a jet of cooling water that sprays from a relief valve under the outboard's powerhead (Figure 4-20). Most of the cooling water is exhausted through the propeller hub or a nearby underwater valve, but a good spray from the telltale indicates that the cooling system is working normally. If the telltale is *not* spraying, the problem may be nothing more than a blockage in the telltale orifice. Try working the end of a paper clip into the orifice; if the spray resumes, all is well.

If your motor lacks a telltale but the cooling water exits through the exhaust, check to see that it is flowing freely. For any engine, keep an eye on the temperature gauge to see that the engine is not overheating.

If your outboard motor has a warning signal, heed it and immediately shut down your engine upon hearing it. Then check the water intake. Floating plastic debris is a frequent source of intake problems. If you have a stern drive or an outboard, shut off the engine, then raise the motor or the outdrive to see if anything is clogging its intake ports.

Also, while waiting for the engine to warm up, check all gauges to see that everything is functioning properly. Is your alternator charging correctly? Does your voltmeter show problems with your battery? If you have a stern-drive, inboard, or four-stroke outboard engine, do you have enough oil pressure?

Getting Underway

With the engine warm and all gauge readings satisfactory, it is time to get underway. Secure all loose gear about the deck, and after you have cleared the pier, take in all fenders.

Before casting off, pay special attention to the direction and strength of the wind and water current. You will need to work with these as you leave and when you return. Also, note all hazards and obstructions in the area.

To cast off, untie all lines not needed in maneuvering away from the pier, and bring aboard those you will take with you. Stow them where they are readily available and where they will not be a hazard. Some skippers leave their lines at the pier so they will be there to tie up with when they return. Take at least a bow and a stern line with you. You may want to stop for fuel or for lunch, and you will need them at that time.

Figure 4-21 shows lines that will safely moor your boat to a pier or a seawall. If you have tied these lines with appropriate knots, they will be easy to untie and cast off. The best knots for mooring purposes are clove hitches, half hitches, and belaying to a cleat (see Chapter 11).

As you leave the dock, move at idle speed. Most marinas have a 5-knot or 5-mile-per-hour speed limit. You are liable for any damage caused by your wake or wash, and may also be cited for negligent operation.

In open water, avoid cruising at top engine speed. Top speed is hard on an engine and can be dangerous. Many boats become unstable at top

BEFORE YOU GO

A "pre-underway" checklist will ensure that your boat's systems are running smoothly before you go. Don't leave the dock only to discover that your steering doesn't work. Take the time to start the engine(s) and check the steering and gears, cooling water flow, oil, electrical systems, and through-hull fittings. Like a pilot making preflight checks, you should inspect your boat and its systems before every trip. Brief your passengers, too, as discussed in the accompanying text.

Routine maintenance of your boat and systems will save time and money on repairs later. See Appendix I for a sample preventive maintenance checklist you can modify for your boat.

speeds, and serious—even fatal—accidents may result. Vessels that are particularly unstable at top speeds include those with deep-V hulls, those with single-cable steering, and those that are overpowered. Bass boats operated at high speeds should be equipped with dual-cable steering to reduce the amount of play inherent in a single-cable system.

As a vessel's speed increases, the amount of its hull surface in contact with the water decreases. The less hull contact there is, the less control you have over the vessel. If you feel your boat becoming unstable, immediately slow down, lower your outdrive or outboard farther into the water (i.e., toward the transom), and/or lower your boat's trim tabs, if present. ***Trim tabs***, also known as flaps, are a pair of hinged plates mounted on either side of the transom's bottom edge. In the raised, horizontal position, they have little effect on trim, but when lowered they lift the stern and force the bow down (Figures 4-22, 4-23, and 4-24). The tabs are usually controlled hydraulically by means of rocker switches mounted at the helm, so that they can be adjusted underway. They can also be adjusted independently, so that you can lower the flap on the side of the boat that's heeling into a crosswind or due to uneven weight distribution (Figure 4-25).

No Wind/Current

When there is no current and the wind is not strong, the easiest way to leave a pier in a boat less than 30 feet long is to push off from it. Once your boat is far enough away from the pier, you can proceed in forward or reverse gear.

If you try to leave the pier merely by powering forward without pushing off first, you may find yourself bumping along its entire length. Remember that when you turn away from the pier while moving forward, your stern swings into the pier.

A simple way to leave a dock is by backing out. Turn the outboard or stern-drive lower unit in the direction you want the stern to move, then back out slowly. Once you are clear, go forward. (This technique also works for twin-screw inboards.)

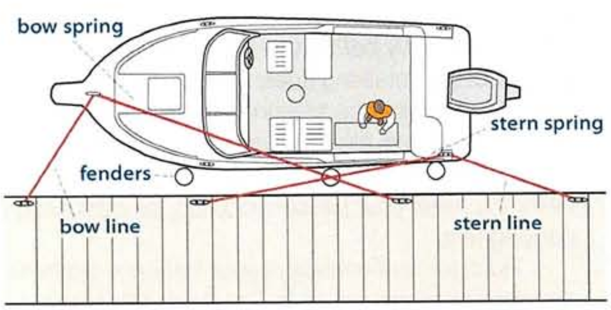


Figure **4-21.** A typical dockline configuration.

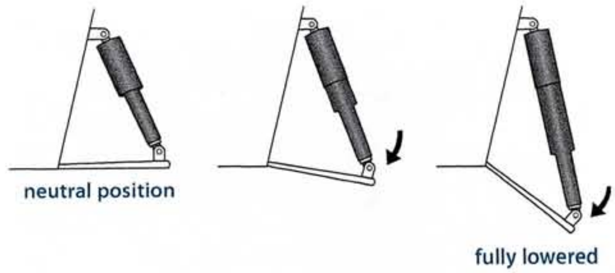


Figure **4-22. Left to right:** Trim tab adjustments. In their neutral, raised position, trim tabs have little impact on boat trim, but when fully lowered they lift the stern and force the bow down.

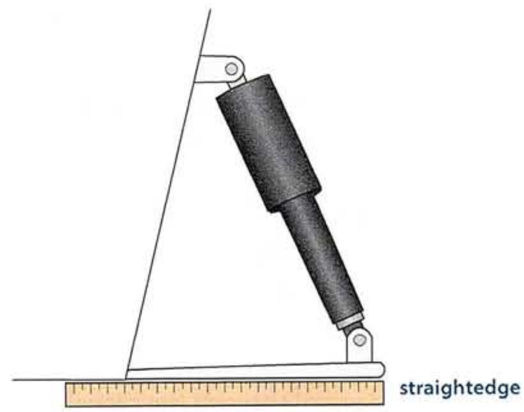


Figure **4-23.** Checking a trim tab with a straightedge. The tab should align with the hull when the indicator dial at the helm position reads zero.

Wind and Current

Wind and current have different effects on different boats. Using the following generalizations, experiment to gauge their impacts on your boat.

Deep-draft boats with comparatively low above-the-water profiles are less affected by wind than by current. There is less boat above the water upon which wind can act, and more boat in the water on which current can act.

Generally, the bow of a powerboat is higher than its stern and is considerably lighter. Thus, the

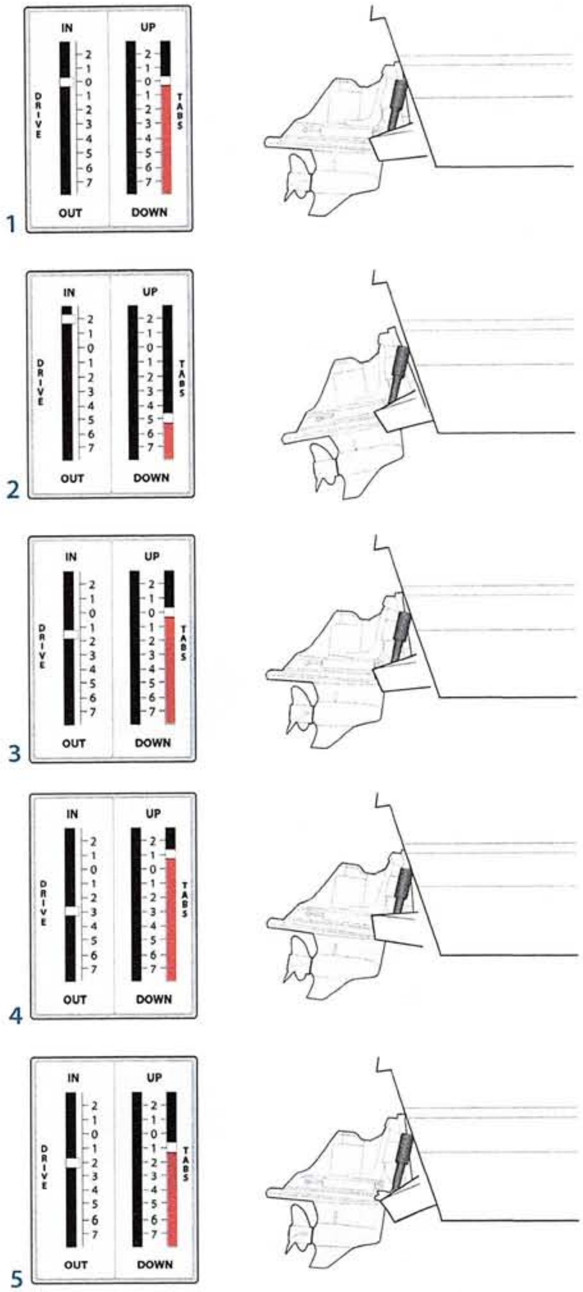


Figure **4-24.** The use of drive trim and trim tabs in tandem to control the trim of a stern-drive boat. **1. Zeroing in:** To create a reference point, use a straightedge such as a yardstick to line up the tabs and drive so they are parallel with the bottom. **2. Getting on plane:** To get on plane faster, use the drive and tabs to raise the stern and keep the bow down. **3. 20–30 knots (smooth water):** The tabs are now aligned with the bottom, and the drive is up. **4. 50 knots or more (smooth water):** The tabs are lifted out of the water stream and the drive is trimmed up to a point just before the prop ventilates. **5. 50 knots or more (rough water):** To keep more of the boat in contact with the water for a smoother ride, bring the drive down from its maximum position and lower the tabs slightly. (REPRINTED WITH PERMISSION FROM *FAST POWERBOAT SEAMANSHIP* BY DAG PIKE)

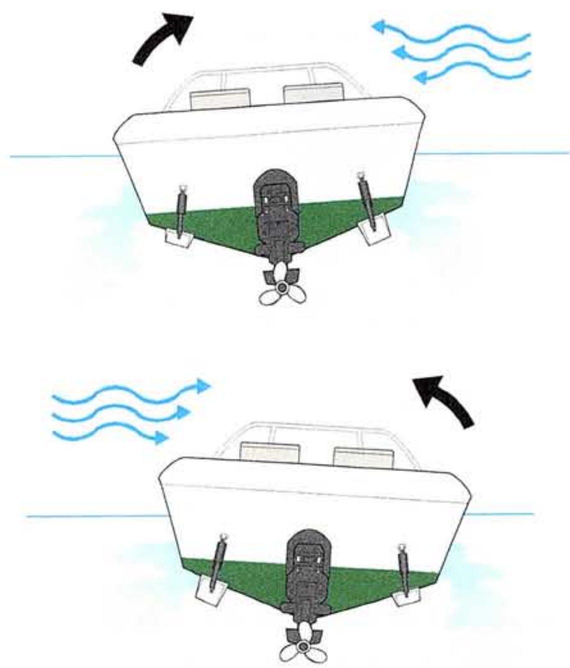


Figure **4-25.** Trim tabs can be adjusted individually to counter the tendency of a boat to lean into a strong crosswind from starboard (top) or port (bottom).

bow almost always turns away from the wind. This leaves the stern, with its lower freeboard, pointed toward the wind and waves when the boat is not anchored by the bow.

Wind/Current Off the Pier

When the wind or current (whichever predominates) is coming from the direction of the pier (Figure 4-26), getting underway is simple. Cast off all lines and let the current or wind carry you far enough away from the pier to allow safe maneuvering.

Wind/Current On the Pier

When the wind or current is pushing you toward the pier, the problem is more difficult. If there are no boats behind you and your boat has a stern-drive or outboard engine, it is easiest to back away. With all lines cast off, turn your helm away from the pier and back out slowly. When you are far enough away from the pier, you can turn and go forward.

If there is insufficient room behind you for that maneuver, however, you may need to perform an additional step (Figure 4-27). In this case, use your bow line to assist in pulling the stern away from the pier. Fasten one end to your bow and pass the line

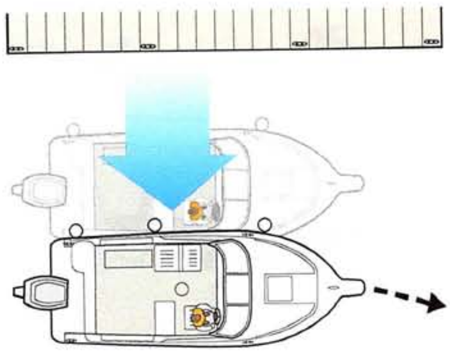


Figure **4-26.** Leaving a dock with the wind blowing off the pier.

once around a ***bollard*** (post) or a ***cleat*** on the pier. Bring the other end of the line back to the boat and make one or two simple turns around the bow cleat. Now turn your helm away from the pier and back out slowly. The stern will swing out while the bow line prevents you from backing down on your neighbors. You can then straighten your helm, retrieve your line, and back out.

Alternatively, power forward gently against your bow spring line with your helm turned toward the dock (Figure 4-28). The spring line will prevent forward movement while your stern swings out. When your stern has swung sufficiently, retrieve your spring line and back clear. (This method also works with an inboard engine.)

Wind/Current On the Bow

Leaving a pier with the wind or current on the bow is simple. Push the bow away from the pier and go forward at idle speed. The wind or current will swing your bow out and you can go straight forward. This works even in close quarters.

In very tight conditions, a stern spring line can be used to prevent backward movement of the boat as the bow swings out (Figure 4-29). Run a temporary line from the boat's stern cleat around a pier cleat or piling and back to your boat. Secure it with one or two simple turns around the stern cleat. In this way, you can easily retrieve your line after the boat is free of the pier—but be sure to get it back aboard quickly after you release one end before it wraps itself around your prop.

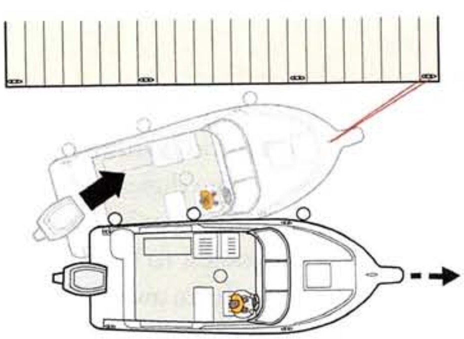


Figure **4-27.** Backing against a bow line enables you to kick the stern away from the pier without backing down on the boat behind you. Loop the bow line around the bollard or cleat on the dock so that you can recover it from the boat as you back away from the pier.

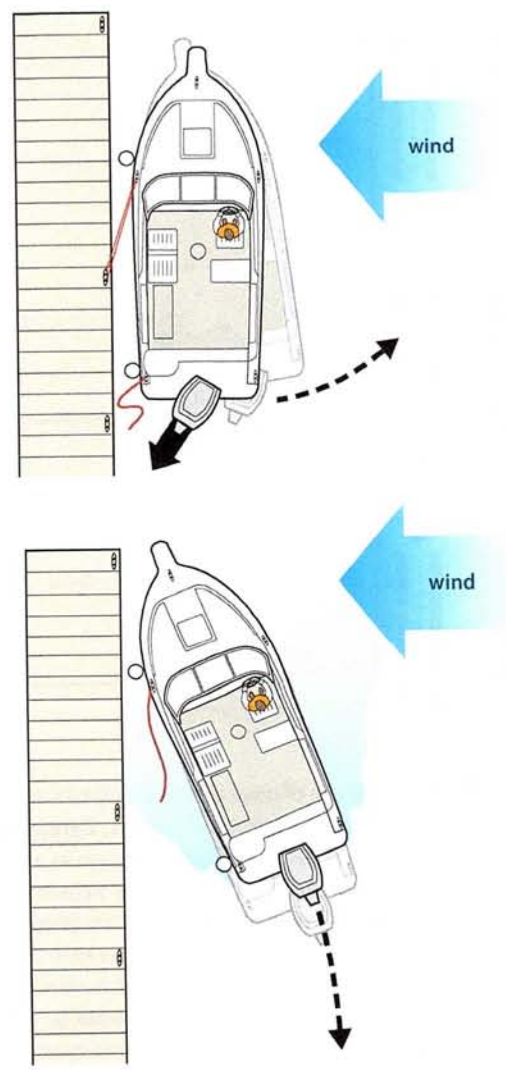


Figure **4-28.** Another way to kick the stern away from a pier is by powering ahead against a bow spring line with the propeller discharge (or rudder) turned toward the pier (top). Once the stern is sufficiently clear, you can back away from the pier, recovering the spring line as you go (bottom).

Wind/Current On the Stern

Having the wind or current on your stern is only a little trickier. If you are not in close quarters, simply push away from the pier and go slowly forward or back until you're clear. In close quarters, you can use a bow spring line to temporarily secure the bow while pulling the stern out with the propellers. Run the line back from a bow cleat and around a cleat or piling on the pier, then back to the bow, making one or two wraps on the bow cleat. Turn the wheel away from the pier and back out the boat's stern as in Figure 4-27. When the boat is clear, retrieve the temporary bow spring. Alternatively, turn the wheel *toward* the pier and power gently *ahead* against the bow spring until the stern swings out (as in Figure 4-28), then shift into reverse to back clear. (This latter technique also works with an inboard boat.)

Turning in a Narrow Channel

You may find it necessary to turn 180° in a channel that is too narrow for your boat's turning radius. A twin-screw boat will have no problem, nor is this maneuver much of a problem for an outboard or stern-drive boat when the wind is on the bow. In this case, simply hug one side of the channel and make a sharp turn toward the other side (Figure 4-30) while reducing your engine speed and shifting to neutral. The wind will bring the bow around and you will be on your way.

If the channel is too narrow for a complete turn, start the turn as in Figure 4-30, but when your boat approaches the far side of the channel, shift into neutral while you turn the helm all the way in the opposite direction, then shift into reverse. Now apply power to back up while pulling the stern in the desired direction. When you once more approach the original side of the channel, shift into neutral and turn the helm the opposite way again, then go forward again to complete the turn (Figure 4-31).

Things get a little trickier when the wind is blowing on your stern in a narrow channel. When your boat turns sideways, the wind will bear directly on one side, and this will cause your boat to resist completing a full turn (Figure 4-32). Also, the boat will continue to be blown up the channel. In this case, it is advisable to hug one side of the channel, then shift into reverse, turn your wheel toward the far side of the channel, and apply throttle so as to drive your stern backward toward the far side (Figure 4-33). After crossing the channel, reverse the helm again and power forward. In a very narrow channel such as a marina approach, it may be necessary to repeat this procedure several times to complete the full turn.

When the wind is strong and blowing from your stern, you may not be able to turn even by backing. In this case, lower your anchor. The wind will cause you to fall back on the anchor, bringing your bow into the wind. Now as you head into the wind, retrieve your anchor line and anchor. This maneuver requires quick action by the person tending the anchor and should be used only in extreme cases.

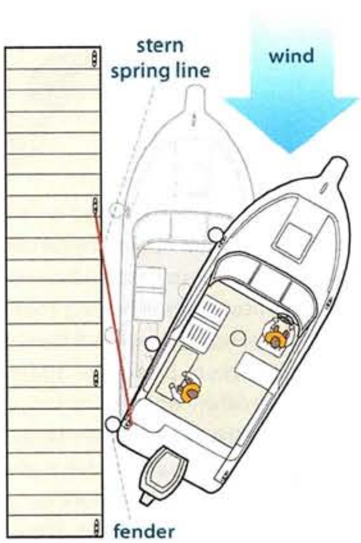


Figure **4-29.** Powering astern against a stern spring line will kick out the bow. You can then leave the dock in forward gear. This technique is useful when the wind or current is on your bow as well as when the wind is blowing toward the dock.

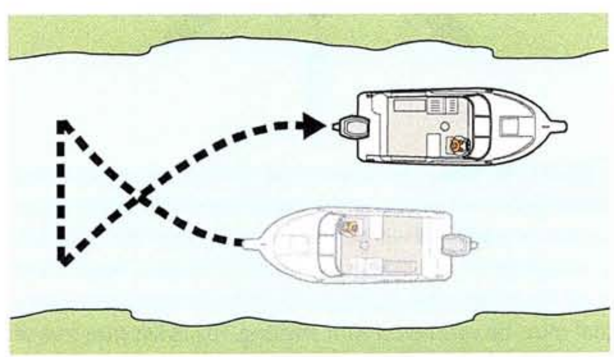


Figure **4-30.** Turning a boat in a narrow channel.

Watch Your Wake!

A variety of speed signs are posted by state, county, and municipal authorities (Figure 4-34), and you have the responsibility of knowing the signs in your area. The terminology varies. The slowest zone may be marked "idle speed zone" or "no wake zone," or it may specify a top speed. This is often defined as the slowest speed you can possibly go and still maintain steerage, sometimes referred to as clutch speed.

The intermediate zone may be called a "slow speed zone" or "no damaging wake zone." This may be defined as the maximum speed where the boat remains level, or a boat speed that will produce a wake no larger than a certain height.

A planing vessel goes through three stages as it increases its speed (Figure 4-35). At slow speeds, it is a displacement boat, but as it accelerates, its stern sinks and its bow rises. When this happens, you cannot see the water immediately in front of you, and a

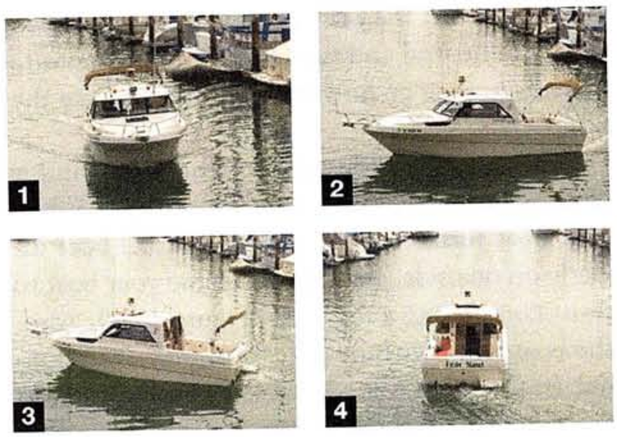


Figure **4-31.** A stern-drive boat making a controlled turn in a narrow channel. (PHOTOS BY BOB DENNIS)

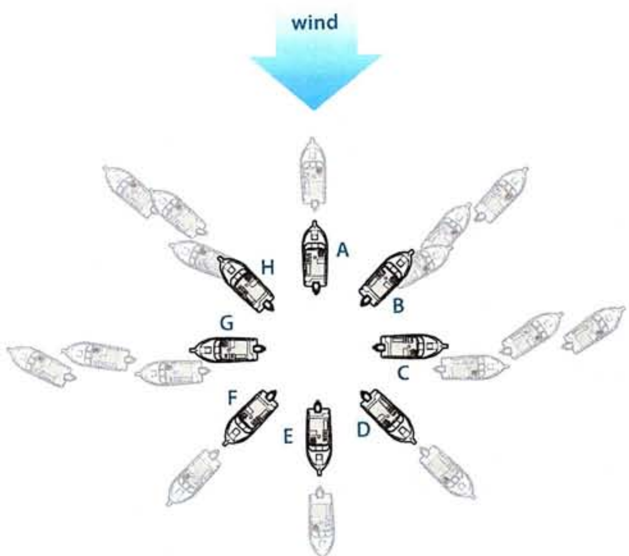


Figure **4-32.** The influence of wind on a boat powering ahead. Boat A will of course be slowed somewhat, and any turn to port or starboard will be exaggerated when the wind begins to push on one side or the other of the bow. Boats B and H will have their bows pushed away from the wind, a tendency that must be countered with steering. This is likewise true of boats C and G. Boats D, E, and F are least affected. (ADAPTED WITH PERMISSION FROM *GETTING STARTED IN POWERBOATING* BY BOB ARMSTRONG)

Figure **4-33.** The influence of wind on a boat going astern. We'll assume that the boat has a right-handed propeller, and therefore tends to turn toward port when backing in an absence of wind. Since most boats will swing their bows away from the wind if left unattended, boat A will back straight into a fresh breeze even if it backs to port in the absence of wind. Boats E, F, G, and H, on the other hand, will veer to port in an exaggerated fashion due to the wind on their bows. Boats B, C, and D can be made to back to starboard in a strong breeze even if they refuse to do so at other times, or they can be backed straight, albeit with offset as shown. These effects are most pronounced for single-screw inboard boats, but even a twin-screw boat or a properly trimmed stern-drive or outboard boat will tend to swing its stern into the wind when backing upwind as in boats A, B, and H. (ADAPTED WITH PERMISSION FROM *GETTING STARTED IN POWERBOATING* BY BOB ARMSTRONG)

Figure **4-34.** A speed limit and no-wake sign at a marina entrance. (PHOTO BY BOB DENNIS)

large wake follows your boat as water rushes in to fill the "hole" made by your squatting stern.

In this stage, your boat is dangerous to other boats and to property and is also most costly to operate. Its wake can rock other boats and swamp smaller ones, and people in nearby vessels may fall and injure themselves or even be knocked overboard. Your wake can damage seawalls by undercutting them and harm immature sea life in nearby wetlands. It is advisable to run your boat slower or faster than this intermediate speed when there are no speed restrictions. When there are, slow down enough to avoid this second stage (Figure 4-36).

Eventually, as you increase your power, a planing boat rides up over its bow wave and gets on plane. When this happens, both its bow and its fuel consumption drop, and the boat again feels comfortable. There is still a wake, but it is lower than the second-stage wake. When you pass other people, stay far enough away that your wake does not disturb them. Should you be unable to avoid other boats, slow down until you are off plane and back on a level keel—i.e., below the second stage of the speed curve.

As a planing vessel slows down, it passes through the above stages in reverse order. The hull usually settles quickly once you reduce power, stopping in a relatively short distance. In fact, you must avoid slowing down too quickly, or your wake will overtake your boat and may even roll in over the transom, swamping the boat.

Man Overboard

Underway, there is always a risk that someone will fall overboard. That's one of the reasons you wear a PFD. When someone does go overboard, every moment is important, and you and your crew

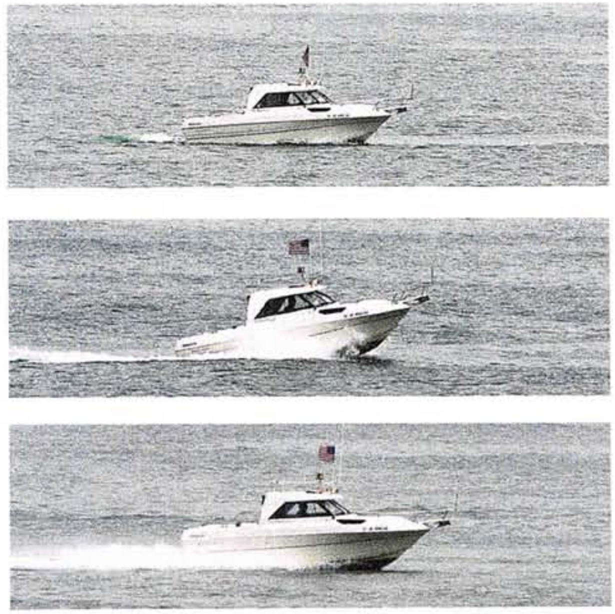


Figure **4-35.** **Top to bottom:** A powerboat traveling at slow speed, getting up on plane (note squatting stern and bigger wake), and planing (level keel, smaller wake). (PHOTOS BY BOB DENNIS)

should therefore rehearse ahead of time how to react. If you have guests aboard, explain your procedures to them before you go.

The actual recovery of a person from the water requires the skipper to exercise extreme care. The object is to recover the person in the water as quickly as possible while avoiding undue risk to the crew on board. In short, don't make a bad situation even worse.

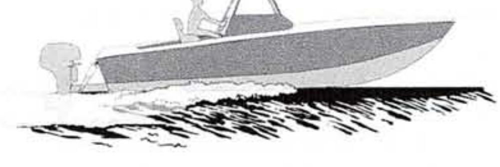


Figure **4-36.** Trim tabs can keep a boat on plane at lower speeds. The top boat is squatting dangerously, creating a large wake and running the risk of submerging the bracket-mounted outboard or even taking a wave over the transom. The bottom boat, with trim tabs deployed, is traveling at the same speed but in much better trim. (COURTESY LENCO MARINE)

Sound the Alarm

What is done in the first moments after someone falls overboard may well determine the success or failure of the recovery. The first person to realize that someone has fallen overboard should immediately shout an alarm and point to location of the victim. You should shout loudly and indicate on which side of the boat the person fell. For example, yell "Man overboard, port side!" and keep shouting until the skipper hears and understands.

The skipper should immediately get the engine or engines into neutral and assign someone to keep the victim constantly in sight. If you have a GPS, punch in the coordinates of the accident location; most GPS receivers have a man overboard (MOB) button for just this purpose.

If your boat has a life ring buoy or similar device assigned for this purpose—as it certainly should—throw it to the victim, but wait until there is a reasonable expectation of the victim reaching the life buoy. If the boat has moved out of throwing range from the victim, you will have to get back to the victim as quickly as possible (see below). It is advisable to tie a polypropylene retrieval line to the life buoy, because polypropylene floats (Figure 4-37). The person in the water can then either grab the line or the buoy, at which point your crew should pull gently but firmly on the line to pull the person toward the boat. If a life ring or buoy is not immediately available, however, throw anything that floats.

MAN-OVERBOARD PROCEDURES

1. Instruct crew and passengers to:
   A. Keep a close watch for people falling overboard. (A buddy system works well, especially with small children.)
   B. If someone does fall overboard, announce in a loud voice, "MAN [or CREW] OVERBOARD!" point to the MOB, and do nothing except watch the MOB, pointing continuously, while the captain turns the boat and returns to the MOB.
   C. While the boat is returning to the MOB, prepare a throwable PFD and line that should be available for just this circumstance. As soon as the MOB is close enough (or, even better, before he or she is too far away), throw the PFD or buoy close enough for the MOB to grasp.
2. Have an MOB recovery plan for your boat, and practice its implementation.

Returning to the Victim

If your boat travels well past the person overboard before you can get it stopped, your first priority is to get back to the victim. After making absolutely certain that the victim is nowhere near your propeller or propellers, make a short, hard turn to return to him or her, following the instructions and the pointing finger of the person you have assigned to keep the victim in constant sight. If you have lost visual contact, return to the MOB coordinates you should have punched into your GPS. If the victim is not located after a short search, make a Mayday call to the Coast Guard on Channel 16, and brief them on the situation.

As you approach the victim, do so very slowly and with your bow pointing directly into the wind, waves, or current, whichever is predominant. Throw a life ring or anything that floats as soon as the victim can reasonably reach the flotation aid or its line. Your final approach should be very slow, and be sure to turn off your engine. Even in neutral, propellers may continue to spin and are dangerous. A propeller can cause serious injury and/or death to anyone in the water. Because of this, turn off the engine whenever someone is in the water.

If the victim cannot grab the line or can't keep his or her head above water, make every attempt to recover the person from aboard the boat before allowing someone to go overboard to assist. Anyone who does go into the water to assist should be trained in rescue techniques and should be wearing a PFD with a lifeline. It is common for an MOB to panic and try to climb on top of the rescuer, increasing the chance that they will both drown. The boat captain has the responsibility to weigh the risks of every decision and to prevent an emotional crew from taking unwise actions.

Figure 4-37. Throwable PFDs. Ideally, the attached retrieval line should be polypropylene.

Retrieving the Victim

Retrieving someone from the water, even someone who can help him- or herself, is difficult when there is no boarding ladder or special device to assist, especially when your boat's freeboard is higher than about 12 inches. If the victim cannot assist his own recovery, there is a good chance that even strong people aboard the boat may not be able to get him aboard.

If your boat is very small, it is usually advisable to recover a person over the bow or stern to keep from capsizing. On larger boats, the stern is the best recovery point because the victim can grab the outboard or outdrive for assistance, using it as a makeshift ladder. When a boarding ladder is available, it can be deployed anywhere, although the stern is the most common location. A secured loop of line extending about 2 feet below the waterline can be used as a "step" to assist a person who has the ability to use it.

If the victim is wearing or can put on a PFD, the recovery crew can try dunking him just before pulling him up. The inertia from bobbing up after being dunked will assist in the recovery. The victim should be facing the boat so that if the initial recovery attempt gets him or her only partway on board, he or she can be held by the torso until the crew can get a new purchase on the victim's legs or belt.

If this fails, turn the victim's back toward the boat and attach a line around his chest and under his armpits, with both parts of the line leading up over his back to the crew on deck to assist in the pulling action (Figure 4-38). The natural roll of the boat may also assist the recovery. Failing this, the only option may be to secure the person so that his or her head is above water, and await additional aid.

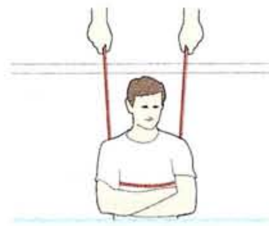


Figure **4-38.** Using a line under the arms to help get a person back on board.

Larger sailboats have the advantage of having winches aboard, and can use the boom as a lift point. A *preventer* (a line from the boom to a cleat, toe rail, or other attachment point) should be used to lock the boom in a stationary overboard position.

Propeller Safety

Man overboard accidents have a high potential of leading to propeller strikes; these are extremely harmful and often life threatening. Following some commonsense rules will help avoid these accidents: never start a boat with the engine in gear; don't allow anyone to ride on a gunwale, transom, or bow; insist that everyone in the boat is seated properly; appoint a lookout whose sole job is to watch for anyone who is not positioned safely and to sound an alarm if someone falls overboard; be on the alert for people in the water, especially when you're in areas where swimmers may be present. As a boat operator, you should investigate some of the new technologies for preventing propeller strikes: guards that prevent contact with a propeller, interlocks that automatically turn off the engine to prevent a strike, and wireless sensors should all be considered.

Docking

Docking a boat can be a source of pride or embarrassment. Some skippers approach a pier at breakneck speed and throw their engines into reverse at the last moment. If they don't go into the pier, they pull alongside just in time to be pounded against the pilings by their own wakes.

Don't be a hot rodder. Make your approach cautiously and slowly. All you need is enough speed to steer your boat. A slow approach doesn't look as spectacular, but it is better seamanship. It is also good seamanship to have fenders, docking lines, a heaving line, and at least one long line ready in advance of docking.

Given a choice, approach a pier or mooring with your bow headed into the wind or the current, whichever is the dominant influence. It is harder to make the boat stop where you want it to when you are heading downwind or downstream. Downwind docking requires more skill than docking into the wind.

Plan your approach carefully. A bad approach can cause your boat to slam into the wharf or another boat, with costly results. Leave yourself an escape route as you make your approach, and if you see a problem developing—such as a gust of wind, a misjudged angle, a swinging boat, or an inattentive boater invading your path—just start over. It is much better seamanship to bail out and try again than to persist in a bad, perhaps even dangerous, approach. Prudent skippers try to foresee and prevent problems before they happen.

Docking with No Wind or Current

In the absence of wind and current, an approach angle of about 20° is ideal (Figure 4-39). Simply bring your bow slowly into the wharf, pier, or float, and just before touching, turn parallel with the dock and reverse your engine or engines to stop the boat. Your fenders should be in place, and you should have your bow and stern lines ready to deploy, their inboard ends secured to the boat's bow and stern cleats. Have your crew *step*—not leap—onto the dock with docklines in hand.

If your boat is a single-engine inboard with a right-handed prop, a port-side-to landing is ideal. That way, when you put the engine in reverse, the propeller's side thrust (sometimes called propeller walk) will nudge the stern into—rather than away from—the dock.

Wind Blowing Off the Pier

When the wind is blowing off the pier toward you, as in Figure 4-40, head into it at a steeper-than-normal angle. The stronger the wind, the greater will be the angle of your approach. In a very strong wind, your approach may even have to be straight in or perpendicular to the pier.

When close to the pier, send the bow line ashore and tie it off. Then put your helm hard over toward the pier and reverse your engine slowly. Backing against the bow line will bring your stern around to the pier. Place a fender between the pier and your boat as you reverse.

As an alternative, after you have a bow line secured, send a stern line ashore and let the line handler on the dock warp in your stern. This only works when you can throw the stern line to a waiting line handler, however. You do not want an anxious crew jumping 2 to 3 feet from the deck to the pier to secure the boat.

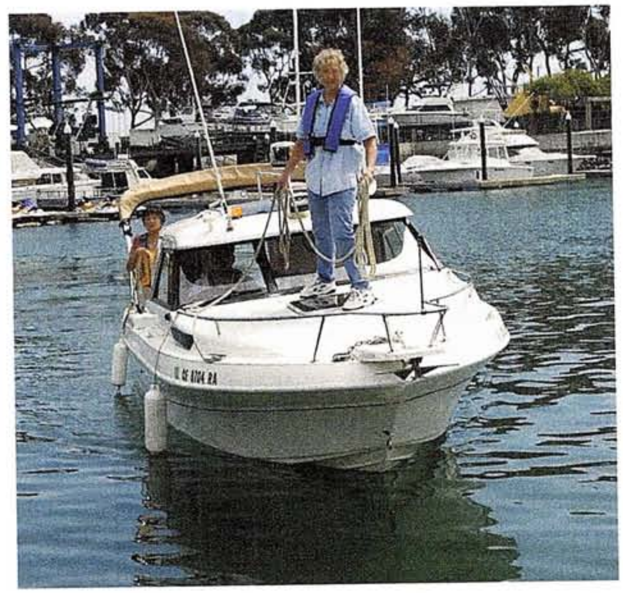


Figure **4-39.** Docking on a calm day with no current. The approach is made at an angle of roughly 20° with the dock face. Fenders are in place, and crewmembers have the bow and stern lines ready. (PHOTO BY BOB DENNIS)

Yet another alternative is especially useful for a single-engine inboard boat. In this variation, when you're close to or nudging the pier, send a bow spring line rather than a bow line ashore to be secured near the aft end of the available dock space. Then power gently forward against the spring with your helm hard over away from the dock. This should cause your stern to swing into the dock.

Wind Blowing On the Pier

When the wind is blowing toward the pier, approach as you would in the absence of wind and current but turn parallel with the dock farther out than usual (Figure 4-41). Then simply let the wind blow you in. Since the bow will fall off more quickly than the stern, turn your helm away from the pier. Then, should it be necessary, ease your boat forward to bring the stern in.

Always have fenders deployed in advance to cushion the impact of a landing. When the wind is strong, the impact may be considerable. No one should EVER use their arms or legs to fend off as a boat approaches the pier. Arms and legs have been broken or even crushed in this manner. A heavy boat, even when moving slowly, carries a lot of momentum and is difficult to stop.

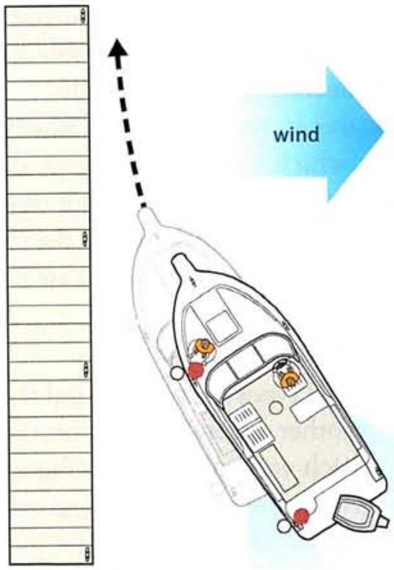


Figure **4-40.** With the wind blowing off the dock, this boat approaches at a steeper-than-normal angle before turning more parallel with the dock face at the last moment. The stronger the wind, the steeper the approach angle must be, and the more critical it becomes to get the bow line made fast quickly. Then you can back against the bow line to bring the stern in.

Mooring to a Permanent Anchor

Mooring buoys fasten to permanent anchors sunk deeply into the bottom (Figure 4-42). You will find them near yacht clubs and in some harbors, where they have been placed for the convenience of boaters. In the Florida Keys, you can find them near favorite diving spots so that you can tie up to them instead of anchoring on a coral reef and damaging it.

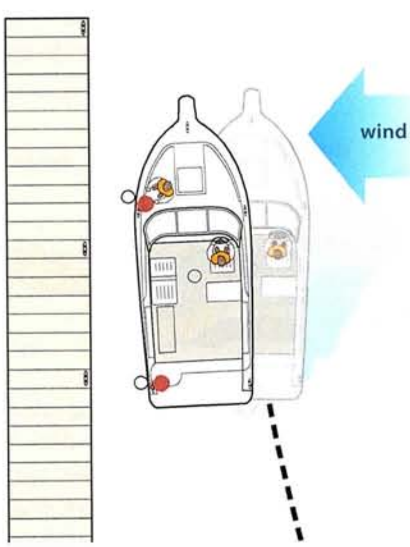


Figure **4-41.** When the wind is blowing toward the dock, make your approach to an imaginary dock a few feet seaward of the real dock, then let the wind blow you in.

Mooring buoys are the only ones boaters may tie up to legally. Mooring to any aids to navigation, including buoys, is illegal. Many mooring buoys are privately owned, so get permission before you use them.

As you approach a buoy, remember that some boats are more sensitive to wind while others are more sensitive to current. Approach the buoy against the stronger force, wind or current. When other boats are moored in the vicinity, see how they are heading and then adjust your approach to parallel them. Shift into neutral when you see that you have enough forward momentum to reach the buoy.

There should be a pickup float attached to the buoy (or to the chain beneath it) by a long rope, or ***pendant***. Have your crew snag the pickup float and bring it aboard. (Sometimes the float will have a wand to facilitate pickup; other times, you will have to snag it with a boathook—Figure 4-43.) Secure the pendant to your ***bitt*** (a post on the foredeck) or a bow cleat. After you have tied to the pendant, stop your engine and let your boat drift back.

If you misjudge your approach, simply continue around, line up your approach once more, and try again. This is better seamanship than trying to back down to the buoy.

Some boaters moor both forward and aft, or they might moor forward and anchor aft. Both these practices are discouraged and could cause your boat to swamp or capsize as tides and winds change.

Leaving a mooring is easier than leaving a dock. About the only problem is keeping the pendant out of your prop. You can do this by backing up slowly and dropping the pendant only when there is no longer any danger that it will foul the prop.

Anchoring

Every skipper should master the art of anchoring. You need this ability not just for protection, but for the enjoyment of boating.

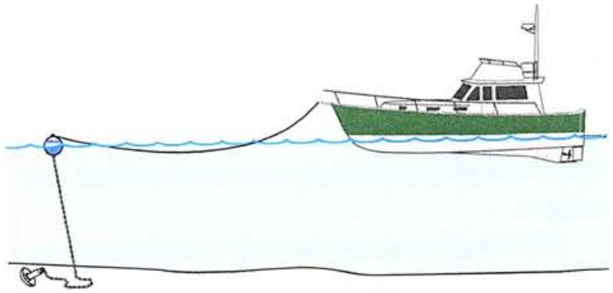


Figure **4-42.** A typical mooring rig.

Figure **4-43.** A crewmember on a cabin cruiser using a boathook to pick up a mooring. (PHOTO BY BOB DENNIS)

Equipment

Anchoring equipment is called *ground tackle*. The kind of ground tackle a boat should carry depends on several factors, including the type, weight, and length of your vessel. Also important are the characteristics of the bottom sediment and the depth of the water in which you will anchor, as well as the strengths of the wind and current. To be adequate, your ground tackle must hold your boat securely under the most adverse conditions.

Anchor Rode

The *rode* of an anchor is its line and chain. An effective combination consists of 4 to 6 feet of heavy chain, a shackle, a thimble, and a nylon line (Figure 4-44). The chain helps the rode lie flat on the bottom, thus enabling the anchor to dig in. It also protects the line against chafing on rocky bottoms.

The ***shackle*** is a U-shaped piece of hardware, commonly made of galvanized steel, with a pin or bolt across its open end. It connects the chain to the line. Secure the pin or bolt with a length of wire so it won't work loose, causing you to lose your anchor.

The ***thimble*** is a horse collar–shaped metal or plastic device that is inserted in the eye splice at the end of the anchor line. Its outer surface has a shallow, U-shaped cross section so that the eye splice will not slip off it. The thimble keeps the eye splice from chafing on the shackle.

Nylon makes an excellent anchor line because of its elasticity, which eases the shock of the boat's movements on the anchor. The anchor chain serves the same purpose. As your boat surges, the chain rises and falls, thus easing the strain on the anchor.

Types of Anchors

There are several types of anchors, and the choice of one over another depends mainly on the type of bottom in which you will anchor (Figure 4-45). Some have greater holding power than others.

DANFORTH/FLUKE. The most popular anchor for recreational craft is the Danforth (Figure 4-46). This is a lightweight anchor with long, narrow, twin flukes that pivot about the stock and dig into the bottom when the anchor is pulled by the rode. A Danforth anchor is of little use on a grassy bottom, however, because the flukes slide across the grass rather than digging in. The anchor works well in mud and sand but may get hung up on a rocky bottom.

To attach a **trip line** to a Danforth, drill a hole in the crown, tie one end of the line there, and place a small buoy on the surface end of the line. If the flukes snag on a cable or rock, you can retrieve the anchor with this line.

Alternatively, you can shackle the anchor chain itself to a hole in the crown, then lash it to the anchor ring with a relatively weak line. If the anchor hangs up, tie off the anchor rode to a cleat

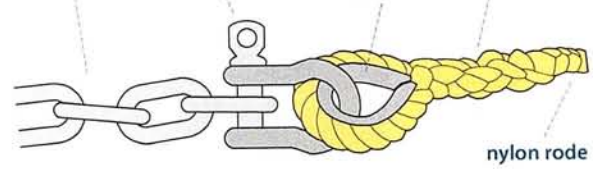


Figure **4-44.** A combination of chain and nylon rode is a popular choice for anchor ground tackle. The chain at the anchor end of the rode resists chafe on the bottom and provides a more nearly horizontal lead from the anchor, enabling the anchor to dig into the bottom more firmly. The nylon rode acts as a shock absorber and is lighter and easier to handle than chain. The connection between the two is best made with a shackle through a thimbled eye splice in the nylon rode, with the thimble protecting the nylon from chafe.

or bitt and power ahead slowly, being careful not to foul the line in your prop. When you have gone far enough, the line fastening the anchor chain to the ring will break. Going farther forward will usually pull the anchor loose.

In one modified Danforth design, the anchor has a slotted shank containing a movable ring to which the anchor chain attaches. If the anchor hangs up, running back across it with a slack rode will usually pull the ring down to the crown, and a slight pull will then free it.

Anchoring with this modified Danforth requires some care. As you lower the anchor, keep the rode taut, and when the anchor hits bottom, back the boat down while keeping slight pressure on the rode until the anchor digs in. If you don't follow this procedure, the ring may slide to the crown and cause the anchor to skip across the bottom instead of digging in.

MUSHROOM ANCHOR. A mushroom anchor is stockless (Figure 4-47) and has a cast-iron bowl at the end of its shank. In large sizes, it is used for permanent moorings. Mushroom anchors gradually dig deeply into a mud bottom, and when embedded, they have tremendous holding power. They do not, however, provide the instant holding power of other anchor types, and are therefore less appropriate for anchoring than for mooring. Small mushroom anchors are used by recreational fishermen when angling, but should not be used to secure a boat left unattended. They do not work well in grassy and rocky bottoms.

GRAPNEL. A grapnel anchor has a straight shank with four or five curved, claw-like arms and no stock (Figure 4-48). This anchor lacks the strength for regular use on a boat of any size, but on a small boat you can use it to anchor above rocks, the idea being to hook one or more of the arms under a rock. It's a good idea to tie a buoyed trip line to one of the arms at the crown, so that you can retrieve the anchor when (not if) it hangs up under a rock.

NORTHILL ANCHOR. The Northill anchor has a stock at its crown instead of its head, and its arm is at a right angle to its shank. The angle of its broad flukes assures a quick bite and penetration, and the bills' sharp points cause the anchor to dig into the bottom as soon as there is a pull on the anchor line. This is a difficult design to store and carry on board, however, and is not commonly used.

PLOW. The plow anchor, a British design (Figure 4-49), takes its name from the shape of its fluke, which resembles a plow. The fluke digs in quickly and deeply in response to a pull on the anchor line. This is an efficient anchor but clumsy to handle and

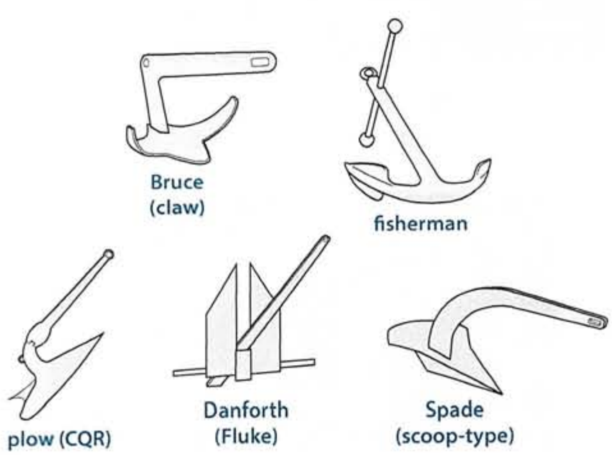


Figure **4-45.** The most common anchor types.

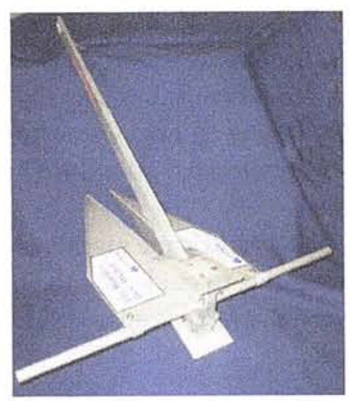


Figure **4-46.** A Danforth anchor.

Figure **4-47.** Small mushroom anchors like this one are sometimes used by anglers, but larger mushrooms are used mainly for permanent moorings, as they must sink into the sediment before they are effective.

stow, and is used most often on large boats, where it stows outboard, on an anchor platform at the bow. Plow anchors are marketed under various names, including CQR and Delta.

SCOOP-TYPE/SPADE. There is a relatively new anchor that's marketed under different names, including Spade, Sword, Ultra, and Raya, shaped like a shovel with a concave fluke. There is a version of these with a roll-bar on the top, marketed under the names of Buegel, Rocna, Manson Supreme. There is no consensus on whether these various scoop-type designs are superior to other anchor designs such as the plow or Danforth/fluke.

Your Boat's Anchors

Your boat should carry at least two anchors. One anchor may be small and light for easy handling. Use this *lunch hook* in good weather, when anchoring in protected areas, or for short stops while fishing. The second anchor should be larger and heavier for overnight anchoring or for use when the smaller anchor might drag.

Cruisers should consider carrying a third anchor as well, for use in heavy weather. Use this storm anchor in winds of 30 knots (34 miles per hour) or higher.

Marine dealers and some marine catalogs have tables and formulas to guide you in the selection of anchors, chain, and lines appropriate for the size of your vessel.

Anchor Line Scope

An anchor holds best when the pull of its rode is as nearly horizontal as possible. For this reason, holding power increases as you increase the length of the rode (Figure 4-50). The *scope* of an anchor rode is the ratio of its length to the vertical distance from your bow chock to the seabed (i.e., the depth of the water plus the distance from the water surface to the bow chock).

Normally, a scope of 7:1 is adequate for holding a boat. Thus, if the water is 10 feet deep and your bow chock is 4 feet above the water, you need an anchor rode of 98 feet. This means you need a lot of line even for a small boat in calm weather and seas. Remember, too, to account for tidal variations when determining how much scope you will need.

A scope of 5:1 is marginal, and a scope of 3:1 is poor unless the weather is excellent and the bottom is good for anchoring. A 3:1 scope may be enough if you have stopped to eat or to fish and you are not leaving the boat, but you should still watch your anchor at all times with this scope.

When anchoring in heavy weather, you should have a scope of at least 10:1, preferably with a good length of stout chain leading from the anchor. You also should maintain an anchor watch in stormy weather.

Anchoring

The first step in anchoring is to check the nature of the bottom and its depth. If you can't do this visually, look at the chart. It may note the bottom type—whether sand, rocks, clay, or mud. You can also tell the type of bottom and its depth by using a lead (pronounced "led") line, which is simply a light line with depth indicators (frequently bits of cloth sewn into the line at 6-foot, or 1-fathom, intervals) and a weight at its end. The end of the weight will usually be hollowed out, and if you place tallow, wax, chewing gum, or bedding compound in the hollow before "casting the lead," you'll bring up a sample of the bottom when you re-

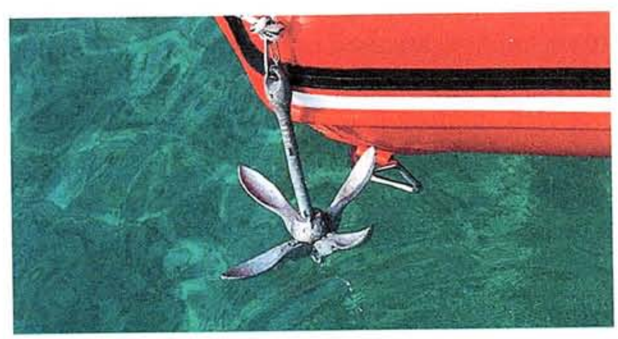


Figure **4-48.** The grapnel anchor on the bow roller of this dinghy is perfect for a short lunch stop. (COURTESY ZODIAC)

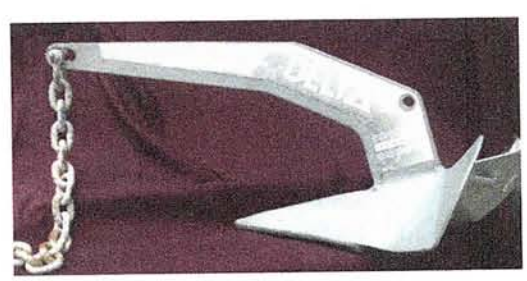


Figure **4-49.** A plow anchor.

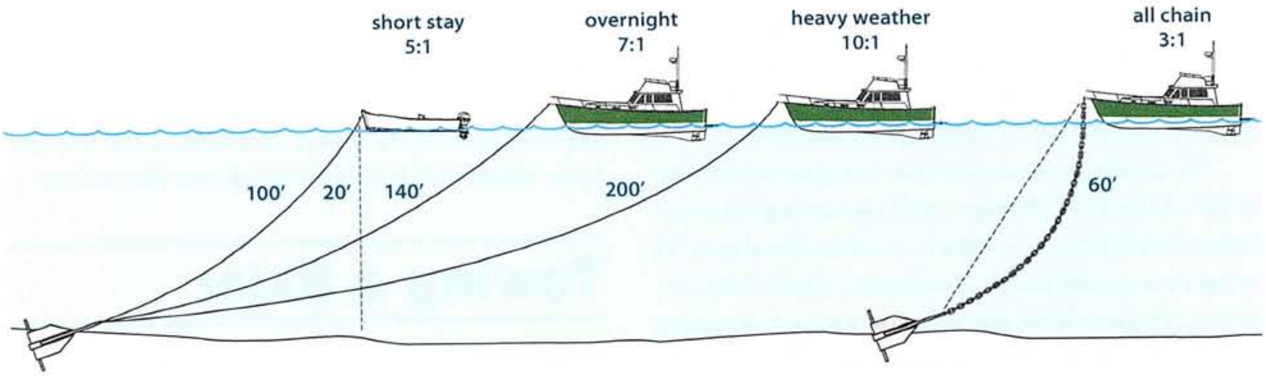


Figure **4-50.** Be sure to pay out sufficient scope on your anchor rode. Boats using an all-chain rode can pay out less scope, but all-chain rodes are usually too heavy for small boats to carry.

trieve it. Not many boats carry lead lines in this age of electronic depth sounders, but they remain highly useful tools, and they rarely break!

When anchoring, be certain that you have tied the end of the rode securely to the boat. In larger boats it is usually secured below the deck in the chain locker.

If the anchorage you select is pleasant and well protected—perhaps with convenient access to a town, restaurant, or other shoreside attractions—it also is likely to be popular and therefore crowded. If you arrive late in the day, a first glance may convince you that there is no room left to anchor, and you may be right. Don't be hasty, though. If your boat is small and floats in very little water, you may find a site close to shore that won't interfere with other boats.

Having chosen a site, note the position of nearby boats to determine where your boat will settle after it falls back on its anchor in response to wind and current. Make sure your anchor rode will not cross the rodes of other boats, and that you will not be within uncomfortable swinging distance of nearby boats.

If the bottom is satisfactory and the water is not too deep or shallow, head your boat into the wind or current, moving very slowly toward your chosen site. Go far enough beyond the site to allow for the anchor rode length, then stop your forward movement and have someone lower the anchor (he or she shouldn't drop or throw it), being careful not to stand on or get caught in the rode. If the boat does not drift astern of its own volition, gently reverse the engine to keep the boat on course. After about one-third of the planned scope is paid out, the line should be temporarily secured to determine whether the anchor is holding. Then the remainder of the rode should be paid out and secured.

An anchor rode should never be tied off to the side or only the stern of your boat. Side or stern anchoring may be convenient but is also dangerous. Large wakes or waves could swamp the boat when you are anchored from the side or stern rather than the bow, and in a current, the stern could be pushed under by the force of the moving water. A secondary anchor from the stern, on the other hand, is sometimes required in very crowded anchorages where there is no room for the boat to swing.

By keeping a hand on the line as it is paid out, you can tell if the anchor has dug in. When it vibrates, the anchor is sliding across the bottom. When it digs in and then skips, or when it just skips, pay out more rode until the anchor digs in firmly. You will feel a definite halt in the drift of the boat when it digs in. When there is a current or a breeze, you will see the bow turn into it. After you have a good bite on your anchor, turn off the engine.

When you have finished anchoring, take sights on two or three stationary objects onshore (Figure 4-51), lining them up with more distant objects behind them. A church steeple rising up behind a red barn, for example, makes a good sight. Should your anchor drag, you can tell by checking these ***ranges***. Most GPS receivers also have an anchor alarm feature that notes your anchored position and sounds an alarm if you drift from this location.

Anchors hold best in mud, clay, or sandy mud. While hard sand is good with some anchors, soft, loose sand is poor, and in soft mud your anchor may not hold at all. Rocks can give good holding power but may hold your anchor permanently!

Avoid anchoring in grassy areas and coral reefs, both of which are habitats for immature marine life. If you anchor in seagrass, you uproot it, and obviously, you should not damage a coral reef.

Be careful how much line you pay out. If the wind or the tide changes, will you swing into another boat, a buoy, a wharf, or onto the shore? If wind or sea conditions deteriorate, check your position frequently to see that you are not dragging anchor. If you are, let out more line. When this is not practical, ***weigh*** (raise) anchor and set it again in a better location. Be mindful of the change in direction of a tidal current. When the current reverses, your anchor may become fouled in its own rode or may lose its hold on the bottom.

Should your boat lose power in shallow water or a narrow channel, lower your anchor immediately. It may keep you from going aground.

Weighing Anchor

When ready to depart an anchorage, go through your departure checklist, then start the engine and make sure it is operating properly. Power ahead slowly to a position directly above the anchor, taking up the rode as you proceed. Usually, the anchor will break free of the bottom when you are over it. It can then be raised and stored.

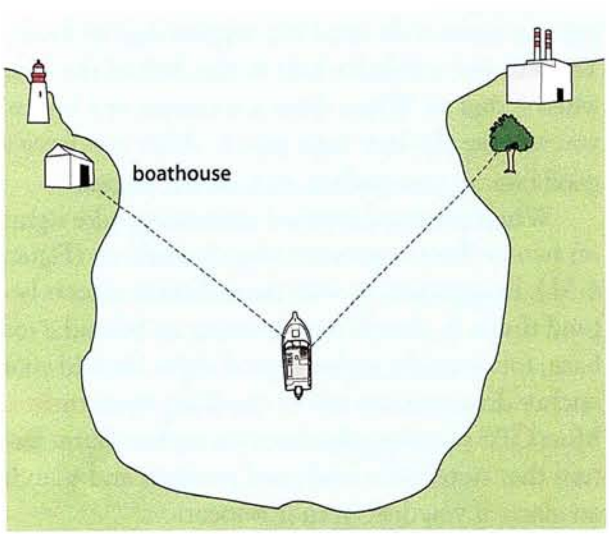


Figure **4-51.** After anchoring, establish ranges onshore such as those shown to keep track of your position. As long as the boathouse remains in front of the lighthouse on one shore, and the tree remains in front of the power plant on the other, this boat has not dragged its anchor.

If the anchor does not break free, it is probably fouled. Take in as much line as possible, and then make the rode fast to a bow bitt or bow cleat and run your boat slowly in circles with the line taut, which will hopefully break out the anchor.

Towing a Skier

Tightrope walkers traversing tall building encounter great risks, but they rarely have serious accidents because they are knowledgeable and they plan accordingly. Water skiers certainly aren't in the same risk category, but the principles of being knowledgeable and acting accordingly are the same. Water skiers rank very high in boating fatalities in the last ten years, so an emphasis on safety is well placed.

Water skiers are exposed to large forces that put the skier and the people surrounding them at risk. For example, a fall at high speed can cause water to enter a body orifice with enough penetration to cause death. Most of the responsibility for safety falls upon the towboat operator. A PWC may be used as a towboat, but the responsibilities are the same. The skier may use other than water skis such as kneeboards or a tube, but the precautions remain the same. The following precautions have been derived from evaluating studies of accidents. Some of these precautions are required by state regulations—check your own state regulations before you head out:

- Assign a second person on board as a skier observer.
- Assure that the skier is wearing a U.S. Coast Guard–approved life jacket. A high-impact jacket is often required.
- Confirm that the operator and skier agree on hand signals (see Figure 4-53).
- Confirm that the towline is at least 60 feet, and that dual towlines are the same length.
- Assure that people and towlines are away from the running propellers. Engine should be off during the dispatch or recovery of the skier.
- The towboat and skier should stay clear of obstructions and areas designated for people; that is, a 100-foot corridor either side of the towboat.

- Anticipate the potential danger from an airborne ski device.
- Always keep the skier in view the entire time that they are in the water.
- Anticipate a PWC towboat being properly rated to tow; that is, 3 people.
- Never ski at night. Some states allow a small leeway to terminate skiing at nightfall.

Heavy Weather

Recreational boating should be a fair-weather activity. The best advice for someone considering going out in a boat in rough weather is, "Don't." Sometimes, though, boaters do get caught out in adverse conditions. Some understanding of the principles of heavy-weather seamanship will be helpful if this happens to you.

Heavy weather, in itself, does not place a small craft in danger. It is comforting to note that a well-found boat operated by a knowledgeable skipper and an able crew is usually equal to the task. Your boat can probably handle adverse conditions better than you can.

Running into a Sea

If you try to power directly into a strong wind and heavy seas, the bow of your boat will plow into the waves instead of lifting over them (Figure 4-54), causing your boat to take a tremendous pounding. Your propeller alternately rises out of the water and falls back in, making your engine load one moment and race wildly the next.

Slow your boat so that the bow can lift with the waves, and don't try to run directly into them. Instead, take them at an angle of about 45°. This will reduce the pounding. Your boat will ***pitch*** and ***roll***—that is, it will go up and down on the long axis and will roll from side to side—but this motion will be easier on your boat and crew than a head-on pounding. Do not let your bow fall off to an angle much beyond 45°, however, because at that point the wind and seas might throw the bow even farther off, causing you to broach. A ***broach*** is a sudden, unplanned, and unwanted turn that leaves your boat beam-on to the seas, which is dangerous for the reasons explained next.

Running in a Beam Sea

When your desired course is parallel to the wave crests, you'll find yourself running in a ***beam sea***. When the seas are high and steep, this is not a course you want to attempt (Figure 4-55). Your boat will roll deeply and uncomfortably, and there's the chance of a wave that is steeper and higher than others rolling your boat sufficiently to capsize it. You can avoid this condition by zigzagging around the steeper crests or by taking the seas at an angle, as described above, rather than beam-to, thus transferring some of the wave-induced motion from rolling to pitching (Figure 4-56).

Figure **4-52.** This water-skier's tow rope is fastened to a towing pylon on the boat. (COURTESY NATIONAL MARINE MANUFACTURERS ASSOCIATION)

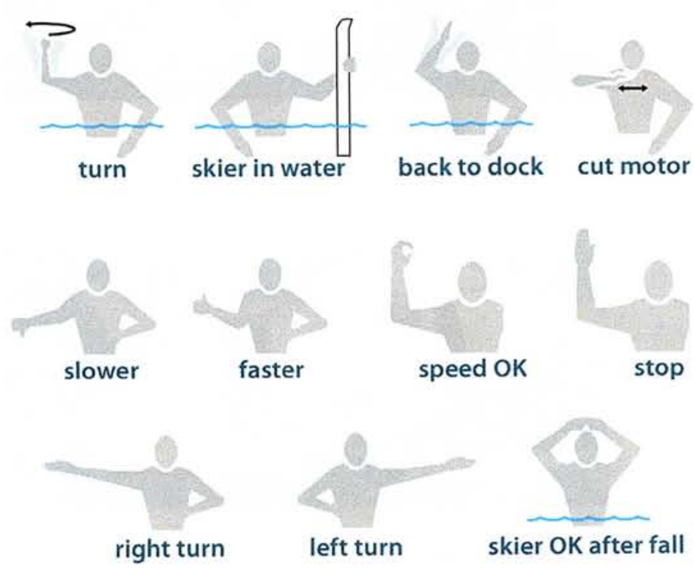


Figure **4-53.** Waterskiing hand signals. (COURTESY NATIONAL MARINE MANUFACTURERS ASSOCIATION)

If you cannot make headway under these conditions, it is advisable to ***heave-to***, or lie-to. Use enough power to keep your bow into the wind, and adjust your speed so you are making neither headway nor sternway. Commercial fishermen call this tactic *jogging*, and it will give you plenty of time to wonder why you didn't listen more closely to the weather forecast before heading out.

Running in a Following Sea

In a following sea, the waves roll in from astern. When the waves are high and have a short ***period*** (i.e., when the crests are close together, as happens in shallow waters), following seas are dangerous, in part because most powerboats have more freeboard at the bow than the stern.

When your boat speed exceeds the wave speed, your boat will crest the wave you're overtaking and careen down the front of the wave. This is dangerous in high seas, first because the boat can easily broach on the wave front, and second because it may, upon reaching the trough, bury, or stuff, its bow in the back of the next wave ahead, shipping water over the bow and possibly broaching (Figure 4-57). Running fast in very high seas might even cause the boat to fall off the front of a wave and ***pitchpole***, or somersault back over front.

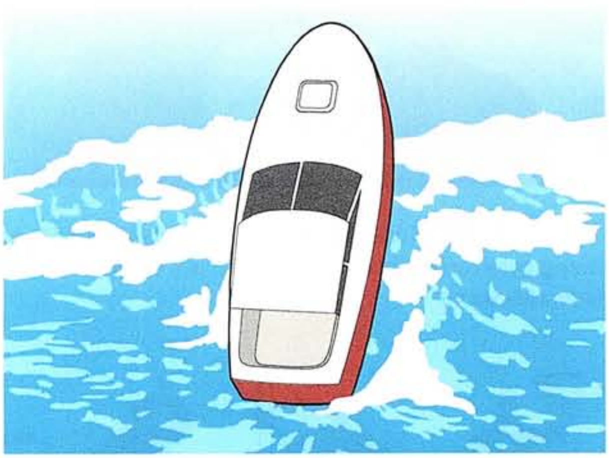


Figure **4-54.** Running directly into a head sea subjects your boat and your crew to a very rough ride.

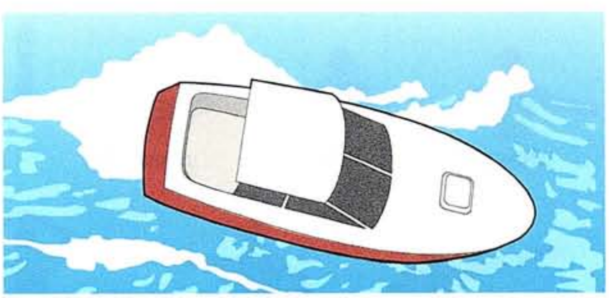


Figure **4-55.** On the other hand, taking the seas on the beam will subject your boat to uncomfortable rolling, and may even put it at risk of capsizing if the seas are steep and high enough.

On the other hand, when you travel too slowly in a big following sea, you risk having an overtaking wave roll in over your transom and swamp the boat. Your boat will be especially vulnerable in this attitude if it has a low transom and is overloaded.

If you must run down sea in heavy weather, it's best to travel at the same speed as the waves. In very rough weather, you'll have to speed up when a wave approaches from behind and slow down when your boat is threatening to break through a wave crest and careen down the wave front. This is tricky, tiring work, and you'd probably do better to take the waves at an angle over the bow as described above. Pick a relatively flat spot between waves to turn the boat up sea.

In more moderate conditions, it will be enough when running down sea to limit your boat speed and watch your stern wave to ensure that it stays within safe limits and does not reinforce an approaching wave crest. Counter any ***yawing*** (unintended course changes caused by wind and sea) by steering and controlling the throttle. When you correct a yaw early, you prevent it from developing into a full-scale broach.

Impaired Visibility

Fog is the most common cause of impaired visibility, but heavy rain, sleet, hail, snow, or dust is also possible. The proper responses are the same for all such conditions.

The first rule for safe boat operation in impaired visibility is, "Don't go." Fog will burn off. Rain, sleet, hail, or snow will stop. Be patient. Being out on the water when the weather closes in puts you in a whole new world that you want to avoid if possible.

Visibility never changes instantly and without warning. Be sensitive to changing conditions. Use the time before the fog or rain closes in to determine your position. If you don't know where you are when the weather closes in, you will not know later.

As the weather closes in, do slow down. Adjust your speed by gauging the distance you can see ahead of you. The Navigation Rules require you to be able to avoid a collision and to travel at a safe speed. It is your responsibility to determine what a safe speed is based on the conditions around you.

The law requires that you always maintain a proper lookout when you are underway, regardless of the weather. The most frequent cause of collisions is a failure to maintain a proper lookout. In poor visibility, post your lookout as far forward as possible. This keeps the lookout as far from the engine noise as possible and makes it easier to hear sounds from other vessels.

In poor visibility, if possible, get clear of channels and shipping lanes. A small boat can frequently operate safely outside the shipping channels; your navigation chart will tell you whether the water depth is sufficient there. If in doubt, drop anchor outside the channel. In the chapters that follow, we'll look at aids to navigation and discuss the navigation rules. Chapter 9 covers navigation in greater depth.

Narrow Inlets

Many rivers and coves connect to the sea by narrow inlets. Although no two are alike, they have a lot in common. Where the tidal range is large, there is usually rapid water flow into or out of the inlet at the height of the flood or ebb tide. These tidal currents often deposit silt and sand in the mouth of an inlet, and the resultant shoals and sandbars shift constantly, which makes it difficult to mark channels with buoys. Seas may break in the mouths of these inlets, especially when waves rolling in from seaward meet an ebb current there. Shoals may also cause unusual currents that run sideways. Many dangerous inlets do not *look* bad until you're actually in them, at which point it may be too late to turn back.

Prudent skippers will research the inlets that they intend to run. Some are known to be benign, and some are a little tricky but manageable with local knowledge and a little forewarning. Some are safe on the flood tide but not on the ebb, and some should be attempted only at high-water slack tide.

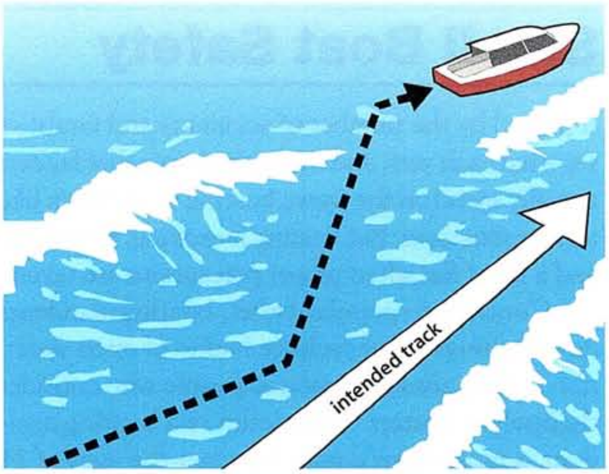


Figure **4-56.** Zigzagging around steep crests and breaking seas is both safer and more comfortable.

Figure **4-57.** Running with a following sea is tricky, tiring work. The boat shown here is careening down the steep front of the wave it has just overtaken, and may bury its bow in the back of the next wave ahead, which could cause it to ship water, broach, or both.

When approaching from seaward, wait for slack or flood tide if possible. Locate the approach channel and make sure everyone aboard is wearing a PFD. Then, if there is a sea running, wait for a set of comparatively small waves, then ride a wave crest in, adjusting your throttle so that you neither outrun the wave nor drop behind it. To exit an inlet, line up your boat in midchannel and point your bow more or less straight into the oncoming waves, playing your throttle so that you have enough power to surmount the crests but not enough to bury your bow in the troughs.

Some inlets are so treacherous that it is prudent to have a local pilot aboard, or to follow the boat of an experienced skipper, or to avoid the inlet altogether.

Small Boat Safety

If judged by the number of accidents and fatalities reported each year, and the limited time that boaters actually spend on the water, boating would seem like a dangerous sport. But boating is exciting, refreshing, and a lot of fun when proper precautions are taken.

Contrary to popular belief, boating accidents do not always occur on large bodies of open water, nor do they always happen to people who consider themselves boaters. The victim of a boating accident is most often a man between the ages of 24 and 34, fishing on a quiet lake on a Saturday afternoon. Often the victim is a hunter. These people may not consider themselves to be boaters, but they should.

People who fish or hunt frequently use small boats of 12 to 14 feet or less in length. Such boats are generally safe but can be unstable and may be dangerous under some circumstances. If you stand up in one, it may capsize. If it is overloaded, it may easily swamp, especially in adverse weather and water conditions.

Although the boat may be unstable, its occupants may stand up and move about to land a fish, shoot a duck, exchange positions in the boat, relieve themselves, or for other reasons. One of them may fall overboard, or their movements may cause the boat to capsize and everyone may end up in the water. If these boaters are not wearing PFDs, they may find themselves in serious trouble.

Many people who drown under such circumstances are good swimmers, but a sudden plunge into cold water is disorienting. Sometimes an injury occurs during the fall—a head is hit on the side of the boat, or a hand is caught in the propeller. These sorts of accidents are always unexpected, so a PFD should be worn at all times. The smaller the boat, the more important it is to observe this rule.

Hunters often overload their boats and fail to get weather checks to learn water and wind conditions. A safe load in favorable weather may not be safe with approaching poor weather, and hunting seasons often coincide with periods of changing weather that may turn suddenly violent.

In a fatal accident that occurred several years ago, two duck hunters launched a small aluminum boat at a ramp in a sheltered cove about an hour before sunrise, when the wind was calm. They carried two shotguns, ammunition, twenty decoys with lead weights, lunches, a thermos of hot coffee, a 50-pound Labrador retriever, two PFDs (which they were not wearing), extra fuel, and a 15-horsepower outboard. Each man weighed about 180 pounds.

Although heavily loaded, the boat was not overloaded for the water and wind conditions in the cove. As the men turned into the river and headed upstream, however, they met a brisk breeze. Since this stretch of the river was short and the wind was blowing across it, surface conditions were fairly calm.

At the first bend in the river, they headed directly into the wind. The combination of the river current and the wind blowing downstream raised considerable spray. Suddenly, they found themselves in a dangerous situation. They turned the boat to return to the cove. Unfortunately, when the boat's beam turned to the waves and the wind, it swamped. One man drowned.

Many other incidents could be cited, but they all teach the same lessons:

- If you move about in a small boat, keep as low as possible; better still, avoid moving about.
- Wear your PFD under all conditions.
- Get a weather report before you launch your boat.
- Keep a weather eye peeled for changing conditions.
- Load your boat with current and anticipated weather conditions in mind, but never overload it.

Running Aground

A soft grounding occurs when a boat runs aground a short distance while going at low speed onto a soft surface of mud or sand. A hard grounding results from grounding a large distance at high speed, or grounding onto a hard rough surface like rocks. The actions and priorities to recover the boat vary according to the conditions—however, there are several critical steps to take:

- Assess and treat any personal injuries.
- Put on life jackets.

- Notify the Coast Guard on your VHF radio, Channel 16. This can be a simple notice of the grounding, or it can be a request for help. Also, hail for assistance from other boaters, either on the VHF or manually.
- Assess whether the hull has been damaged and is leaking. If so, it is most likely safer to remain grounded rather than move the boat off the rocks.
- Assess wind and current to determine strategy for pulling free.
- Consider the effects of the tide.
- Lift the motor drive or tilt your outboard into the "up" position to reduce the draft of your boat's transom.
- Tip sailboats on their side to reduce draft, but make sure all hatches and deck openings are closed tight.
- Rock the boat fore/aft and side to side.
- Remove portable weight to the dinghy, or move crew weight to stern.
- Kedge the anchor by carrying the anchor to deep water and pulling the boat away, either from a dinghy, or by foot, if shallow enough.
- Consider the risk of slingshot recoil from a broken tow line if a winch is employed.

Not all of the conditions encountered when going aground can be addressed here, so expand your skills and knowledge from other sources. The risks of grounding can vary between simple embarrassment to loss of life.

Environmental Concerns

Boating continues to be a popular pastime, and with the ever-increasing number of boats on the water, the small environmental damage caused by each boat is accumulating fast. Also, the public sensitivity arising from major oil spills has resulted in federal and state legislation that imposes heavy penalties for harming the environment. As a boater, it is prudent to be mindful of these environmental risks—and besides, what boater would want to harm the environment that attracts him or her to this activity in the first place?

These are some of the practices that boaters can adopt to reduce pollution and damage to the marine environment:

- Follow channel markers. This assures the safety of your boat, reduces the risk of boat damage from churning shallow bottoms, and leaves bottom-dwelling organisms undisturbed.
- If your boat becomes grounded, try to move into safe water using paddles or by pushing, or wait for a higher tide. Churning your way out is not friendly, and in some cases is not safe.
- Use proper anchoring techniques. This minimizes anchor dragging, thus reducing damage to the sea bottom.
- Maintain good engine performance with regular maintenance checks. This will improve engine longevity and fuel economy. It also reduces the risk of engine failure and will reduce the emission of hydrocarbons.
- Maintain your boat's bottom coating, which improves efficiency and reduces water churning.
- Observe speed limits. This will avoid speed fines and reduce wave action, which in turn reduces shore damage.
- Properly dispose of untreated sewage, plastics, and garbage, as outlined in Appendix A.
- Be careful not to spill fuel or oil during refueling.

Ways to Learn More

Anchoring: A Captain's Quick Guide. Peter Nielsen. Camden, Maine: International Marine, 2007.

Boat Handling Under Power: A Captain's Quick Guide. Bob Sweet. Camden, Maine, International Marine, 2005.

Boating 101: Essential Lessons for Boaters. Roger Siminoff. Camden, Maine: International Marine, 1999.

Boat Maintenance: The Essential Guide to Cleaning, Painting, and Cosmetics. William Burr. Camden, Maine: International Marine, 2000.

Chapman Piloting & Seamanship. 66th ed. Charles B. Husick. New York: Hearst Books, 2009. Chapters 6 and 9.

The Complete Anchoring Handbook: Stay Put on Any Bottom in Any Weather. Alain Poiraud, Achim Ginsberg-Klemmt, and Erica Ginsberg-Klemmt. Camden, Maine: International Marine, 2007.

Confident Powerboating: Mastering Skills and Avoiding Trouble Afloat. Stu Reininger. Camden, Maine: International Marine, 2008.

Fast Powerboat Seamanship: The Complete Guide to Boat Handling, Navigation, and Safety. Dag Pike. Camden, Maine: International Marine, 2004.

Getting Started in Powerboating. 3rd ed. Bob Armstrong. Camden, Maine: International Marine, 2005.

Outboard Engines: Maintenance, Troubleshooting, and Repair. 2nd ed. Edwin Sherman. Camden, Maine: International Marine, 2008.

Powerboat Care and Repair: How to Keep Your Outboard, Sterndrive, or Gas-Inboard Boat Alive and Well. Allen Berrien. Camden, Maine: International Marine, 2003.

Powerboat Handling Illustrated: How to Make Your Boat Do Exactly What You Want It to Do. Bob Sweet. Camden, Maine: International Marine, 2006.

The Practical Encyclopedia of Boating: An A–Z Compendium of Navigation, Seamanship, Boat Maintenance, and Nautical Wisdom. John Vigor. Camden, Maine: International Marine, 2007.

The Practical Mariner's Book of Knowledge: 460 Sea-Tested Rules of Thumb for Almost Every Boating Situation. 2nd ed. John Vigor. Camden, Maine: International Marine, 2013.

The Propeller Handbook: The Complete Reference for Choosing, Installing, and Understanding Boat Propellers. Dave Gerr. Camden, Maine: International Marine, 2001.

Reed's Skipper's Handbook for Sail and Power. 4th ed. Malcolm Pearson. Camden, Maine: International Marine, 2005.

Seamanship Secrets: 185 Tips and Techniques for Better Navigation, Cruise Planning, and Boat Handling Under Power or Sail. John Jamieson. Camden, Maine: International Marine, 2009.

Practice Questions

IMPORTANT BOATING TERMS

In the following exercise, match the words in the column on the left with the definitions in the column on the right. In the blank space to the left of each term, write the letter of the item that best matches it. Do not use an item in the right-hand column more than once.

THE ITEMS	THE RESPONSES
1. ______ propeller size	a. place where fumes are most likely to accumulate
2. ______ ground tackle	b. post or piling
3. ______ bilge	c. device to which an anchor line is secured
4. ______ headway	d. forward motion through water
5. ______ bollard	e. anchoring equipment
6. ______ cavitation	f. turn end over end
7. ______ bitt	g. diameter and pitch
8. ______ shackle	h. swing from side to side about a vertical axis
9. ______ yaw	i. rapid boiling of water
10. ______ pitchpole	j. device for attaching a rode to an anchor

Multiple-Choice Items

In the following items, choose the best response:

4-1. An exhaust blower should be run for 4 minutes before starting an engine to

a. warm up the engine
b. remove carbon dioxide fumes
c. remove fuel vapors
d. remove debris in the bilge

4-2. The propellers of small outboard motors are protected from damage by

a. their warranties
b. shear pins
c. shrouds
d. slip hubs

4-3. Check gasoline fuel lines for leaks

a. during the winter
b. before each use of the boat
c. in the morning
d. every June

4-4. While fueling a boat with a built-in tank

a. close all cabin doors, hatches, and ports before you begin
b. shut off the fuel tank air vent
c. run the blower
d. open all compartments

4-5. After fueling the boat, you should always

a. check for fuel fumes in the engine and tank compartments
b. clean up any spills and put the rags in the bilge
c. wash the deck to remove spilled fuel
d. fill the fuel tank to air vent level

4-6. When you start your outboard motor, check to see that water is coming out of

a. the tattletale
b. the telltale
c. the vent pipe
d. the propeller shaft

4-7. When you refuel a portable tank

a. do it quickly and don't hold up other people at the fueling dock
b. use the best grade of gasoline available
c. close off all compartments
d. do it with the tank on the fueling dock

4-8. When loading your boat, consider

a. sea state and weather
b. the activity you expect to engage in
c. the weight of equipment, fuel, food, and other gear
d. all of the above

4-9. The best way to go through shallow water with a stern drive or outboard is to

a. raise your motor or lower unit slightly and proceed at idle speed
b. lower your motor or lower unit
c. raise your motor or lower unit and increase your speed
d. lower your motor or lower unit and go through at idle speed

4-10. If you tuck your outboard or outdrive in too much, your boat may

a. cavitate
b. be stern-heavy
c. bounce
d. plow

4-11. When viewed from aft, most boat propellers

a. are left-handed
b. are right-handed
c. turn counterclockwise
d. are counterbalanced

4-12. When the pressure on the flat side of a propeller's blades is reduced, the water boils and may damage your propeller. This is called

a. transmission
b. plowing
c. cavitation
d. surging

4-13. An outboard or a stern drive tilts up or down to adjust its

a. steering ability
b. direction of thrust
c. tendency to steer to port or to starboard
d. turning ability

Multiple-Choice Items (continued)

4-14. When leaving a pier in a boat with an outboard or stern-drive engine with a wind or current pushing you toward the pier

a. it is usually easier to back out slowly until you are far enough away from the pier to turn and go forward
b. turn your helm as far away from the pier as possible and go forward
c. release all lines and allow the wind to move the boat
d. run a stern line from your boat around a bollard and back to your boat and then back out

4-15. If you are turning in a narrow channel and have a strong wind on your stern

a. hug the right side of the channel, turn your helm all the way to starboard, and go forward
b. hug the right side of the channel, turn your helm all the way to the opposite shore and back down
c. hug the left side of the channel and go forward
d. hug the left side of the channel, turn your helm all the way to port, and back around

4-16. For normal scope, the length of the anchor rode should be

a. two times the depth of the water
b. three times the depth of the water
c. five times the depth of the water
d. seven times the depth of the water

4-17. To minimize the violent pitching motion when running into a heavy sea, point your bow

a. directly into the waves
b. about 20° to either side of the direction from which the waves are coming
c. about 45° to either side of the direction from which the waves are coming
d. directly away from the direction of the waves

4-18. When caught in severe weather, you should

a. head toward the storm
b. increase speed and run parallel to the waves
c. reduce speed and head for the nearest safe shore
d. tie up to the closest navigational aid

4-19. If your vessel runs aground, you should

a. check for leaks
b. call the Coast Guard
c. gun the engines in reverse
d. check the depth of the water

4-20. The size of a propeller is

a. the diameter of the circle it makes when it turns
b. the theoretical distance it moves forward in one turn
c. its pitch and diameter
d. none of the above

4-21. To improve the efficiency and speed of your outboard or stern drive in smooth water

a. use a high-grade lubricating oil
b. use the highest grade of gasoline available
c. lower your outboard or outdrive
d. raise your outboard or outdrive slightly

4-22. Deep-draft boats are affected most by

a. the wind
b. the size of their engines
c. the current
d. the size of their superstructures

4-23. The primary responsibility for informing crew or passengers about the location and use of safety equipment such as PFDs, fire extinguishers, and docklines belongs to

a. the marina owner
b. USCG personnel
c. the insurance agent
d. the boatowner or operator

Chapter 4

1.	g
2.	e
3.	a
4.	d
5.	b
6.	i
7.	c
8.	j
9.	h
10.	f

4-1	c
4-2	b
4-3	b
4-4	a
4-5	a
4-6	b
4-7	d
4-8	d
4-9	a
4-10	d
4-11	b
4-12	c
4-13	b
4-14	a
4-15	b
4-16	d
4-17	c
4-18	c
4-19	a
4-20	c
4-21	d
4-22	c
4-23	d