

Which Boat Is for You?



The objectives of this chapter are to describe:

- ✓ The importance of boating safety.
- ✓ The U.S. Coast Guard Auxiliary.
- ✓ Parts of a boat in proper language.
- ✓ Types of hulls and means of propulsion.
- ✓ The variety of boats available to match your needs.
- ✓ How to get information on possible defects in a vessel.
- ✓ Considerations in a contract to purchase a boat.
- ✓ The importance of boat insurance.

A BOAT is anything used for transportation on the water. Huck Finn's raft was a boat. A seaplane is a boat when it is on the water. Canoes, kayaks, rowboats, and other small craft are boats. Boats range in size from personal watercraft (PWC) to

(COURTESY RANGER BOATS)

large ships, and they might have deep or shallow hulls; flat, round, or V-shaped bottom sections; and tall or short cabin sides and superstructures. They can be slender or stout, and they might have one, two, or even three hulls. They vary, too, in the materials from which they're built. As defined by the Federal Boat Safety Act of 1971, all boats are vessels, but a vessel is not a boat (and therefore exempt from certain commercial safety regulations) unless it was manufactured or is engaged primarily for noncommercial use or is engaged in carrying six or fewer passengers for hire.

Boats come in such a large assortment because they serve many purposes. In this lesson you will learn about these purposes and how vessels are designed for them. You will also learn the basics of boat construction, materials, and uses.

Boaters' Language

Newcomers to any subject usually must learn a new vocabulary. Boating is no exception. The language of mariners has been developing for many centuries. It has the virtues of utility, economy, and an exactitude you need when talking about boats and boating.

As we introduce terms, we will usually define them for you. You can also find some of them in the Glossary at the back of the book. If you do not find a word listed in the Glossary, look for it in the Index. The first time we use a technical term, we will print it in *red*.

Origins of Boaters' Language

Boaters have been around a long time, so the vocabulary has come from many places: ancient Greece, the Roman Empire, Scandinavia, England, and elsewhere.

Some nautical terms have found their way into our everyday vocabulary. The term "blue Monday" came to us from England. The British Navy disciplined sailors on Mondays for infractions over the preceding week. The punishment consisted of lashes with a cat-o'-nine tails, or whip. No wonder Monday was blue. When not in use, the cat stayed in a sack. Of course, the cat was "out of the bag" when used.

Other terms came from Norway. Most vessels are steered by *rudders*. On an ancient sailing boat, the rudder was to the right of center at the rear, or *stern*, of the vessel. There it was protected from damage when the ship was in port. The *tiller*, which turned the rudder, was kept under the *helmsman's* right arm.

In Norway, the rudder was a "stjorn" board or steering board. *Stjorn*, when pronounced, sounds like "starn." So the right side of a vessel when looking *forward* became known as the *stjorn board* or *starboard* side (Figure 1-1).

When a vessel came into port, it was with its left side next to the *wharf*. This was the side most visible to the helmsman. It was also the side for the "load board." No wonder the left side of the vessel became known as the *larboard* side. "Larboard" and "starboard" are more exact terms than "left" and "right" since they do not change if you are facing forward or *aft*.

Because larboard and starboard sound somewhat alike, they are easily confused. Thus, larboard was changed to *port*. This was a logical choice, as this was the side of a vessel next to the wharf when the vessel was in port. Larger vessels load through *ports*, or openings, in their sides.

Remnants of ancient boats made of large, hollowed-out tree trunks or *keels* still exist. These unstable vessels took on water easily. Although they didn't sink, they were of little value when slightly submerged in rough or icy water.

Planks were added later, and the trunk became but one part of the vessel. The name keel re-

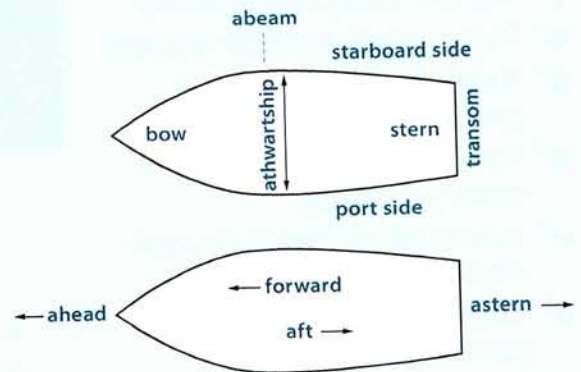


Figure 1-1. Directions and locations on a boat.



Figure 1-2. Bass boats underway. This is a purpose-built boat, meant to get you to the fish in a hurry and give you full walkaround fishability once you get there. (COURTESY RANGER BOATS)

mained, however. The body of the vessel, formed by the keel and the planks together, became known as the **hull**.

The aft terminus of many boats is a flat, vertical surface extending from one side of the vessel to the other. This part of a boat became known as a **transom**, from the Latin root “trans,” meaning across (Figure 1-3).

The **bow** is the forwardmost portion of a vessel. This term came from the Norwegian word “bov,” meaning shoulder, and pronounced “bow.” You can almost see the shoulder of a boat pushing its way through the water.

Types of Boats

Boats come in a wide range of sizes and a great variety of types and models, each optimized to serve a specific need. It would be a wonderful boat that could do all things equally well, but in the real world this is not possible. Boat design and construction involve compromise, and a boat developed for one purpose may serve poorly for another. Likewise, a boat that is safe in one set of conditions may not be safe in conditions for which it is not intended. When you select a boat, be sure it will suit your needs. Also, be certain to operate it in appropriate sea and weather conditions.

Bass boats, for example, help their owners get to good fishing holes quickly (Figure 1-2). They are propelled by one or two high-horsepower outboard motors, and many of them have a small electric motor mounted off the bow to maneuver the boat at slow speeds around fishing holes in a manner that does not spook fish. These boats have sharply pointed bows and minimal V-shaped hulls at the bows. Their design permits them to operate safely at high speeds in sheltered water.

A bass boat can be dangerous, though, when used in a tidal inlet, rough water, or the large swells of an open sea. One feature that makes it dangerous is its low **freeboard**, which is the vertical distance from the **gunwales**, or tops of the boat’s sides, to the surface of the water. In many boats the freeboard is lowest at the transom, higher amidships, and even higher toward the bow, but a bass boat has low freeboard everywhere so that an angler can play a fish with equal ease anywhere on the boat, moving around as necessary. Bass boat owners place a high emphasis on this “360° fishability.”

Another feature that may make some bass boats dangerous in inlets and other rough water is a foredeck that slants downward toward the bow. Such a bow shape can bury or “stuff” itself in a wave, shipping water over the bow and **swamping** the boat. This is not to say that a bass boat is unsafe, which would not be true. What it does say is,

“Operate your boat only under the conditions for which it was designed.”

We will explore other boat types later in the chapter. For the moment, let’s look at one other type. Suppose you are in a *runabout*, a small, mostly open boat powered by one or two outboard motors. These are the boats that populate lakes, reservoirs, rivers, and sheltered coastal waters on pleasant summer days, engaged in fishing, waterskiing, or simply day cruising. A runabout is at its best in those conditions, but it is not designed for a strong wind and a choppy sea.

Suppose you get caught in rough conditions and your runabout is *dead in the water*, or *adrift*. This means that it is not under power and not *moored, anchored, or aground*. As with other boats that are higher in the bow than the stern (as most boats are), its bow will be blown away from the wind. This means that the stern, with little freeboard, turns into the waves. Let’s further suppose that there is a cutout in the transom where the outboard motor is mounted (see Figure 1-3), and let’s assume that there is no self-draining well between the transom and the boat’s open cockpit to intercept a boarding wave. It is all too easy for a wave to roll over the transom and swamp the boat. (And by the way, this example is anything but hypothetical; this sort of accident happens frequently, and the victims are usually unaware of the danger until the wave comes aboard.)

Select your boat to suit your needs, and use it only under the conditions for which it was designed. It always pays to check the weather before you go out and while you are on the water. You can get continuous weather information on your VHF-FM radio. (See Chapter 12 for more on predicting the weather.)

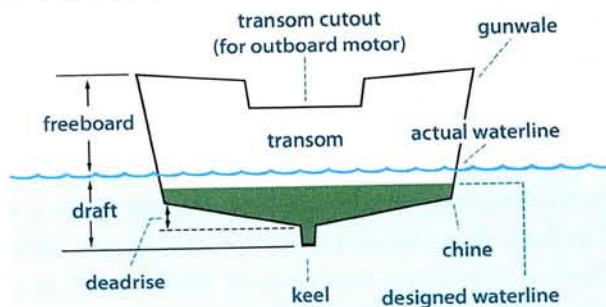


Figure 1-3. Some terms used to describe a boat.

Types of Propulsion

Most recreational powerboats less than 25 to 30 feet long have *outboard motors* (Figures 1-2, 1-4, and 1-5) or *stern-drive engines* (see Figure 1-6 opposite). Stern drives are also called *inboard/outboards*, or I/Os. Most boats longer than 35 feet have *inboard engines*, and those from 30 to 35 feet long might have any of the three.

An outboard motor bolts or clamps to the transom. In the past most outboards were *two-cycle* (also known as two-stroke) engines, meaning that the crankshaft requires two revolutions to complete a power stroke. Many small engines, such as lawnmower engines, are two-cycle. These engines operate at high revolutions per minute (rpm) and produce a large amount of power per pound of engine weight, but this higher engine stress usually results in a shorter engine life and higher maintenance costs. Also, in part because their lubricating oil mixes with the fuel rather than recirculating through separate passageways, two-cycle outboards are characterized by incomplete combustion and resultant pollution, although these problems have been greatly decreased by electronic fuel injection and ignition technologies.

For all these reasons, *four-cycle* outboards are increasingly popular. These operate like automobile engines (or like stern-drive and inboard marine engines, for that matter) in that the crankshaft requires four revolutions to complete a power stroke. These engines are heavier and produce less



Figure 1-4. An inflatable dinghy offers great stability and load-carrying ability. (COURTESY ZODIAC)



Figure 1-5. This cutaway view of a direct fuel-injected 200-horsepower outboard hints at the complexity of a modern outboard motor. (COURTESY MERCURY MARINE)

power per pound of engine weight, but they are also more fuel efficient, more reliable, and generally quieter.

A stern-drive engine is mounted inside the hull (like the inboard engine of a bigger boat), but the engine is connected to a drive unit through a system of gears. This drive unit, also called the *lower unit* or *outdrive*, protrudes through the boat's transom and functions much like the lower portion of an outboard motor. Outboard and stern-drive boats are steered by turning the lower unit in one direction or the other, thereby directing the stream of water discharged by the propeller (Figure 1-6).

Comparing outboard motors with stern-drive engines, outboards are easier to remove for servicing and easier to replace, take up less space inside the boat, and are lighter than stern drives of the same horsepower. Stern drives, however, are quieter and burn less fuel than two-cycle outboards.

Stern-drive engines have longer service lives than two-cycle outboards, and, like inboard engines,

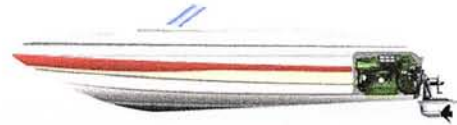


Figure 1-6. A stern-drive engine installation. The outdrive unit rotates for steering and also tilts up (though not enough to emerge from the water) for shallow-water operation or when not in use. (REPRINTED WITH PERMISSION FROM AMERICA'S BOATING COURSE, PUBLISHED BY BOAT ED)

they are quiet, efficient, and out of sight. Yet like outboards, they derive significant speed, steering, and trim advantages over inboard engines from their adjustable, steerable lower units. They are especially popular on fresh water, where the inability to raise the lower unit out of the water when not in use, as you can by tilting an outboard, is of less consequence. In the water, and especially in rough weather, it is easier to work on a stern-drive engine than an outboard, because the stern-drive engine is in the boat and not behind the transom.

The transom on a boat with an outboard motor usually has a large section cut away (refer back to Figure 1-3). This is done to get the lower unit and propeller deep enough for best performance, but a cutaway transom lowers a boat's freeboard and invites swamping.

To keep boats with transom-mounted outboards from swamping, many have a well forward of the transom into which their motors tilt when raised. The well drains overboard, and its forward wall is made high enough to keep most waves from entering the boat. A well takes up deck space, but the lack of a well can be dangerous when waves approach from astern, as described earlier.

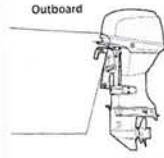
The need for a cutaway transom can be eliminated by attaching an outboard motor to a mount, or bracket, that extends aft of the transom. A bracket-mounted motor is entirely outside the boat, permitting a full transom and unimpeded interior volume. When mounted this way, an outboard will make less noise in the boat, and the full transom will be safer for small children. A bracket-mounted outboard does increase the effective length of the boat slightly, which could be a disadvantage when

maneuvering in close quarters (or when renting a marina slip by the foot), and the engine is harder to reach from inside the boat, but these considera-

TYPES OF PROPULSION

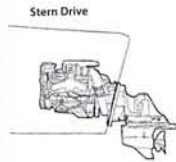
Outboard Motor

- Easy to remove from the boat for servicing
- Lighter than a stern-drive engine
- Takes up little room in the boat
- Poses less danger of fire
- Easily maneuverable with engine in forward gear
- Sufficiently maneuverable with engine in reverse gear
- Drive angle can be trimmed up or down to optimize boat trim underway



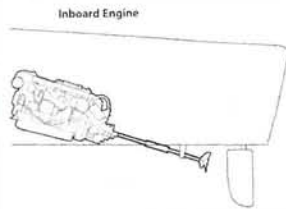
Stern-Drive Engine

- Quieter than an outboard motor
- Uses less fuel
- Longer engine life
- Easier to service
- Easily maneuverable with engine in forward gear
- Sufficiently maneuverable with engine in reverse gear
- Maneuverability is poor to nonexistent when engine is out of gear
- Drive angle can be trimmed up or down to optimize boat trim underway



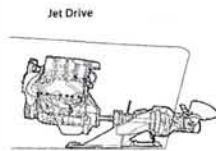
Inboard Engine

- Straight driveshaft from engine to propeller
- All machinery except propeller is in the boat
- Single-engine inboard boats are less maneuverable than outboard or stern-drive boats, especially when backing
- Twin-engine inboard boats are the epitome of maneuverability, and can be steered under engine alone if the steering system fails



Jet-Drive Engine

- No external propeller
- Very maneuverable at medium and high throttle settings
- Less maneuverable at low throttle settings and when backing
- Maneuverability nonexistent when engine is out of gear



tions are outweighed by the advantages of such an arrangement (Figure 1-7).

There are three significant disadvantages of a stern drive. The first is the loss of deck space, since the engine is mounted inside the hull near the stern and enclosed under a large hood. Second, the articulated mechanism connecting the engine to the lower unit may be a source of problems. And third, any engine mounted within a boat's hull presents dangers from fire and explosion; these can be controlled with proper ventilation, however, as described in Chapter 2.

Outboard motors and stern-drive engines are rarely found on boats longer than 35 feet, because their smaller props don't develop enough thrust to move heavy boats effectively. That is why big boats usually use inboard engines, which are generally mounted below the deck amidships or slightly aft of amidships. (Stern-drive engines, by contrast, are mounted aft, against the transom, where there is rarely enough belowdeck room to accommodate them. They therefore require a full or partial abovedeck enclosure.) Inboard engines usually drive straight propeller shafts (Figure 1-8). Inboards are simpler in design and generally more reliable than I/Os, but the propeller is fixed below the hull and inaccessible if it becomes fouled.

Outboards and I/Os can be raised to allow easy removal of debris from the propeller or to escape from a shoal, and an outboard or I/O drive on most boats can be adjusted to trim the boat's bow up or down to the optimum running angle.



Figure 1-7. Mounting an outboard engine on a bracket aft of the transom permits a full transom and unimpeded interior volume. (PHOTO BY ED SWEENEY)



Figure 1-8. Cutaway view of an inboard engine installation. This boat has twin engines, each with its own driveshaft and propeller, and twin rudders. (REPRINTED WITH PERMISSION FROM AMERICA'S BOATING COURSE, PUBLISHED BY BOAT ED)

Jet Drives

Personal watercraft (PWC), as well as some other boats, have a *jet drive*, which is simply an engine-driven pump with an impeller mounted in a tube that jets water out the back end of the tube to serve as a propellant. The advantages of jet drives include fast acceleration, an enhanced ability to operate in shallow water, and enhanced safety for people in the water. The propellers on conventional-drive boats often continue to turn slowly even when their gears are in neutral, and an exposed propeller can cause serious injury. The enclosed impeller of a PWC jet drive does not present the safety hazard to a swimmer that a propeller does (Figure 1-9).

Jet drives are often favored in shallow, rock-strewn waters where propellers are easily damaged. For example, sightseeing boats in the Hell's Canyon area of the Snake River use jet drives. An operator should use caution around rocks even with a jet engine, however. Rocks can puncture a boat's hull.

Although PWCs can operate in shallow, muddy, or sandy water, other jet-propelled boats should not. The difference is in the size of their engines. The engines of runabouts and cruisers equipped with jet drives pump large quantities of water. The mud or sand that is pumped with the



Figure 1-9. A jet-drive engine installation on a personal watercraft (PWC). Water is sucked up through a grating just forward of the enclosed impeller, then discharged astern through the steerable nozzle. (REPRINTED WITH PERMISSION FROM AMERICA'S BOATING COURSE, PUBLISHED BY BOAT ED)

water quickly damages parts in their pumps and propelling mechanisms.

Tunnel Drives

In a tunnel drive configuration, the propeller and part of the driveshaft are partially recessed in a trough in the bottom of the boat. The trough, or *tunnel*, acts as a shroud to protect the propeller and increase its efficiency. It also provides a more favorable thrust angle for the propeller and a better angle of attachment of the driveshaft to the engine. These drives are advantageous in shallow water.

Hull Design

One way to classify boats is by how they ride in the water. *Displacement* boats move through the water and push it aside or displace it. *Planing* boats move faster and, after gaining speed, ride more nearly on top of the water.

There is no single, all-purpose, perfect hull design. Each design is a compromise, and you must make a choice based on your boat's projected use.

Displacement Hulls

All boats at rest or moving slowly are displacement boats. Each displaces a volume of water equal in weight to its own weight. If the weight of the boat exceeds the weight of the water displaced, it sinks deeper into the water until the two weights are equal. This is true of a planing hull, a semidisplacement hull, and a displacement hull, but only the latter is designed specifically to achieve greatest efficiency at slow speeds.

At slow speeds, it is easy for a displacement boat to push aside the water it displaces. A displacement hull is designed to do just that, and the resultant *bow wave* will likely be less for a displacement hull than a planing hull. As speed increases, however, the effort required to push the water aside increases geometrically, and the bow wave becomes higher. In effect, the boat must try to climb its own ever-steepening bow wave and thereby escape its hole in the water in order to go faster. But a displacement boat is not designed to do this, so there is a practical limit to its speed. The longer its water-

line, assuming it is not limited by engine horsepower, the faster it can move, up to a top speed of 1.34 to 1.5 times the square root of its waterline length. (The wave pattern against the hull of a catamaran appears to be sufficiently different from a monohull to exclude cats from these hull speed limitations.) Any attempt to go faster will merely make the stern squat deeper in the water and cause the boat to consume more fuel (Figures 1-10 and 1-11).

This is what limits the top speed of a small trawler yacht to 8 knots or so. It is also one factor making the design of a keel sailboat such an art. All keel sailboats are displacement boats, so the speed potential of similar designs is measured in increments of a tenth of a knot or less. The designer of a racing sailboat must try to increase performance without sacrificing seaworthiness, comfort, or appearance. Again, the top speed for most small displacement boats is about 7 to 8 knots, or about 8 to 9 miles per hour (Figure 1-12).

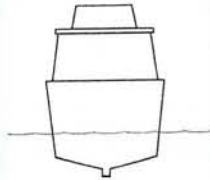
Despite their slow speeds, displacement vessels have advantages and special uses. They are steady and comfortable and can handle rougher water than planing boats. They are more economical to operate and can carry a heavy load of gear and provisions without a noticeable impairment of performance. They lend themselves to cruising and living aboard.

A planing hull climbs its own bow wave, escaping its hole in the water to ride on the water surface. When a planing boat is moving slowly, it is in effect a displacement vessel, but as its speed increases it derives more and more lift from the water beneath its hull until, at higher speeds, it escapes its bow

HULL TYPES

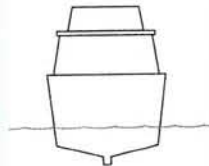
Displacement Hull

- Displaces a volume of water equal to its weight
- Pushes the water out of the way
- Speed is limited by waterline length, making a top speed of 7 to 8 knots for a boat with a length at the waterline between 25 and 30 feet
- Steady and comfortable
- Economical to operate
- Will carry a large load without a significant performance handicap



Semidisplacement Hull

- Rises partly out of the water at cruising speeds
- Can go faster than a displacement hull
- Less efficient than a displacement hull at low speeds
- Less efficient than a planing hull at high speeds
- High fuel consumption at slow speed
- Provides greater cruising range than a displacement hull, with the ability to outrun a storm back to port
- Many trawler yachts and motor cruisers are in this group



Planing Hull

- Fast
- Rides on top of the water at cruising speeds
- Extensive flat surfaces on bottom
- V-shaped cross sections forward of amidships and in some cases all the way aft to the transom
- Stable when planing
- Inefficient at low speeds
- Less comfortable in a seaway than a displacement hull
- Overloading will cause a substantial impairment of performance

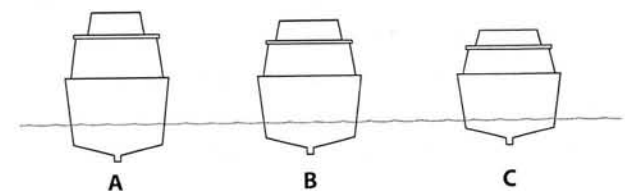
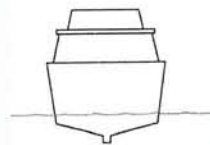


Figure 1-10. These three hulls show similar freeboard and beam at their midsections, but hull A is clearly much heavier, with greater immersed volume. Hull B is intermediate, and hull C is the lightest of the three. Hull A is a displacement hull; hull B, semidisplacement; and hull C, planing. A displacement hull might be round-bottomed, and even a semidisplacement hull might have a tightly radiused round bottom, but shape isn't the primary determinant. It's weight, as these drawings show. (REPRINTED WITH PERMISSION FROM *GETTING STARTED IN POWERBOATING* BY BOB ARMSTRONG)

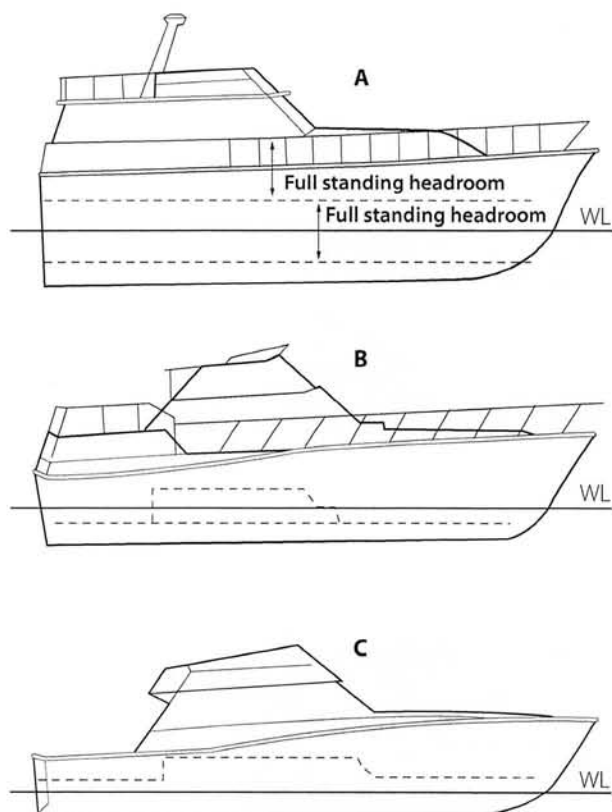


Figure 1-11. The same hulls as in Figure 1-10, here seen in profile. All are about 50 feet long. Boat A has two full-length decks with full standing headroom, while boats B and C offer less room but greater speeds. (REPRINTED WITH PERMISSION FROM *GETTING STARTED IN POWERBOATING* BY BOB ARMSTRONG)



Figure 1-12. **Left:** This fishing vessel in St. John's, Newfoundland, shows how much water a displacement powerboat pushes aside at cruising speed. Any further incremental speed increase is gained only at the cost of greatly increased fuel consumption. **Right:** A sailboat is also a displacement hull. (LEFT PHOTO BY JIM BARTLETT, COURTESY NATIONAL MARINE MANUFACTURERS ASSOCIATION. RIGHT PHOTO COURTESY SPECTRUM PHOTO/FRAN GREON)

wave entirely and is said to be *on plane*, at which point it uses most of its power to move forward instead of pushing water aside. When on plane, it displaces a volume of water less than its own weight, which is only possible due to the hydrodynamic lift that supports it. There are many types of planing hulls. Most have extensive flat surfaces on their underbodies, which are angled upward from the centerline to form V-shaped hull sections. The more nearly horizontal these surfaces—the shallower the V—the harder the ride in choppy and rough water. Flat-bottomed boats usually are more stable than round-bottomed or deep-V-shaped hulls, yet deep-V hulls derive hydrodynamic stability at speed along with a much smoother ride through waves. So-called modified-V or variable deadrise boats have deep-V sections forward to cut through waves and shallower sections aft to give a flat surface on which to plane. The design of planing hulls is a rich and ongoing area of development (Figures 1-13, 1-14, and 1-15).

Semidisplacement Hulls

Some hulls are hybrids, falling somewhere between displacement and planing hulls (Figure 1-16). Up

to a certain power and speed they displace water as any boat does. Beyond this point their hulls rise to a partial plane, but they cannot develop enough hydrodynamic lift to come onto a full plane. Increasing the engine size of a semidisplacement ves-



Figures 1-13. Top and middle: Two planing powerboats skimming over the water in ideal conditions. (COURTESY U.S. COAST GUARD OFFICE OF BOATING SAFETY) Bottom: A commercial vessel with twin jet drives on plane. (COURTESY HAMILTON JET)



Figure 1-14. This approaching powerboat shows two running strakes beneath a chine flat on either side. These features add lift for planing as well as side-to-side stability. (COURTESY BAYLINER)



Figure 1-15. A stern-view illustration showing trim tabs slightly lowered to help a powerboat get on plane. For more on trim tabs, see Chapter 4. (COURTESY LENCO MARINE)

sel increases its top-end speed, and so does decreasing its weight. It never gets “on top” like a planing hull, however. Most **cruisers** and many **trawlers** fit into this group. Many sailboats up to about 19 feet in length have semidisplacement hulls as well. In the right conditions, a high-performance sailing dinghy can even get up on a full plane.

Catamaran Hulls

Power catamarans have become popular in recent years, their principal attractions being their intrinsic stability, spacious decks, and a soft ride in choppy water. They are designed both with displacement and with planing hulls, but a 25-foot displacement-hulled catamaran can often cruise at



Figure 1-16. A semidisplacement hull at speed, showing separation of the wake around the transom. (COURTESY CRUISERS YACHTS)

25 knots—a planing speed—because its hulls are so narrow that they escape the normal limitations of a displacement hull (Figure 1-17).

Some anglers prefer trailerable, outboard-powered 20- to 30-foot catamarans for offshore fishing due to their stability, soft ride, and cruising speeds. The principal limitations of a catamaran in this size range include the lack of room in its narrow hulls (although there is plenty of room on deck) and the fact that waves over a certain height and steepness will slap the roof of the tunnel between the hulls,



Figure 1-17. A power catamaran showing a good turn of speed and a comfortable hull. (COURTESY VENTURER)

which can be annoying and uncomfortable. True planing cats, because they ride higher when on plane, have a slight advantage over displacement cats on this point.

Details of hull design will have a significant effect on a catamaran's characteristics. A test drive under a range of conditions is highly recommended before making a purchase.

Sailboats

Sailboats are discussed in this book's companion text, *Sailing Skills and Seamanship*.

Uses of Boats

A common way to classify powerboats is by their uses. Powerboats include *utility boats*, *runabouts*, *cruisers*, *pontoon boats*, *houseboats*, *personal watercraft*, and others. Some of these may be available in both monohull and multihull configurations.

Utility Boats

Utility boats include *prams* and *dinghies*, *inflatables*, *skiffs*, and *utility outboards*.

Prams and Dinghies

Prams and dinghies are among the smallest of the utility boats. *Dinghies* have a pointed bow, and *prams* have a squared-off bow (Figure 1-18). Both serve as *tenders* for larger craft, transporting people, gear, and supplies to and from the larger craft. They are usually 8 to 10 feet long and have wide *beams*, or widths, relative to their lengths. They usually have oars for rowing, but may also have small outboard motors. On cruises, they are either towed behind a larger boat or carried aboard.

Inflatables

Inflatables are used as dinghies and as sportboats (refer back to Figure 1-4). They are extremely stable, can carry significantly larger loads than rigid boats of the same size, and are usually so buoyant that they will stay afloat even when filled with water. As dinghies, they may be towed astern, hoisted



Figure 1-18. Two sailing prams underway. The Optimist class of prams, which are very much like these, are raced worldwide. Prams without sailing rigs, built for rowing, serve as stable, inexpensive tenders for larger boats. (COURTESY NATIONAL MARINE MANUFACTURERS ASSOCIATION)

on *davits*, stored on deck, or deflated and stored in a locker.

Generally, inflatables used as sportboats have hard transoms to which outboard motors may be attached. Some, known as *rigid inflatable boats* or RIBs, have fiberglass hulls along the sides of which, above the waterline, are attached inflated (and sometimes foam-filled) tubes (Figure 1-19). RIBs plane and steer more easily than inflatables with nonrigid hulls. Although heavier than other inflatables, RIBs weigh considerably less than all-fiberglass boats of the same size—an advantage for transporting as well as when underway—and their inflated or foam-filled collars give them excellent positive buoyancy.

Skiffs

A skiff is a flat-bottomed utility boat with straight or slightly flared sides. (A boat with flared sides is wider on deck than at the waterline. This describes most boats.) One form of skiff is a *jonboat*—a long, narrow boat with a flat bottom (Figure 1-20). It



Figure 1-19. A rigid inflatable boat (RIB) provides excellent buoyancy and stability with lower weight than a conventional fiberglass boat of similar size and capacity. (COURTESY ZODIAC)

may be as short as 10 feet or as long as 16 feet. A jonboat has the same width from bow to stern, which means that the bow is square (like a pram's), not pointed, and resembles the transom stern although it might be slightly narrower. Also, the flat bottom turns up slightly near the bow end. A homemade jonboat is most often made of wood, but commercially built ones are usually made of aluminum.

Although skiffs are easy to row, many have small outboard motors. A skiff with a wide beam is stable and ideal for hunting or fishing in sheltered waters.

Utility Outboards

Utility outboards are small boats much like rowboats. They have small outboard motors and are sometimes difficult to row.

Some utility outboards have small decked-over areas in their bows, but most are completely open.



Figure 1-20. An aluminum jonboat with camouflage paint for duck hunting. (COURTESY U.S. COAST GUARD OFFICE OF BOATING SAFETY)



Figure 1-21. The qualities valued most in a utility outboard are stability and load-carrying ability, achieved in this boat in part with a blunt, skiff-like bow. (COURTESY BOSTON WHALER)

They are usually 12 to 14 feet long, and can operate in choppy water than skiffs because of their pointed bows. The amount of chop in which they are safe, however, depends on their freeboard and load. They are popular as fishing boats and should be used in sheltered waters (Figure 1-21).

Runabouts

Runabouts are small, sporty craft used for day cruising, waterskiing, and fishing (Figure 1-22). They may be completely open or have decked-over bows, and the roughness of the water in which they can operate depends on their freeboard and the weights of their loads.

Runabouts range from highly polished craft with cushioned seats used primarily for day cruising and ski towing to boats designed primarily for fishing.

Bowriders

One type of runabout has a split dashboard and windshield that gives ready access to the forward part of the boat (Figure 1-23). This is called a **walkthrough** windshield. Usually, the forward area has padded seats that can be used while the vessel is underway. This type of boat is sometimes called a **bowrider**. A bowrider boat should not be confused with **bowriding**, where passengers sit on the raised, forward deck of the vessel. They may or may not have their legs draped over the side, and may or may not be straddling a **stanchion**, an upright post that supports the **bow rail**. Bowriding is a danger-



Figure 1-22. **Top:** The classic wooden runabout of 50 years ago was a thing of beauty with its varnished wooden hull. The inboard engine of this Hacker Craft is beneath the hatches on the afterdeck. Speedboats in the era of low-powered engines had to be narrow to reduce their resistance through the water. (COURTESY HACKER BOAT COMPANY) **Bottom:** The modern equivalent of a Hacker Craft is perhaps not as beautiful, but it's more durable, more versatile, more affordable (since they are mass produced), and requires less upkeep. (COURTESY BOSTON WHALER)

ous activity. Rails can give way; a person can fall overboard because of an unexpected wave, wake, or sudden turn; or when the boat is docking, legs can be crushed against pilings. Since bowriding is so dangerous, and a fall overboard can be fatal (it is difficult for the person to avoid the boat's propeller), it is illegal in most states and in all federal parks and waters.



Figure 1-23. A bowrider, showing the walkthrough windshield that is characteristic of the type. (COURTESY BAYLINER)

Cathedral Hulls

Another type of runabout has a **cathedral hull**, which is V-shaped in the middle and has smaller Vs on each side (Figure 1-24). While it is a very stable boat, it is a hard ride in rough or choppy water.

Open Fishermen

Less sporty runabouts are used primarily for fishing. An **open fisherman** (Figure 1-25), for example, has no raised decks. Instead it has a **console**, most often in the center of the boat, and is therefore called a **center console** boat. The console holds the **helm** or steering wheel, the boat's instruments, and the gearshift mechanism.

Center console boats make excellent fishing boats. They are usually powered by outboard motors, and some have dual outboard installations. Many have at least one disadvantage, however—their shallow depth from the gunwale to the deck. This makes it difficult for fishermen who like to stand on the deck and lean their legs against the gunwale for support. Many other small boats have this disadvantage.



Figure 1-24. In the Boston Whaler line of boats, the smaller models—13 feet and under—derive much of their stability from the sponsons of a cathedral hull form (top). The 15- to 17-foot models (middle) derive more stability from their greater hull width, so the sponsons can be reduced in favor of a deeper-V central hull that offers smoother rough-water performance. This trend continues in the 18-foot and longer boats (bottom), with the sponsons replaced by chine flats. (COURTESY BOSTON WHALER)



Figure 1-25. A center console fishing boat—the cockpit provides protection from the sun. Rod holders on the hardtop are another feature shown here. (COURTESY COAST GUARD AUXILIARY)

Cuddy Cabin

Trailerable boats with a **cuddy cabin** (Figure 1-26) offer a modest degree of shelter. Although intended for overnight cruises, the cabin is seldom used for this purpose since it is small and difficult to keep insect free. Cuddy cabin boats usually lack sanitary and cooking facilities, although portable **heads** or toilets may be added. A cuddy cabin can serve as dry storage space, and it does provide some security for equipment left aboard or for your children if you're caught on the water by a squall or rainstorm.

It is often difficult to go forward around a cuddy cabin, which means that to anchor, you usually must enter the cabin and crawl up through a **hatch** to



Figure 1-26. A cuddy cabin offers shelter and creature comforts but impedes access to the foredeck. (COURTESY BOSTON WHALER)



Figure 1-27. A walkaround cuddy incorporates a narrow side deck for access to the foredeck. (COURTESY BOSTON WHALER)

reach the forward deck. The novelty of this wears off quickly, especially if you are bottom fishing and are frequently moving from one spot to another.

In some boats, this disadvantage is overcome by “walkaround” cuddy cabins, created when space is taken from the upper areas of the cabin and used for walkways on each side of the vessel (Figure 1-27). In addition to making anchoring easier, this arrangement usually provides a seat forward on which it is legal to ride.

Cruisers

Large runabouts with cuddy cabins are like small cruisers. Strictly speaking, though, cruisers are motorboats with cabins, *galleys* (cooking facilities), plumbing, and other facilities necessary for living aboard comfortably (refer back to Figure 1-16).

Cruisers come in many shapes and sizes and range from small overnight vessels to boats for extended voyages and living aboard. Cruisers, in general, are more *seaworthy* than runabouts. While in the past most cruisers were displacement craft, today most are semidisplacement craft powered by single- or dual-engine installations. Small cruisers may use outboards or stern drives, but those longer than 30 feet or so usually have inboards.

Pontoon Boats

Pontoon boats are popular for use in sheltered waters. In their simplest form, they are platforms



Figure 1-28. An outboard-powered pontoon boat. (COURTESY TRACKER MARINE)

mounted on two or more cylindrical floats, but they are often more elaborate.

Most pontoon boats have outboard motors, though stern drives are common on larger boats (Figure 1-28). All pontoon boats have a shallow *draft*, which means they do not require much water in which to operate.

Pontoon boats are popular on rivers and small, inland lakes, where they are used as fishing boats, cruisers, work platforms, and party boats. They tend to be unstable and are not suitable for use in rough water, however. Use them with extreme caution in exposed waters, and do not expose them to severe weather. Pontoon boats with covered tops may blow over when winds are strong so do not use them then or on large bodies of water.

Houseboats

A houseboat is a variation of a cruiser and offers most of the conveniences of home, including hot and cold running water (Figure 1-29). They usually have one or two stern-drive or inboard engines; some have enough speed and power to plane and to tow water-skiers.

Houseboats give their owners a lot of space, but at some cost. Seaworthiness is sacrificed for livability—they are limited to relatively sheltered waters because of their hull designs, low freeboards, and large windows, which are vulnerable in rough water and, if broken, would let waves aboard.



Figure 1-29. A houseboat underway on sheltered waters. (COURTESY U.S. COAST GUARD OFFICE OF BOATING SAFETY)

Canoes

Canoeing is one of the few quiet, restful, yet adventurous boating activities open to all (Figure 1-30). Besides being an excellent physical activity, canoeing affords boaters the opportunity for a peaceful on-the-water experience or a challenging go at a set of rapids.

For those who want a little assist in propulsion, many canoes will support a small outboard engine. Some can even be rigged with a sail.

All of this fun, however, does come with a price. Canoes are not very stable, and to be a safe and competent canoeist requires practice and the development of basic skills. Good balance, good paddling technique, and the ability to steer a boat with little or no keel and no rudder are just a few of the requirements for safe canoeing.

While canoeing looks easy, it is by no means risk free. Remember, a canoe is just as much a water vessel as a large motor or sailing yacht and must adhere to all boating regulations and good practices.



Figure 1-30. Exploring a lakeshore in a solo canoe. (COURTESY U.S. COAST GUARD OFFICE OF BOATING SAFETY)

Due to the risk of inadvertent capsizing, the wearing of a **personal flotation device** (PFD), or life jacket, is highly recommended in a canoe. We discuss life jackets in Chapter 2.

Kayaks

Kayaking is fast becoming widespread. It is not uncommon to see kayaks on lakes, rivers, and streams, and even on oceans and their tributaries (Figure 1-31).

These vessels have the remarkable ability to allow the boater and the boat to act almost as one. The actions of the boat and boater together produce results unlike any other boat/boater relationship. Great physical activity and exciting maneuvering are hallmarks of kayaking.

Getting wet is one of the enjoyments of this sport. It will probably happen often, so knowing how to recover from a rollover is a must, as is wearing proper flotation devices. Kayaks are inherently safe vessels, but have a high accident rate; since kayaks are so simple to operate, kayakers often ignore basic safety precautions.



Figure 1-31. **Top:** Tackling whitewater in a river kayak. **Bottom:** Beached sea kayaks. Note the compasses in the fore-decks—you don't need a compass in a river kayak! (COURTESY U.S. COAST GUARD OFFICE OF BOATING SAFETY)



Figure 1-32. Top: A PWC operator maneuvers away from the launch ramp at a Dana Point, California, marina. (PHOTO BY BOB DENNIS) Bottom: Early PWCs were solo craft, but that is no longer true, as this Sea-Doo demonstrates. (COURTESY BOMBARDIER RECREATIONAL PRODUCTS)

Remember, kayaks are vessels and therefore subject to all maritime laws, regulations, and good practices.

Personal Watercraft

Personal watercraft (PWC) are highly maneuverable, jet-driven vessels that can operate in very shallow water (Figure 1-32) and carry up to four riders. Most people know these planing vessels as Jet Skis, a registered trademark.

Boatbuilding Materials

The first boats were built of wood. Today, boatbuilders use fiberglass, aluminum, steel, wood with epoxy, and combinations of these materials in addition to wood.

Steel

Steel is an ideal material for shipbuilding. Unfortunately, steel-hulled boats less than 30 to 35 feet long are too heavy for economical operation, but when speed can be sacrificed for strength, steel is an excellent building material, producing a boat that will withstand collisions and groundings to an extraordinary degree.

Aluminum

Aluminum hulls are light, cost less than hulls made of other materials, and can take the hard knocks of canoeing, fishing, groundings, and ice floes. Many canoes, skiffs, jonboats, runabouts, and small cruisers, among other small craft, are built of aluminum, as are larger custom motor yachts and voyaging sailboats (Figure 1-33).

Aluminum has the disadvantage of being noisy; all sea noises are heard through the hull. Noises inside the hull are also transmitted to the water—an important consideration for anglers. And aluminum is a good transmitter of heat, so aluminum hulls tend to sweat considerably.

Another disadvantage of aluminum is that it is easily corroded by *electrolysis*. This is not a disadvantage for canoes and skiffs used in fresh water and stored on land, but it is a serious consideration for boats moored in salt water.

Boats moored in salt water usually have their bottoms painted with *antifouling paint* to reduce plant and animal growth. Most of these paints contain copper. In salt water, copper and aluminum set up an electrolytic action, and the aluminum quickly corrodes. Tin-based antifouling paints,



Figure 1-33. An aluminum runabout underway. (COURTESY LOWE BOATS)

which do not interact as readily with aluminum, were once used on aluminum hulls but the U.S. Environmental Protection Agency has determined that the tin is poisonous to marine life, so such paints are now banned.

There are presently two alternatives for protecting aluminum. One is to use a layer of non-metallic paint between the hull and the antifouling bottom paint, which works fine unless a scratch exposes the aluminum hull. The other alternative is to use a polymer antifouling paint, which is expensive and difficult to apply.

Wood

Wood, once the primary choice of boatbuilders, is used much less frequently today. This is not because wood is an undesirable construction material; many people would not trade their wooden boats for any other. Wood is attractive and, if properly maintained, lasts a long time. Good wood for boat construction is expensive, however, and demands considerable attention. Owners of traditional plank-on-frame wooden boats spend many hours each year getting them ready for launching. Wood needs scraping, sanding, and repainting annually, and the underwater seams of wooden boats need periodic *caulking* to make them watertight.

These drawbacks have been overcome with newer methods that use wood in combination with reinforcing resins and fabrics to eliminate caulked seams, increase longevity, and reduce maintenance while retaining the distinctive beauty of a wooden boat. In stitch-and-glue boatbuilding, for example, hull panels are cut to prescribed measurements from marine plywood sheets, laid down over tem-



Figure 1-34. A strip-built tandem canoe, suitable for home construction. (COURTESY NICK SCHADE)

porary station molds cut to the cross-sectional shapes of the boat at various points along its centerline, and then stitched together where their edges meet using temporary wire stitches. The stitches hold the hull together long enough for these joints to be permanently glued with rock-solid epoxy fillets; then the entire structure is covered with fiberglass, Dynel, or another fabric laid in place with epoxy or fiberglass resin. This technique is not only user-friendly for home builders, but it also makes a handsome, long-lasting boat.

Another popular technique—especially suited to canoes and kayaks built in a home workshop—creates a boat from narrow strips of wood coated and attached with epoxy resin. The boats are beautiful and amazingly durable and maintenance free, and the skills required are well within reach of an enthusiastic amateur builder (Figure 1-34).

While methods like these have spurred a renewal of amateur wooden boat building, they are not suitable for commercial production of boats. In production boatbuilding, fiberglass predominates.

Fiberglass

For commercial boatbuilding, fiberglass is the material of choice. Fiberglass boats account, in large part, for the rapidly growing popularity of recreational boating. Our nation's waterways abound with fiberglass runabouts, center consoles, cruisers, and other powerboats, and unless you have special needs that an aluminum skiff, jonboat, or canoe can best meet, your first boat should probably be fiberglass.

Fiberglass is relatively inexpensive and can easily be formed into complex shapes and curves (Figure 1-35). It's ideal for production boatbuilding because a single hull mold can be used to build dozens or even hundreds of copies of the same hull. Furthermore, fiberglass is easily repaired when damaged, lasts seemingly indefinitely, and most importantly for the average boatowner, is easily maintained, requiring much less effort and time than wood. Less time spent on maintenance means more time on the water.

Fiberglass, or more properly, glass-reinforced plastic (GRP), does have disadvantages. It is heavy, for one thing; fiberglass with the strength of steel weighs more than steel. Today's more carefully engi-



Figure 1-35. A fiberglass boat under construction. (COURTESY NATIONAL MARINE MANUFACTURERS ASSOCIATION)

neered boats are a lot lighter than the fiberglass boats of 30 to 40 years ago, however, simply because early fiberglass boats were built to wooden boat thicknesses (in the absence of better guidance) and thus were way overbuilt. Also, although the glass will not burn, the resins that bind it together will.

How Fiberglass Boats Are Built

To build a production run of fiberglass hulls, the builder needs a mold in which the fiberglass materials can be shaped and adhered. The first step, therefore, is to construct a **plug** in the shape of the hull, and then form a mold over the plug. Imagine carving the shape of the hull from a huge block of wood; if you could do this, you would be creating a plug. The surface of the plug must be flawless so that the inner surface of the female mold formed over the plug will also be flawlessly smooth. When the fiberglass mold has cured and been properly stiffened on the outside, the plug is removed from the mold, which is then ready for building a series of hulls.

Each hull is built from the outside in within the female mold. The gelcoat is sprayed over the mold surface first, which gives the vessel its color and finished, mirror-smooth outer surface. Then follow layers of fiberglass mat (or chopped fiberglass strands sprayed from a hand-operated gun) alternated with layers of finely woven fiberglass cloth and/or coarse woven roving, until the desired thickness of the hull is reached.

The strength and durability of the hull will depend on what fiberglass materials and resins are used, how they are combined, how many layers are laid down, and how much quality control is exercised throughout. When hull thickness is built up

in part with chopped strands sprayed from a chopper gun (which mixes the strands with resin as it sprays), the gun operator must be careful to keep the fiber-to-resin ratio at optimal levels—neither resin starved nor too resin rich. Ask the dealer if the boat you're looking at incorporates chopped strand. If it does, ask what kind of quality control the builder exercises.

A builder will also typically make a hull thicker near the keel and in high-stress areas, and may use special, directionally reinforced materials locally to impart particular strength. After the hull is laminated and cured, it is strengthened with stiffeners, stringers, and other members. Then decks, cabins, and superstructure are added; usually these too are fiberglass, and in production boatbuilding these so-called parts are likewise laminated in molds.

Variations on the Method

Over time, variations on the fundamental method have evolved. In one, known as **sandwich construction**, a core material (usually balsa wood) is sandwiched on either side by layers of fiberglass impregnated with resin. Other core materials are sometimes used, such as Airex foam or other formed plastics. Sandwich construction provides a boat that is strong and buoyant. Should leaks develop in the fiberglass and water reach a balsa core, however, rot will occur.

In another variation called a **matched-die process**, male and female molds, usually made of metal, are clamped together with a fiberglass-and-resin laminate between them. By applying the correct pressure and heat, the hull is made uniform throughout.

The international demand for environmental and worker safety, along with the need for more efficient manufacturing, has resulted in another new process for producing fiberglass products in the marine and aircraft industry called the **Seeman Composite Resin Infusion Molding Process**, or SCRIMP. This process, like the matched-die process, requires a male and female mold between which the fiberglass or other filler material is encapsulated. Then resin is injected with a vacuum assist to ensure that unwanted encapsulated gases are removed. This is an environmentally clean process and results in a laminate with no voids. This process can be used to produce aircraft and

even small submarines as well as boats, and is finding increasing favor, in large part because of its environmental benefits.

General Considerations

Fiberglass boats are strong, and since most production-line boats are built of fiberglass, they dominate the market. A fiberglass hull lasts indefinitely—longer, usually, than the engine that powers it and the gear it carries—so the used-boat market is also dominated by fiberglass. For these reasons, as well as for economy and ease of maintenance, your first boat is likely to be fiberglass—along with your second boat and most boats thereafter. The quality of workmanship is not always obvious in a fiberglass boat, so the reputation of the builder should be one important guide for you. Ask around, and browse boat sites on the Internet.

Fiberglass is heavier than water and a fiberglass boat filled with water will sink unless it has built-in flotation. All new boats less than 20 feet long (sailboats, canoes, kayaks, inflatables, multihulls, and raceboats excepted) are legally required to have sufficient built-in flotation to keep a portion of the boat above water even when the boat is flooded. (This would not be feasible on larger

boats; however, they are less vulnerable to swamping.) Sometimes the flotation is in the form of a sealed compartment; sometimes it is Styrofoam or another closed-cell foam. Consider adding supplemental flotation to an exempted boat as well. An offshore kayak, for example, could capsize miles offshore, and the boater might have insufficient freeboard even after righting the boat to bail it out.

You can find out more about the boat you wish to buy by reading the literature published by its manufacturer. How complete is the information? Reputable manufacturers want you to know what you are buying, and are usually proud of their quality control programs, which are critical in this industry. If you can visit the manufacturing plant, arrange for a tour. Most factories will be glad to show you boats in various stages of construction.

Your Intended Use

One guideline in selecting a boat is how you will use it. Make certain the boat you intend to buy matches your intended use. People tend to look at boating in one of two ways: some owners take pleasure in knowing that their boats are built for heavy seas, while others enjoy the rush of adrenaline they get from pushing their boats to their limits. The table on pages 28–29 gives you some idea of how the various powerboat types are grouped in terms of intended use and seaworthiness.

Not all boats are designed for the rigors they will endure. Hull failures are common on planing boats driven by would-be ocean racers since most hulls are not designed for jumping wakes and waves and lunging off swells.

Displacement and semidisplacement hulls can also be overstressed. For example, a houseboat used on the ocean may be subjected to stresses for which it was not designed. Even a well-constructed boat hull can be damaged by use in adverse sea conditions.

BOATBUILDING MATERIALS

Steel

- Strong and heavy
- Better for large boats than small
- Must be painted to avoid rust

Aluminum

- Lightweight
- Relatively inexpensive
- Rather noisy
- Can take hard knocks
- Vulnerable to electrolysis in salt water

Fiberglass

- Today's most popular boatbuilding material
- Strong and heavy
- Easily molded
- Easily repaired
- Relatively easy to maintain

Marine Surveyors

Marine surveyors make boats their specialty, serving much the same function that home appraisers serve ashore. If you are planning to buy a used boat, it is a

good idea to hire a surveyor. The surveyor will assess the boat's condition and tell you what it needs to bring it to good working condition. He or she will also appraise the boat's value based on condition, builder's reputation, and the local market for the kind of boat in question, so that you can judge the fairness of the asking price. Finally, a surveyor can help you judge to what extent the money you save by buying old versus new will be consumed by the repairs and upgrades you might have to make. With a little knowledge and care you can eliminate many boats from consideration without the expense of a professional survey, but when you get ready to make an offer, you're well advised to get a professional second opinion. Sometimes a surveyor will also suggest that you hire a mechanic to compression-test and otherwise evaluate the boat's engine or engines.

Buying a Boat

When you are buying a boat—new or used—there is no substitute for a written sales agreement that clearly states your intent and that of the seller. This should prevent unpleasant surprises. The sales contract should state the price, delivery date, and method of payment, and should also include an inventory of the boat's equipment and a detailed description of the overall condition of the boat. Any refundable deposit you make should be noted, along with possible limitations on the refund. If a loan is involved, the contract should state whether the sale is subject to the availability of the loan.

The contract should also stipulate that the sale is subject to a satisfactory marine survey. As a buyer, you should take a sea trial, but have the survey done on land. Problems noted during the trial run and the survey should be addressed in the contract. If the boat is not being sold "as is," the contract should say so. It should also state whether the seller is responsible for correcting problems or defects and if so, what the time limit is for making such corrections. The length of time for discovering and correcting new problems after the purchase date should be included as well.

Even if you are having the boat surveyed, you should ask probing questions about its prior use, maintenance record, and history of problems. Has

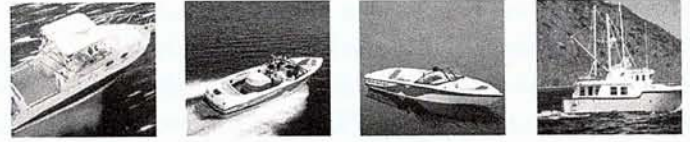
it had any blistering? Has it had accidental damage? What is its present condition? The seller should be completely honest, but again beware!

Finally, make certain that you have all of the boat's papers. You will need them for state registration or for new documentation with the Coast Guard, as you'll see in Chapter 2.

As a buyer, you should realize that you do not have any rights under the seller's insurance. Arrange to have your own insurance in place at the closing date.

Ways to Learn More

- All About Powerboats: Understanding Design and Performance.* Roger Marshall. Camden, Maine: International Marine, 2002.
- The Boat Buyer's Guide to Motor Yachts and Trawlers.* Ed McKnew. Camden, Maine: International Marine, 2006.
- The Boat Buyer's Guide to Sportfishing Boats.* Ed McKnew. Camden, Maine: International Marine, 2006.
- The Boat Buyer's Guide to Trailerable Cruisers and Runabouts.* Ed McKnew. Camden, Maine: International Marine, 2006.
- The Boat Buyer's Guide to Trailerable Fishing Boats.* Ed McKnew. Camden, Maine: International Marine, 2006.
- Chapman Piloting & Seamanship.* 66th ed. Charles B. Husick. New York: Hearst Books, 2009. Chapter 1.
- Getting Started in Powerboating.* 3rd ed. Bob Armstrong. Camden, Maine: International Marine, 2005.
- Boating Magazine's Insider's Guide to Buying a Powerboat: Featuring Tips and Traps for the Smart Boat Buyer.* J. R. Lamy. Camden, Maine: International Marine, 1999.
- The Pontoon and Deckboat Handbook.* David Brown. Camden, Maine: International Marine, 2007.
- Your First Powerboat.* Bob Armstrong. Camden, Maine: International Marine, 2008.
- Sorensen's Guide to Powerboats.* 2nd ed. Eric Sorensen. Camden, Maine: International Marine, 2008.



Seaworthiness Factors

Hull Shape	Most Efficient Hull	Fastest Hull	Inshore Fishing	Water Skiing	Wake Boarding	Trawler-Style Yacht
Boat speed	low to moderate	highest	low to moderate	high	high	low
Sea states	flat water	flat water	moderate seas	flat water	moderate waves	moderate to large seas
Wave height	0-1 feet	none	0-2 feet	0-1 feet	up to 3 feet	sea heights to 30% of length
Hull shape	round hull	3-point hydro	V or round	V hull	V hull	round or V
Hull length	long	moderate	moderate seas	moderate	moderate waves	moderate to long
Draft	shallow	low	shallow	shallow	moderate to deep	moderate to deep
Waterline length	long	low	moderate	moderate	moderate to heavy	moderate to heavy
Beam	narrow	wide for stability	moderate	proportional to length	proportional to length	proportional to length
Displacement	light	as light as possible	light to medium	moderate to light	moderate to heavy	moderate to heavy
Horsepower	low or very low	very high	low to moderate	high for length	high for length	low to moderate
Bow height	low to moderate	low	low to moderate	low to moderate	low to moderate	high
Bow fineness	fine to moderate	fine	fine to moderate	moderate	moderate	moderate to full
Bow flare	moderate	none	minimal	minimal	moderate	moderate to high
Deadrise angle	low	moderate	0-5 degrees	0-5 degrees	5-10 degrees	5-12 degrees
Sea-worthiness	limited	limited	limited	limited	limited	good
Comfort when stopped	tendency to roll	none	moderate	moderate	moderate	some roll
Comfort at cruising speed	comfortable	none	moderate	moderate	moderate	comfortable
Comfort at full speed	comfortable	none	moderate	moderate	moderate	comfortable
Range	moderate	limited	limited	limited	limited	extensive
Construction costs	moderate to high	very high	moderate	moderate to high	moderate	moderate to high
Suitable for use on:						
Estuaries/salt marshes	yes	no	yes	no	no	no
Small ponds/small lakes	yes	no	yes	yes	yes	yes
Large lakes	select optimum conditions	select optimum conditions	select optimum conditions	select optimum conditions	select optimum conditions	yes
Coastal shorelines	select optimum conditions	select optimum conditions	select optimum conditions	select optimum conditions	select optimum conditions	yes
Open ocean	select optimum conditions	no	select optimum conditions	select optimum conditions	select optimum conditions	select optimum conditions



Inshore Cruiser	Offshore Cruiser	Offshore Sportfisherman	Inshore Racer	Offshore Racer	Inshore Catamaran	Offshore Catamaran
moderate	moderate	high	very high	very high	moderate to high	very high
moderate to large seas	moderate to large seas	moderate to large seas	moderate seas	moderate to large seas	moderate seas	moderate to large seas
sea heights to 20% of length	sea heights to 30% of length	sea heights to 30% of length	sea heights to 20% of length	sea heights to 30% of length	sea heights to 20% of length	sea heights to 30% of length
round or V	round or V	V hull	V hull	V hull or catamaran	round or V	mostly V
moderate to long	moderate to long	moderate	long	long	long	long
moderate to deep	moderate to deep	moderate	low to moderate	low to moderate	low	low
moderate	moderate to heavy	moderate	long	long	long	long
proportional to length	proportional to length	proportional to length	proportional to length	narrow for length	narrow hulls/wide overall	narrow hulls/wide overall
moderate to heavy	moderate to heavy	moderate	light to moderate	light to moderate	low to moderate	light to moderate
low to moderate	moderate	moderate to high	high	high	moderate to high	moderate to high
low to moderate	high	moderate to high	low	low	moderate	moderate
moderate to full	moderate to full	moderate	fine to moderate	fine to moderate	moderate	moderate
low to moderate	low to moderate	high	minimum	minimum	moderate	moderate
5–12 degrees	8–15 degrees	10–18 degrees	8–20 degrees	15–25 degrees	10–20 degrees	15–25 degrees
good	excellent	good to excellent	limited	moderate to excellent	good	good
some roll	some roll	good	some roll	some roll	good	good
good	excellent	good to excellent	good	moderate	good	good
good	excellent	good to excellent	good	good	good	good
moderate	extensive	good	limited	good	low to moderate	high
moderate	moderate to high	moderate to high	high	moderate to high	moderate to high	moderate to high
yes	no	no	no	no	no	no
yes	yes	yes	no	no	yes	no
select optimum conditions	yes	yes	yes	yes	yes	yes
select optimum conditions	yes	yes	yes	yes	yes	yes
select optimum conditions	yes	yes	select best conditions	yes	select optimum conditions	yes

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

1. _____ stanchion
2. _____ starboard
3. _____ aft
4. _____ head
5. _____ transom
6. _____ planing hull
7. _____ outboard
8. _____ tender
9. _____ bowrider
10. _____ PWC

THE RESPONSES

- a. toward the back of a boat
- b. the stern cross section of a square-stern boat
- c. a runabout with seats in the front
- d. it transports people and gear
- e. it rises up on top of the water when it has enough speed
- f. a personal watercraft
- g. a marine toilet
- h. its engine is mounted on the transom
- i. the right side of a boat, looking forward
- j. it holds up a rail

Multiple-Choice Items

In the following items, choose the best response:

- 1-1. The shortest distance from the waterline to the top of a vessel's sides or transom is its
 - a. freeboard
 - b. gunwale
 - c. deadrise
 - d. draft
- 1-2. Select your boat to suit your
 - a. local waters
 - b. pocketbook
 - c. needs
 - d. desires
- 1-3. A vessel is anything used on the water for
 - a. skiing
 - b. transportation
 - c. fishing
 - d. cruising
- 1-4. The part of a stern-drive engine that is outside the vessel is called the
 - a. outboard
 - b. propeller
 - c. upper unit
 - d. outdrive
- 1-5. If a boat weighs more than the water it displaces, it
 - a. sinks
 - b. floats
 - c. is sluggish
 - d. handles easily
- 1-6. Skiffs, jonboats, houseboats, and pontoon boats should be used only
 - a. in sheltered waters
 - b. for pleasure
 - c. in fresh water
 - d. for fishing

Multiple-Choice Items (continued)

- 1-7.** The primary responsibility for the safety of all persons on board a boat whether rented or privately owned belongs to
- the boat manufacturer
 - the insurance company
 - the boat operator
 - the rental agency
- 1-8.** The means of propulsion often used in rocky, shallow water where propellers are easily damaged is
- an inboard
 - an outboard
 - an I/O
 - a jet drive
- 1-9.** When selecting a powerboat, consider
- a boat that matches your intended use
 - the most expensive one you can afford
 - purchasing only a planing hull
 - the value of a jet drive
- 1-10.** If you are buying a used boat, have it examined for possible defects by
- the Coast Guard
 - a reliable dealer
 - a friend
 - a marine surveyor
- 1-11.** The forward part of a vessel is called the
- bow
 - transom
 - hull
 - stern
- 1-12.** Fiberglass is a popular boatbuilding material because it is
- strong and heavy
 - easily molded
 - easily repaired
 - all of the above
- 1-13.** From the Norse, we got the term "steering board," which eventually became
- starboard
 - port
 - larboard
 - forward
- 1-14.** The keel and the planks of a boat together make the
- stringers
 - hull
 - bilges
 - deck
- 1-15.** Which of the following is a vessel?
- a raft
 - an inflatable
 - a PWC
 - all of the above
- 1-16.** A bass boat can become dangerous in rough water because of
- its low freeboard
 - its high gunwales
 - its heavy stern
 - its large V-shaped hull
- 1-17.** A planing-hulled vessel
- is usually round on its bottom
 - is characteristically slow
 - rides on top of the water at cruising speeds
 - pushes its way through the water when underway
- 1-18.** The flat, vertical surface on the aft portion of boats is called the
- steering board
 - loading board
 - transom
 - cross member
- 1-19.** The top speed of a displacement-hulled vessel depends primarily on its
- draft
 - length
 - weight
 - freeboard
- 1-20.** In the water, and especially when it is rough, the easiest type of engine to work on is
- a stern drive
 - an outboard
 - a magnetic drive
 - a pulse drive

Chapter 1

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

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