Your Guide to Propeller Terminology

Learning the Lingo

From Henry H. Smith & Company

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Propeller Size

The size of a prop is described using two sets of numbers. These correspond to the diameter and pitch. The pitch always follows the diameter when describing a propeller.

Diameter

The first number listed in a propeller size. Diameter is defined as two times the distance from the center of the hub to the tip of the blade. It can also be looked at as the distance across the circle that the prop would make when working.

Pitch

The last number listed in a propeller size. Technically speaking, pitch is the theoretical distance a prop moves forward in one revolution - assuming there is no “slippage” between the prop blade and the water. In the real world, there is some slippage and therefore the distance advanced is less than the design pitch. Pitch can be visualized as the tightness or looseness of the blades as they swirl around the prop hub. If the blades appear tightly wound and angled sharply inward toward the hub, the pitch is high. If the blades appear loosely wound and angled outward from the hub (that is, they appear flatter), the pitch is low.

Cupping

Many of today’s propellers incorporate a cup at the trailing edge of the propeller 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. A cupped propeller also works very well where the motor can be trimmed so that the propeller is near the surface of the water. The cup will typically result in better performance, and higher top end speed on one of these applications.

Ventilation

Air from the water surface or exhaust gases from the exhaust outlet being drawn into the prop blades causes ventilation. When this situation occurs, boat speed is lost and engine RPM climbs rapidly. This occurs most often with high transom mounting, over-trimming the engine, and sharp turns.

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 metal erosion or "cavitation burn" to the prop's blade surface. There are numerous causes of cavitation such as incorrect matching of propeller style to application, incorrect pitch, physical damage to the blade edges, etc.

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, and has implications with respect to boat performance. Aft rake helps to trim the bow of the boat upwards, which often results in less wetted surface area and therefore higher top end speed. Aft rake propellers also typically "bite" better on ventilating type applications. Forward, or negative rake, helps hold the bow of the boat down. This is more common in work boat type applications.

Selecting the Right Propeller For Your Boat and Engine

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 a 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:

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Operating Range = 5000-5600 RPM

Top End of Operating Range = 5600 RPM

Tachometer Reading = 4800 RPM

Difference = 800 RPM
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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 could, in fact, be that more than one propeller would be suitable for your boat and motor combination depending on your usage. It is imperative, however, that the wide open throttle RPM fall within the range specified by your engine manufacturer