PROPELLERS

Propeller Selection

It is important to you, as a boater, to understand the basics of propellers. This will enable you to determine the propeller that is best suited for your application. The following is only a guide; to save time, ask your marine dealer or boat manufacturer for advice on selecting a propeller.

The propeller on your outboard motor is the means by which the horsepower, developed by the engine, is converted into thrust to propel your boat. As such, its care and selection is very important to insure continuous service and satisfactory performance.

Several propeller options are available to you, if you want to change your performance for better top end speed or to increase load carrying performance.

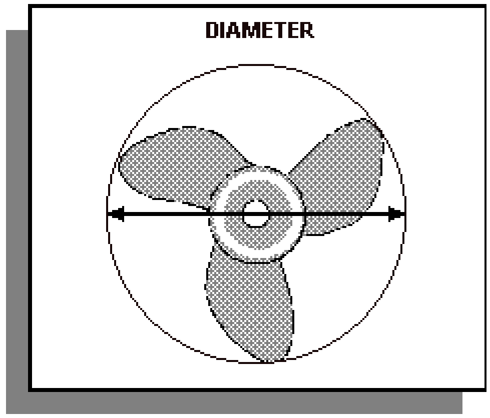
Materials

Composite and plastic propellers are generally used for emergency situations. Aluminum propellers, being the most common, have reasonable durability for most applications.

Stainless steel propellers are stronger than most all other propeller materials. Some advantages are longer life and high hydrodynamic efficiency derived from stiffer blades.

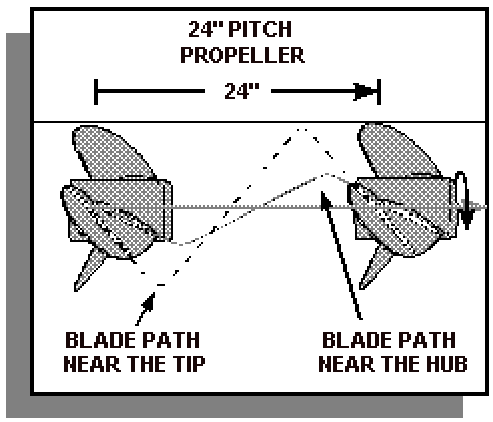
Diameter

Diameter is simply the width of the circle described by the rotating blades.



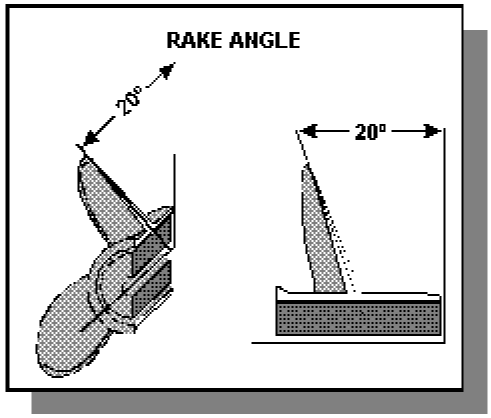
Pitch

Pitch is the angle of the blades expressed in inches of theoretical travel in one revolution of the propeller. This propeller has a pitch that will theoretically result in 24in. of forward travel in one revolution. In use, the propeller experiences *slippage* so that its actual travel per revolution is less than the stated pitch.



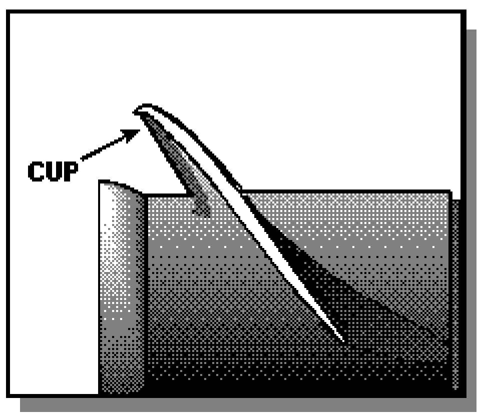
Rake

Rake is the measurement of the angle of the tilt of the blade's tip toward or away from the gearcase. The angle is measured on a line extending from the center of the hub through the center of one blade.



Propeller Cup

Cup is the added curved lip on the trailing edge or blade tip. This added curvature will increase pitch when added to the trailing edge and increase rake when added to the tip. Cupping a propeller will cause a decrease in RPM. The actual amount of RPM decrease is dependent on where, how much, and the quality of the cupping. Cupping also tends to decrease ventilation and allows higher trim angles and transom settings.



Propeller Hubs

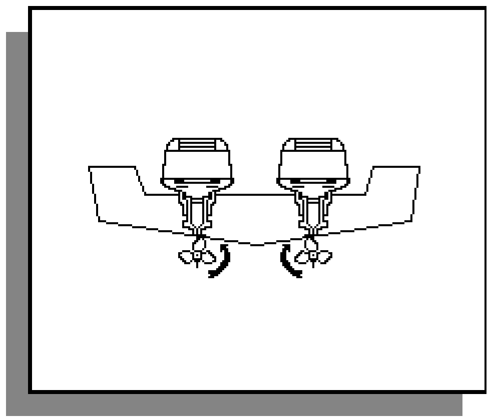
Most propellers have a splined bushing in the hub that attaches the propeller to the propeller shaft. The bushing is mounted to the propeller with flexible rubber. This rubber acts like a shock absorber. If the propeller strikes something hard, the rubber flexes and helps protect the gearcase components from damage.

Identification

There are several specifications that are used to define a finished OMC propeller. Besides the part number, a propeller is normally identified by two numbers, such as 13 x 9, followed by a material identification, aluminum or stainless steel. In the number sequence 13 x 9, the first number is the diameter, and the second number designates the propeller pitch.

Counter-Rotation

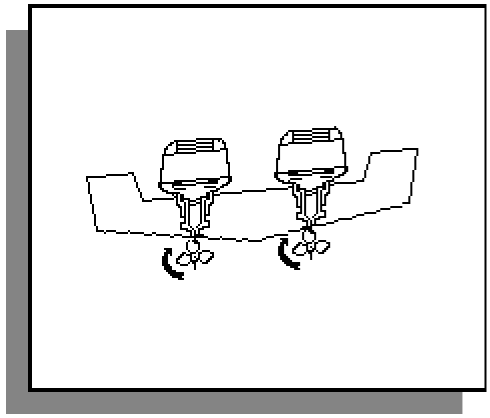
Steering can be a real chore with a dual engine power setup. When the props turn in the same direction, the boat tends to list and steer off course. Keeping an even keel and true course requires constant attention, especially in choppy water and high winds. Much of that problem can be solved by having two props turn in opposite directions. In other words, counter-rotation. The major advantage of **counter-rotation** is its ability to enhance performance by reducing steering effort in all RPM ranges.



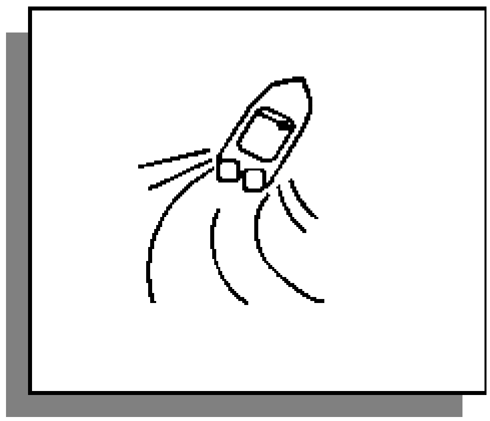
Most single engine boat setups normally operate in forward motion using clockwise rotation of the engine and gearcase. Although counterclockwise rotation setups have been used since the creation of the outboard engine, the use of **counter- rotation** has become more prevalent in the last decade. This increase is largely due to the manufacturing increase of larger **twin** engine recreational boats and performance boats.

To better understand how counter-rotation enhances performance, you must first understand what happens under normal conditions using clockwise rotation propellers. Clockwise rotation propellers, when turned in the same direction, will tend to list or walk to the right side of the direction they are moving forward in.

The illustration below shows two effects of clockwise (Right Hand) propeller rotation. The listing of the propeller to the right, pulling the gearcase in the same direction, and the effect of propeller torque, causing the boat to roll over to the port side.



The illustration below shows how clockwise (Right Hand) propeller torque forces a boat into a right hand turn.



Left-handed or counterclockwise rotation is usually accomplished by using a special gearcase configuration that rotates opposite of engine rotation under normal operation. Counter-rotation is mechanically achieved by driving the gear clutched to the propshaft in counterclockwise rotation when shifted into forward gear. A counter-rotation gearcase is completely different than a standard gearcase, as it is comprised of special parts that provide strength and durability to accomplish this reversed rotation.

Ventilation and Cavitation

Ventilation occurs when surface air or exhaust gases are drawn into the propeller blades. The load on the propeller is reduced by the mixing of air or exhaust into the water steam causing over revving.

Anti-ventilation Plate: Large plate cast into gearcase housing directly above propeller. Helps reduce surface air from being pulled into blades.

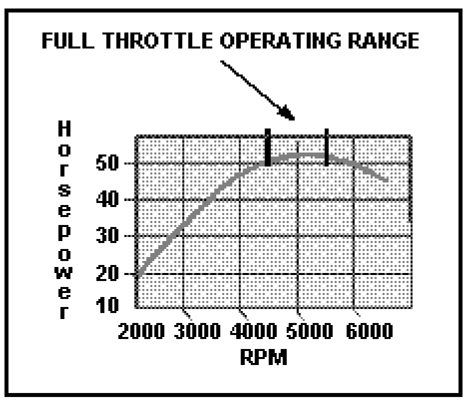
Cavitation: The aeration (bubbling) and boiling effect of water caused by creation of a low pressure area. Generally caused by a solid shape (propeller blade) passing through the water, in such a position and speed, that a low pressure area is formed due to the inability to move through the water in nonresistant manner. An example is, a propeller blade that has a rough edge would not cut efficiently through the water, thus creating a low pressure area. If the pressure drops below the vapor pressure, a cavitation bubble will form in that region. These bubbles will collapse when they reach the higher pressure region of the blade. This causes a rapid change in pressure and can result in physical erosion. You may notice burns (erosion) at some area on the face of the blade.

Common rules of thumb:

1. Ventilation can lead to excessive slippage.
2. Cavitation can lead to ventilation and/or slipping.

Operating Range

The following chart illustrates a typical outboard motor horsepower curve. The curve represents data that is determined by running an engine on a dynamometer through the RPM range up to W.O.T. (Wide Open Throttle). This chart indicates a peak of 50 HP at 5000 RPM. 50 HP would be the engine's overall power rating.



The recommended W.O.T. operating range is determined to permit operating latitudes without sacrificing engine durability or performance.

The recommended W.O.T. operating range for this motor would probably be 4500-5500 RPM.

The operating range is stated on the specification page of the **Operator's Manual** and is used when selecting a propeller.

Maintenance

Check your propeller often for nicks, rolled tips, or bent blades. Any distortion from normal will cause a loss in performance and can create vibrations harmful to the engine. A propeller with worn blades will allow the engine to accelerate beyond the recommended operating range which can result in damage to the engine.

Keep the bottom of the boat clean. Tests prove that cleanliness plays an important part in boat performance.

A fouled bottom, an accumulation of marine growth, moss and barnacles in sea water, and the accumulation of dirt, slime, lime, and other matter in fresh water, is the major cause of poor boat performance. Cleaning the boat's bottom frequently during your boating season will greatly improve boat performance.

To show the dramatic effect cleanliness plays, a boat was left anchored in salt water for 40 days. The running tests were made with a 35 HP engine which was removed from the boat after each test. A three-man load was used.

Speed:

- At beginning of test . . . 25.0 mph (40 km/h)
- After 10 days in water. . 21.5 mph (35 km/h)
- After 20 days in water. . 18.5 mph (30 km/h)
- After 40 days in water. . 13.0 mph (21 km/h)

Selection Guidelines

To select the optimum propeller for the use of your boat and motor combination, keep the following guidelines in mind:

1. Have a selection of propellers to test with.
2. Use an accurate tachometer to measure RPM.
3. Use an accurate speedometer or some means to measure boat speed.
4. Safely test each setup at W.O.T.
5. Make sure every test is with identical settings. (i.e.: Boat load, trim angle, engine height, water conditions, etc.)
6. Power trim equipped engines should be tested at their optimum trim angle. Optimum trim angle is the highest trim position that can be run without excessive venting (slippage) either in a straight line or in turns.

Check your Operator's Manual and note the RPM of the engine at its rated horsepower and the recommended operating range. Your objective is to check to see that the propeller allows the engine to run near the rated RPM, but under no circumstances outside the recommended operating range.

Make several runs in opposite directions, and determine the maximum RPM and speed. If RPM is lower than recommended, select a lower pitch propeller and make several runs recording RPM and speed.

Testing Guidelines After testing is complete, if results show:

1. RPM is too low at W.O.T.
   - Reduce pitch and retest
2. RPM is too high at W.O.T.
   - Increase pitch and retest
3. RPM is within recommended range
   - Verify RPM

The correct size propeller will provide the best overall fuel economy and performance.

Things to Remember

1. Engine RPM at W.O.T. must be within the recommended operating range with the rated horsepower RPM as the target number (see specification in Operator's Manual).
2. Increasing or decreasing propeller pitch directly affects engine load throughout its RPM range.
   - A high load (high pitch and/or diameter) on an engine will result in lower engine RPM throughout its entire RPM range for a given throttle setting.
   - A light load (low pitch and/or diameter) on the engine will result in higher engine RPM throughout its entire RPM range for a given throttle setting.
3. A boat's hull design may limit its overall performance; even a highly efficient handmade propeller will not overcompensate for an inefficient hull design.

4. Transom height, angle, and engine trim angle all affect propeller performance.
5. Atmospheric pressure, temperature, and humidity all affect engine performance, which directly affects propeller performance.
6. Salt water is more buoyant than fresh water; this may cause some hulls to run faster than identical freshwater setups.
7. Water conditions can play a big part in boat performance and propeller efficiency.
8. The boat's load and position of the load can significantly affect performance.

Propeller Material and General Comments	Average Cost	General Purpose	General Style	Largest Pitch Size Available from Most Suppliers
Composite / plastic propellers are low in price, have reasonable impact resistance. May not be repaired, although some have replacement blades	Usually lower or comparable to aluminum $130	Generally emergency usage only	3-4 blades, round ear, low rake, minimal cupping	Same as aluminum, usually up to 23 in.
Aluminum propellers are most common, low in price, and have reasonable durability, although relatively soft and are repaired at a reasonable cost	Reasonably low $180	All-around boating performance	3-4 blades, round ear, low rake, minimal cupping	Generally up to 23 in.
Stainless Steel propellers are expensive, very strong for longer life, more efficient due to greater strength permitting stiffer blades, and a blade design that provides less slippage and flexing. Somewhat expensive to repair.	Higher than above starting at $300-400	Above average and performance boating	3-5 blades, usually round ear, adequate rake & cup	Largest OMC size is 29 in. Others make over 29 in.