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PRODUCT/SERVICE BULLETIN

BULLETIN #803211

DATE: 7/23/98

SUBJECT: Torque-Shift Prop Manual (installation, operation & maintenance).

Welcome to the exciting new world of automatic pitch adjusting propellers. Torque-Shift props are available with several combinations of blade and cam styles, pitch ranges, shift control springs, and Auto-Pitch hubs. This customization level, together with their periodic maintenance requirements, make it necessary that you (or your mechanic) understand the prop's assembly and maintenance procedures.

The latest Torque-Shift props feature continuously variable shifting over about a 3:1 pitch range! Additionally, their load sensing ability, like that in automatic automotive transmissions, provides high rpm under hard acceleration and at top speed, yet lower rpm during light load cruise conditions!

This prop may not be preset for your particular combination! Its shift points may have to be adjusted after you have run initial test runs with a speedometer and tach.

WARNING: TO PREVENT EQUIPMENT DAMAGE OR PERSONAL INJURY, READ THIS MANUAL BEFORE OPERATION! If this is your first experience with a Hole-Shot IV Torque-Shift prop, please read ALL these instructions carefully before use.

The prop is EASY to work on, however, if you do not understand any steps (or lack the mechanical ability to follow them through), please seek out expert assistance! Our technical department will be happy to provide UNLIMITED FREE TECHNICAL ASSISTANCE! Please have your current prop serial # ready when calling.

INSTALLATION

1) Remove the old prop AND THRUST WASHER from the gearcase (The thrust washer is the thick stepped washer you see, on the prop shaft, after removing the prop). Apply a **light** film of anti-corrosion marine grease on the boat's prop shaft spline and taper before slipping on the Torque-Shift prop. The Solid-Hub version Torque Shift's "Auto-Pitch" hub has a **BUILT IN THRUST TAPER** and will not use a thrust washer. The Rubber Hub version has a special thrust washer included with it. Both versions require using an appropriate combination of prop nut and prop nut washer (a special thin Land & Sea prop nut and/or spring washer is available if your stock hardware will not work) to secure the prop at about 40 foot pounds torque.

TIP: Be sure to use "Never-Seez" or an equivalent anti-galling compound on any stainless steel to stainless steel threads!

WARNING: Always follow your engine's owner and service manual safety warnings when removing or installing props.

2) While pressing the prop firmly FORWARD, rotate it a couple of times to make sure there is no interference between the prop hub and any part of the gearcase. Next, while pulling the prop AFT, check that the blades of the prop do not hit the cavitation plate, trim tab, etc. as you turn the prop.

TIP: Check clearance in both the high and low pitch positions! You need at least 1/4" of clearance between the blades and any part of the gearcase! On some engine brands you will have to cut or remove the trim

tab/anode plate for clearance, those manufactures also sell special trim tabs and/or flat anode plates that provide the extra clearance needed by high rake performance props.

INITIALLY TEST RUNNING THE PROP

WARNING: Normally props are NOT preset for YOUR particular engine and boat combination or personal driving preferences! Since the prop's shift points are affected by several adjustable parameters and driver controlled operating conditions, A TACHOMETER AND EXPERIENCED OPERATOR ARE ALWAYS A MUST! Drivers without a natural "ear and feel" for the operating RPM range of their engine must watch the tach (as in a standard shift automobile)! GROSS OR PROLONGED OVER REVVING OF THE ENGINE CAN LEAD TO ENGINE DAMAGE!

1) To break in a NEW prop, run it under moderate loads. i.e. With the engine trimmed to a neutral setting, GENTLY accelerate onto plane, then GRADUALLY accelerate up to about 3/4 speed while trimming out. Slow back to idle and a bit more aggressively accelerate again, this time gradually to top speed. Watch your tach!

TIP: Trimming out will tend to make the prop up-shift more and will DROP RPM!

Running the engine in reverse shifts the prop to high pitch! Since, it takes a few shifts on a newly assembled prop for the components to "run-in", the first few downshifts may not be consistent. So, if the prop does not launch the boat from the DOWN-SHIFTED position (very noticeable), get off plane and try again at a lower trim setting and/or the engine height.

TIP: A NEWLY ASSEMBLED prop might "stick in high gear" during the first few tests! If this occurs, just tap the blades in towards the center of the hub (with a mallet) to get it back into low pitch. This problem will disappear once the prop is broken in.

2) WATCHING THE TACH CAREFULLY, gradually run the boat up to near top speed while simultaneously moving the trim OUT to its optimum setting. Under full throttle, assuming you are running the optimum cam combination, you should notice the engine's RPM "hanging" near peak power while the boat accelerates. This is made possible by the prop continuously up-shifting as the boat accelerates, thus constantly making maximum horsepower available! The actual RPM that you "shift-out" at during full throttle operation is affected by the shift cam's profile, the trim setting and/or engine height!

The exact shift RPM of the prop is effected by several interrelated factors; one of these is propeller slippage. Under conditions of high prop slippage (i.e. while cavitating and/or ventilating due to excessive trim angle or engine height) the prop will tend to UP-SHIFT MORE, dropping RPM! Likewise under low slip conditions (i.e. while abruptly decelerating, light load low speed cruising, or running at low trim angle and/or transom height) the prop will favor the down-shifted position.

TIP: If the prop does not up-shift enough (too high RPM), try again using slightly more trim OUT and/or engine height! If this does not drop the RPM enough, a longer shift cam profile with a higher letter (e.g. an "X" cam instead of a "W" cam) must be substituted.

If the prop over-shifts (too low RPM), try again using less trim OUT and/or engine height! If this does not increase the RPM enough, a shorter shift cam profile (lower letter) should be substituted, then for final tuning, the pitch limit screws are used to limit the maximum possible up-shift (as explained later under "ADJUSTING THE SHIFTING PROP").

TIP: Since engine trim angle (and sometimes transom height) is a variable that the driver has control over, this knowledge lets an operator MANUALLY BIAS SHIFTING under many operating conditions! i.e. By running the trim way IN (and/or transom jack down), you will tend to force the prop to stay DOWN-SHIFTED, conversely, by trimming OUT you can force the prop to UP-SHIFT more! Use this trimming technique whenever you want to override the props present shift RPM! EXPERIMENT WITH THIS TRIM VS SHIFT POINT CONTROL (using the tach) UNTIL YOU HAVE A NATURAL FEEL FOR IT. It's the best way to learn to take full advantage of the Torque- Shift prop's abilities.

With any prop, to get maximum top end speed, you do need to have the correct RPM (for maximum HP) and the optimum trim (for minimum drag). This means you will need to find the cam (or limit screw setting) that allows the engine to maintain the correct top end RPM WITHOUT COMPROMISING YOUR BEST TOP END TRIM SETTING! For example: If you were using an "X" cam and getting 4,400 RPM at full throttle and the boat's best trim setting, but the engine actually wanted about 5,000 RPM, then a switch to a "shorter" shift cam profile like a "W" (lower letter) would be a good place to start. While you could also have raised the RPM with the pitch limit screws, it would leave the full throttle midrange at 4,400 RPM until the blades had pitched up far enough to hit the limit screws (at the top end). Testing will let you decide which method works best in your application.

If you have the correct blade size, style cams, and pitch setting, the rig will accelerate hard and almost immediately reach peak power RPM. It will then hold that RPM as the prop up-shifts to compensate for increasing boat speed and you can expect nearly the same top speed of similar style fixed pitch thru-hub props. Read on for tips on maximizing performance.

WARNING: To avoid prop failure from centrifugal loads, do NOT run the prop over 3,500 PROP-shaft RPM! (i.e. A stern-drive with a 1.5:1 gear ratio @ 5,200 ENGINE RPM is running 3,466 prop-shaft RPM; an outboard with a 1.87:1 gear ratio should not be run over 6,545 engine RPM!) For prolonged running, adjust pitch so prop-shaft speed will not exceed 3,000 RPM.

ADJUSTING THE SHIFTING PROP

This section deals with "bolt-on" tuning changes for the Torque-Shift prop. It does NOT cover changes that can be made to the prop's shifting characteristics (and propeller efficiency) by custom modification of the blade shape, weight, and area. Such specialty work should only be handled by prop shops experienced with the shifting prop.

1) PITCH LIMIT SCREWS: The easiest thing to adjust is the maximum pitch limit. Assuming you're using the correct part # blades for the rig, but the prop is OVER-SHIFTING (too low RPM) at the top end, then you can turn the stainless steel pitch limit screws (see KEY #8 on REPLACEMENT & OPTIONAL PARTS BREAKDOWN) CLOCKWISE to limit the maximum pitch and raise TOP SPEED RPM.

***TIP:** The pitch limit screws have no affect on the low end or mid-range RPM. If the prop over revs in those areas it is cam and/or spring choice related, or mechanical problem. Pitch limit screws should only be adjusted to change top end RPM.*

To limit the maximum UP-SHIFT pitch of the blades, use Land & Sea's Torque-Shift multi-tool (#950-903) or the included 5/32" hex key T-wrench (through the oblong access holes in the plastic diffuser/synchronizer ring) and evenly turn the pitch limit screws CLOCKWISE. (See figure 1)

***TIP:** As when blueprinting any prop, this can be done using a pitch gauge (like Land & Sea's #950-900); however, identical part # Torque-Shift blades are held to interchangeable tolerances so, if you are careful to visually set the thread depth of each limit screw the same, you can do a good job of pitch adjustment without special tools. Once they are screwed in CLOCKWISE far enough that they contact the blade's synchronizer pins at top speed, each FULL additional clockwise turn of the limit screws changes pitch about 2"!*

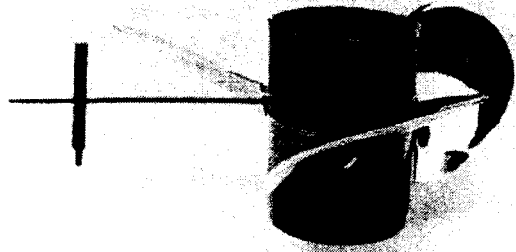


Figure 1: Adjusting the pitch with a Land & Sea multi-tool.

WARNING: Do not turn the pitch limit screws so far clockwise that they rub into the plastic diffuser/synchronizer ring! If you can not set your required top end pitch within these guidelines, switch to different blades (i.e. a 26"/19" blade set). From factory settings you have about 3 revolutions counter clockwise and 1 revolution clockwise to make your adjustments. If you require more, a different blade set may be required.

You should on water test, readjusting as necessary, your maximum pitch setting until you get optimum top end performance. This adjustment flexibility is half the fun of running a Torque-Shift prop, and it sure beats buying new wheels just to try a little different pitch!

2) REPLACEABLE CAMS: You ultimately will use the pitch limit screws to increase TOP END RPM to match your engines exact requirements, but as with the mid-range, you should select a cam profile that comes as

close as possible to automatically holding the optimum RPM WITHOUT the aid of the limit screws (i.e. with the limit screws retracted fully into the spokes) and without over-revving at top speed. Several optional interchangeable shift cam profiles are available to match the prop's shift characteristics to individual rigs.

When all else is equal, the longer the shift cam's profile the LOWER the prop's operating RPM and vice-versa. A shift cam profile chart is included to help you identify each cam's shift characteristics by the letter stamped in it. Gray bars on the chart indicate the relative full throttle shift RPM of the various cams under identical conditions. i.e. if you want your engine to always operate at HIGHER RPM, select a cam with TALLER gray bars!

Cams are a slip fit in the blade shanks and are easy to field install (as explained later under "BLADE & CAM REMOVAL")! Do NOT intermix different shift cam profiles.

3) CONTROL SPRINGS: Various tension control springs are available to FINE TUNE the PART THROTTLE shift characteristics. LIGHTER spring tension (or no springs at all) will LOWER RPM at part throttle and vice-versa. Do not intermix spring tensions!

TIP: Normally start with the standard 30 lb. (copper color) springs.

4) OTHER: Several blade types (cleavers, round ears, small and large blade area, etc.) are available to fit the same Auto-Pitch hub. This allows trying different characteristic blades without buying a complete prop. Consult the latest Land & Sea catalog for information.

As you can tell by now, there is almost an infinite combination of off-the-shelf blades, shift cam profiles, springs, and settings that can be experimented with. Additionally, like fixed pitch props, the stock Torque-Shift blades can usually be custom modified for a given application to further increase top end! While we can not give an exact recommendation for every rig, we will gladly assist you in sorting out any new application. Please feel free to contact the factory about any problem or to tell us about any particular combination you have discovered. The shifting prop is the beginning of a whole new learning curve for novices and experts alike. By sharing information, we will all be able to take maximum advantage of this new technology.



Figure 2: Removing spring



Figure 3: Pulling out guide pin

BLADE & CAM REMOVAL

1) Set the prop on a bench, with the plastic diffuser ring down. Screw the LEFT HAND threads of the Land & Sea multi-tool into the spring's coils (you can also use needle nose vise grips). Pull each spring hook out from its groove in the forward face of the hub and remove the springs from the prop. **DO NOT OVER-STRETCH THE SPRINGS!** (See figure 2)

WARNING: Wear eye protection when removing or installing springs!

2) Using the Land & Sea multi-tool (or a 10mm hex key T-wrench), remove the three black plastic 3/4"-16 guide pin retaining screws from the "Auto-Pitch" hub.

TIP: If these plastic screws ever seem "stuck", placing the hub in a freezer for an hour will shrink the screw and should free it up!

3) Thread the Land & Sea multi-tool (or any 1/4"-20 bolt) into the hole in each 9/16" x 1-3/4" stainless steel guide pin and pull the guide pins out of the hub. (See figure 3)

4) Slide the blades out from the hub.

5) Drop each cam from its pocket in the blade's shank. (See figure 4)

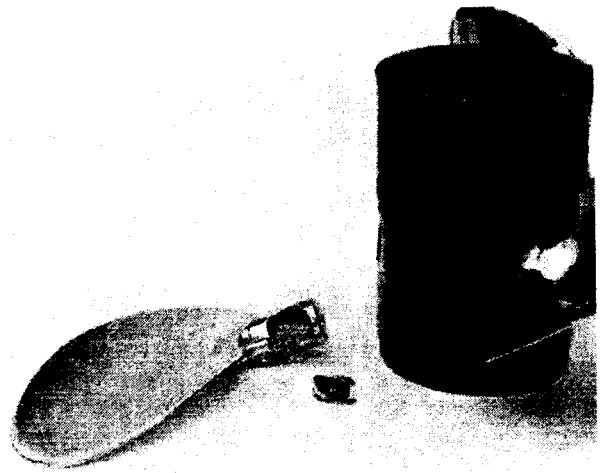


Figure 4: One blade with cam out of hub

CAM & BLADE INSTALLATION

1) Slip the plastic diffuser/synchronizer ring (flared end aft) over the back of the hub. Note: **DO NOT** apply any grease or other lubricants to any of the prop's components! Doing so will only attract dirt and bind up the prop's operation.

2) Drop an appropriate shift cam insert into each cam pocket in the blade's shank.

3) Slide identical style blade and cam assemblies into each of the hub's bearings. Each blade's synchronizing pin must slide into its **ROUND 5/16"** hole in the diffuser/synchronizer ring. **DO NOT CONFUSE THESE HOLES WITH THE OB-LONG PITCH LIMIT SCREW ACCESS HOLES!**

4) Slide each guide pin into the hub, making certain that its small diameter end interlocks with the shift cam in its blade's shank.

WARNING: Test for interlock by pulling out on each blade!

TIP: Always remember that the threaded ends of the guide pins must face aft to allow pulling them back out with a bolt!

5) Initially set the pitch limit screws (see "ADJUSTING THE PROP" section) retracted fully into the spokes so they **DO NOT** limit the maximum pitch!

6) Install the 3/4"-16 black plastic retaining screws to hold each guide pin in place. **LIGHTLY** tighten each screw until it **JUST BOTTOMS THE GUIDE PIN AGAINST ITS BLADE'S SHANK**, then back the screw out **EXACTLY 1/4 turn!**

WARNING: THESE SCREWS ARE A SELF-LOCKING INTERFERENCE FIT. If you do not feel a definite drag (about 5 inch pounds) as you run them in, REPLACE the plastic retaining screws! DO NOT BACK THESE PLASTIC GUIDE PIN RETAINING SCREWS OUT MORE THAN A QUARTER TURN! When properly assembled, the hex faces of the retaining screws and prop hub will be about 1/8 inch above the hub surface! FAILURE TO FOLLOW THIS PROCEDURE COULD RESULT IN SHIFT MECHANISM FAILURE AND/OR BLADE LOSS!

7) Hook each control spring around the groove in its blade's synchronizing pin. Stretch each spring so the other hooked end sets in its groove at the forward face of the prop hub. DO NOT OVER-STRETCH THE SPRINGS!

WARNING: Wear eye protection when removing or installing springs!

TIP: The mechanism will work a bit stiffly just after reassembly (especially if any of the parts are new) but will free up with a few minutes of actual operation! You can not verify correct operation of the prop on a bench since, without centrifugal pull on the blades, they will not move out and ride on the cam profile! Be sure to break the prop in with a few easy runs up to top speed before using full throttle out of the hole!

MAINTENANCE

After the first 25 hours of operation (and then about every 50 hours depending on duty-cycle) the prop should be inspected as follows:

- A) Inspect the shift cam surfaces and the guide pins for wear or denting. Small chips on the thin short "non-working" wall of the cams do not affect operation. Minor "gray" discoloration of the hardened stainless steel guide pin's bearing surface and minor surface rusting on its other surfaces is normal! Any "raised burrs" on a blade's shank near its shift cam pocket must be removed with a flat file.
- B) Visually examine the condition of the blade shank bearings. Replace the bearings if they have worn through the black liner material to the white backing material. Minor "tears" in small sections of these bearings is primarily due to removing and installing blades, and does NOT necessitate bearing replacement!
- C) Likewise, check the condition of the guide pin bearing(s). Replace the bearings if any point has worn through the bronze surface to the steel backing. (Or if their i.d. exceeds .502" at any point.) Note: Guide pin bearings last much longer than the blade shank bearings.
- D) Check the plastic diffuser/synchronizer ring's 5/16" holes for excessive slop on the blades' pins. Replace if the holes are sloppy on the blade's synchronizer pins.
- E) If used, inspect the pitch limit screws and the blades' synchronizer pins for significant wear. Replace as indicated, minor denting can be removed by filing.

TIP: When removing or installing pitch limit screws, always thread them in and out from their WORKING end, so that any banded up ends never pass through the hub's internal threads!

Repair or replace any worn parts and reassemble.

WARNING: Prop shops should contact Land & Sea before customizing or servicing the blade for free instructions.

The Torque-Shift prop's blades are individually field replaceable at relatively low expense. Identical part # Torque-Shift blades are held to interchangeable pitch and balance tolerances, so you do not have to replace all blades if only one or two are damaged!

ADDITIONAL RELATED ACCESSORIES

THIN NYLON LOCKING PROP NUTS (#302-010 for Merc and OMC with 3/4"-16 thread) allow fast, easy prop installation when the stock nut and locking hardware will not fit or is too inconvenient for frequent prop changes. (Always use "Never-Seez" or an equivalent anti-galling compound on stainless steel to stainless steel threads!)

TORQUE-SHIFT PROP WASHER (#310-310) Stainless flat washer that prevents prop nut from digging into prop (required with rubber hub).

UNIVERSAL PITCH GAUGE (#950-900) is a functional, low-cost tool to measure pitch easily and reliably on all props (both left and right hand rotation) that utilize the standard 1" spline. Especially handy for setting Torque-Shift props!

TORQUE-SHIFT DEMO TAPE (#802-001) An exciting 5 minute VHS video tape that demos and explains the incredible Torque-Shift Prop to customers, friends, etc.

TORQUE TAB (#534-001) reduces or eliminates right hand steering torque at high transom settings.

RIGID MOTOR MOUNTS reduce or eliminate "chine walking" problems at high speed.

HYDRO-ELECTRIC TRANSOM JACK (#101-600) The "state of the art" in hydraulically adjustable transoms. Maximizes a boats dual-purpose flexibility.

HYDRO-FLOW II NOSE CONE KITS streamlines the gearcase and provides reliable cooling water and speedometer pick-up at extreme transom heights.

TROUBLE SHOOTING

PROP CONTINUOUSLY FAILS TO UP-SHIFT ENOUGH (too high RPM):

Engine trimmed in too far; trim engine out further and earlier to up-shift more.

Engine mounted too low; raise jack plate more (outboards only) to up-shift more.

Too short a shift cam profile; change to a higher letter shift cam profile (see cam profile shift chart).

Pitch limit screws are turned in (clockwise) too far and are digging into synchronizer ring.

Dirt, thick grease, or damaged part binding mechanism; clean or replace parts to allow free movement.

The 3/4"-16 black plastic retaining screws are set to low. (see Cam and Blade installation)

PROP OFTEN FAILS TO DOWN-SHIFT:

Engine trimmed out too far; trim engine in further to force down-shift.

Engine mounted too high; lower jack plate more (outboards only).

Too long a shift cam profile; change to a lower letter shift cam profile (see cam profile shift chart).

Control springs missing, worn-out, or too light; replace or switch to higher rate spring.

Slowing down too gradually with too much trim-out; make a more abrupt deceleration with more trim-in to force downshift.

The 3/4"-16 black plastic retaining screws are set to low. (see Cam and Blade installation)

Pitch limit screws are turned in (clockwise) too far and are digging into synchronizer ring.

PROP FREEZES IN UP-SHIFTED POSITION:

Prop is newly assembled; tap the blades in towards the center of the hub (with a mallet) to get it back into low pitch.

(Avoid using reverse until prop has shifted properly a couple of times!)

Too long a shift cam profile; change to a lower letter shift cam profile (see cam profile shift chart).

Control springs missing, worn-out, or too light; replace or switch to higher rate spring.

The 3/4"-16 black plastic retaining screws are set to low. (see Cam and Blade installation)

Pitch limit screws are turned in (clockwise) too far and are digging into synchronizer ring.

PROP DOWNSHIFTS TOO VIOLENTLY:

Engine trimmed in too far; trim engine out further when decelerating quickly.

Too short a shift cam profile; change to a higher letter shift cam profile (see cam profile shift chart).

PROP UP-SHIFTS TOO FAR TOO EARLY (too low RPM):

Engine trimmed out too far; trim engine in further to up-shift less.

Engine mounted too high; lower jack plate more (outboards only) to up-shift less.

Too long a shift cam profile; change to a lower letter shift cam profile (see cam profile shift chart).

PROP DOWN-SHIFTS TOO MUCH AT PART THROTTLE:

Engine trimmed in too far; trim engine out further to hold in up-shift state.

Engine mounted to low; raise jack plate more (outboards only) to hold up-shift longer.

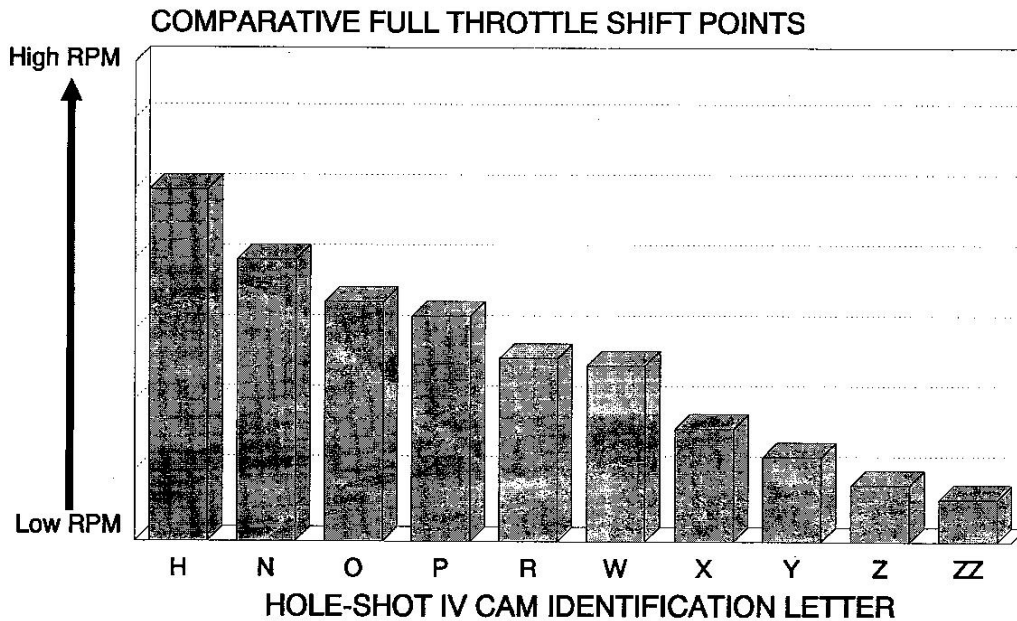
Too heavy control springs; remove or switch to lighter rate spring.

Too short a shift cam profile; change to a higher letter shift cam profile (see cam profile shift chart).

2) REPLACEABLE CAMS: Your salesperson will have recommended a cam profile that he felt best suited you and your boat. Several cams may work on your boat, with cams toward the end of the alphabet providing easier shifting and lower cruising RPMs and cams toward the beginning of the alphabet providing better acceleration but possibly requiring trimming to avoid excessive RPMs. Your preferences or the unique characteristics of your boat may warrant a cam change. You ultimately will use the pitch limit screws to adjust TOP END RPM to match your engine's exact requirements; but for best acceleration, you should select a cam profile that comes as close as possible to automatically holding peak horsepower RPM during full throttle acceleration without over-revving at top speed. Several interchangeable shift cam profiles are available to match the prop's shift characteristics to individual rigs.

TORQUE-SHIFT CAM PROFILE SHIFT CHART

Use to select other cam options after
initial test running with a known cam #.



When all else is equal, the longer the shift cam's profile (letters toward end of alphabet) the higher the pitch that will be reached and the LOWER the prop's operating RPM, and vice-versa. A shift cam profile chart is provided above to help you identify each cam's shift characteristics by the letter stamped on the flat surface of each cam. Gray bars on the chart indicate the relative full throttle shift RPM of the various cams under identical conditions. i.e. if you want your engine to always operate at HIGHER RPM, select a cam with TALLER gray bars! Cams are a slip fit in the blade shanks and are easy to field install (as explained later under "BLADE & CAM REMOVAL")! Do NOT intermix different shift cam profiles.

3) CONTROL SPRINGS: Various tension control springs are available to FINE TUNE the PART THROTTLE shift characteristics. LIGHTER spring tension (or no springs at all) will LOWER RPM at part throttle and vice-versa. A combination of light springs and cams with a long cam profile (letters toward the end of the alphabet), can result in inconsistent downshifting. If you want a stronger downshift, try a higher tension spring. Do not intermix spring tensions.

TIP: Normally start with the 30 lb. (copper color) springs that come standard with the prop.

4) OTHER: Several blade types are available to fit the same Auto-Pitch hub. This allows trying blades with different characteristics without buying a complete prop. Consult the latest Land & Sea catalog for information.

As you can tell by now, there is almost an infinite combination of off-the-shelf blades, shift cam profiles, springs, and settings that can be experimented with. Additionally, like fixed pitch props, the stock Torque-Shift blades can usually be custom modified for a given application to further increase top end! While we can not give an exact recommendation for every rig, we will gladly assist you in sorting out any new application. Please feel free to contact the factory about any problem or to tell us about any combination you have discovered. The shifting prop is the beginning of a new learning curve for novices and experts alike. By sharing information, we will all be able to take maximum advantage of this new technology.