



Propeller Terminology	sid. 2-5
Determining Engine RPM	sid. 6
Propeller Sizing	sid. 7
Propeller Installation	sid. 8
Frequently Asked Questions	sid. 9-10

Blade Back

Suction side. Forward side of the blade (surface facing the bow).

Blade Face

Pressure Side, Pitch Side. Aft side of the blade (surface facing the stern).

Blade Number

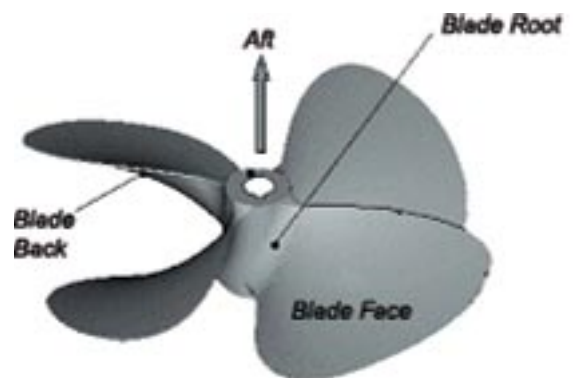
Equal to the number of blades on the propeller.

Blade Root

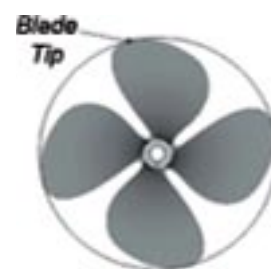
Fillet area. The region of transition from the blade surfaces and edges to the hub periphery. The area where the blade attaches to the hub.

Blade Tip

Maximum reach of the blade from the center of the hub. Separates the leading and trailing edges.

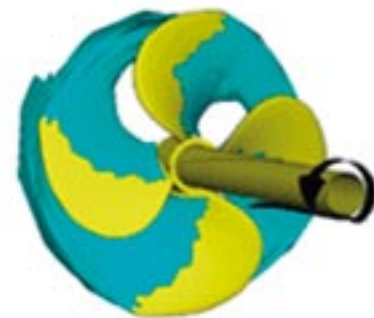


Blade Number = 4



Cavitation

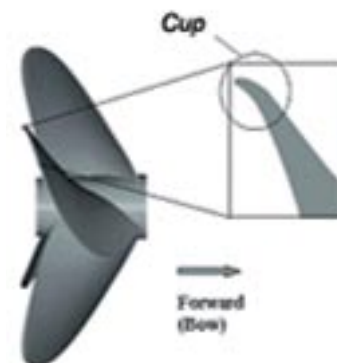
Cavitation, (which is often confused with ventilation), is a phenomena of water vaporizing or “boiling” due to the extreme reduction of pressure on the back of the propeller blade. Many propellers partially cavitate during normal operation, but excessive cavitation can result in physical damage to the propeller’s blade surface due to the collapse of microscopic bubbles on the blade. There may be numerous causes of cavitation such as incorrect matching of propeller style to application, incorrect pitch, physical damage to the blade edges, etc...



3-D Cavitation Pattern Visualization

Cup

Small radius of curvature located on the trailing edge of the blade. This curved lip on the propeller allows it to get a better bite on the water. This results in reduced ventilation, slipping, and allows for a better hole shot in many cases.



Diameter

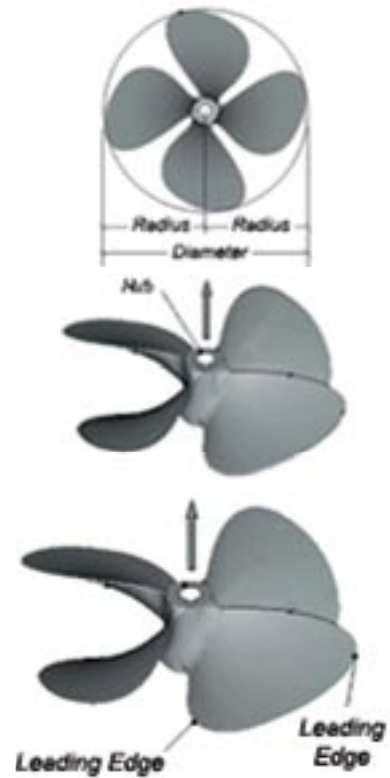
Diameter is the distance from the center of the hub to the tip of the blade x 2. It can also be looked at as the distance across the circle that the propeller would make when rotating. It is the first number listed when describing a propeller.

Hub

Solid cylinder located at the center of the propeller. Bored to accommodate the engine propeller shaft. Hub shapes include cylindrical, conical, radius, & barreled.

Leading Edge

The edge of the propeller blade adjacent to the forward end of the hub. The leading edge leads into the flow when providing forward thrust.



Thru-hub exhaust propellers

consist of a round barrel to which the blades are attached. The exhaust passes through the barrel and out the back, without making contact with the propeller blades. This provides a good clean water flow to the blades, usually resulting in good acceleration and hole shot.



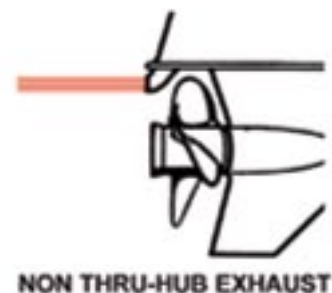
Over/Thru-hub exhaust propellers

are a combination of thru-hub and over-hub exhaust propellers. This allows some exhaust to escape at lower RPMs, providing a controlled amount of exhaust flooding. These types of propellers will allow the propeller to be slightly easier to turn during initial acceleration, allowing for a better hole shot on some engine/boat combinations.



Non thru-hub exhaust

propellers are used for inboards using shaft driven propellers, stendrives using through hull exhaust, and on some outboards that don't route the exhaust through the lower unit torpedo.



Pitch

Pitch is defined as the theoretical forward movement of a propeller during one revolution — assuming there is no “slippage” between the propeller blade and the water. Pitch is the second number listed in the propeller description.

Radius

The distance from the axis of rotation to the blade tip. The radius multiplied by two is equal to the diameter.

Rake

Rake is the degree that the blades slant forward or backwards in relation to the hub. Rake can affect the flow of water through the propeller.

Aft Rake helps to trim the bow of the boat upward, which often results in less wetted surface area and therefore higher top end speed.

Forward, or negative rake, helps hold the bow of the boat down. This is more common in workboat type applications.

Rotation

When viewed from the stern (facing forward): Right-hand propellers rotate clockwise to provide forward thrust. Left-hand propellers rotate counter-clockwise to provide forward thrust.

Skew

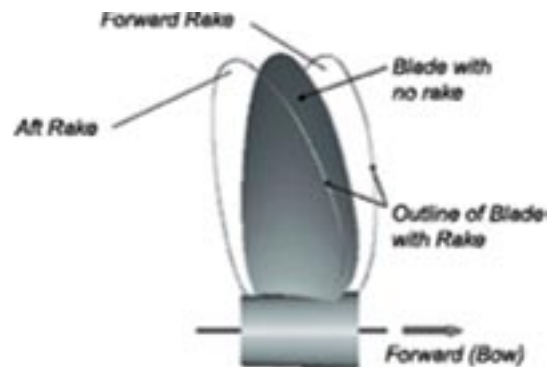
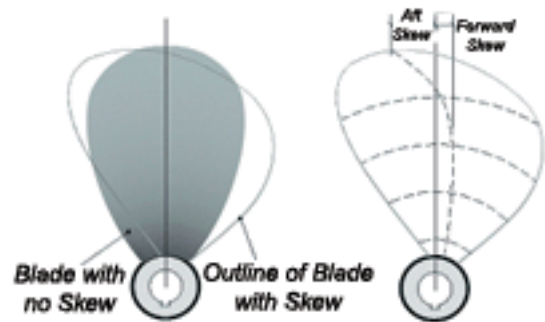
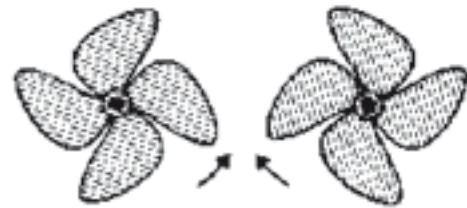
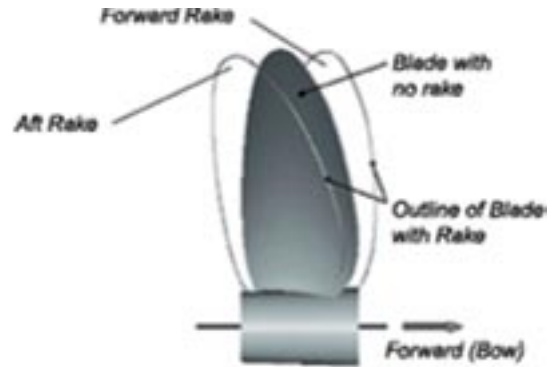
The transverse sweeping of a blade such that when viewing the blades from fore or aft shows an asymmetrical shape.

Aft Skew: Positive skew. Blade sweep in the direction opposite of rotation.

Forward Skew: Negative skew. Blade sweep in the same direction as rotation.

Slip

Slip is the difference between actual and theoretical travel of the propeller blades through water. A properly matched propeller will actually move forward 80 to 90 percent of the theoretical pitch.



Trailing Edge

The edge of the propeller adjacent to the aft end of the hub. When viewing the propeller from astern, this edge is closest. The trailing edge retreats from the flow when providing forward thrust.

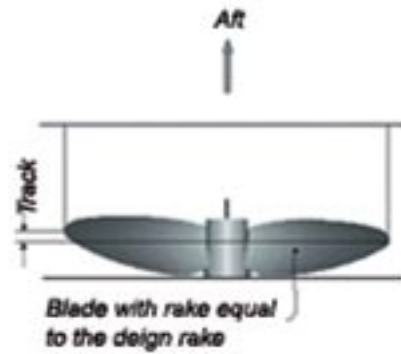


Track

The absolute difference of the actual individual blade rake distributions to the other blade rake distributions. Always a positive value and represents the spread between individual blade rake distributions.

Ventilation

Ventilation is a situation where surface air or exhaust gases are drawn into the propeller blades. When this situation occurs, boat speed is lost and engine RPM climbs rapidly. This can result from excessively tight cornering, a motor that is mounted very high on the transom, or by over-trimming the engine.



The propeller size for your boat and engine combination is based on the wide open throttle operating range for your particular engine. This can be located in your operator's manual. This will be expressed in terms of a certain horsepower at a certain RPM.

The goal in propeller selection is to determine what propeller style and size will maximize performance for your boat, while allowing your engine to operate in the recommended RPM range. The correct propeller will prevent the engine from over-revving, yet allow it to reach the minimum RPM where maximum horsepower is produced.

Using your existing propeller, determine what is the maximum RPM you are able to obtain. If, during this test, you begin to exceed the maximum rated RPM of the engine, reduce throttle setting to a position where maximum RPM is not exceeded.

If your test results in your being able to over-rev the engine, you need to increase the pitch of the propeller. Increasing the pitch increment by 2" will result in approximately a 300-400 RPM drop. If your testing shows however, that you are only able to obtain an RPM somewhat lower than the maximum rating given by your engine manufacturer, you would need to decrease pitch. Decreasing pitch would increase your RPM.

Switching from an uncupped to a cupped propeller would also reduce your RPM. The cupped propeller of the same pitch and diameter will typically reduce your RPM by around 200.

Once your wide open throttle RPM falls within the recommended range of the engine manufacturer, you have a propeller that is suited correctly for your boat with respect to RPM. You may however, not be satisfied with respect to skiing performance or trolling speed. It is best in circumstances like these to have two propellers. One to accommodate one set of circumstances and the other to perform best under the different load. It could, in fact, be that more than one propeller will be suitable for your boat and motor combination depending on your usage. It is imperative, however, that the wide open throttle RPM falls within the range specified by your engine manufacturer.

The best propeller size for your boat and engine combination is based on the recommended operating range at wide open throttle (w.o.t.) for your engine, which you will find in your operator's manual. This will be expressed in terms of a certain horsepower at a certain RPM (revolutions per minute).

The goal in prop selection is to determine what propeller style and size will maximize performance for your boat, while allowing your engine to operate in the recommended RPM range. The correct propeller will prevent the engine from over-revving, yet allow it to reach the minimum RPM where maximum horsepower is produced.

Run the boat/motor at w.o.t. under normal operating load to determine the maximum RPM you are able to obtain. A tachometer is necessary for this test. Adjust the motor trim angle for the optimum performance. If during this test, you begin to exceed the maximum rated RPM of the engine, reduce throttle setting to a position where maximum RPM is not exceeded.

If your test results in your being able to over-rev the engine, you need to increase the pitch of the propeller. Increasing the pitch increment by 1" will result in approximately 200 RPM drop. If your testing shows, however, that you are only able to obtain a RPM somewhat lower than the maximum rating given by your engine manufacturer, you would need to decrease pitch. Decreasing pitch would increase your RPM.

Example:

Operating Range =	5000-5600 RPM
Top End of Operating Range =	5600 RPM
Tachometer Reading =	4800 RPM
Difference =	800 RPM

For every 1" of pitch size, the effect will be approximately 200 RPM. Knowing this, take the difference in the above example at 800 and divide it by 200. The result is 4. The prop to use will be 4" in pitch less than the prop that was used.

Switching from an uncupped to a cupped propeller will also reduce your RPM. The cupped propeller of the same pitch and diameter will typically reduce your RPM by approximately 200.

Once your wide open throttle RPM falls within the recommended range of the engine manufacturer, you have a propeller that is suited correctly for your boat with respect to RPM. If you use your boat for fishing, cruising and skiing, one prop probably won't do all three things equally well. It is best in circumstances like this to have two propellers. One to accommodate one set of circumstances and the other to perform best under the different load. It is imperative that the wide open throttle RPM fall within the range specified by your engine manufacturer.

CAUTION

Before servicing a propeller, be sure the engine is in neutral with the ignition off or disconnected to avoid any possibility of the engine starting and causing injury.

CAUTION:

Do not install any propeller without a thrust washer in place. If a thrust washer is not used, severe damage could occur to the propeller and/or engine. If you see a tapered surface toward the engine end of the prop shaft, the thrust washer is not in place on the shaft. Your thrust washer may adhere to the front of your old prop when removed.

Mercury/Mariner/MerCruiser: If the propeller strikes the Trim Tab, replace the trim tab with Quicksilver flat plate anode #76214A5 or equivalent available

Make sure your thrust washer is on the prop shaft with the tapered end in first to match the tapered surface of the prop shaft.

Caution: Do not install any propeller without the thrust washer in place.

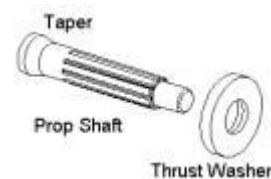
Clean and grease the splines of the prop shaft.

Align the keyways in the propeller housing with keys on the hub. Slide the propeller housing onto the hub.

Slide the propeller and hub assembly onto the propeller shaft. Place your tab washer on the end, then install and tighten the locking prop nut. Make sure your tab washer and prop nut turn simultaneously. Tighten to 55 ft.-lb. Align 3 tabs on tab washer with grooves on castellated Spider Washer cap. Tap or bend tabs down into grooves.

For propeller shafts that use a cotter pin: Install the Locking Nut and tighten to 55 ft.-lb. Reinstall Cotter Pin and bend ends or consult your Engine Owner's Manual for proper prop nut torque and fit specifications.

Rotate Prop in neutral by hand to make sure the blades do not strike the trim tab and anti-ventilation plate.



NOTE:

Locking Nut should be checked for tightness every 20 hours of operation.

Q. What prop should I use with my boat and motor?

A. First, determine how the boat will be used or what the normal load will be. If this boat normally operates with one specific passenger load, propeller size is relatively easy. If it has multiple uses ranging from light to heavy loads, the selection of one or two propellers may be necessary.

Q. Why change propellers?

A. The stock outboard with which most outboards are equipped is a compromise. Since it has fixed diameter and pitch, it is limited in its use and may not provide satisfactory performance for every combination load that will be encountered. One important fact to note is that the propeller moves the boat through the water at a specific engine R.P.M., and H.P. is directly related to that R.P.M. The engine cover is marked with a certain H.P. rating, but in most instances the full benefit of the possible H.P. is not realized. Along with the H.P. rating, equal emphasis should be placed on the R.P.M. at which the related H.P. is developed. This is where the propeller comes into the picture. Outboard engines are designed to run at peak R.P.M for full efficiency. Excessive R.P.M. with its increased friction and wear is harmful. It is equally harmful to run the engine overloaded to the point that it can not achieve its rated R.P.M. This results in excessive carbon build up with subsequent problems of poor fuel economy, pre-ignition, frequent spark plug failure, scoring of the cylinder walls and even burned pistons.

Q. How can I be sure my motor is operating within the recommended rpm range?

A. This can be checked with a tachometer. There are various types commercially available.

Q. What are diameter and pitch?

A. If a propeller is specified as 10x12 in size, this indicates it is a 10" diameter by 12" pitch. Propeller Dimensions are always given in this order. Diameter is determined by doubling the distance between the blade tip and the center of the hub. Pitch refers to blade angle. In this example, the 12" pitch indicates that with each prop revolution the boat theoretically would advance 12". Due to slippage, actual advance is somewhat less.

Q. Why do outboards of the same power sometimes take different props?

A. This is due to differences in lower unit gear ratios. Stock outboards are geared so that the propeller shaft turns at a slower speed than the R.P.M at the powerhead. This is usually expressed as a ratio such as 12:21 or 14:28, referring to the number of teeth in the drive gears. In the first example, the crankshaft gear has 12 and the propeller shaft the gear has 21. This means the propeller shaft turns only 57% as fast as the indicated R.P.M at the power head. The lower the gear ratio, the larger the propeller that can be used. In other instances, engines of different makes may develop their maximum horsepower at different levels. Check your owner's manual to determine the correct R.P.M for your engine.

Q. What is the correct transom height for my outboard engine?

A. On average boats, it is best to mount the engine so the cavitation plate is approximately 1” below the bottom of the keel, or 1” below the bottom of boats without keel. For racing boats, better speeds can be attained by raising the engine to reduce lower unit drag and exhaust back pressure. The best transom height can only be determined by experimenting. The best performance will be obtained by mounting the engine as high as possible, or to the point just before propeller cavitates excessively.

Q. Will a different prop correct bad torque action (listing and hard steering).

A. Usually not. Most likely it is the result of any of several irregularities in the hull, the steering hook-up, or the engine mounting. If an engine has a right rotating propeller, steering wheel should be on the right or starboard side. Modern outboards have built-in features in the lower units to compensate for torque. Engine tilt should be such that the prop is horizontal when underway. If it is up or down, the propeller can have a definite pull to one side. See that the engine is at the exact center of the transom and is sitting level. Check boat bottom for warping, distortion, which could cause difficulty.