AeroStar MARINE CORPORATION

# *POWER PITCH® and SWITCH BLADE® PRO Marine Propeller Transmissions*

*DETAILED OPERATING AND INSTALLATION INSTRUCTIONS*

## *INTRODUCTION*

Thank you for purchasing your Power Pitch® Pro or Switch Blade® Pro Series Propeller Transmission. The Power Pitch® Pro and Switch Blade® Pro propulsion systems are referred to as a marine transmission because they utilize an advanced internal control system that is far more sophisticated than a simple propeller with movable blades. By replacing your old fixed pitch or simple variable pitch propeller with the Power Pitch® Pro or Switch Blade® Pro Propeller Transmission you will adding an exciting new dimension to your boating experience. The Power Pitch® series are designed for boats having stern drives and most outboard applications while the Switch Blade® series are tailored for specialized outboard applications such as Bass Boats. Aerostar Marine also offers several different blade designs that are intended to provide the best possible performance for your boat. Please contact Aerostar Marine or an authorized dealer if you have any questions regarding your application.

## *BEFORE INSTALLATION*

Before installing your Power Pitch® or Switch Blade® Pro Series Propeller Transmission, check that you have the correct pitch and style of blade for your boat. Although pitch designations between various propeller manufacturers are not always consistent, normally, you would select a Power Pitch® (or Switch Blade®) transmission having the same pitch designation as the existing fixed pitch cruising propeller installed on your boat. Because blade area also effects engine rpm, you may need to move up 1 inch in pitch if you are changing from a 4 bladed prop to a 3 bladed prop, or if you are changing from a larger (blade area) 3 bladed prop to a smaller 3 bladed prop. Note that the Power Pitch® (or Switch Blade®) blade pitch designation corresponds with the high pitch setting. If you currently use two props, one at lower pitch for pulling water-skiers and one of higher pitch for high speed cruising, the blade pitch designation on the PowerPitch® (or Switch Blade®) should match the pitch of your higher pitch cruising prop. For example, if you now have a 19 pitch cruising fixed pitch prop and your engine rpm is between 100 to 300 rpm below the engines rpm limit (red line) when you are at full throttle and the outdrive (or outboard engine) is trimmed to best speed, then you would normally select 19 pitch blade for your PowerPitch® (or Switch Blade®) transmission. Because of the significant improvement in acceleration provided by this transmission, you can often install a PowerPitch® (or Switch Blade®) with blades having 1 to 2 inches greater pitch than that of your current fixed pitch cruising prop and still obtain excellent operation. However, you should check that your engine does not become “lugged down”, but continues to operate in its desired power region. Generally to stay within the desired power region, maximum speed will be obtained at an rpm normally no more than 500 to 700 rpm below red line. Consult your engine operation manual for specific data on your engine. As guidance, a 1 inch increase in propeller pitch will lower the peak engine rpm at maximum cruising speed by approximately 200 rpm.

You should also check to insure the transmission hub splines and mounting hardware are correct for your specific sterndrive or outboard engine. The hubs are 4 1/2 inch nominal diameter and are available with either 15 tooth and 19 tooth splines. The 19 tooth splines are for the Volvo (OMC) SX series sterndrives while the more standard 15 tooth splines are for Mercury, OMC (Original Cobra and King Cobra sterndrives; Johnson and Evinrude outboards), Yamaha, and Suzuki. Also, there is separate mounting hardware for each of these drive/engine manufacturers. The mounting hardware consists of a special thrust washer placed on the drive shaft in front of the transmission, and a special drive shaft cylinder nut to secure the transmission to the drive shaft. The



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thrust washers used for each drive/engine systems are as follows:

| **Thrust Washer** Part Dash No. | **Drive/Engine** System | **Reference** Thickness (inches) |
|---|---|---|
| -1 | Mercury and Yamaha | .46 |
| -3 | OMC and Volvo SX (Evinrude/Johnson outboards, Cobra and SX sterndrives) | .36 |
| -5 | OMC (King Cobra sterndrives) | .49 |
| -9 | Suzuki | .65 |

The special drive shaft nuts used to secure the transmission to the drive shaft for each of these drive/engine systems are as follows:

| **Drive Shaft Nut** Part Dash No. | **Drive/Engine** System | **Thread** Size | **Nut Cylinder** Length (inches) |
|---|---|---|---|
| -1 | Mercury | 3/4-16 | 2.30 |
| -3 | OMC / Vovo SX | 3/4-16 | 1.85 |
| -7 | Yamaha / Suzuki | M18-1.5 | 2.30 |

## *INSTALLATION*

Before you can install your new Power Pitch® Pro or Switch Blade® Pro Series Propeller Transmission you must first remove you old prop and its mounting hardware. It is best to make this change while at the dock or, better still, while your boat is on its trailer. Because your engine may be easily started, before attempting to remove the old propeller or install the new transmission on your boat, for your safety it is important that you check that the engine control lever is in “NEUTRAL” position and that the ignition key and/ or switch is “OFF”. It is also best to place a block of wood between the anti-ventilation plate and the blade tip to protect your hands and prevent the propeller from turning, which could cause accidental engine starting, while removing the prop shaft nut.

Since blades can be damaged, once you have removed your old prop it is a good idea to stow it securely in your boat as a spare along with all the mounting hardware and prop nut wrench. Each manufacturer’s mounting hardware varies, but it generally consists of a forward thrust washer positioned in front of the transmission, a rear thrust spacer positioned behind the transmission, and a shaft nut with a locking tab or cotter pin. There also may be (e.g. Mercury) a thin continuity washer placed between the transmission and rear thrust collar.

To install your new Power Pitch® Pro or Switch Blade® Pro Marine transmission, first place a liberal amount of suitable waterproof lubricant on the splines, threads, and thrust taper on the propeller drive shaft. Then place the correct Aerostar Marine thrust washer for your specific sterndrive or outboard on the drive shaft taking care that the tapered hole in the thrust washer mates properly with the drive shaft taper. Now, while aligning the splines, slide the hub onto the drive shaft. You should check to insure the hub has slid all the way forward on the drive shaft such that inner hub seats against the thrust washer. Make sure the forward recess on the outer hub inserts adequately (approximately 3/8 of an inch) within the torpedo housing, but does not rub against the torpedo housing. Some Mercury drives incorporate a zinc anode inside the torpedo housing and you should check that the hub and counterweight arms do not contact these zinc anodes. If you suspect contact, remove the zinc anode and remove material from the aft of the anode by sanding or filing it as required to provide clearance, then reinstall the anode and propeller.



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***CAUTION: Check that there is clearance between the blade tips and the trim fin mounted to the anti-ventilation plate.***

Manually turn the propeller and check that their is a minimum of 1/4" clearance between the propeller blades and the trim fin mounted to the underside of the anti-ventilation plate. For some Mercury drive systems (e.g., most four cylinder sterndrives) you may need to modify the existing fin or replace it with Mercury's high performance trim fin P/N 822-777A1 to achieve adequate clearance. For some Suzuki outboards you may also need to modify the existing trim fin to obtain adequate clearance. As a temporary measure you can simply remove the trim fin and its attachment bolt and operate without the trim fin installed. You may feel an increase in steering torque particularly during rapid acceleration when operating with the trim fin removed. To remove the trim fin you will need ether a 3/8" or 5/16" hex socket (Allen) wrench or a 1/2" socket wrench with a short extension, depending on the make and year of your sterndrive or outboard motor.

Check to see that you have the proper drive shaft nut for your specific drive shaft. Slide the locking tab washer on the bronze drive shaft nut making sure that the two keys (or teeth) are facing forward. Install the bronze drive shaft nut into the center hub opening on the drive shaft. The cylinder portion of the nut should face forward on the drive shaft. The locking washer should be against the end of the hub center shaft. Align and engage the two keys (or teeth) with the slots in the hub center shaft. Use a 1-1/16 inch box end or socket wrench to tighten the nut, and again, for your safety, use a block of wood between the anti-ventilation plate and blade tip to keep the transmission from turning. Torque the nut to between 55 to 65 ft.-lbs. Note that the flange on these special drive shaft nuts incorporates slots and when tightening the nut you will need to make sure one of the slots is aligned with one of the tabs on the locking tab washer.

Finally, to positively lock the nut onto the drive shaft, locate the tab on the locking tab washer that best aligns with one of the slots in the flange of the nut, then with pliers or a flat bladed screwdriver, pull the outer tip of the tab aft and inward and bend it so that it fully engages the appropriate slot in the flange.

***CAUTION: DO NOT PRY AGAINST THE END OF THE PLASTIC SHIFT POINT SET KNOB WHEN BENDING THE LOCKING TAB AS THIS MAY DAMAGE THE SET KNOB.***

## DESCRIPTION OF THE UP SHIFT OPERATION

Once the shift point has been set for your particular boat/engine set up, the Power Pitch® and Switch Blade® Propeller Transmission will automatically shift the blades from low to high pitch at the optimal engine rpm, depending upon boat loading and applied power. This is accomplished by a patented mechanism that holds the blades in position and senses blade loading to automatically vary the shift timing according to changes in operating conditions. We call this SmartProp™ Technology and without it the continually varying and sometimes instable hydrodynamic loads acting upon the blades will result in inconsistent and undesirable shift operation. The PowerPitch® and Switch Blade® transmissions are designed to provide smooth and consistent shifts in blade pitch under all boating conditions.

The up shift operation, that is the shift from low to high pitch, is similar to the operation of a car automatic transmission. If you do a full throttle, maximum power acceleration, the transmission mechanism will allow the engine to "wind out" to the maximum rpm set point before shifting the blades into high pitch. However, if you do a more moderate, partial throttle acceleration, the shift mechanism will sense these conditions and automatically shift the blades into high pitch at a lower, more comfortable rpm. You will find the transmission automatically adjusts the up shift timing according to such factors as boat weight and planing speed, throttle (applied



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power), and pulling loads (water skiers). When accelerating, you do not need to always use full throttle as the Smart Prop™ mechanism will automatically shift the blades as the boat comes on plane, so long as you have supplied sufficient power to plane your boat. Also you may initially wish to apply full power to accelerate on plane more quickly, then reduce power to maintain a more moderate cruise speed. If you reduce power before the set shift point, the transmission will normally shift the blades to high pitch during or soon after you reduce power. You can also cause the transmission to shift sooner by momentarily pulling the power sufficiently to "unload" the blade thrust then reapply the desired power. The prop will normally shift immediately as the power is reapplied.

## *ADJUSTMENT OF THE UP SHIFT TIMING*

The optimal timing of the up shift or shift from low to high pitch for your specific boat and engine combination is set by turning the black knob at the rear of the hub. This knob has been preset at the factory to a nominal position that is likely not at the optimal or correct position for your particular boat. Thus, once you have installed the transmission on your boat, you will need to perform some simple tests and adjust the shift timing control knob to obtain proper operation on your boat. You will find that setting the proper shift timing is easy, requires no special tools, and takes only a few minutes.

The initial set up is made by conducting a few full throttle, maximum acceleration tests. First accelerate gradually taking care not to exceed the engines maximum RPM limit, to check the operation of the propeller. Unless the shift point is obviously too low (i.e shifts well before the boat is planed), or too high (no shift before engine rpm limit is reached), you should make a minimum of three more rapid, full throttle acceleration tests before adjusting the shift timing control knob to better establish the shift point. To obtain consistent set point test data, for each tests, allow the boat to come fully off plane and close to being completely stopped with the throttle in neutral. Then apply full throttle in a rapid but smooth motion. It is also easier to leave the sterndrive or outboard in the full trim down position for these set up tests. Once the transmission shift point set up is complete, you can return to using your normal throttle and trim operation.

Best acceleration performance is generally achieved when the shift from low to high pitch occurs just after the boat becomes planed. When you initially apply the throttle it is normal to see the bow of the boat rise slightly as your boat begins to climb out of the water. A general indication or reference to judge when your boat becomes fully planed is when you see the bow start to come down. If the shift from low to high pitch occurs to early, particularly if the boat has not yet planed, the higher blade pitch will not allow the engine rpm to reach its best power operating region, resulting in poor acceleration. If the shift occurs to late, the lower blade pitch will not allow the blades to maintain thrust as the boat speed increases, also reducing acceleration as well as top speed. If the shift from low to high pitch does not occur before the engine reaches its rpm limit, you could exceed the rpm limit of your engine. Thus, you will need to monitor the engine tachometer and, if necessary, pull back the throttle before the engine rpm limit (red line) is reached.

To provide margin for variations in shift rpm that will normally occur do to changes in boat weight, pulling load, and other operating conditions, it is best to set the full throttle, maximum acceleration shift point so that it occurs at least 200 rpm below the engine's rpm limit. Unless you have a heavy, slow planing boat, you will normally find the optimal shift point will occur substantially below (300 to 800 rpm) the engine rpm limit. If you have a light, very quick planing boat, you may find the optimal shift point is even lower (800 to 1200 rpm below the engines rpm limit). Precise setting of the shift point rpm is not particularly critical, since the primary objective is to not have the shift too early or before the boats is planed, but also not too late where you feel that you are losing acceleration, waiting for the blades to shift.

When making adjustments of the shift point control knob, rotate the knob clockwise (CW) as you look forward, to increase the shift point, or counterclockwise (CCW) to decrease the shift point. Before making adjustments, be sure the engine ignition is turned off, then raise the sterndrive or outboard so you can reach the



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shift control knob. As you turn the control knob, you will feel the spring click detents which hold the set knob in position. You will also notice that the adjustment sensitivity or change in shift point engine rpm for each click in the set knob's detent position, increases as you get closer to the optimal shift point for your boat. For example, if the initial shift point were either set much too low or too high, you will probably find that one click or detent rotation of the control knob will results in very little (50 rpm or less) change in the shift point, and thus, you may need to rotate the knob 3 to 5 clicks (detents) between each full throttle acceleration test to get more quickly within the optimal shift point region. Once you are near the optimal shift point, the change in shift point rpm may increase to between 100 to 300 rpm per click (detent) so you should then limit your adjustments to 1 to 2 clicks (detents) between each test. Be sure to lower your sterndrive or outboard to full down trim before restarting your engine.

After you have completed the set up tests for your boat you may wish to record the detent position of the shift point control knob for future reference. To do this, count the click detent you feel as you slowly rotate the set knob clockwise (CW) until, with only moderate force, you can no longer rotate the knob. The allowable control knob clockwise rotation will stop when the metal adjustment collar threaded onto the control knob bottoms out against the knob. The number of click detents that you have counted is then the set point for your boat. Now, turn the control knob back counterclockwise (CCW) the same number of click detents to reposition the control knob at your optimal shift set point. Caution, do not turn the control knob excessively hard at the ends of its allowable rotation, especially in the counterclockwise (CCW) direction, as you may damage the control knob. For reference, there are approximately 44 click detent positions between the full clockwise (CW) and full counterclockwise (CCW) limits, and for most boats, you will find the optimal set point is between 15 to 25 click detent away (counterclockwise, CCW, rotation) from the full clockwise (CW) rotation limit.

An advantage to recording the set point for your boat is that it makes it easier to return to this setting if you wish to temporarily change the operation of your transmission. For example, you may wish to have the transmission stay in low pitch and not shift to high pitch when you are doing lots of lower speed maneuvers (e.g. pulling "Tubers"). To do this you would simply raise your sterndrive or outboard, and turn the shift control knob clockwise (CW) 4 or 5 clicks (detents). Then reposition the control knob back (CCW) to your optimal set point when you wish to resume normal shift operation.

## *DOWN SHIFT OPERATION*

The SmartProp™ mechanism in the Power Pitch® Pro or Switch Blade® Pro Series Propeller Transmission also hold the blades in the high pitch position to prevent undesirable fluctuations in engine rpm during cruise operation or when making subsequent power (throttle) or trim adjustments. The mechanism also incorporates a feedback system to prevent premature downshift into low pitch, when the throttle is substantially pulled back. Without this patented blade holding feature, the hydrodynamic drag loads acting on the blades when the throttle is rapidly reduced would cause the blades to prematurely flip back into the extreme low pitch position, generating a braking effect that can uncomfortably "throw" the passengers and cargo forward in the boat. Thus, the SmartProp™ blade holding mechanism provides a smoother, more pleasant de-acceleration of the boat.

The operation of the down shift, or shift from high pitch back to low pitch, is similar for all boats and does not require any set up or adjustments. You will find the timing of the downshift is generally quite subtle so you may not notice it. The downshift usually occurs between 1500 to 2500 rpm when the power is pulled back and the boat begins to settle off plane. You can vary the down shift somewhat by varying the throttle (power) slightly as the boat slows down and settles off plane. If you apply a small amount of power such that you cancel the drag loads on the blades, the transmission will normally shift down before the boat settles off plane. If you add more power as the boat slows and before it settles off plane, you can apply sufficient thrust load to keep the blades in high pitch as the boat continues to settle completely off plane. Thus, by this technique you can hold the blades in high pitch for trolling or maneuvering off plane. To allow the blades to return to low pitch, simply reduce power momentarily.



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If you pull the throttle back to slow the boat rapidly, as the boat settles off plane, you generally will get a backwash wave that tends to splash the stern of the boat. A common technique to reduce the splash is to reapply partial power to keep the boat ahead of the backwash wave. If you continue to hold this partial power, and the transmission has not yet shifted down into low pitch, the additional power load will maintain the blades in high pitch. Thus, if you wish to further advance the throttle to accelerate the boat, but also wish to have the transmission first shift back to low pitch, you will need to momentarily reduce power to relieve the thrust load on the blades, then reapply power as desired.

## *TRIM AND CRUISE OPERATION*

Most sterndrives and outboards are equipped with a power trim system to hydraulically raise or lower the outdrive or outboard engine. There is generally an indicator on the console that shows your the position of your sterndrive or outboard drive system. Unless you need to raise the drive to avoid rocks or other obstacles in shallow water, you will normally trim your drive system to the full down position before advancing the throttle. If the trim is up when you advance the throttle substantially, the bow will normally rise excessively and the blades may “blow out” or loose it’s bite in the water causing a rapid rise in engine rpm. If you experienc blade blow out, you will need to immediately pull the power back to prevent the engine from exceeding it’s rpm limit (red line). Thus, it is a good practice to always check that the drive system is in the full down trim position before advancing the throttle.

Trimming your drive system out (up) somewhat during cruise operation substantially reduces drag, thus improving top speed and fuel economy. The amount of trim required varies greatly between different style boats, drive systems, and propellers. The amount or trim will also vary according to the specific operating conditions that you are using your boat. For example, trimming your drive system to obtain your boat’s best top speed will generally require more up trim than more moderate speed cruising. If you are doing turns or other maneuvers, depending upon the design or you boat and it’s mounting of the outdrive or outboard engine, you will generally need to trim the drive system down somewhat from the top speed trim position to give the blade more bite to prevent blow out during sharp turns.

As mentioned, when you first apply power to accelerate your boat on plane, you will normally need to put the drive system in the full down trim position. For most boats you should generally wait until the boat has come on plane, before you begin to trim the drive system up. For some boats you may wish to begin trimming the drive system up before the boat is planed. An example is for very quick planing hulls (e.g. Bass Boats) when you want to obtain maximum possible acceleration. For these quick planing boats, you may want to begin to trim just a few seconds after applying full power, depending upon the speed of the boat’s trim system. The objective is to keep the bow from dropping to low after the boat planes as this will reduce acceleration and top speed. However, if you trim too much or too early, it may cause the blades to slip. If the up trim is excessive, it will cause the blades to blow out on acceleration.

Once your boat is on plane, you will need to trim your drive system appropriately for the cruising condition you wish to operate under. To obtain best top speed, you will need to gradually trim the drive system up, while monitoring both the speedometer and tachometer to observe when your boat achieves its maximum possible speed, without exceeding the engine’s rpm limit. Because it takes time for your boat to accelerate and stabilize it’s speed, you will need to be patient when trimming, especially if you are attempting to squeeze out that last 1 or 2 m.p.h. in top speed. One technique is, once the boat becomes planed, to raise the drive system up to about 1/2 to 3/4 of the estimated up trim required for best speed and let the boat speed stabilize. Then “bump” the trim switch for more up trim an observe whether the boat’s speed went up or down. If the speed increased, try another “bump” up in trim. If the speed decreased, then “bump” the trim back down, and that now should be your best speed trim position. Another technique is to slowly trim the drive system up as the boat continues to accelerate, taking care not to over trim, since this will cause the blades to slip or blow out. As the boat nears it’s maximum speed, continue trimming very slowly until your hear or feel the blade slip or “ventilate” slightly, then



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trim down a little to allow the blade to "hook up" properly.

Once you have found the best trim position for your boat, you should observe the indication on your trim indicator for future reference. Note that the best speed trim position for your boat will also vary because of changes in boat weight and power, so it is best to use the trim indicator as only a good reference. If you plan to cruise at a more moderate speed, after planing, simply trim the drive system up to around 1/2 to 3/4 of the amount of trim you observed on your trim indicator for best speed, or other position that you find provides good all-around operation, and leave it in that position while cruising.

***In the event your boat or drive system strikes an object or for some reason your transmission would loose a blade, for your safety it is important to keep both hands on the steering wheel, especially when cruising at high speed. Loss of a blade can result in a large turning force and vibration on the steering wheel, particularly for boats without power steering. This is especially critical on light, fast boats (e.g. Bass Boats). Also for safety, all occupants in the boat should wear suitable US Coast Guard approved life jackets.***

Before or while you pull the throttle back to slow the boat, it is a good practice to trim the drive system (sterndrive or outboard) down. This will allow the blades to "hold" better should you wish to reapply power. Also, some boats (e.g. Bass Boats) tent to be more unstable (e.g. chine-walk) if the drive system (outboard engine) is left trimmed up when power is reduced.

## PERFORMANCE TESTING

You may want to do some performance tests on your boat to evaluate your new propeller transmission versus your old propeller. It is important, when conducting any performance tests, to keep all other variables constant to minimize the influence of these other variables. Thus, if you are attempting to establish the boats absolute top speed, it is important to keep other factors constant such as the drive system trim, boat weight (fuel and passengers), weight distribution (passengers in bow or stern seats), wind velocity and direction, and water conditions (smooth, light chop, or rough). Another important factor is engine power which can vary significantly due to changes in air temperature and humidity, as well as altitude. Higher air temperature and altitude, will lower the maximum power output of your boat's engine (approximately 1% for each 10°F change in air temperature, and approximately 7% for each 1000 ft. change in elevation), while increasing humidity will usually cause a small increase in power. Most boats will obviously run faster at lighter weight, but also when the weight is distributed more toward the stern as this allows more bow lift, which, in turn, reduces hull drag.

As an example, for an 18 to 20 ft. boat, you may observe about a 2 m.p.h. drop in top speed from light to heavy and another 2 m.p.h. drop if the boat is loaded more forward than aft. If the water is rough, it is almost impossible to obtain consistent performance test results, so it is best to do these test only on smooth or light chop water. Their may also be a difference in speed (about 1 m.p.h.) between smooth and light chop water surface conditions, but some boats are faster in chop while others are faster in smooth water. Wind conditions will have an obvious effect on both speed and acceleration as a 5 m.p.h. wind can easily cause a 1 m.p.h. increase or decrease in top speed. Also, if tests were conducted at different times where the temperature increased significantly, you could see another 2 m.p.h. drop in speed due to a loss in the engine's maximum power.

Thus, the combined effects of these outside factors could potentially cause an 8 m.p.h. change in a typical boat's top speed. Since this potential 8 m.p.h. variation in test results is greater that the speed variations normally observed between different, but well designed blades, it becomes obvious why its so important to minimize these outside factors when evaluating the performance of different propellers. Even when taking care to be consistent, it is difficult to obtain reliable data to within 1/2 m.p.h. for top speed tests or within 1/2 second for



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acceleration tests. Also, in most boats the speedometer is not particularly accurate. Using the top speed indication on your boat's speedometer is fine as a measure of the relative performance on your particular boat, but you will need to use a more accurate system, such as a radar gun, if you intend to compare speed tests with results obtained on another boat. When using a radar gun (or similar land based reference system), you will also need to be aware of any water currents as these will cause errors in true boat speed relative to the water. Thus, a 1 m.p.h. water current in the direction of the boat will add to the boat's speed and cause a 1 m.p.h. error in the speed indicated on the radar gun.

To obtain good test results it is best to perform several identical tests, then average the observed data. For example, to get good top speed results, make 3 or 4 top speed runs in opposite direction to correct for wind. Take care to trim the drive consistently for each run and keep the boat loading the same. Remember fuel is a major weight factor so try to keep the fuel quantity as constant as practical (e.g. within 5 to 10 gallons, 30 to 60 lbs, for light boats).

Similarly, to obtain good acceleration test results you should also make 3 or 4 full throttle accelerations in opposite direction. A good method is to measure the time to accelerate the boat from stop to a set reference speed. You will normally want to pick a speed above the boat's planing speed and should find that using a speedometer indication of 20 m.p.h. and 30 m.p.h. are good reference speeds for most boats. You will need a stop watch capable of measuring to 1/10 of a second, which can be purchased at most sporting goods supply stores. Take care to make sure the boat is completely stopped before each test and be consistent on when and how quickly you advance the throttle, and when and how much you trim the drive system. Trimming the drive (or outboard) up after planing will generally improve acceleration slightly, particularly if you are using a higher reference speed; however, you will generally find it easier to not use the trim during these tests. You may need a few practice runs to refine your timing so that you can hit the throttle and stop watch, steer the boat straight, and observe the speedometer, all at the same time. It may help to have someone handle the stop watch timing and record the data separately, while you handle the throttle, steer the boat, and observe the speedometer, but you will need to coordinate your actions so that you do not induce additional error due to the delay (or anticipation) of each persons reactions. Boat weight or pulling load has a major impact on acceleration. Consequently, you will notice more acceleration improvement at higher boat weight or pulling load.

Determining the best speed and acceleration performance that can achieve is of interest to many boaters, but it is equally important to judge your overall satisfaction and thus, not become too focused on any single performance number. Other performance aspects such as ability to hold well in turns, smoothness, and consistency in operation are more subjective, but are none the less important when conducting these evaluations. The Power Pitch® Pro and Switch Blade® Pro Series Transmission have been designed to provide excellent speed and acceleration performance without compromising these other important performance aspects.

## *CLEANING AND INSPECTION*

The PowerPitch® Pro and Switch Blade® Pro Series transmissions are made of high strength stainless steel and the mechanism bushings are made of composite, self-lubrication materials. These materials have excellent corrosion resistance to salt water and exhaust gases, thus these transmissions are designed to provide satisfactory operation in either fresh and salt water. However, the materials in yourtransmission (or sterndrive and outboard) are not completely impervious to corrosion, marine growth and other contamination found especially in salt water when subjected to these conditions for extended periods. Therefore, it is a good practice to periodically clean your transmission (or sterndrive and outboard) to reduce corrosion and remove contamination.

The easiest way to clean your transmission is simply to flush wash it in clean, fresh water and wipe clean with a soft cloth or paper towel. This should be done anytime you remove your boat from the water. If you moor your boat for an extended period, you may need to periodically remove your transmission from the drive shaft and clean it. This should be done if you notice any inconsistent shift operation, or if you see signs of marine



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growth or other contamination on or in the transmission. If you plan to moor your boat but not use it for an extended period (several weeks), it is advisable to remove your transmission along with the mounting hardware and store it in a safe, dry place until you return. Removal and reinstallation is simple and further set up of the shift point upon reinstallation is not required.

If your the shift operation of your transmission is not performing properly, or if you suspect contamination or damage, you should remove the transmission for further inspection. Any damaged parts will need to be replaced or repaired by Aerostar Marine or an authorized repair center. Thus, if you see any damage, missing parts or loose fasteners, contact Aerostar Marine or one of its authorized repair center. Pay particular attention to insure the blades are not cracked or otherwise damaged. For your safety, as well as the safety of others, ***DO NOT OPERATE YOUR TRANSMISSION IF DAMAGED***.

If you see any marine growth or other contamination, first soak or flush rinse your transmission with clean fresh water. If you still notice marine growth or film, you can soak the transmission in a light solution of fresh water and bleach (1/2 cup bleach per gallon of water) for a few hours, then, thoroughly flush with fresh water and wipe clean with a soft cloth or paper towel. You can gently blow clean the interior of the transmission with shop (compressed) air, but take care not to dislodge any of the mechanism pin retaining clips.

If the transmission interior appears to have excessive carbon or other exhaust deposit build up, you can flush clean the transmission with light petroleum based solvent or comparable marine solvent based cleaners. Note that a thin black soot coating throughout the transmission interior is normal for two stroke outboard installations and is not a problem unless this buildup becomes excessive such that the motion of the mechanism or flow of exhaust gases are impaired. If you use solvent cleaners, thoroughly flush rinse your transmission with fresh water, and, if possible, blow dry with shop (compressed) air to remove the residual solvent. These solvent or other petroleum based cleaners will not damage the transmission components, but they do act as lubricants, and will sometimes cause your transmission to shift too early for a few upshift cycles. If you use anticorrosion spray or storage seal, these also act as lubricants, and you will need to insure they are rinsed thoroughly. Thus, if you have used solvents or other petroleum based products, you should not attempt to readjust the upshift point of your transmission until these lubricating residues become washed out as, in all likelihood, the shift point will, after 2 to 5 shift cycles, stabilize and return to your prior set point.

If you have experienced inconsistent shift operation, you may need to check the internal mechanism to see if any contamination or damage has impaired its movement. To accomplish this, you will need to remove the large snap ring on the hub inner slide shaft aft of the control knob. This snap ring retains the return spring and there is a significant preload (40-80 lbs) so be careful when removing the snap ring. It is best to have someone help by pushing down on the metal cap at the aft end of the spring to relieve the load on the snap ring while you remove the snap ring with a pair of snap ring pliers, then slowly relax the spring. Once the spring is fully relaxed, you can remove the aft cap retainer (metal), the spring, and then the inner cap retainer (plastic) located inside the control knob cavity. You now should be able to manually cycle the mechanism between high and low pitch by simply pulling or pushing the control knob which is attached to the internal mechanism slide module. Check to insure that the sliding motion is free and easy. If there is no apparent damage, but you notice biding or sticky motion, you should clean the transmission internal components as describe above to obtain free and easy motion of the mechanism.

While the return spring is removed, you should also check to insure the mechanism moves the full or required amount to properly hold the blades in both the low and high pitch positions. To check the low pitch position, push the slide module full in (forward) and check that the figure 8 shaped link on the right side of each blade positioning mechanism contacts their corresponding stops (or bosses) on the metal collar that is threaded onto the black plastic shift point control knob. You should also check that the mechanism properly holds the blades in low pitch. For this check, with the slide module push full in, you should not be able to manually twist the blades about their shanks toward higher pitch and cause the mechanism to shift out of low pitch. Summarily, to check the full motion to the high pitch position, pull the slide module full out (aft). The blades should now be



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in the high pitch position and the opposite figure 8 links, or those on the left side of each blade positioning mechanism, should lightly contact their corresponding stops (or bosses) which are attached to the forward end of the slide module casting. Also check that the mechanism properly holds the blades in high pitch by verifying that you can not manually twist the blades about theirs shanks toward lower pitch and cause the mechanism to shift out of high pitch when the slide module is pulled full out.

If you find the movement of the mechanism is restricted such that the mechanism does not appear to properly hold the blades in either the low or high pitch positions, check for contamination. If the fully retracted motion into low pitch appears restricted, check the inner hub region forward the slide module to see if any obstruction is there that could prevent the slide module from reaching its full in (forward) motion. If the fully extended motion into high pitch appears restricted there may be something obstructing the full, outward motion of the three flyweights which move the slide module aft. These flyweights are connected to the hub casting between each of the three pairs of parallel spokes and move within slots in the slide module casting. It is difficult to inspect this area for contamination without further disassembly, but you can gently use shop (compressed) air to adequately clean this area. As a check for full motion, you should hear the flyweights contact the hub cylinder inner wall when the slide module is pulled full out (aft). If you have adequately cleaned your transmission and still have problems, contact Aerostar Marine or an authorized dealer for assistance.

To reassemble the return spring components first slide the plastic spring cap onto the hub aft slide shaft. Note that the channel or groove in the cap should face aft. Next, slide the return spring over the hub shaft and insert or push the forward end of the spring into the groove in the plastic cap. Then slide the metal cap on the hub shaft and over the aft end of the spring. Finally with someone's assistance, push the spring and cap assembly in (forward) sufficiently to expose the snap ring groove in the hub slide shaft, and, with a pair of snap ring pliers, install the snap ring. Note that as a resulted of the manufacturing process, most snap rings have one edge that is sharper than the other and it is best to install the snap ring with the side having the sharper edge facing aft.

You are now ready to reinstall your transmission on your boat.

## *CHANGING BLADES*

To change or replace the blades you must remove the transmission from the drive shaft, then remove the return spring so that the mechanism can be manually placed in the high pitch position. To accomplish this, you will need to remove the large snap ring on the hub inner slide shaft aft of the set point control knob. This snap ring retains the return spring and there is a significant preload (40-80 lbs) so be careful when removing the snap ring. It is best to have someone help by pushing down on the metal cap at the aft end of the spring to relieve the load on the snap ring while you remove the snap ring with a pair of snap ring pliers, then slowly relax the spring. Once the spring is fully relaxed, you can remove the aft cap retainer (metal), the spring, and then the inner cap retainer (plastic) located inside the control knob cavity.

To access the blade shank attachment screws, which are in the front end of the blade counterweight arms, the blades must be in the high pitch position and, for this the mechanism slide module must be positioned fully out (aft). Because the black shift point control knob will extend past the end of the hub slide shaft, you will need to insert the special drive shaft nut in the end of the hub to act as a spacer. Now place the hub vertically, forward end up and resting on the aft end of the drive shaft nut. With the mechanism now resting in the high pitch position, you can access the hex socket head (Allen) set screws in the blade arms using a 3/16 inch Allen wrench.

For each blade you wish to replace, locate the screw access hole in the blade's corresponding attached counterweight arm. There are two set screws in each hole. First remove the short locking set screw, then loosen the blade attachment screw and turn it out a minimum of 10 turns so it is completely retracted from its mating cavity in the blade shank. If you are changing all blades, remove the locking screw and backout the

attachment screw in all blade arms. The blades should now be loose and easily removed by pulling out on each blade; however, to prevent the counterweight arms internal thrust washers from falling out, it is best to first position the hub horizontally, with one blade vertically up, pull this blade out and insert the new blade. Then rotate the hub to position the next blade vertically and replace this blade. Then do the same for the last blade. When inserting the blade shanks, make sure the holes in the counterweight arm and the thrust washer are properly lined up with the holes in the hub bushings. Also, take care when inserting the blade shanks not to damage the hub bushings.

If the blades do not pull out easily, insure that the screws are properly backed out. If the blade still cannot be removed by hand, there may be a small burr on the shank screw cavity and you may need to gently pry the blade out. You can do this by using two large flat bladed screw drivers and insert the ends of the screw drivers between the hub and the blade on opposite sides of the blade shank. This will provide the needed leverage to pry the blade out, but be careful not to damage or scratch your hub.

If the blade counterweight arm thrust washers fall out they can be easily repositioned. To do this remove the blade from the arm missing the thrust washer and position the hub horizontally with this shank hole up. Then with your fingers or a small pair of pliers, insert the thrust washer between the counterweight arm outer surface and hub inner surface. It is easiest to insert the washer from the aft end of the hub.

With the new blades now installed and all thrust washers in their proper positions, you can reposition the hub vertically with the aft end resting on the drive shaft nut so that you can again, access the attachment screws. First, fully engage each of the attachment screws into their mating blade shank cavities by tightening these screws securely (16 to 20 ft.-lbs). When tightening the attachment screws, you should feel that the screws "bottom out" in the blade shank cavity. If the screws continue to rotate slightly while you are tightening them, then this is an indication that the screws are not fully engaged, thus you will need to continue tightening, provided you do not exceed the screw torque limit. If the screw still does not seat properly, remove the suspect screw and inspect for the cause of the screw not becoming fully engaged into the shank cavity. After you have secured all of the attachment screws and are confident they are fully engaged, you can reinstall the short locking screws. These screws should also be torqued securely.

***As a word of Caution; IMPROPER SCREW ENGAGEMENT OR TIGHTENING MAY ALLOW THE BLADES TO BE THROWN OUT OF THE HUB DURING OPERATION RESULTING POSSIBLE SERIOUS INJURY, so please, for your safety as well as the safety of others, insure all screws are properly installed.***

You should be able to manually cycle the mechanism between high and low pitch by simply pulling or pushing the control knob which is attached to the internal mechanism slide module. Check to insure that the sliding motion and blade rotation are free and easy.

You are now ready to reinstall the return spring. To reassemble the return spring components first slide the plastic spring cap onto the hub aft slide shaft. Note that the channel or groove in the cap should face aft. Next, slide the return spring over the hub shaft and insert or push the forward end of the spring into the groove in the plastic cap. Then slide the metal cap on the hub shaft and over the aft end of the spring. Finally with someone's assistance, push the spring and cap assembly in (forward) sufficiently to expose the snap ring groove in the hub slide shaft, and, with a pair of snap ring pliers, install the snap ring. Note that as a resulted of the manufacturing process, most snap rings have one edge that is sharper than the other and it is best to install the snap ring with the side having the sharper edge facing aft.

You are now ready to reinstall the transmission on your boat.



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