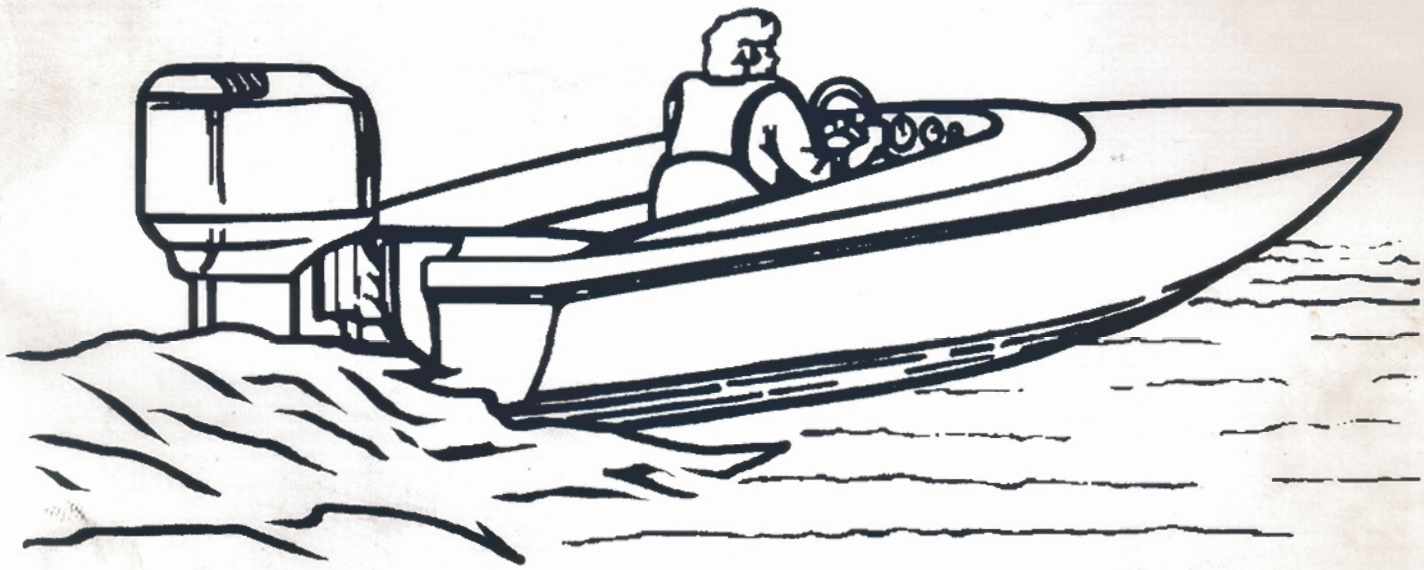
GUIDE TO HI-PERFORMANCE BOAT OPERATION



MERCURY Racing

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⚠ WARNING

It is very difficult for a person standing or floating in the water to take evasive action should they see a power boat heading in their direction even at low speed. Therefore it is strongly recommended that when your boat is in the immediate vicinity of people in the water, the unit be shifted into neutral and the engine be shut off. **SERIOUS INJURY IS LIKELY IF CONTACT IS MADE WITH A PERSON IN THE WATER BY A MOVING BOAT, GEAR HOUSING, PROPELLER, OR ANY SOLID DEVICE RIGIDLY ATTACHED TO A BOAT OR GEAR HOUSING.**

This booklet is directed primarily toward owners and operators of high performance outboard powered boats. However, much of the information has broader application to any type of power (stern drive, jet, etc.) as well as lower performance boats. Before proceeding with these suggestions, you should read all owner's manuals associated with your boat and power package.

Information in this booklet has been provided by:

Mercury Racing
Fond du Lac, Wisconsin

Mercury Marine Hydrodynamics Engineering
Fond du Lac, Wisconsin

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MerCruiser
Stillwater, Oklahoma

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Safety for Yourself and Others

Notice

Throughout this publication, **DANGER, WARNINGS** and **CAUTIONS**, accompanied by the international **HAZARD** symbol ⚠ , may be used to alert the user to special instructions concerning a particular operation that may be hazardous. **OBSERVE THEM CAREFULLY**.

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions plus "common sense" operation, are major accident prevention measures.

⚠ DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices which could result in minor personal injury or product or property damage.

IMPORTANT – Indicates information or instructions that are necessary for proper operation and/or maintenance.

The Thrill of High Performance Boating

There are several good reasons why an increasing number of boaters are choosing to spend some of their leisure hours participating in high performance boating.

For many of these boaters, the lure to move over the water at what can seem like a breathtaking speed, provides them with unmatched pleasure. For others, there is that informal, never ending competition with your neighbor that pits your knowledge and driving skills against theirs.

High performance boating is an exhilarating sport, synonymous with speed and friendly competition. Today, many high performance boats also adequately lend themselves to cruising, water skiing or fishing activities. They provide fast, versatile and comfortable boats that you and your passengers can safely enjoy.

The growing popularity of high performance boating, especially in the past decade, has been an incentive to manufacturers to design and market more sophisticated boats, engines and accessories. Significant improvements have been made in engine gearcase design and propeller technology to complement boat design advancements and to address the high performance boater's needs.

With the continuing evolution of more powerful and efficient outboard motors and stern drives married to improved, lighter but stronger and faster boat designs, it becomes more important than ever for owners and drivers of high performance boats to go through an operational learning procedure. Proper boat operation and handling procedures can help make them aware of, and perhaps eliminate some of the potential surprises that can occur from otherwise difficult situations.

The following information is presented in an effort to walk new high performance drivers through a series of instructional steps to prepare them for the different boat handling characteristics associated with high performance boats.

Operators Knowledge and Experience

A high performance boat is not the beginners rig for a new and inexperienced boater. To the contrary, it should be regarded as the most advanced level of boating that only a knowledgeable, experienced and skilled boater should pursue.

Yes, it is very easy to get "turned on" to high performance boating by watching them perform on television and reading the powerboat magazines that extol the thrills of the sport.

Good common sense can easily be pushed aside by the desire to be a high performance boat operator before acquiring the necessary basic knowledge and experience.

When you are ready to join this advanced level of boating, select a competent marine dealer well versed in high performance boating to guide you in your selection based on your experience, usage and needs. Be sure that the dealer, or recommended expert you select, spends time with you during your first high performance boating experiences. This expert support and training will help prepare you for safe and enjoyable high performance boating.

Terms Used In This Booklet

Bow Searching, Hunting - The tendency for a boat to creep into a slight unintended turn during slow or idle speed operation. Usually associated with deep-V hull designs, or hulls with a sharp V at the bow.

Bow Steer - Can occur on plane when the boat is running flat or in a bow down attitude. Usually caused when the outboard motor or stern drive is "trimmed in" too far. Can cause unintentional turns which, if uncontrolled, can result in a full spin out.

Cavitation - As a shape passes through water at an increasing speed, the pressure that holds the water to the sides and back of the shape is lowered. Depending upon the water temperature, when the pressure reaches a sufficiently low level, boiling will begin. This occurs most often on a propeller at the leading edge of the Blade. It can also occur on the side of a gearcase or inside the water pump. When speed is reduced and the pressure goes up, boiling will subside.

Chine Walk - An occurrence associated with V-bottom hulls, with or without a pad. When this type of hull is operated at high speed, only a minimum of "V" or pad is in the water. Hull wetted area is minimal. In a well "trimmed out" attitude of the outboard motor or stern drive, the hull may have a tendency to roll or fall off of the point of pad to one side and then the other. This rolling action must be stopped or controlled if the oscillation appears to be intensifying. Unchecked, the boat may go out of control and flip over or eject the occupants. It is controlled by small, properly timed continuous steering corrections. It also helps to have a very tight steering system with minimal backlash.

Crab, Crab Angle - An oblong object, such as a boat or gearcase, moving ahead but not directly in line with its longitudinal axis. For example, the slight angle to the left or right that the gearcase is moving in relation to the water flowing past it. Most pronounced with an elevated engine installation and surfacing type propellers. The term can also refer to a boat when its bow is not pointed directly in the direction of travel, such as in a turn or in a strong side wind.

Cup - When the trailing edge of the propeller blade is formed or cast with an edge curl outward (away from boat) increasing the pitch, it is said to have a cup. The cup helps the blades to hold (not break loose) when operating in a cavitating or ventilating situation. This then permits the engine or stern drive to be trimmed out further or be mounted higher on the transom resulting in reduced gearcase drag or a more efficient hull attitude.

Crisp Cup - Refers to the trailing edges of cupped propeller blades. Crisp, means a nice, sharp, clean edge on the pressure side of the cup. Not rounded or laid back.

Cupped Skeg - Located under the anti-ventilation plate, the trim tab loses its effect of compensating for steering torque as the engine (gearcase) is raised higher on the transom. Some high rake propellers require the trim tab to be removed to provide blade clearance on some gearcases. To help compensate for the lack of, or reduced trim tab effect, some gearcases have skegs that are cambered or cupped on the trailing edge. There are also wedges that can be attached to the trailing edge of the skeg to serve the same purpose. With the usual right hand rotation propeller that will "paddle wheel" to the right, the skeg cup will be to the right.

Cushion, or Shock Absorbing Hubs - Propellers with a rubber drive hub surrounding the drive splines which provide shock absorption during shifting or low speed light impact.

(continued on next page)

Dampen Out - Used in conjunction with chine walking or porpoising. Indicates the oscillation reduces or stops without corrective action by the driver.

Foot Throttle - An accessory item that allows the throttle function to be separated from the combined throttle/shift operation common in the single lever side mounted remote control. Allows the driver to control the throttle with his foot and keep both hands on the steering wheel. Provides a means of achieving throttle spring back to neutral but is subject to unintended throttle action in rough water. A foot throttle is normally used in sit-down race boats.

Hook A Chine - Chine refers to the edge on each side of the hull where the bottom meets the hull sides. Hooking a chine occurs when the chine dips down far enough to dig into the water usually in a turn. This can cause the boat to hook or dig in and cause the boat to suddenly turn more sharply than anticipated and/or roll up on its outside edge. In severe cases, the boat can roll over and/or occupants can be ejected.

Gunnel - The upper top side area of a boat above the rub rail. Most generally a flat section, sometimes equipped with step pads which are used to step onto when entering or exiting a boat.

Gearcase Blowout, Propeller Blowout - Water flow around the gearcase and to the propeller must be virtually undisturbed to provide optimum propeller thrust, steering control and cooling water intake.

Under certain conditions of engine height and trim angle, a boat speed may be reached where the vertical and horizontal crab angle of the gearcase torpedo is sufficient to prevent the water from flowing normally around the sides of the torpedo. A subsequent increasing reduction in local water pressure near the nose of the torpedo can finally result in the formation of cavitation. As speed continues to increase, the cavitation bubble stream stretches further toward the aft end of the torpedo where the exhaust gas is exiting. When this low pressure bubble stream finally reaches the exhaust gas, the gas can rush into this low pressure area and almost instantly flood all the way forward to the origin of the cavitation bubbles.

At the same time, the exhaust gas also spreads out sideways into the adjacent low pressure regions on the side of the gearcase, strut and/or skeg, and are instantly washed back into the propeller blades.

The sudden multiple effects of this action include:

- A loss of thrust resulting in a speed reduction
- An increase in RPM (increased propeller slip)
- A loss of bow lift generated by the propeller resulting in a less efficient, flatter hull attitude.
- A sudden change in steering load with the boat usually wanting to veer slightly to the left.

These could result in a momentary loss of control by an unsuspecting or inexperienced driver.

Jerk Tests (Now known by the American Boat and Yacht Council as the Quick Turn Test) - A series of steering maneuvers performed at progressively increasing boat speeds with the engine trimmed out for optimum planing speeds. The steering wheel is abruptly turned 180° in the direction toward which the torque is pulling the wheel. The purpose is to find out the nature of the boat reaction to an emergency avoidance maneuver.

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Lanyard Stop Switch - (Also known as an Emergency Stop Switch or Kill Switch) An ignition shut off switch that is actuated by a lanyard that is attached to the driver's life jacket, clothing or body. The purpose of which is to turn off the engine if the driver is thrown from or leaves his position behind the wheel far enough to actuate the switch for any unexpected reason.

Mush or Mushing - Refers to the forward motion of the boat in a bow high attitude at a velocity just short of that needed to plane the boat off where it will then achieve a much more level ride. This velocity is generally somewhere between 10 mph and 20 mph. Any boat's greatest wake is generated in the mush condition or operation. In some boats, forward visibility can be noticeably reduced during this bow high mush condition. This very inefficient boat attitude should be passed through as quickly as possible.

Nose Cone - A streamlined addition that can be added to the nose of the gearcase torpedo. A nose cone adds more rudder area, which in turn will reduce the crab angle, but most importantly, raises the threshold velocity where serious cavitation can lead to gearcase blowout.

Non-Through Hub Exhaust - Terminology used to describe a propeller hub style that allows engine exhaust discharged through the back of the gearcase torpedo to exit directly over the propeller hub and blade roots. There is no exhaust containing tube. The absence of this tube eliminates tube drag and can thereby increase top speed, but this allows gearcase blowout to occur more easily. The absence of the tube can also make planing off slightly more difficult.

Paddle Wheel Effect - As a rotating propeller is elevated through the surface of the water, either by jacking or mounting the engine or drive in a high position, a sideways force imbalance occurs whereby the propeller in addition to providing thrust, wants to walk sideways in the direction of rotation. This pull, which can be substantial, can be felt through a conventional steering system and must be resisted at the steering wheel.

Porpoise, Porpoising, Bounce - Terms used to describe a continual rhythmic up and down motion of the boat bow, not caused by wave action. Usually associated with over trimming the engine (too far out), weight distribution (center of gravity too far aft) or hull bottom design (aft bottom surface has a rocker).

Prop Blow Out - Refer to Gearcase Blow Out.

Rake or Blade Rake - Refers to the blade slant, relative to a plane perpendicular to the plane of the propeller shaft. Typical rake angle can vary from –5° (forward slant) to 30° (rearward slant). This angle is unrelated to the pitch angle.

Sharp Leading Edge (propeller blade) - Term used to describe the leading (forward) edge, important for surfacing type propellers. For optimum performance the leading edge should be sharp (an edge that is between .005" and .015" thick. Not quite as sharp as a razor blade) not rounded or beveled.

Solid Hub Propellers - The splines to fit the propeller shaft are machined directly into the propeller hub. Shock absorbing hub inserts are not used.

A solid hub propeller is not recommended for use on units that are shiftable and use the standard dog clutch shifting mechanism. The shock loads during shifting can be damaging to the drive train.

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Solid or Firm Motor Mounts - Outboard motors intended for general use are designed with rubber mounts suitably soft to isolate most of the engine vibration from the boat. On some fast boats where delicate control becomes more essential, it may be desirable to incorporate mounts with much reduced or no flexibility. Of course with the use of such alternate mounts comes increased boat vibration.

⚠ CAUTION
OUTBOARD POWERED BOATS CAPABLE OF EXCEEDING 80 MPH SHOULD USE SOLID ENGINE MOUNTS.

Spin-Out - Refers to a boat while on plane suddenly turning sharply, often reversing direction. This is usually caused by a forward area of the hull digging into the water and veering to one side allowing the aft end of the boat to rapidly pivot around the bow. This can be associated with starting an intended turn, then compounded by a bow steer situation, running bow down, hooking a chine, or even hooking an inside sponson of a true tunnel boat.

Squirrely, Squirreliness - Refers to somewhat unpredictable running characteristics of a boat that gives the driver an uneasy feeling as to the handling and control at a specific speed, balance and trim setting. This condition requires the driver's undivided attention at all times.

Steering Backlash - This term refers to any play or lost motion in the steering system between the engine steering arm and the steering wheel. It is always desirable, but particularly with high performance boats, that steering backlash be minimized. Dual steering cables, correctly adjusted, used with outboards & single stern drives or dual hydraulic steering cylinders attached directly to dual stern drives are excellent installations for minimizing back lash.

Strake - Strakes are lifting surfaces incorporated most often on the bottom of V-type hulls. They are placed parallel to and on either side of the V or keel. They may start at or ahead of the transom, and run forward toward the bow. Depending on the desired running attitude of the boat, the number, width and length of the strakes may vary from one hull design to another.

Through-Hub Exhaust - Propellers with through-hub exhaust contain an outer hub to which the blades are attached. The outer hub is in direct contact with the water. The inside area between the inner and outer hub, provides the passage for engine exhaust gases to exit, thus the name through-hub exhaust. This is the most common propeller design used on outboard motors and stern drives.

Tow-In, Tow-Out - These terms apply to dual outboard engine or stern drive installations. The propeller shafts of both gearcases should be parallel to each other when maximum speed is attained.

When counter-rotating gearcases and propellers are used, the two units should be adjusted with some tow-in or tow-out at rest, so that at maximum speed the side forces (paddle wheel effect e.g.) will pull the units into a parallel position taking up the inevitable play in the steering system.

Trim, Engine or Drive - Larger outboards and stern drive units can be remotely adjusted in a vertical-longitudinal plane. This feature is referred to as power trim. Changing the outboard or drive unit angle alters the running attitude of the hull in relation to the water surface.

Common references used with power trim are:

Neutral Trim, Vertical, 0° Trim - Means that the outboard motor or stern drive is adjusted so that the propeller shaft is parallel to the surface of the water. In this position, there would be no steering torque with an outboard (possibly a little with a stern drive).

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Trim-In, Trim Down, Trim Under, Kicked In - Refers to the outboard engine or stern drive unit being trimmed or moved in toward the transom. This pushes the bow down.

Trim out, Trim Up, Kicked Out - These terms describe the outboard engine or stern drive unit position as it is adjusted away from the neutral position and the transom. This lifts the bow somewhat. Excessive trim out may no longer hold the bow up as the prop begins to lose its bite.

Trailering Position - Tilting the outboard engine or stern drive beyond the normal running position to maximum tilt up position. Convenient for beaching, trailering, or idling in shallow water.

Trim Tab - A manually adjustable metal trim device located on the aft, underside of the anti-ventilation plate on the gearcase. The trim tab can be rotated to either port or starboard of center as required to help reduce possible steering torque at a specific speed and engine or drive trim setting. The trim tab is effective only when the outboard or drive are mounted at a lower or conventional installation height. Once considerable air gets under the anti-ventilation plate, the trim tab becomes ineffective. Trim Tab is also a term used for the After Planes or Trim Planes which are attached to the transom of some boats near the chine and are used to adjust the boat longitudinal and lateral attitude.

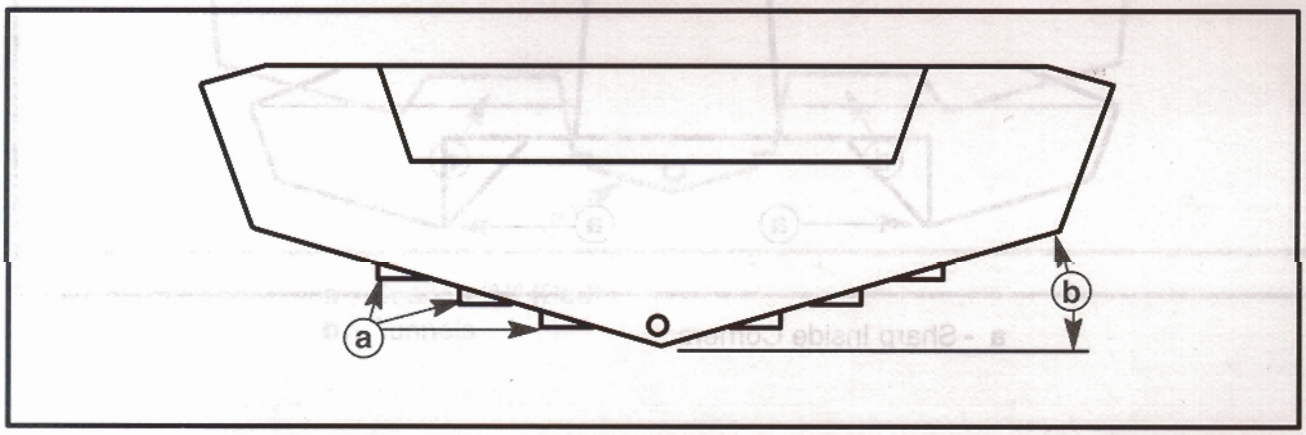
Ventilation - An occurrence when air from the waters surface or exhaust gases from the exhaust outlet are drawn into the propeller blades. The normal water load is reduced and the propeller over revs, loosing much of it's thrust.

Water Pressure Gauge - A dash mounted pressure gauge used to monitor the cooling water pressure in the cylinder block. Proper interpretation will indicate inadequate cooling water to the engine and can thus assist in averting engine damage.

High Performance Boat Configurations

"V" Bottom With Strakes

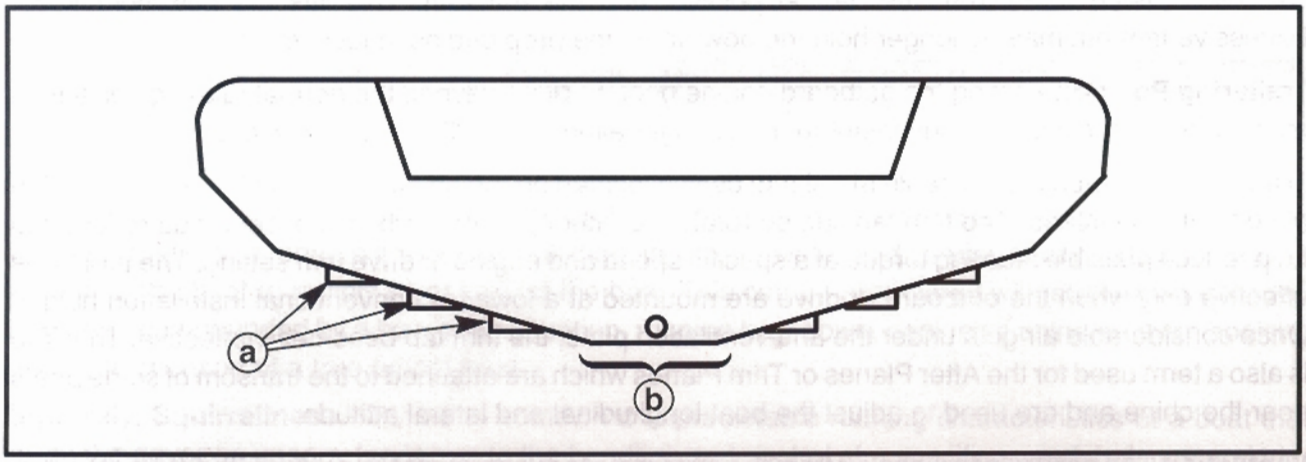
This is presently the most common bottom design offering good speed with a soft ride that depends upon the angle of the "V" (called deadrise), the radius of the keel line, and the use of strakes.



a - Strakes
b - V-Deadrise

"V" Bottom With Pad And Strakes

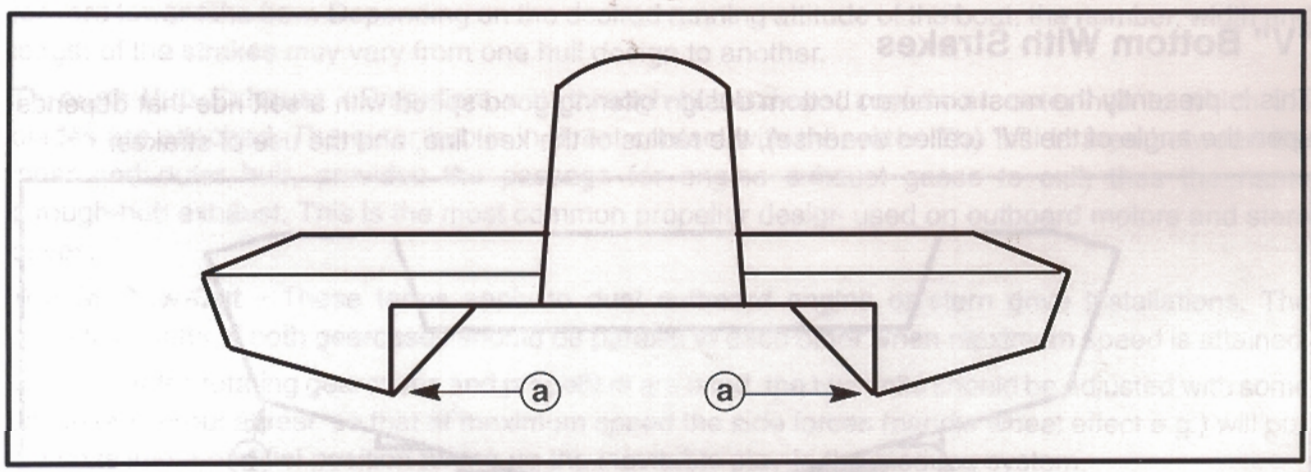
To increase top speed with only a little loss of softness in the ride, some boats are made with a small flat at the very bottom called a "pad".



a - Strakes
b - Pad

Tunnel Bottom

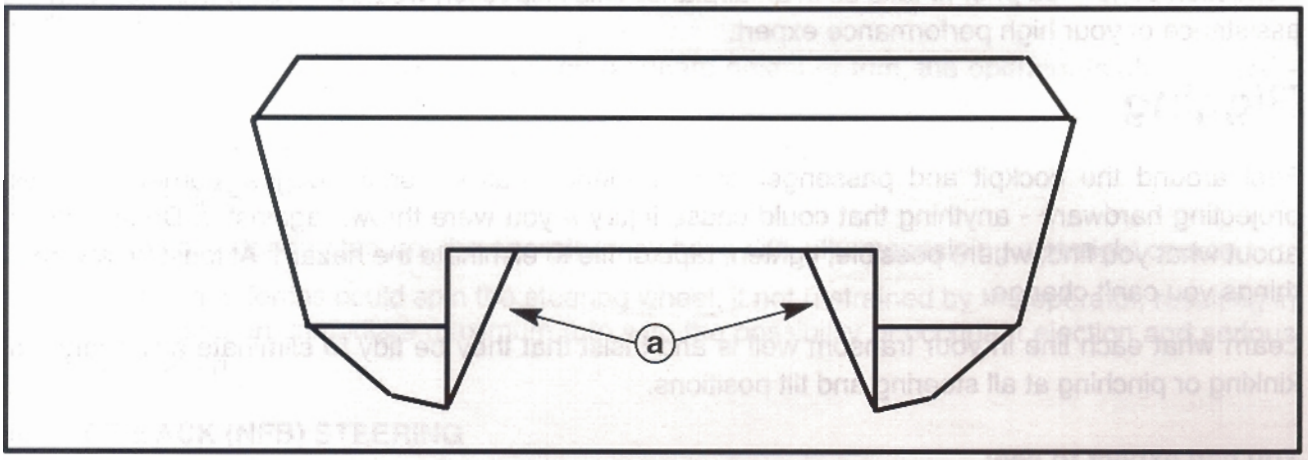
This is a rather new shape to come out commercially and is most popular in racing circles. It differs from the older catamaran bottom in that the inside corners (between the bottom and the tunnel) are quite sharp. This allows incredibly sharp high-speed turns and a very soft ride with up to a moderate chop. Some of these hulls have experienced handling problems at low speeds.



a - Sharp Inside Corners

Catamaran

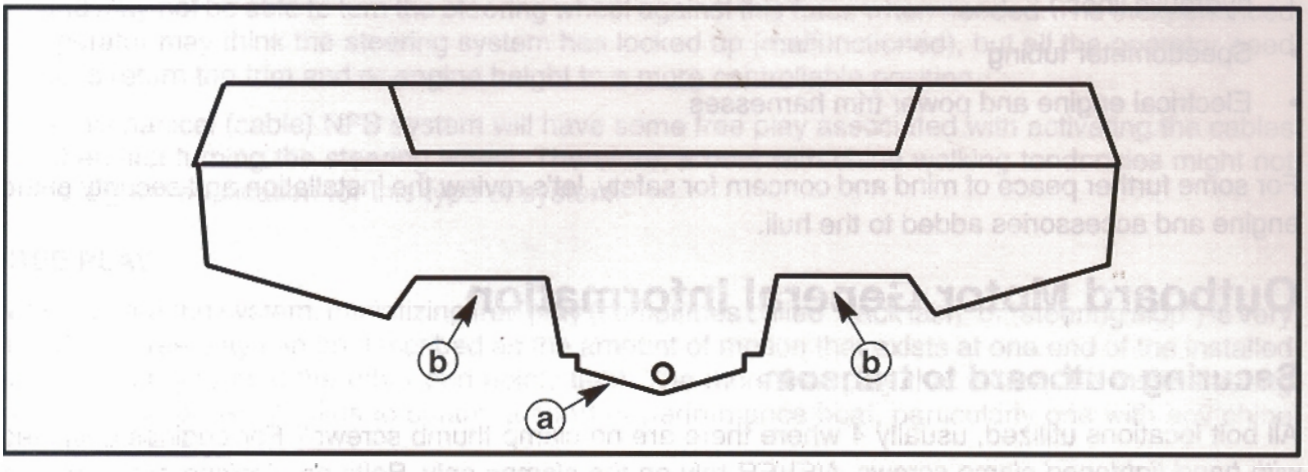
This new style of catamaran gives an improved ride due to the fact that the air entering the bow of the tunnel area generates lift on the hull at high speed. Thru this lift factor, the wetted surface and drag on the hull is reduced and speed and ride are enhanced.



a - Tunnel Area

Tunnel Vee

The latest new shape combines a shallow "V" bottom with twin tunnels, one on either side of center pod. Top-end performance is usually superior to true "V" bottom, but rough water ride is less comfortable.



a - Shallow "V" (Pod)
b - Tunnels

Checking Over The Rig

Prior to launching the boat for the first time, we strongly recommend that you perform a thorough inspection of the entire rig. This inspection may be compared in many respects to the pre-flight inspection performed prior to take off in an airplane. This inspection would best be performed with the assistance of your high performance expert.

Rigging

Feel around the cockpit and passenger compartment areas for sharp edges, corners, screws, projecting hardware - anything that could cause injury if you were thrown against it. Do something about what you find; where possible, tighten, tape or file to eliminate the hazard. At least be aware of things you can't change.

Learn what each line in your transom well is and insist that they be tidy to eliminate any chance of kinking or pinching at all steering and tilt positions.

You can expect to see:

- One or two steering cables
- Shift cable
- Throttle cable (looks just like the shift cable)
- Fuel line (IMPORTANT: See that the primer bulb can easily be seen and grasped.)
- Power Trim hydraulic lines (Later vintage outboard engines do not have exposed external hydraulic lines.)
- Speedometer tubing
- Electrical engine and power trim harnesses

For some further peace of mind and concern for safety, let's review the installation and security of the engine and accessories added to the hull.

Outboard Motor General Information

Securing outboard to transom

All bolt locations utilized, usually 4 where there are no clamp thumb screws? For engines designed with hand tightened clamp screws, NEVER rely on the clamps only. Bolts and locking nuts must be installed thru clamp brackets and transom.

⚠ WARNING

Before operating, outboard(s) MUST BE SECURE to boat with bolts and locknuts. Failure to bolt outboard(s) to transom may result in damage to boat and/or loss of outboard(s) and possibly injury to occupants of boat.

Steering Systems

FULL FEED BACK STEERING

Full steering forces are transmitted from the outboard to the steering wheel at all times.

ADVANTAGES:

- As steering loads increase with increased outboard height or trim, the operator is always aware of the force required to turn the boat.
- Under heavy steering loads, free play will be at a minimum.

DISADVANTAGES:

- Under severe steering torque, the operator may have difficulty maintaining a straight course.
- Heavy steering forces could spin the steering wheel, if not restrained by the operator, resulting in the boat doing an immediate maximum turn with the possibility of occupant ejection and serious injury or death.

NO FEED BACK (NFB) STEERING

Steering forces are not transmitted to the steering wheel until the operator turns the wheel.

ADVANTAGES:

- If the operator releases the steering wheel, the boat will continue on the selected course and will not experience the sudden turn of a full feed back system.

DISADVANTAGES:

- With increased outboard height or trim, the operator may be unaware of increased steering loads and may not be able to turn the steering wheel against this force when needed. The inexperienced operator may think the steering system has locked up (malfunctioned), but all the operator need do is return the trim and or engine height to a more controllable position.
- A mechanical (cable) NFB system will have some free play associated with activating the cables when first turning the steering wheel. Therefore, a boat with chine walking tendencies might not be a good application for this type of system.

FREE PLAY

With any steering system, minimizing free play (sometimes called "back lash" or "steering slop") is very important. Free play can be described as the amount of motion that exists at one end of the installed system when you hold the other end rigidly tight. The more free play that exists, the more steering wheel motion or skill it takes to control a sport or performance boat, particularly one with any chine walking tendency.

Systems with inherent Free Play	Systems with minimal Free Play
All single cable systems.	All hydraulic systems either with or without power assist
No feed back dual cable	Full feed back dual cable

STEERING SYSTEM DESIGNS

All cable or hydraulic steering systems multiply the operators mechanical advantage to reduce the force required to turn the steering wheel.

CABLE (A cable transfers steering inputs to the outboard or stern drive.)

SINGLE CABLE SYSTEM	DUAL CABLE SYSTEM
Will usually have more free play than a dual cable system	Free play can be minimized in a full feed back system.
Not recommended for high performance applications.	Recommended for high performance usage.
Can be used with a full feed back or no feed back system. Power steering available.	Can be used with a full feed back or no feed back system. Power steering available.
Length and routing of cable is important for proper steering feel and response.	Length and routing of cable is important for proper steering feel and response.
Less expensive than hydraulic or dual cable systems	Less expensive than hydraulic systems

HYDRAULIC (Steering inputs transferred to the outboard or stern drive hydraulically.)

Hydraulic steering usually falls into two categories; with or without power assist. Power assisted hydraulic steering allows for quicker steering responses because steering wheel turns lock to lock can be reduced while not increasing operator effort.

Hydraulic Steering System Features:

- Distance and routing from helm to steering rams does not affect steering response or feel.
- Minimal free play
- Recommended for high performance usage.
- No feed back systems.

OUTBOARD STEERING RECOMMENDATIONS

All high performance applications should use a **no feed back (NFB)** steering system with a minimum amount of free play. Options would be a dual cable NFB system, a hydraulic NFB system, or a dual cable or hydraulic power steering NFB system. Power steering should be seriously considered for fast outboard powered boats where trim and engine height can bring major steering loads to the helm.

Outboard Installation Height

If your boat is expected to do 50 MPH maximum, it will probably be best to leave the engine at a 20" transom height. Lightly loaded boats powered by smaller engines doing between 40 MPH and 50 MPH may benefit slightly by raising the engine up to 1 inch and using a cupped hi-rake propeller.

If your peak boat speed is expected to be 60 MPH, engine height should be up to 22" to 24". This is not just a hi-performance suggestion. Steering torque and boat stability, as well as top speed, will improve as the engine is raised". The only potentially negative result may be some prop "blow out" or ""break loose" (explained on page 5) upon accelerating with a heavy load. It is also becoming important at 22" to 24" to use a hi-performance prop possessing a sharp leading edge, crisp cup, and at least 15° of rake.

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At this height your trim tab is no longer effective as a means of altering steering torque. On some gearcases the standard trim tab must be removed to provide blade clearance for hi-performance propellers. A flat plate zinc anode, part number C-76214, is available as a replacement to provide continued protection against galvanic corrosion.

If your boat will approach 70 MPH, a little more transom height can be used, perhaps 23" to 25". However, at 24" some steering torque pulling to the right (with the common right hand rotation propellers) may occur. Above 70 MPH, 24" to 25" transom height is desirable, but now, at a best speed trimmed-out condition, steering torque to the right may be quite noticeable.

Stern drive powered hi-performance boats will probably have the drive mounted slightly above the standard "X" dimension.

It is very important to monitor engine water pressure as extreme height and trim-out positions are used. On some boats, reduction in cooling water entering the water intakes can cause engine overheating and severe damage.

Very serious Hi-Performance enthusiasts will install a temperature gauge near the top of their outboard block but down stream in the cooling water flow to avoid being fooled by a water pressure reading created by a steam pocket. 140°F (60°C) is considered the maximum acceptable temperature measured here.

Accessories:

Check for the location and secure storage of:

a. A paddle
b. A fire extinguisher
c. An emergency horn (particularly if one is not permanently installed)
d. A throwable life cushion (Required by Federal Law)
e. The boat registration card (are boat numbers properly mounted?)
f. Ropes with which to tie up
g. A spare strong rope suitable for towing
h. Spare propeller with thrust hubs and prop nut plus a wrench which fits the prop nut
i. A flashlight
j. A legal Coast Guard approved life vest for each person in the boat (Required by Federal Law)
k. A spare small gas tank (tied down)
l. The battery – are the battery cables tightened securely? Is it securely fastened down – can't slide or tip? Are the battery terminals covered or protected to prevent accidental electrical shorting? (Required by Federal Law)
m. Where is the fuel tank installed?
   Aft – best for top speed
   Bow – best for planing off and rough water.
   Is the fuel tank vented? (facilitates filling, eliminates trapped air) Is the fuel tank storage area ventilated? (greatly decreases chance for explosive gas vapor/air mixture buildup).

⚠ WARNING

USE CARE when transporting fuel container, whether in a boat or car. DO NOT fill fuel container to maximum capacity. Gasoline will expand considerably as it warms up and can build up pressure in the fuel container. This can cause fuel leakage and a potential fire hazard.

MerCruiser Steering

MerCruiser power packages come standard with MerCruiser's internal power steering. This durable system provides precise effortless steering control and is recommended for most sport boat applications. On certain applications, however, MerCruiser recommends the use of an external power steering system where the power steering cylinders connect directly to the drive unit on the outside of the boat. This arrangement gives additional support for even tighter, more firm steering control, and is recommended for the following applications:

- High speed single or twin engine applications and/or boats with unusual handling characteristics. It is virtually impossible to give a specific recommendation as to when external power steering should be used, as this varies from boat design to boat design. Generally speaking, it is recommended to use external power steering on boats which run in excess of 70 MPH. However, there are boats which run 60 MPH that would benefit from the use of external power steering. Because of the many variables involved, the final decision as to whether or not external power steering is required rests with the boat manufacturer and must be made after a thorough test and evaluation of each specific boat model. If there is any question whether or not external power steering is necessary, MerCruiser recommends that it be installed.
- Any Hi-Performance sport boat powered by three or more engines.
- Off shore boats or other applications where the boat and drive units may come out of the water occasionally.
- All IIIA SSM and V SSM High Performance Stern Drive applications.

External power steering systems are generally either mechanical cable actuated or hydraulic actuated. If cable actuation is selected, combining dual steering cables with an internal control valve kit (P/N 89645A35) will provide an even tighter feel (less steering backlash). This kit can not be used with hydraulic activation.

External power steering and hydraulic helm systems can be obtained from the following after market suppliers:

Latham Marine Inc.
280 S.W. 32nd Court
Ft. Lauderdale, FL 33315
Phone: (954) 462-3055

Mayfair Performance Group
11 Industry Drive
Palm Coast, FL 32137
Phone: (904) 446-0660

On dual or triple engine high speed applications, MerCruiser recommends the use of a Quicksilver Priority Valve Kit (Part Number 79691A4). This kit allows two power steering pumps to be used and helps to ensure that power assist will be maintained if one engine or power steering pump should stop functioning (engine runs out of fuel, etc.).

(Steering VI SSM)

The VI SSM High Performance Stern Drive requires a hydraulic helm steering system and comes factory equipped with external power steering.

Multiple Stern Drive Steering Tie Bar Arrangements

With multiple stern drives it is important to consider which of several possible steering systems should be selected.

Internal Tie Bar Only

At the lower end of the performance spectrum (boats not capable of speeds in excess of 60 MPH) the basic internal tie bar is recommended. It connects the slave stern drive to the stern drive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from the stern drive manufacturer.

Internal And External Tie Bar

As a boat moves into a moderate performance range (60-70 MPH) or for a reduction in steering backlash, an external tie bar should be added. External tie bars are usually designed to attach at the aft power trim cylinder bosses which is an excellent location because of its proximity to the propeller. HOWEVER, because of the potential overstress that can occur if one drive is trimmed much differently than the other, a dual trim control kit (P/N 90362A3) should be installed so as to limit this potential lilt differential to about 20°.

External Power Steering

When boat speeds move past 70 MPH or if additional steering backlash reduction is desired, external power steering is recommended. This normally will include an external tie bar mounted at the same general location of the power steering cylinders which are generally attached at the top of the stern drive's drive shaft housing. With this steering system, no internal tie bar should be used. These steering cylinders can be attached either inboard (between) or outboard of the stern drives.

External Power Steering With Low External Tie Bar

For the fastest boats (over 80 MPH) or for the ultimate in steering backlash reduction, use external power steering, BUT (where mechanically possible) with the external tie bar mounted at the trim cylinder boss location (as described in choice #2). Again this system does not use an internal tie bar.

Mercury Marine does not recommend the use of an external tie bar ONLY (no internal tie bar) when using the internal power steering system. This can cause excessive loads on the steering components on the drive connected to the internal power steering system. These increased loads can damage the steering components, resulting in increased play in the steering of the boat.

Stern Drive and Outboard Multi-Engine Toe-In/Toe-Out Adjustments

The units should be checked for steering play between the units when the boat is at rest. If any play exists, the units should be adjusted with some toe-in or toe-out at rest, so that at maximum speed the side forces (paddle wheel effect e.g.) will pull the units into a parallel position, taking up the inevitable play in the steering system. As one or more tie bars are added to the steering system and/or external power steering is installed, the units should be adjusted to a parallel position at rest as all of the play in the steering can be adjusted to zero.

Afterplanes-Trim Tabs-Trim Plates

Some hi-performance boaters prefer to add afterplanes, more commonly on boats over 24'in length. After planes are generally used at low planing to moderate planing speeds. When raised they generally have no effect on boat operation. When lowered individually or together they can (1) level the ride (2) hold the bow down for more level ride at low planing speed. The afterplanes are generally not employed until it is determined that trimming the outboard(s) or stern drive(s) fully is not achieving the desired bow down attitude. Lowering the afterplanes at high speed is generally not done as it lowers the bow and reduces the speed.

This should normally be accomplished by trimming in the outboards or drives or reducing the throttle or both. Afterplanes in the 10" long to 20" long range are usually preferred on hi-performance boats in the 24' to 36' range, with the 11" to 13" long afterplanes being most commonly installed. Longer 30" afterplanes may be preferred on longer hi-performance boats (40+) or relatively slow cruisers. If your boat is equipped with afterplanes you should test it for reaction at various speeds with the afterplanes increasingly lowered. Some things to consider are, (1) How low does the bow go? (2) How much of a bow steer tendency is there?

General Boating Information

Boarding and Familiarization

If you are just about to launch, don't forget the bilge plug.

Can the gunnel be stepped on? If so, is it slippery or is it equipped with slip resistant step pads?

When you step on the gunnel, how stable is the boat? Does it tip easily? What is the safest way to get aboard? How will you direct your passengers to board safely?

Settle into the driver's seat:
Is it a bucket type that will give some side support or can you easily slide off? Is there a good place for you to brace your feet? Is there a good handle for your passengers to hold on to?

Locate all controls and instruments

- Steering Wheel (VERY IMPORTANT – Is it slippery?) How many turns end to end (lock to lock)? About three give or take a half turn is normal. Grab the wheel firmly with both hands and push and pull on it. Does it seem very strong? It's the only thing you have to hold on to during any accidental or purposefully violent maneuvers. Do you trust it to help keep you in the boat?
- Throttle - Is it combined with the shift lever, or is it a separate hand or foot throttle? If it is a combined side mount control, is it located conveniently without restrictions to full travel in forward and reverse? Does the dashboard, arm rest or side of boat interfere with maximum travel? Might your knuckles scrape or hit anything, particularly the steering wheel? Can you feel the neutral position and detent when you move the throttle/shift lever from forward or reverse to neutral?
- Power trim control switch or buttons. Are they located in the throttle/shift handle, on the steering wheel, or on the dashboard?
- Ignition key and engine choke button (if applicable). Are they conveniently located?
- Tachometer, speedometer, water pressure, engine temperature and fuel gauges should all be located to be viewed without visual obstruction. A little head movement is permissible, but at top speed you will want to easily view the speedometer and tachometer.

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- Voltmeter or ammeter, hour meter, oil pressure (not on outboard engines), power trim position indicators and after plane position indicators within easy view of driver (if installed).
- Other accessory switches for bilge blower (generally not used with outboards), bilge pump, running lights, horn, courtesy lights and related fuses or circuit breakers should be totally familiar to the driver.
- Lanyard Stop Switch -We can't emphasize enough the wisdom of using a lanyard stop switch on Hi-Performance boats or powerboats in general where there is no real possibility of passengers leaving their seats or walking around. We further suggest that you keep the lanyard attached to your life jacket as a reminder to you and your passengers to wear a U.S. Coast Guard approved life vest when the boat is underway. Should the boat driver lose his balance or be thrown from the driver's position, a sufficient distance to activate the switch, the chances of anyone being hurt are reduced if the engine immediately shuts off. Remember, however, that even with the engine shut off, planing boats can take several hundred feet to fall off plane and come to a stop.

Passenger Seats

Sit in the passenger seats. Does the seat design hold you in place, or can you slide off easily? Do your feet have something to brace against and are there convenient hand holds for each passenger? Are there any sharp edges on the fiberglass or trim that could cause minor injuries? If a passenger is likely to hold onto the seat cushion or back, will it stay secured or is it loosely resting in place? (Later, when you're driving with passengers, remember how insecure you felt in their seats with no steering wheel to grasp. Passengers have one other disadvantage – you know when you're going to make a turn but they don't). Never allow a passenger to sit, stand, lie or ride in a location not intended for high speed operation, such as carpeted surfaces on fast fishing boats or the fishing seats while underway.

The First Ride

⚠ WARNING

If you are new to Hi-Performance boating, or have stepped up to a new, more powerful, faster rig, we strongly recommend that you be accompanied on your first ride by a person experienced in Hi-Performance boat operation and handling.

Wear a good quality life jacket regardless of how well you swim. Have a friend accompany you in a second boat.

Other Operators

Be very cautious about permitting other persons to operate your hi-performance boat. Several considerations must be taken into account, how much experience or training do they have with hi-performance boats. How much experience or training do they have with boats of your specific type or hull design.

Starting the Engines

READ THE BOAT & ENGINE OPERATION AND MAINTENANCE MANUAL THOROUGHLY

If you don't understand any portion, contact your dealer for a demonstration of actual starting and operating procedures.

⚠ WARNING

The operator (Driver) is responsible for the correct and safe operation of the boat, the equipment aboard and the safety of all occupants aboard. We strongly recommend that the operator read the Operation and Maintenance Manual and thoroughly understand the operation instructions for the engine, boat and all related accessories before using the boat.

Boating Off Plane

With a hi-performance boat you need a high-pitch prop. This puts a much higher load on the engine when you shift into gear. To keep the engine from stalling when it is shifted into gear, it may be necessary for the neutral idle rpm to be set up higher than it would be if you were using low pitch propellers. Typically, the neutral idle may be from 800 rpm to 1000 rpm.

It's wise to always shift into gear with a quick motion so as not to grind the clutch teeth. Never shift when any passengers aren't seated in proper seats.

Practice a little. When shifting into gear, (forward or reverse) use care not to move the shift/throttle lever far enough to open the throttle when you aren't intending to.

Idle away into at least three or four feet of water so that the engine or stern drive can be trimmed down without the lower unit or propeller hitting bottom. Before you attempt to accelerate to on-plane, find out what happens when you back up.

Drop the engine into reverse and as you begin to move, look at the build up of water on the transom. How much reverse throttle can you apply before you are concerned about any water coming into the boat? Most new boats have self-draining transom wells which will hold out considerable water. Routing holes for all the lines in the transom at the sides of the well are often not sealed and water may come in through such holes. Check this again whenever you have passengers in the back seat as the boat will sit lower in the water. Also, don't forget the adverse effect of waves washing over your transom when backing into them. While backing, frequently look at the transom so that you are aware of the situation.

⚠ WARNING

It is very difficult for a person standing or floating in the water to take evasive action should they see a power boat heading in their direction even at low speed. Therefore it is strongly recommended that when your boat is in the immediate vicinity of people in the water, the unit be shifted into neutral and the engine be shut off. **SERIOUS INJURY IS LIKELY IF CONTACT IS MADE WITH A PERSON IN THE WATER BY A MOVING BOAT, GEAR HOUSING, PROPELLER, OR ANY SOLID DEVICE RIGIDLY ATTACHED TO A BOAT OR GEAR HOUSING.**

You might idle forward a bit to feel how the boat responds. While coasting forward, check how quickly it stops when applying reverse thrust. Get to know how much reverse thrust you can generate to break your forward motion. It's safer (and drier) to learn about maximum reverse thrust while coasting forward – and that is when you need it – rather than when accelerating backwards. Remember, the boat will not slow up as fast when filled with passengers or heavy gear as when it's light. In addition a well trimmed out engine provides less braking.

Does the boat hunt around a bit when you try to idle forward in a straight line? This is common and is generally dealt with by steering with small, early corrections. Don't let the boat gain any turning momentum.

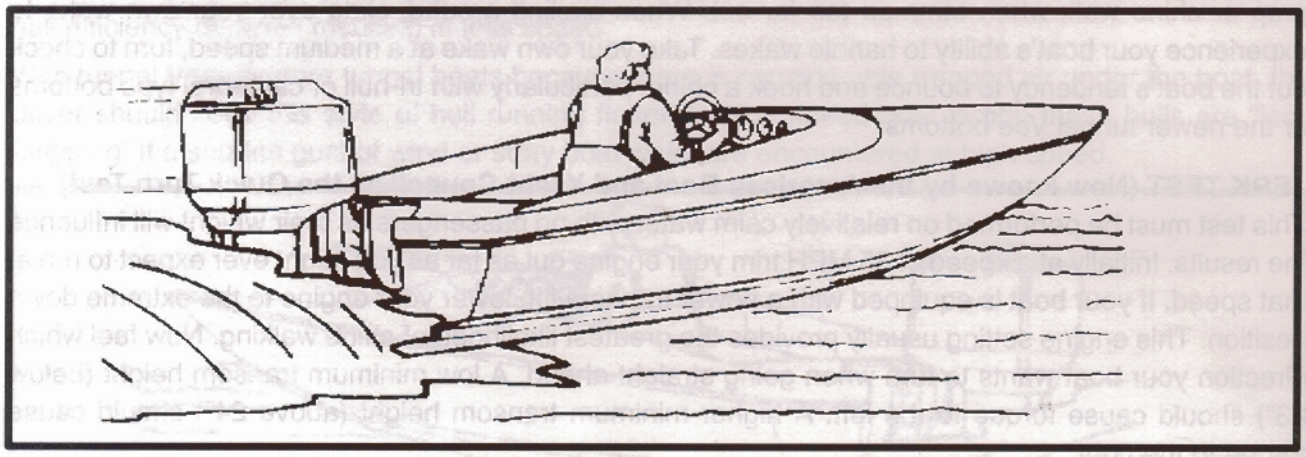
Getting Up and Running On Plane

First, choose a relatively calm day for your first run (and leave any passengers on the dock).

Second, if your boat is not equipped with a windshield, it's advisable to wear goggles, tight-fitting sunglasses with a restraining strap, or in some way protect your eyes from the high-velocity air impact that may contain an occasional bug.

Third, is the water deep enough to plane off? You may need up to a foot more water depth to plane off than you need to simply idle around. Trim the engine to full down (in or under). Does the trim indicator read correctly? With an outboard, notice the kicked-under attitude of the engine. Now trim out to the maximum where the trim will automatically shut off in some models or into a rapid tilt mode in other models. Notice the position of the trim indicator needle and the kicked-out attitude of the engine. These are the extreme limits you should operate within while planing, but in practice you will probably need much less than maximum trim-out. (Some hi-performance / racing models may have no trim limit switch & can continue to trim up all the way to a full trailer position).

To first get on plane try it trimmed full down. This should make for the quickest planing, but when you are on plane you will probably feel some definite steering torque pulling to the right. Some boats may also want to bow steer. You may feel this as a pull on the wheel along with the bow wanting to move right or left. If this occurs, the boat is probably riding too flat. So you will want to trim out to a position where the engine is about vertical, a rather medium trim position. On most boats this will provide nice handling and good top speed.



When planing off (engine trimmed under), give the engine enough throttle to get on plane quickly. To linger in the "mush" condition can be unnecessarily hard on the engine and certainly makes big waves that generally annoy others. Steer back and forth a little to get the feel of the steering torque. Later, try planing off at more of a mid-trim position. Pay attention to varying steering torque's so that should an emergency arise you will know how much effort will be required to avoid something in the water. Also note how the bow comes up higher during planing off at a more trimmed-out condition. Generally, prop break loose will be a little more severe as trim-out is increased. Stern drives & outboards equipped with power steering will not experience this steering pull.

If you are using non-through-hub-exhaust style props ("chopper" or "cleaver"), you may need considerably more throttle and RPM to push up on plane, because the prop must digest all of the exhaust which at low accelerating speeds is easily drawn into the low pressure side of the temporarily heavily loaded blades.

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With outboard power, do not hesitate, if necessary, to let the engine RPM climb to 5500 RPM, 6000 RPM or even 6500 RPM for the short duration of planing off. Once up on plane, the prop blades will shed the exhaust bubble and will appear to shift into a more solid bite. You can feel the engine speed jump down a few hundred RPM. The boat will shoot forward slightly. (If this occurs more than once, it's due to the blades not shaking their bubble at the same time.) Once on plane you can expedite this occurrence by a brief backing off on the throttle. If this type prop is run deep enough in the water, if the boat load is light, and if you accelerate on plane at part throttle, it may not break loose at all.

Conventional through-hub-exhaust props may also break loose but usually not as severely. This is the result of a high engine setting allowing the prop to pull in surface air.

Some of the advanced designs of through-hub-exhaust props generally will not break loose at all.

The higher the installation, the more important it is to keep the prop blade leading edges sharp, the tips thin and sharp, and the cup totally concave with a crisp corner or trailing edge.

Now that you're on plane, get used to the boat at 30 MPH to 40 MPH. Trim in and out fully to experience the changing steering torque. Feel it shift from puling to the right when kicked under to pulling to the left when kicked out unless your engine is mounted quite high, in which case, the pull will consistently be to the right. (This reaction would reverse were the engine equipped with a left-hand rotation propeller.) Maneuver around at the trim extremes so that you can learn at a relatively safe speed how much your boat will want to bow steer and potentially spin out when trimmed under, or to porpoise, blow out the prop or chine walk when trimmed too far out. When circling around, slide over your own wake to experience your boat's ability to handle wakes. Take your own wake at a medium speed, turn to check out the boat's tendency to bounce and hook a chine, particularly with tri-hull or cathedral type bottoms or the newer tunnel Vee bottoms.

JERK TEST (Now known by the American Boat and Yacht Council as the Quick Turn Test)
This test must be performed on relatively calm water with no passengers as their weight will influence the results. Initially at a speed of 35 MPH trim your engine out as far as you might ever expect to run at that speed. If your boat is equipped with a power transom lift, lower your engine to the extreme down position. This engine setting usually provides the greatest likelihood of chine walking. Now feel which direction your boat wants to turn when going straight ahead. A low minimum transom height (below 23") should cause torque to the left. A higher minimum transom height (above 24") should cause torque to the right.

With your hand at the top of the wheel, jerk the wheel 180° (in 1/2 second or less) in the direction the torque wants to go and hold it with no reduction in throttle. This manipulation is what a driver might be expected to do if suddenly confronted with an object dead ahead. If you experience no steering torque, try this test in both directions.

The boat may rock over and back a few times (chine walk), but should quickly dampen out. If the boat does calm down quickly, increase your speed by about 5 MPH and repeat the test. As you test at higher speeds sooner or later you may discover that you cannot hold the 1/2 wheel turn, while maintaining your throttle setting without feeling excessively uncomfortable in your boat. You have now discovered at what speed you can make an emergency turn safely at those worse case running conditions. Trimming the engine under or raising the engine will probably raise your safe emergency turn speed a little.

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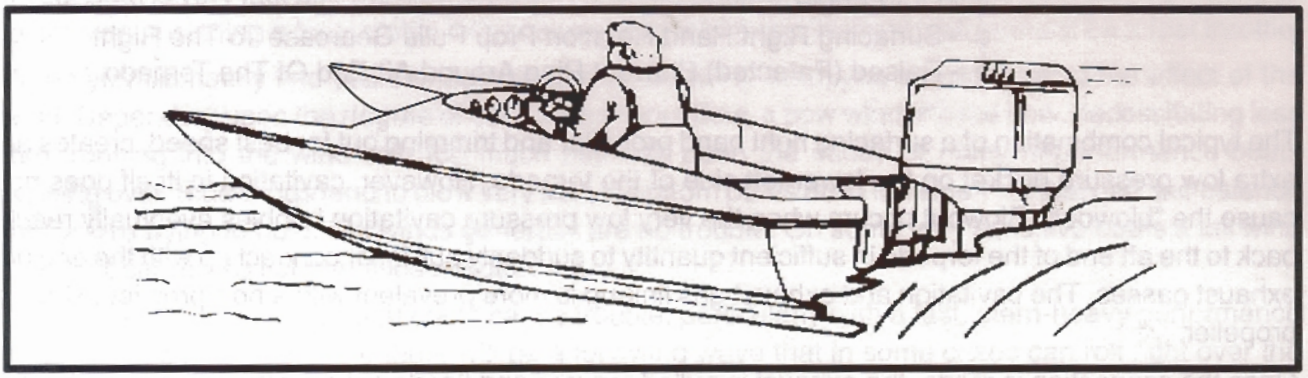
However, you and anyone allowed to drive your boat should be aware of this handling characteristic. With tunnel vee boats or flat bottom boats with an inadequate steering fin, the boat will begin to merely crab but not change direction appreciably.

With V-bottom boats factors that can raise your safe handling speed are a tighter steering system or eliminating steering backlash, going to stiffer mounts, or redistributing your boat load, usually forward a little.

Of course it must be understood that as water conditions get rougher, lower speeds will be necessary for a safe quick turn.

Now if you are ready for WOT (wide open throttle) and the wind and waves are light, trim the engine to a medium position, get a good grip on the wheel, and increase the throttle so long as you feel secure. The boat will rise higher out of the water and in many cases, particularly with V-bottoms, require continual small steering corrections to hold it level and in a straight line, as it wants to fall sideways off the narrow aft portion of the bottom that remains in the water, often referred to as becoming "squirrely". The steering torque, if present, will probably be harder to the right. As your experience dictates and provided everything feels under control, hit the trim out button briefly. Typically the bow will come up a little and the boat speed will increase a hair. However, watch for a little steering torque change, and the handling may get a little more "squirrely". You're on your own now as to how much trim out you want to try. Usually your ability to handle the "squirreliness" will determine how far out you want to go. In other cases the top speed will start to decline while the steering torque and rooster tail will still be climbing. This is a result of the propeller beginning to lose its ability to lift the bow. As the bow begins to drop, the hull efficiency declines resulting in less speed.

With tunnel Vees or pure tunnel boats because there is considerable trapped air under the boat, the driver should keep this style of hull running flatter. In high speed boat jargon these hulls are "less forgiving" if a sudden gust of wind or stray boat wake are encountered at high speed.



Many high performance boaters are aware of a phenomenon that limits their top speed below what would otherwise be possible with the available horsepower. This phenomenon is commonly called "gearcase blowout" or just "blowout". Following is an explanation of why blowout occurs and how to correct it.

To be practical the torpedo of a non-racing gearcase must be of a diameter and length just sufficient to house the shafts, gears, bearings, shift mechanism and a few other related parts. Hydrodynamics designers can only hope to make the exterior shape of the gear housing the best they can (within their design constraints) to deter cavitation from occurring at the torpedo nose or any surface interruptions such as a lubricant filler hole.

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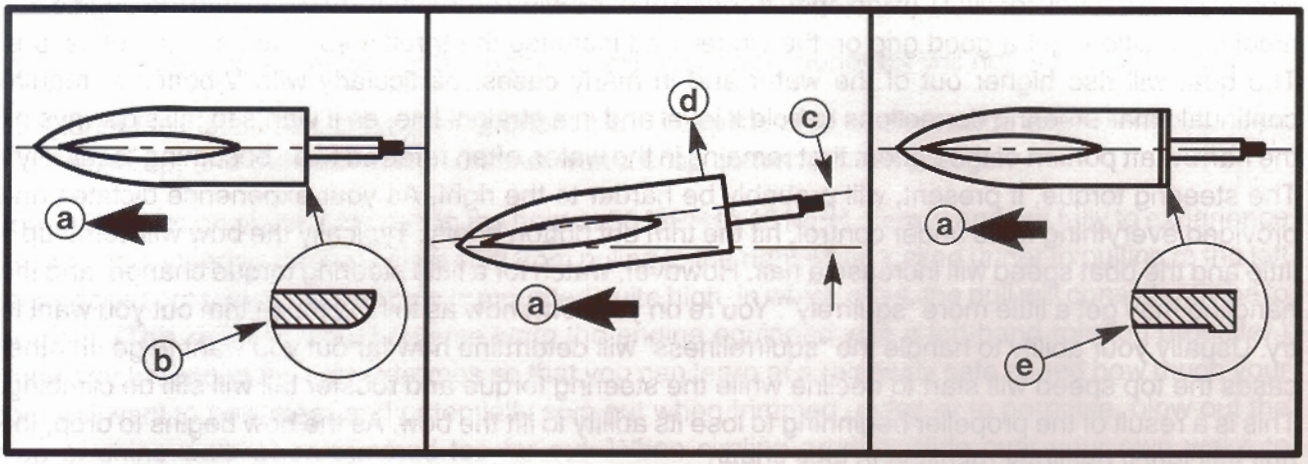
Inevitably as speed is increased cavitation will occur. Since low pressure is the cause of cavitation anything that further reduces the pressure on any side of the torpedo will hasten cavitation. Trimming the unit out will cause lower pressures on the underside of the torpedo, around the skeg, but an even more insidious culprit is the effect of a surfacing propeller pulling the aft end of the torpedo to the right with a right hand rotation propeller. This causes lower pressure on the left side because of the angle which the gearcase is forced to run through the water. This is commonly called the "crab" angle (see Figure 2 following).

Figure 1 Figure 2 Figure 3



a - Direction Of Boat
b - Any Torpedo Rounding At This Corner Encourages Blowout At A Lower Speed
c - Crab Angle
d - Surfacing Right Hand Rotation Prop Pulls Gearcase To The Right
e - Raised (Patented) Blowout Ring Around Aft End Of The Torpedo

The typical combination of a surfacing right hand propeller and trimming out for best speed, creates an extra low pressure pocket on the lower left side of the torpedo. However, cavitation in itself does not cause the "blowout". Blowout occurs when the very low pressure cavitation bubbles eventually reach back to the aft end of the torpedo in sufficient quantity to suddenly pull in, or connect up with the engine exhaust gasses. The cavitation and exhaust gas link-up is more prevalent with a non-prop jet exhaust propeller.

Once the connection is made, the exhaust is pulled forward and floods out over the low pressure side of the gearcase (the left side with a right hand rotation propeller) and feeds back into the prop blades causing a sudden and drastic reduction of lift or thrust generated by the low pressure side of the propeller blades. This partial unloading of the propeller creates four sudden reactions: (1) The bow lifting effect of the rake diminishes causing the bow to drop. (2) The hard steering torque to the right is suddenly reduced causing the boat to veer slightly to the left. (3) The reduced load on the propeller allows the engine to rev up by 200 RPM to 300 RPM, & (4) The wetter boat bottom and reduced propeller efficiency cause the boat to go slower by perhaps a couple of miles per hour.

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Several outboard manufacturers have available special gearcases with longer, more streamlined torpedo noses. This helps by adding more rudder area thus reducing the "crab angle" and provides a larger, more gentle nose radius which reduces nose cavitation. This change has usually increased speed by up to 3 MPH in the 90 MPH range. Some of the gearcases also include "cupped skegs, i.e. casting or bending the trailing edge of the skeg to the right to help partially steer the unit back out of its crabbed position (assuming a right hand rotation propeller). This not only noticeably raises blowout speed but greatly reduces steering torque. Additionally skeg sizes have had to increase with higher engine installations to help reduce the crab angle. Other than running with excessive trim out one of the most significant causes of blow out is a torpedo that has been buffed in a way that water rolls off the trailing edge of the torpedo. (See Figure 1)

Some gearcase designers attack this problem by casting the torpedo in a very slight conical shape and provide a raised ring around the circumference at the aft end of the torpedo (See Figure 3, Previous Page). This feature, which can vary from .005" to .050" in height, retards the connection of exhaust to torpedo cavitation by creating a higher pressure fence much like the diffuser ring or flare on the aft end of prop jet propellers which deters the exhaust from being drawn forward into the low pressure side of the prop blades. Within the range given, the higher the bump, the higher the speed protection, but with slight additional drag.

One of the more important specific tasks to perform at or near WOT is a sudden chop of the throttle. If you are trimmed out a bit with a relatively high engine installation, the steering torque is probably very noticeable to the right. When you chop the throttle it will reverse and briefly go hard to the left. If you are not expecting it, the wheel could spin out of your hand and put you in to an unexpected, hard left turn. It would be wise to work up from half throttle at this maneuver. In addition, if your boat is a bowrider,check it out with some additional, people simulated weight in the bow. It's a good idea to discover your boats degree of maneuverability at WOT (as it is at all speeds) because it may be very limited.

If your boat is very fast and the steering effort is annoying (with one hand on the throttle) you may wish to consider installing a foot throttle. Many experienced hi-performance boaters insist on a foot throttle.

When you ultimately find yourself boating in a 10-20 MPH wind, you should explore the effect of the wind. Depending upon the degree of deck flare in your bow, a bow wind lifts the bow, necessitating less trim. running into the wind with too much trim has been the cause of many hi-performance boats blowing over. Side winds tend to blow very fast, V-bottom boats off to the side – off that delicate balance that you're trying to hold. Tail winds generally are no trouble. On some very sensitive boats a tail wind lets the boat run so flat that it loses speed.

There is one maneuver left that could cause trouble, particularly with a fast, stern-heavy performance boat. When coming off plane there will be a following wave that in some cases can roll right over the transom, even into the boat. Turn around and watch for it, and if it appears necessary, give the engine a little throttle just as the wave arrives. This situation can become much worse with two or three people sitting in the stern of the boat.

In general, as you add passengers or weight of some kind, there are some things to be aware of.

Generally they are added toward the rear of the boat where seats are commonly found. This will make planing off more difficult and prop blowout more severe. However, once on plane, things are generally a little better since with more weight, the boat sits lower in the water. The boat should be more stable in rough water, in turns, and at maximum speed. Of course, it will be somewhat slower and you don't want to drive around as sporty as you might when out alone, as a courtesy to your passengers. If your passenger load is toward the front as in a bow-rider design, planing should not be very difficult. However, top speed will be off more noticeably as the hull will run at a less efficient flatter angle.

Special Multiple Engine Considerations On V-Bottom Boats

An engine mounted off center on a V-bottom boat will normally be operating behind an angling surface. This depresses the water flow coming off the boat bottom lower on one side of the gearcase strut (the side toward the center of the boat) than the other. Since the cooling water intakes are usually located in the strut, this phenomenon can cause air to be sucked in through the top holes of the center facing intakes if the engines are raised much above the basic 20" or 25" transom height. This problem has led boaters to plug the upper holes on the inside intake. This can be done by applying an epoxy body putty to the upper holes. In some cases, on very fast multiple engine boats with very high transom settings, the inside intakes will be totally plugged and the outside intakes will have their upper holes plugged. This may keep air out but adequate cooling may now depend on high boat speed to ram enough water into the few remaining intake holes.

Another more obvious problem in picking up adequate cooling water can occur in turns where the engine on the outside of a turn with a boat that leans well into the turn can have its intakes momentarily lifted above the water line. If this becomes a serious problem, plugging upper holes can again be helpful.

Another cooling related problem with multi-engine boats has to do with the center most strakes which typically are located about a foot off of the boat centerline. The vast majority of the hulls in the 30' range normally equipped with twin engines terminate these strakes from 5' to 10' ahead of the transom. If these strakes are not terminated smoothly, (perhaps a 12" transition) they can cause surface air to be sucked into the low pressure created behind the strake and at speeds generally over 50 MPH cause low, extremely irregular water pressure on any engine whose water intakes lie in the path of these air bubbles. (Figure 4)

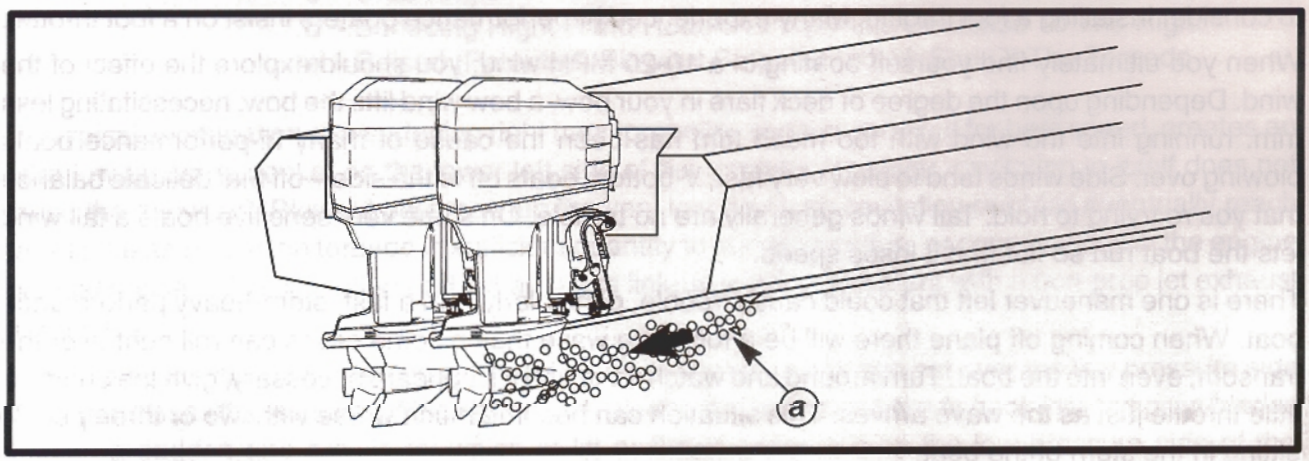


Figure 4

a - Air Bubbles Created Behind Strake Flow Into Engine Water Intake

Fixes include fairing out the strakes with body putty, moving the engines further out (and up), changing to a special high performance, low level water intake gearcase and plumbing in transom mounted auxiliary water pickups. Again, water pressure or water temperature gauges are extremely beneficial and could save you from a big repair bill.

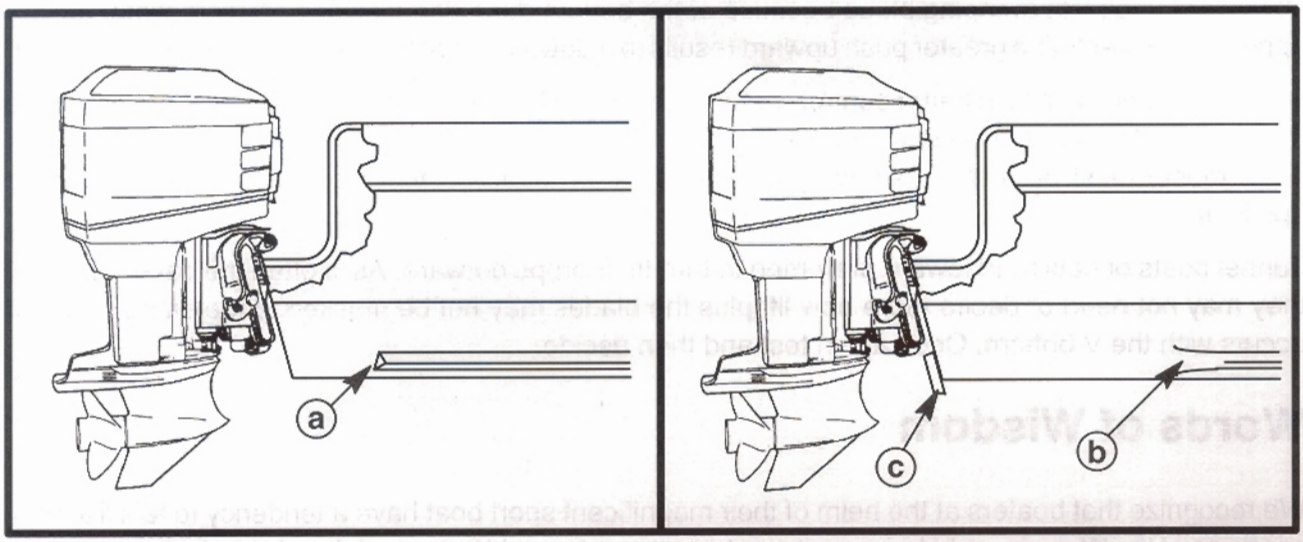
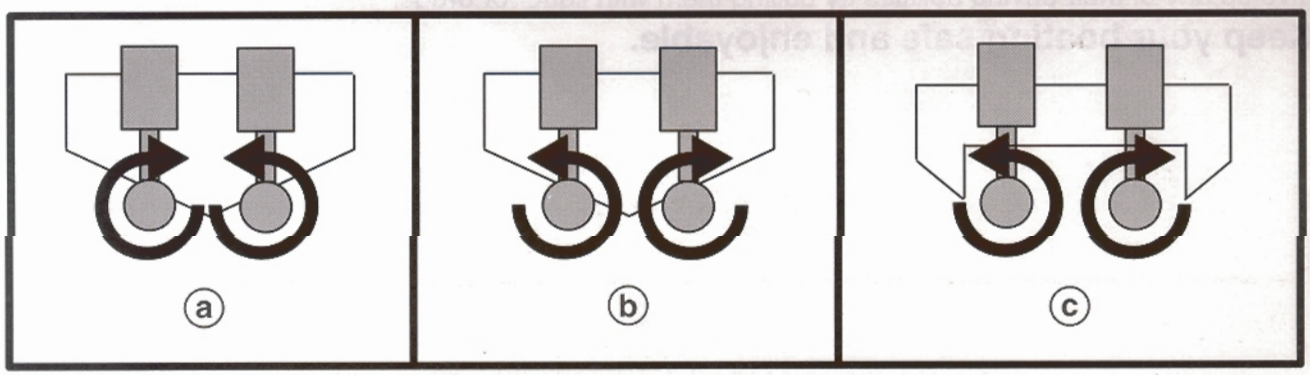


Figure 5

a - Strake Terminated Too Close To Transom And Terminated Abruptly
b - Strake Fared Out And Terminated More Forward Of Transom
c - Transom Mounted Water Pickup

If your dual engine boat is very fast and may encounter rough water, you will undoubtedly desire to run counter-rotating propellers (which may require a gearcase or drive change). Fast dual engine boats with both props turning in the same direction have been known to have their sterns walk around in a hurry when coming off a wave with the bow up where the prop blades are in the water but not much if any skeg is. Counter rotation is also helpful in holding down steering torque. This of course, is not a factor on engines equipped with power steering.



a - V-Bottom (Inward Turning)
b - V-Bottom (Outward Turning)
c - Tunnel or Cat (Outward Turning)

Whether to turn the propellers inward or outward is a choice to be made by testing. Today, there is a trend with Hi-Performance "V" bottom boats to turn them inward given the unusual somewhat elevated installation height. "Turning inward" proponents feel that a little more top speed is achieved because there is a little more bow lift. The upward (outboard) swinging blade sees more water than the downward (inboard) swinging blade because of the bottom dead rise masking off more water as you approach the keel. The greater push upward results in a down force at the prop which results in bow lift.

Some also feel that a little better control comes with turning inward. On the other hand, there are some major Hi-Performance V-bottom producers who prefer turning the props outward for superior results. Each model must be tested each way to determine the direction that works best for that specific application.

Tunnel boats or cats tend toward preferring to turn their props outward. As is often the case with cats, they may not need or desire more bow lift plus the blades may not be masked in the same way that occurs with the V-bottom. Once again test and then decide.

Words of Wisdom

We recognize that boaters at the helm of their magnificent sport boat have a tendency to feel like they are "King of the Waterways." However, if sport-boating is to avoid being legislated out of existence, a lot of common sense and concern for others on the water must be observed. Any conscientious and courteous sport-boat driver will not mix speed with swimmers, skiers, fishermen, sailboats, etc. Since you can obviously get there very quickly, go where you have more space and your noise and wake won't be bothersome to others. In addition, with the growing popularity of personal water craft which are highly maneuverable and relatively small, you must steer clear when approaching one from the rear or sides. PWC operators love to dart suddenly to one side.

One more comment must be made regarding high speed operation of faster hi-performance boats. Many, if not most, high-speed boats require from their driver a high level of concentration and quick responses. Between holding the boat on its point or pad and watching the water ahead for any traffic, stray wakes, or debris coming at you at perhaps over 100 feet-per-second, a smart driver isn't going to give up any of their driving abilities by dulling them with liquor or drugs.

Keep your boating safe and enjoyable.