

What moves you

INSTALLATION MANUAL 2016 M4 SERIES SHAFT SYSTEMS





M4 SERIES SEATORQUE SHAFT SYSTEM General Installation

INTRODUCTION

This Manual covers the "M4" series of shaft system. M4 systems are designed to fit vessels where the shaft exits the hull through a shaft Pocket or Alley

The manual is provided as a step by step procedure for the correct method of installation, the assumption is made that the Shaft Pocket is already in place and sized per the supplied engineering drawings for the system ordered and therefore only addresses the actual system installation.

Please refer to page 3 in this manual which outlines the tools that may be required to successfully complete the installation.



M4-Series Shaft System and Shaft Pocket



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Section 1. PRE INSTALLATION GUIDE

Section	<u>Title</u>
1)	Pre Installation Guide.
2)	Approaches to installation.
3)	Strut or "P" bracket – pre-installation and alignment.
4)	Preparation of the system for installation.
5)	Step by step installation instructions.
6)	Installing the Propeller Seal carrier
7)	Setting the casing in strut or "P" Bracket New 2016 M4 Method.
8)	Setting the casing in strut or "P" Bracket Pre 2016 Injection Method.
9)	Installation of Oil Tank and hoses.
10)	Installation of Transmission Adapter
11)	Alignment of Cardan Shaft
12)	Installation of Cardan Shaft
13)	Bolts that carry Torque and Those which require a Thread Locker.
14)	Oiling the System.
15)	Galvanic Bonding of the System.
16)	Painting the System.
17)	Post Installation Notes.
18)	Final Installation OEM Check and Sign Off.
19)	Addendum

Please take the time to read this manual thoroughly before attempting any work on the shaft system. Do not change the recommended order of installation as certain components may only be successfully installed in the manner described.



Section 2. APPROACHES TO INSTALLATION

NOTE: Dirt is the enemy of a reliable machine, practice cleanliness at all times, keep all components stored in clean areas, sealed bags or wrapped in clean protective material prior to and during installation. Keep all components in heat shrink packaging until ready to install. Examine each component for dirt contamination prior to installation, clean before installation as needed.

WHAT YOU WILL NEED TO BEGIN INSTALLATION.

Please make sure you have the following items prior to the installation of your system to ensure a smooth process.

- 1) Seatorque Shaft System Installation Manual.
- 2) Engineering Drawings prepared by Seatorque for the Specific Vessel and shaft system (to verify measurements and placements).
- 3) Seatorque supplied bolting pattern drawing template or optional drilling fixture.
- 4) For aligning the strut to the shaft line, a suitable Length of Schedule 40 Aluminum or PVC pipe, equal to the diameter of the shaft casing of the system being installed. (This should become a permanent installation fixture for future use).
- 5) Torque Wrench see attached fastener application/tool requirement guide for size.
- 6) Allen Wrenches– see attached fastener application/tool requirement guide for size.
- 7) Socket set, Open/Ring or Combination Wrenches/spanners assorted Metric and Imperial Sizes.
- 8) Straight edge & set square to Check Alignment of U-Joints and Strut.
- 9) Loctite^{TMTM} RED # 271 or BLUE #2701 or equivalent for Propeller Seal Carrier Bolts.
- 10) 3M- 5200TM Fast Cure Urethane Marine Adhesive Sealant or equivalent for Isolator Mounting and Shaft Casing Threads. (See Footnote).
- SCS Full Synthetic Gear Oil 75w-90, API-GL5. OR Optional SCS SAE 150 Fully Biodegradable, Eco-friendly Shaft lubricant (Shipped with system).

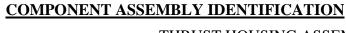
Footnote:

Any suitable/equivalent Poly-Urethane Marine Adhesive can be used for this application as it is only used to seal the main casing threads from water intrusion as well as to seal and set the nuts and washers on the Isolator Mount studs.

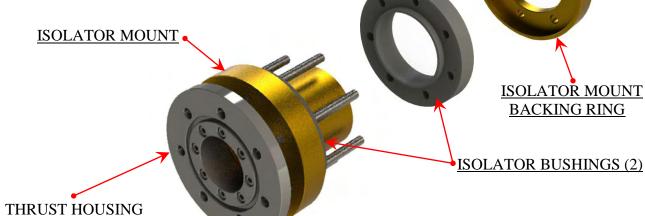
The SEATORQUE shaft system is composed of pre-assembled components. These assemblies are designed to make the installation of the system as simple and straight forward as possible. To preserve the Factory Warranty some components are sealed ready for installation to the vessel. To ensure a successful installation, please take care to install these components in the order outlined in this manual.

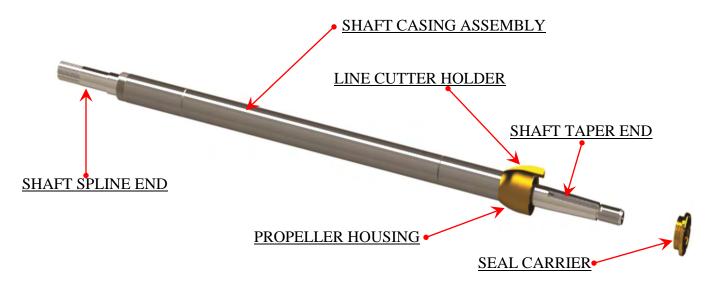


Section 2. Approaches to Installation Continued









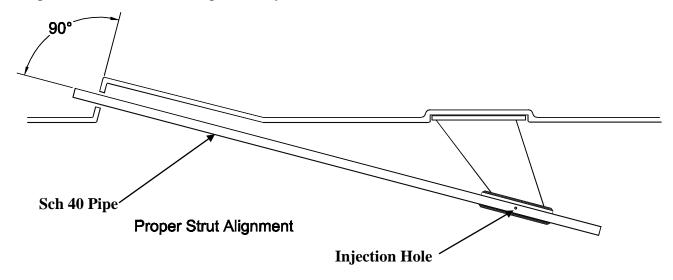
MOUNTING FLANGE



Section 3. STRUT ("P" BRACKET) PRE-INSTALLATION AND ALIGNMENT.

In all cases the strut should be pre-set prior to system installation. This is a large advantage in a production environment but also should be contemplated on a one-off basis as it provides simplicity of installation.

Again it is assumed in this manual that all mounting preparation work has already been undertaken and that the thrust bulkhead and Stern Tube have already been prepared for system installation. It should be noted that traditional methods of identifying shaft Center Line is not necessary for the simple installation of a Seatorque shaft system.



Ensure that $\frac{1}{4}$ inch (6mm) injection holes are drilled both sides of the strut barrel on centerline with the shaft and centered half way along the strut barrel.

The tool used to align the strut is a length of Schedule 40 pipe the same size as the casing of the shaft system being installed and long enough to span through the strut back through the face of the shaft Pocket (Please refer to the specification page where System Casing Dimensions are listed).

Place strut in position on hull, insert one bolt on each side of strut palm to attach strut loosely to hull. Slide the section of pipe through the strut and into the main center hole in shaft pocket. Referring to illustration of "**proper strut alignment**", note that the objective is to make the pipe lie flat along the bottom surfaces of the strut barrel, and checked with a suitable square be perpendicular (90 degrees) to the thrust bulkhead face. Install the 4 set screws (if fitted) in the threaded holes of the strut palm to allow the strut to be fine adjusted and permanently positioned without losing shaft alignment.

Remove pipe from strut, lower strut from hull and apply bedding compound as per normal mounting practice and re-install strut to hull. Insert all bolts up through strut and through hull structure. Snug bolts loosely until 4 set screws contact the mounting surface. Slide alignment pipe back into position and final check alignments, make adjustments necessary to achieve the correct parameters.

Remove alignment pipe and allow strut to set permanently. Clean up bedding around strut palm and once set, remove the 4 set screws. Fair the strut palm to hull. Providing that all conditions in "strut alignment drawing" have been met, the strut is now successfully installed.

Section 4. PREPARATION OF THE SYSTEM FOR INSTALLATION

All Seatorque shaft systems are assembled in a clean environment at the Seatorque factory and shipped "dry" assembled as a unit with both ends shrink wrapped for protection. After removal of the system from the shipping crate, certain pre-assembled components must be removed. These are described step by step below. Remove all hardware boxes, these are individually identified, the contents being outlined on the master packing list included with each shipment. Please verify that all components and hardware is complete as listed, also please note carefully if any components are marked as back-ordered which might affect scheduled installation of the system.

- 1) Remove the protective shrink plastic from thrust bearing end of the shaft system taking care not to damage the cosmetic finish of the housing surface.
- 2) Make sure that the propeller end of the shaft is secure and cannot slide out of the casing assembly. The shaft and casing is assembled in a dirt free environment and it is important that the shaft remains inside the casing during installation. Should it be necessary to remove the shaft for any reason, care must be exercised to keep the components free from contamination, dust or debris before re-assembly.



3) Remove the Bolt in the center of the shaft coupling.

4) Remove the coupling from

the splined shaft end, place in a <u>clean</u> area and cover ready for re-installation.



5) Remove all nuts & washers holding the thrust housing in place on the Isolator Mount Bolting Flange. Slide the thrust housing assembly off the end of the splined shaft. Wrap the housing in a protective cover and place in a clean area until required, the thrust bearings are inside the housing and therefore attention to cleanliness is imperative.



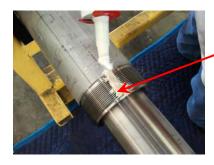
6) Unthread and remove the Isolator Mount completely from the shaft casing (RH Thread CCW to undo). Undo the nuts and washers and slide the remaining Bushing and Backing Ring from the shaft casing.

7)

Section 5. STEP BY STEP INSTALLATION OF SYSTEM

- 8) Protect the exposed Casing threads from damage with masking tape or similar. Slide the casing and shaft assembly through the pre-installed strut/bracket, slide the backing ring and urethane bushing over the casing with the lip on the aft bushing facing forward. Continue to slide the casing forwards until the propeller housing contacts the aft end of the strut/bracket barrel.
- 9) Place a jack at the shaft pocket. Align the casing to the center of the main hole in the shaft pocket.





10) Apply Polyurethane Marine Adhesive to casing threads on the inboard end of the shaft/casing assembly.

Spread the 5200 evenly over the surface of the threads completely through 360 Degrees.



Note: Casing has a machined nose with flat face finish designed to mate with a seat in the isolator Housing providing a positive seal when tightened, an O-ring is also included to ensure a permanent seal. The 5200 is necessary to seal threads against water intrusion and possible crevice corrosion.

The following steps are done from inside the engine room of the vessel.

11) Slide the threaded end of the Isolator Mount with Urethane Bushing through the main center hole in the pocket face. Align the threaded end of the isolator to the threaded end on the casing outside the boat and turning clockwise CW, tighten the isolator home until it stops hard against the end of the thread. Note: It is important that the casing and isolator mount are tightened until the end of the casing is metal to metal with the seat in the isolator Mount.

Note: Do not remove 5200 bead that will appear at the back of the housing, this will ensure a positive seal with the threads against water intrusion and possible corrosion. (RH Thread - TURN CW)

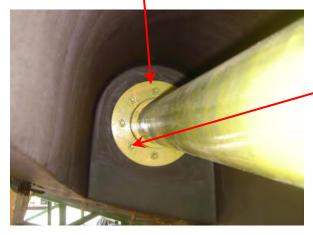


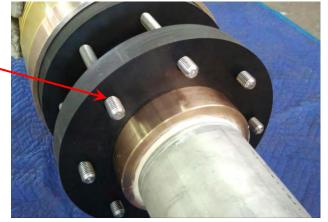
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INSTALLATION MANUAL CONTINUED

Section 5. Step by Step Installation of the System - Continued

- 12) Slide outer urethane bushing over the studs and firmly up against the pocket face. Apply a thick bead of Marine Adhesive sealant around the base of each stud.
- 13) Slide the Bronze Isolator Backing Ring into place over the urethane bushing with the studs protruding.





14) Install Stainless Steel Spring Washers and Hex Nuts supplied with the system onto the studs. Pre-tighten all nuts by hand, final tighten all nuts to the correct torque settings and tightening sequence outlined in the shaft torque sheet in this manual using a correctly calibrated torque wrench.

NOTE: When correctly tightened the walls of the bushing should show a small amount of bulge no more

than 1/16" (1.5mm). NOTE: See tightening sequence diagram at the back of this manual next to

torque settings

Check point; Make sure that the O-ring Seal is in the groove machined on the face of the Thrust Housing Mounting Flange as shown.

Note: The system is shipped with a spare O-ring in the hardware box in case of loss or damage.



15) **Check point**; Make sure the Oil Impeller O-ring seal is installed in the groove provided inside the bore of the bearing housing as shown.

Note: The system is shipped with a spare O-ring in the hardware box in case of loss or damage.



Section 5. Step by Step Installation of the System - Continued



16) Pre-oil spline and shoulder of shaft thoroughly with Shaft Oil; also making sure that the bore of the Thrust housing and O-ring are well lubricated.



17) With the oil ports aligned to the top, slide the Thrust Housing Assembly onto the shaft, the mounting studs will slide through the holes in the Isolator Bolting Flange, push housing firmly up against the flange making sure that main O-ring seal is correctly seated (a very small gap will be visible between the isolator flange and the thrust housing, this is due to the O-ring projection, and will close up once the nuts and washers are installed (see step 18).



18) **Check point**, Make sure that the coupling O-ring is installed in the groove provided inside the

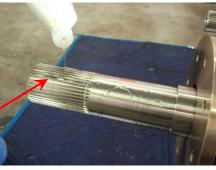


box with the system Incase of loss or damage

Section (5). Step by Step Installation of the System - Continued



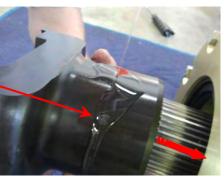
19) Lubricate the internal and external splines of coupling and shaft with Seatorque shaft oil.





20) Lubricate the outside of the Shaft Coupling barrel surface where the oil seal rides, carefully engage the shaft/coupling splines and push Shaft Coupling firmly home against

bearings in Thrust Housing Assembly.





21) Lubricate the threads of the Main Coupling Bolt with shaft oil and install Shaft Bolt and Coupling Washer to end of shaft. Hand tighten bolt until it is snug against the coupling.



22) Important, tighten the bolt to the correct Pre Torque and then Final torque settings using a properly adjusted Torque wrench. Settings are shown at the back of this manual on the Shaft specification page. It is mandatory that the specifications for any of the bolts outlined in this manual are applied exactly as called for, not enough torque will de-rate the shaft specifications, and too much torque, may cause internal damage.



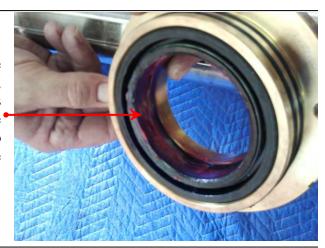
NOTE: DO NOT USE LOCTITETM WHEN INSTALLING THE SHAFT COUPLING BOLT.

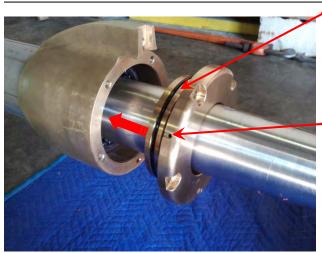
Final tighten Casing with a pipe wrench or Stillson Wrench to approximately 300 Ft/Lbs (before proceeding to section 6).



Section 6. INSTALLING PROPELLER SEAL CARRIER

- a) Remove the seal Carrier from its protective shrink wrap.
- b) Make sure both seals are properly aligned in the carrier; the seals are shipped already greased, however visually check that the grease is as illustrated in fig.2, if not, apply general purpose Synthetic Grease to the space between the two seals ensuring that the grease is level with the lips of the two seals.





- Apply a film of grease to the O-rings on the outside nose of the carrier.
- d) Install the Seal Carrier over the shaft taper and aligning the bolt holes push the carrier firmly home into the Propeller Housing.
- •NOTE: Make sure that the water injection port is positioned to the **Left** or **Right** side of the housing. The water injection port **must not** be positioned vertically.

The port may become plugged with silt or mud in shallow water if facing down and facing the top it will be covered by the line cutter holder.

e) Install the Stainless Steel Allen head bolts with Red Loctite[™] 271 (or Blue 2701) and tighten firmly.



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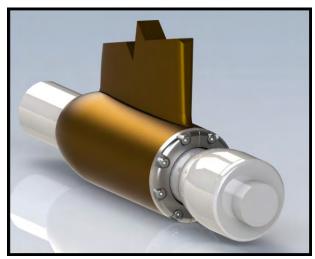


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INSTALLATION MANUAL CONTINUED

Section 7. SETTING THE CASING TO STRUT – 2016 M4 MECHANICAL STRUT GLAND



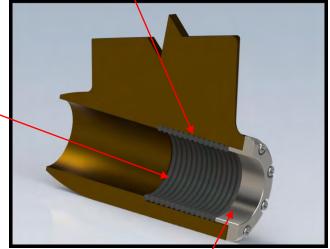
From 2016 Onwards all strut barrels are of the M4 Mechanical strut mounting type. The strut barrel is machined to accept multiple 3/8" diameter EPDM Rubber O-Rings supplied as individual pieces at the correct length to fit the OD/ID of the Casing and Strut Barrel. These rings are stacked together to form a sleeve that is then compressed by a bolted cap which expands the O-Ring packing gripping the shaft casing and supporting it within the strut assembly.

This method has been developed by SCS to provide a more efficient and simpler installation of the shaft system as well as allow more service options in the field.

Supplied with the Shaft system will be the required number of O-Ring strips (Generally between 10 and 14 pieces depending on system size) plus one or two extra

The strut cap is supplied in two halves to allow easy installation/dismantling together with the correct number of Stainless Steel Allen Head Bolts.

- a.) Once the shaft system is installed, take one piece of the O-Ring, grease it with general purpose water proof grease. Wrap it around the shaft casing at the rear end of the strut barrel and with the two ends aligned push the ring as far as possible into the cavity in the barrel (usually far enough to fit the next piece in place).
- b.) The next piece of O-Ring should be installed with the ends 180 Degrees opposed to the first piece.
- c.) Repeat the process until all pieces are installed.



Note: The bolting cap can be used as a tool to push the O-Rings into the cavity.

Once all the pieces are installed the cap should have a gap approximately one diameter (3/8") clearance to the bolting face of the Strut Barrel to provide sufficient compression to expand the Rings.

Install both halves of the Bolting Cap aligned to the bolt holes with the joint between the two halves oriented vertically. Install all the Allen Head bolts and tighten the cap home until it contacts with the face of the strut barrel. One at a time remove each Bolt and re-install it using High strength LoctiteTM or equivalent.

Final tighten all bolts to 120 inch/Lbs. (13.6 Nm).

SEAT PROUE

Section 8. OPTIONAL METHOD

SETTING THE CASING TO STRUT USING PRE 2016 3M-5200 INJECTED METHOD

If the strut barrel is provided with threaded jacking points and set screws, jack up casing until it is centered in the barrel. Radial clearance should be approximately 1/8 to a 1/4 of an inch and equal all around the barrel front and rear. If no jacking points are provided then support the system with blocking so that it is held centered.

Insert a length of 1/8" or 1/4" Rubber O-ring stock into the clearance between casing and strut barrel. Starting at the top of the barrel and by stretching the O-Ring material to reduce its diameter push into gap all around the casing until it meets the other end. Cut the O-Ring material leaving a small space between the ends as a breather hole. Repeat this at the other end of the Strut barrel.

Through the two ¼ inch holes drilled either side of the barrel at the mid point, inject strut with 3M-5200 FAST CURE. Start injecting on one side until 5200 appears at either end or injection hole on opposite side. As this occurs, plug off areas where bedding can escape and inject from opposite side injection point. Keep injecting until satisfied that all air in the barrel has been displaced.

It is important to leave strut to post cure or until Adhesive (5200) has set before removing jacking screws or spacers (usually 24 hours to set and 48 Hours for full cure). For safety allow at least 24 hours for full cure before removing jacking screws. NOTE: Jacking screws must not be left in place permanently as they will cause wear and ultimate damage to the casing during routine operation of the vessel as well as create excess noise and vibration.

If Rubber O-ring stock has been used this should be left in place as it provides good protection as well as a clean finish for the ends of the strut barrel. To final finish, remove any tape, plugs and/or spacers, and with a sharp knife slice off any protruding 5200 flush with each end of the strut barrel. Remove jacking bolts and inject jacking locations with 3M-5200TM or install stainless steel pipe plugs to final seal holes.

NOTE:

3M-5200 is a Polyurethane based Elastomer. It is cured by oxygen and water vapor, i.e. the humidity or moisture in the air is all that is required for it to achieve full cure. Once the container has been opened the process has started, it will continue to cure even when no longer in contact with the atmosphere. To Guarantee

Very Important:

Do not use any Alcohol based products to pre clean the area where 5200 is to be injected, alcohol fumes may neutralize the curing process, please read and follow the 3M instructions provided in the Addendum section for its use and compatibility.

Alcohol derivatives can be found in solvents as Methyl, Ethyl, Propyl, Isopropyl, Hydroxide, Propane and Methanol. The only safe solvent that can be used is pure Acetone without any additives. Most paint thinners and surface cleaners, including mineral spirits can contain many of the above ingredients and therefore should not be used. To help ensure correct cure, spray or mist the inside of the strut barrel with clean water prior to injection.



Section 9. INSTALLATION OF OIL RESERVOIR TANKS

Oil Tank and hose Installation:

The oil tank is supplied complete with the correct length and diameter of hoses and fittings. Location of the tank should be as close to the thrust housing as possible with the bottom of the tank <u>above</u> the connection ports on the thrust housing. Wherever possible the bottom of the tank should be approximately 12 inches (300mm) to 36 Inches (900mm) above DWL (displacement waterline), this provides good positive pressure to the shaft system and oil seals. Hoses may be connected to either port in the bottom of the tank (direction of flow reverses with change in shaft rotation).

It is important that the correct oil flow is maintained to the oil tank as the volume and surface area of the tank forms a part of the shaft oil cooling capacity during operation.

The tank system flow is designed with two 4 foot hose runs (supplied as one 8 foot long piece) 4 foot is the **maximum** recommended length for the hose diameter and flow characteristics. Location of the tank should be kept within this hose length.

For installations where this is not possible please contact Seatorque factory for application assistance and plumbing alternatives.

NOTE:

Liquid sealant such as Hydraulic LoctiteTM should be used on all NPT pipe threads on the oil tank.

<u>Do Not</u> use sealant of any type on JIC flare fittings on the Thrust Housing ports.

Do Not over tighten JIC flare fittings or they may leak.

<u>Do Not</u> use Teflon or PTFE pipe tape on any connections as pieces of tape can get trapped under shaft seals causing leakage and/or their premature failure.

DO NOT SUBSTITUTE THE SUPPLIED HOSE WITH ANOTHER TYPE. The supplied hose is Parker "Pushlok" type 801 hose and is compatible with Seatorque Full synthetic Shaft Oil or optional Seatorque Fully Biodegradable Oil.

<u>Do Not use Hose Clamps</u> or any other type of clamps or clips on the supplied barbed fittings, "Pushlok" hose fittings are designed to be leak free and withstand pressures of 250 PSI without the use of hose clamps. **Use of clamps will cause leaks and ultimate failure of the hose system.**

Maximum Bend Radius is 15 times the hose diameter. Be careful not to install the hoses with less Bend radius than recommended or restrictions within the hose system will result in inadequate oil flow.

NOTE: Oil coolers are NOT NORMALLY REQUIRED on M4 series shaft systems.

Section 10. <u>INSTALLATION OF TRANSMISSION ADAPTER</u>

The transmission adapter is bolted to the output flange of the marine gear and adapts the gear output flange to mate with the Cardan Shaft Universal Joint assembly. The Adapter is made to order to suit the make and model of transmission fitted to the vessels main propulsion engines. Please verify that the adapter is a match to the transmission output coupling.



Remove the Nyloc self locking nuts and flat washers from the studs of the adapter. Align the mounting studs to the bolt pattern on the gear output flange, push home far enough to



install the flat washers and Nyloc Nuts on the back side of the flange. Once nuts are in place push firmly home. The adapter is a precision machined component designed to mate with high accuracy to the pilot or mating ring on the Gear output flange. Due to tolerance range sometimes this will mate together very easily and in other cases it will require tightening the nuts at the rear of the flange to pull the adapter into place. Once this is achieved the faces of the adapter and flange will be hard up against each other with no measurable gap between them.

Tighten the nuts to correct settings (See Bolting Torque Sheet at the back of this Manual for correct torque values).



Note: Do not use Loctite TM on the nuts and studs.

Self locking Nylon type nuts as supplied require flat washers; spring type washers should not be used.

SEAT PROUE INSTALLATION MANUAL CONTINUED

Section 11. ALIGNMENT OF THE CARDAN SHAFT (UNIVERSAL JOINT)

Alignment of the Seatorque shaft system will take approximately 20 minutes or less to complete if the following parameters are met. The terminology "Co-Planar" must be understood to mean that coupling faces are completely parallel to each other, i.e. Parallel lines in three-dimensional space are Co-planar, but skew lines are not.

Deflection is the angular degree at each end of the Driveline which allows for an offset dimension relative to shaft centerline and transmission shaft centerline. (See drawing of deflection below).

The following conditions must be met for a successful alignment:

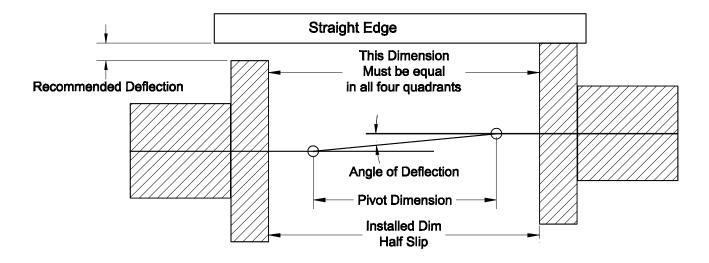
- a) (Cardan Shaft): A double universal joint drive shaft is installed between the engine and propeller shaft in a "Z" configuration; (a "W" configuration cannot be used when the engines are mounted on flexible rubber isolators).
- b) ("Z" configuration): Both companion flange and output coupling must be co-planar, (i.e. both faces are parallel to each other).
- c) **Deflection** must be present, this allows both universal joints to cycle and lubricate themselves. The recommended deflection figure is outlined on the enclosed chart. This is not the maximum permissible deflection, but a mean static setting, which will allow for full movement of the main engines during operation of the vessel in poor sea conditions.
- d) (Yoke Timing): Deflection angles must be the same, one end positive and the other end negative to allow the yoke oscillations to cancel themselves end to end.
- e) (A slip joint): of minimum 2 inch (50mm) must be included in the driveline to take up fore and aft as well as vertical movement of the main propulsion engines without bottoming out.
- f) (Slip condition): A Universal drive shaft assembly must be installed in a free slip condition. (Any point between a ½" from fully collapsed length and no more than the fully extended length). A rigid or fully collapsed connection will allow the engines to "lean" against the shaft resulting in possible damage to the thrust bearing assembly, the Universal Joint Bearings as well as vibration and noise transmission within the vessel. Any condition where the slip is exceeded or is over extended will reduce the torque capacity of the drive shaft slip splines causing premature failure.
- g) (**Torque Rating**): A correctly rated series of universal drive shaft and correct coupling adaptors must be installed.



Section 11. Alignment Of The Cardan Shaft - continued

Alignment Procedure:

- 1. Measure the distance between the output adaptor (on the transmission flange) and the shaft coupling face. With both couplings in the vertical position, measure at the outside diameter of the key slot to the same position on the opposite coupling, top and bottom. Turn the couplings to the horizontal position (90 Deg) and measure the same key slot dimension, face to face, left and right. If the flange faces are Co-planar, all dimensions will be equal.
- 2. If the top vertical dimension is greater than the bottom vertical dimension then the front of the engine must be raised (or rear lowered), and vice-versa if the opposite condition is met. Similarly the horizontal side to side dimensions will show if the nose or tail of the engine will need to be moved Port or Starboard to ensure that coupling faces are Co-planar.
- 3. Once satisfied that the arrangement is Co-planar, place a straightedge across both the transmission adapter and the shaft coupling down the fore and aft centerline of the shaft. Push down on the end that is on the higher of the two flanges to raise the other end up, parallel to the shaft centerline. Measure the gap from the straight edge down to the adapter or companion flange (see drawing of deflection). Do this exercise in the vertical as well as the horizontal positions. (The deflection can be in any direction rotated around 360 degrees of the driveline assembly).
- 4. Check the measured gap dimension against the deflection chart to ascertain the actual deflection of the assembly.
- 5. Equally adjust all four mounts at the front and rear of the engine to raise or lower to achieve the correct deflection specified for your series of wing bearing assembly.



Drawing of Deflection

Section 11. Continued:

To find the Angular Deflection by use of trigonometry, the following procedure can be used. Using step 3 on page 17; measure the gap between the straightedge and coupling. Measure the installed pivot dimension of the Cardan Shaft (universal joint assembly) and apply the following formula using Arc Tangent or Inverse Tangent:

Where D = Measured Deflection Pd = Pivot Dimension

Angle = ATAN(D/Pd) or on a scientific Calculator Tan-1(D/Pd)

Similarly, the correct deflection can be calculated using the known tangents for 1.5° and 3° as follows:

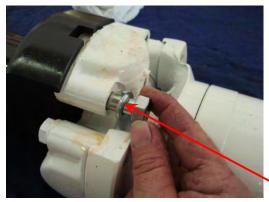
0.026186 times Pd for 1.5° 0.052407 times Pd for 3.0°

Either Metric or Imperial units can be input to return the angle or deflection in all approaches

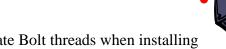
Section (12). INSTALLATION OF THE CARDAN SHAFT (UNIVERSAL JOINT).

Once alignment has been verified as correct and all coupling and adapter bolts are set to their correct torque values, the Universal Joint Driveline or Cardan Shaft can be installed.

This is managed more easily by installing one end of the Cardan assembly to the Shaft Coupling first.

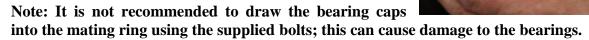


Lift the assembly by the Yoke, and with Shaft coupling and Cardan end oriented vertically, install the bottom bearing cap key into the keyway machined in the coupling face. Swivel the top bearing cap into contact with the coupling and secure the bottom bearing cap with two bolts (finger tight).



Note: Lubricate Bolt threads when installing

In most cases it will be necessary to firmly strike the top bearing cap with a soft mallet to jump it into the mating ring of the coupling. (Before installation the bearing caps are larger in diameter than the mating ring and require compression to fit).



Install remaining two bolts and snug bearing caps up into position on coupling face. Lift the other end and repeat the procedure.

The assembly splines need to be extended for the bearing caps to mate with the transmission adapter correctly. With the short or close coupled joints the relief valve on the end of the yoke should be released to allow the internal vacuum to be relieved, a special tool is supplied with these joints to accomplish this. The long series joint do not require this step.

once installed the amount of slip can be measured at the expansion joint on the yoke, this measurement should be a



minimum ½" inside of the total slip available for the installation to be correct. Should conditions exceed this specification please contact Seatorque Factory for help and assistance.

Once all bolts are hand tightened into place, they must be set to the correct torque setting from the chart in the rear of this manual.



Section (12). Installation of the Cardan shaft – Continued

MECHANICS™ (WING BEARING) - CARDAN SHAFT DIMENSIONS

Wing Bearing	(Tcs) Short Duration	Maximum Torque Ft/lbs	Swing Diameter inch	Min. Length Collapsed inch	Slip	Min Installed Length inch
Series	Torque Ft/lbs (Nm)	(Nm)	[mm]	[mm]	Length inch [mm]	[mm]
2C	553 (750)	1098 (1490)	3.34 [85mm]	6.00 [152mm]	0.984 [25mm]	6.492 [165mm]
5C-Short	1950 (2650)	4167 (5650) 4167 (5650)	4.84 [123mm]	6.10 [155mm]	0.79 [20mm]	6.495 [165mm]
5C-Long	1950 (2650)		4.84 [123mm]	21.50 [546mm]	4.00 [102mm]	22.50 [571.5mm]
7C-Short	4200 (5398)	7892 (10700)	6.22 [158mm]	11.00 [279.4mm]	2.00 [50.8mm]	12.00 [305mm]
7C-Long	4200 (5398)	7892 (10700)	6.22 [158mm]	20.38 [499mm]	5.12 [130mm]	21.38 [543mm]
8.5C-Short	10320 (14000)	14973 (20300)	6.89 [175mm]	11.340 [288mm]	2.09 [53mm]	12.34 [313mm]
8.5C-Long	10320 (14000)	14973 (20300)	6.89 [175mm]	21.5 [546mm]	5.12 [76mm]	22.5 [521mm]
10C-Short	19160 (26000)	29281 (39700) 29281 (39700)	8.858 [225mm]	15.551 [395mm]	1.378 [35mm]	16.24 [412mm]
10C-Long	19160 (26000)		8.858 [225mm]	34.00 [864mm]	4.00 [102mm]	36.00 [914mm]
12.5C	41772 (56635)	61070 (82800)	11.023 [280mm]	19.527 [496mm]	3.70 [94mm]	21.377 [543mm]

		Pivot Dimension inch	Min** Recommended Deflection inch	Max** Recommended Deflection inch	Bolt Size	Bolting Torque
Series	Part #	[mm]	[mm] @ 1.5 Deg	[mm] @ 3.0 Deg	(Grade)	FT/Lbs (Nm)
2C	SCS-2C-L140-25CC	5.957	0.156 [4mm]	0.312 [8mm]	5/16-24 UNF (G8)	20 (27)
5C-Short	SCS-5C-L155-20CC	5.157 [131mm]	0.135 [3.5mm]	0.270 [7mm]	3/8-24 UNF (G8)	25 (34)
5C-Long	SCS-5C-L155-101EL		0.560 [14.7mm]	1.11 [28mm]	3/8-24 UNF (G8)	25 (34)
7C-Short 7C-Long 8.5C-Short 8.5C-Long	SCS-7C-279-50S SCS-7C-517-130L SCS-8.5C-288-53S SCS-8.5C-546-130L	8.978 [228mm] 20.00 [508mm] 9.417 [239mm] 22.50 [572mm]	0.272 [6.9mm] 0.517 [13.14mm] 0.247 [6.27mm] 0.589 [15mm]	0.544 [13.8mm] 1.036 [26.3mm] 0.494 [12.5mm] 1.179 [30mm]	1/2-20 UNF (G8) 1/2-20 UNF (G8) 1/2-20 UNF (G8) 1/2-20 UNF (G8)	70 (95) 70 (95) 75 (102) 75 (102)
10C-Short 10C-Long 15C	SCS-10C-L395-35CC Length To Order TBA	13.681 [347.5mm] -	0.358 [9.1mm] -	0.717 [18.2mm] -	5/8-18 UNF (G8) 5/8-18 UNF (G8)	100 (136) 100 (136)

^{** =} Recommended Specifications at min installed length - Seatorque Control Systems LLC



13). Bolts and threads, that require Loctite™ and Bolts and nuts which carry torque settings.

The majority of fasteners are installed at the factory and form a large part of the non serviceable assemblies which therefore require no further attention in the field.

The general "rule of thumb" is, if there is a torque specification for a bolt or fastener, LoctiteTM should not be used.

All Torque settings are based on a lubricated thread condition (Unless otherwise stated).

The only bolts that require LoctiteTM are the Seal Carrier bolts; these should be tightened hand tight and locked with LoctiteTM Red 271 High Strength (or Blue 2701). If these are not available then High Strength Permanent thread locking fluid should be used.

Polyurethane Marine Adhesive (not LoctiteTM), must be applied to threads that require sealant; primarily this refers to the shaft/Casing threaded end to M4 Isolator mount and Isolator Mount studs, nuts and spring washers.

(See page 7, Steps 9 & 10).

14). Oiling the System.

SEATORQUE SHAFT OILTM

This specially formulated Full-synthetic, extreme pressure oil has been developed specifically for Seatorque Control SystemsTM; it contains many specialized additives for marine use and is critical to the maintenance cycle of 3000 hours or 3 years, do not use or accept alternatives (For further information, please refer to the technical service sheet at the back of the owners handbook in the service information section).

Due to the viscosity of the shaft oil it will take an appreciable amount of time for the air to purge from the system. Fill reservoir tank to full mark, oil level will drop quickly initially. As tank approaches the low level, fill to full mark once again. Over the next 24 hours monitor tank level and replenish oil as necessary. Once the boat is launched and the boat is under power, if not already achieved, air will purge very quickly. It is important that at least 3 quarts or liters of oil are in the system and that the oil tank is full before the boat is launched. Once purged, top the oil tank up to the Max mark on the sight gauge.

15). Galvanic Bonding of the System.

The system is substantially protected from corrosion and electrolysis, the materials used in submerged areas are balanced together closely on the metals nobility scale and in some cases, as with the shaft casings, can be coated against direct contact with water, and therefore should not require any additional protection from anodic systems installed within the vessel.

It is not recommended that shaft zincs or any other form of anode should be attached to or around the system.

The isolator and thrust housing are provided with clearly marked bonding points at one of the thrust housing mounting studs. This should be connected with 10 Gauge wire to the standard vessel bonding system.





There are many schools of thought as to the best way to bond equipment; SCS carries no view as to which method may be correct. However, Electrolysis and Galvanic corrosion are two very different and unrelated phenomena.

Electrolysis is the result of leakage of electrical current, sometimes called "stray current", from faulty on-board equipment, electrical system faults or dockside power supplies with poor ground isolation.

Galvanic corrosion is the result of dissimilar metals connected by an electrolyte such as salt water. The SCS system is stable on the metal nobility scale and all components are internally and externally electrically connected. By connecting the SCS system to the vessels main bonding system, practically all instances of galvanic action will be eliminated.

Propellers also commonly show signs of erosion, quite a few of these instances are incorrectly blamed on either Electrolysis or poor bonding. It is very common for propellers to exhibit erosion around the blade roots and tip which are in fact caused by propeller cavitation. This is more a function of propeller design and/or use.









Bulletin SCS-CP0211 Suggested Cathodic Protection

This Bulletin to be used in conjunction with SCS suggested wiring diagram CP-0211-09.

This suggested system is based on Passive Cathodic protection and as such should not be connected to DC negative on the vessels wiring system.

Please note that this suggested approach is based on the Nobility scale found from the recognized Galvanic series of metals with reference levels set from a Silver-Silver Chloride electrode.

<u>Material</u>	Potential Voltage <u>Millivolts [Mv]</u>
Stainless Steel 304/304L/316	0.00 - 10 (passive)
Manganese Bronze	270 - 340
Nickle Aluminum Bronze (NyBrAI). [Propellers]	280 – 360

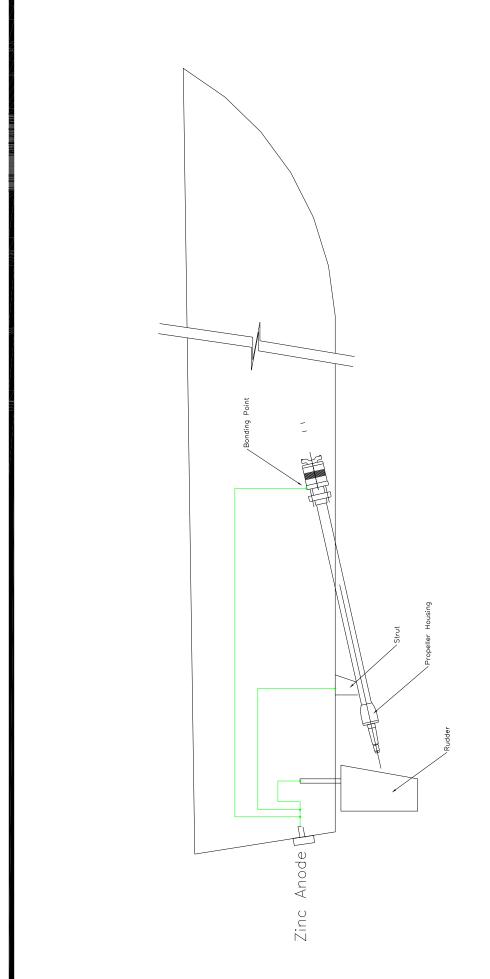
Measure the voltage in Millivolts between the Anode installed in the hull and the metals to be protected (Cathode) with the boat floating in Salt Water.

Using the highest potential from the chart above add 200 to 250 Millivolts to the reading obtained.

Adjust the size of the Zinc Anode until the reading equals the above result. This will depend on the location and area (size) of the metal to be protected.

Do Not Exceed 1000 Mv, there could be risk of damage to the Anti-Fouling paint used on the hull of the boat.

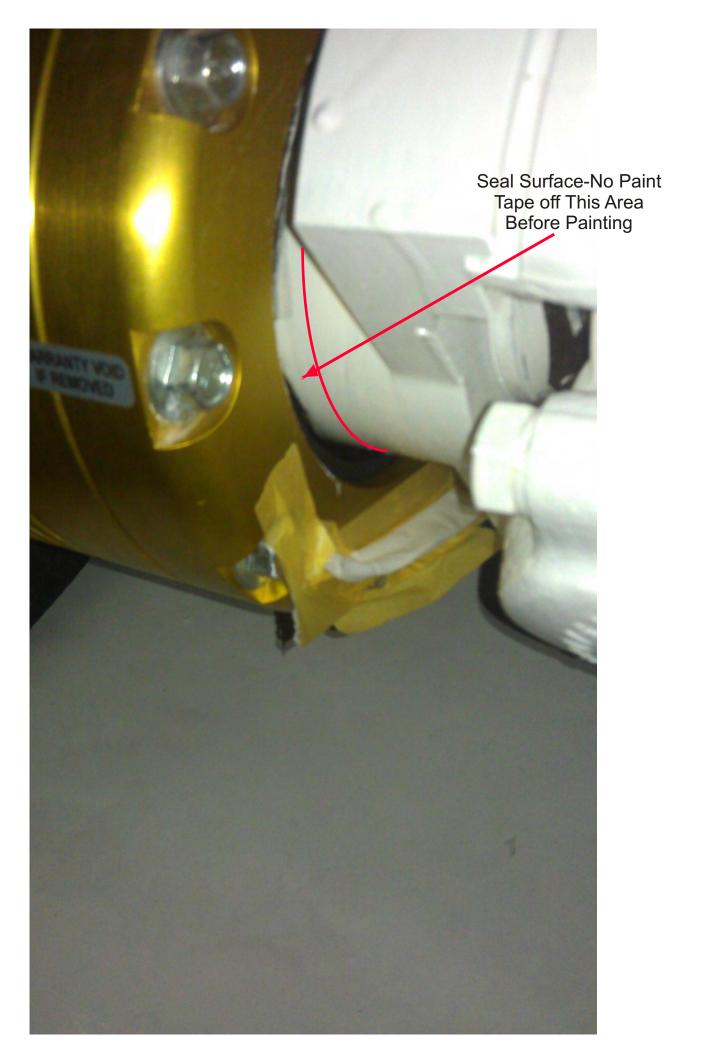
Derived from the Yacht and Boat Council of America (ABYC) guidelines.



SUGGESTED METHOD OF CATHODIC (PASSIVE) PROTECTION Please refer to Cathodic Protection Bulletin SCS-CP0211

	SEAT	ORQUE CO	SEATORQUE CONTROL SYSTEMS LLC 2779 SE Monroe Street
		Stuar 72-220-30	i, FL 34997 20 Fax: 772-220-3012
DRAWING No: DESC CP-0211-09	DESCRIPTION: -09		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN: INCHES [] ARE IN MILLIMETERS
PROJECT:		DEPARTMENT:	ENT:
DRAWN BY:	DATE:	APPD:	DATE:
SCALE:		REVISION:	

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SEAT ORQUE

16). Painting of system.

It is important that the entire Seatorque system is protected from possible corrosion by direct contact with salt water. It is imperative that the external shaft system is painted with two part under water primer and at least two coats of high quality Anti-fouling paint.

Failure to paint and protect the shaft system will result in premature corrosion and possible failure.

For inboard components, it is particularly important that coupling seal areas are properly masked before applying any paint for cosmetic or protective purposes. Paint in the seals will cause premature failure of the oil seals voiding warranty coverage. The steel couplings are supplied pre-treated with protective coatings which are designed to inhibit rust. Proper maintenance will further stop the couplings from corroding, spray the inboard components of the system with WD40 or a similar water dispersal agent for continued protection.

17). Post-Installation Notes

After installation is completed and the system has been filled with oil, the system requires a "break-in" period to bed the seals. During this time some residual oil may appear to weep from the system. This is normal; please allow at least 10 hours of operation for the break in process to complete.

After the system is installed, or after any service work, and to keep bilges clean, wash the housings front and back with denatured alcohol to wash off any residual oil.

(Remember to keep caustic cleaning chemicals away from housings).

If any weeping or oil drips appear excessive or do not diminish after the initial break—in period:

- 1) Monitor the oil level site gauge on the SCS oil reservoir tank for fluid level change as well as a time frame and measurement of the level change.
- 2) Place an oil absorber product at the location of any accumulated oil to help assess the severity of the drip.
- 3) Contact your local Service Center or the SCS Factory Customer Service Department and give a clear and comprehensive report detailing the problem.

Please remember that the more detail and information provided at this stage will assist SCS service technicians in diagnosing the problem which will result in a faster determination of the service support required. Wherever possible to help clarify the diagnosis please provide a photograph of the problem.

Please also note that an oil weep or drip does not denote that the system is in any danger of failure, system problems will not occur as long as the oil level is visible in the oil reservoir sight tube.

Normal operating temperatures should stabilize at 180°F (82° C), be careful not to touch the thrust housings after the vessel is stationary or when working around the thrust housings, severe burns could be sustained.



18). FINAL INSTALLATION OEM CHECK AND SIGN-OFF SHEET.

During/After Installation of your Seatorque Shaft System, please verify the following "Checkpoints" have been completed and are in compliance with the SCS installation procedures outlined in this manual.

Please note: This Check Sheet is to aid the builder and its management team in establishing that all components are installed correctly. It may be impossible during any third party inspection to verify many of the items listed without dismantling the system once installed, and therefore could impact the validity of the SCS warranty pre or post-delivery of the vessel.

Dated Checked	Initials of Installer **
	Verify shafts marked "Port & Starboard" are installed Port & Starboard
	Verify Thrust Housings are positioned with the Oil Ports facing UP
	Verify All O-rings have been installed correctly:
	1) Thrust Housing to Isolator Bolting Flange
	2) Oil Impeller
	3) Coupling
	Verify Isolators are sealed to shaft casing Thread with 3M-5200 TM or equivalent
	Verify coupling bolt is set to correct torque rating per installation manual
	Verify No Loctite TM was used on coupling bolt
	Verify U-joint bolts are set to correct torque rating per installation manual
	Verify No Loctite TM was used on U-joint Bolts
	Verify the U-joints are installed within the correct free slip dimension
	Verify Co-planar alignment of transmission and shaft couplings
	Verify U-joint driveline deflection is within specified parameters
	Verify struts have been aligned & injected as per installation manual
	Verify Oil Reservoir Tanks are installed per the manual and are within 4 feet hose run from the Thrust Housings (unless otherwise approved).
	Verify the correct SCS supplied Oil Reservoir Hose type and fittings have Been installed - No Substitutions NO hose clamps or clips are used on supplied push-lock fittings



17). Final installation OEM check and sign-off – continued.

Date Checked	Initials of Installer **
	Verify the seals in the seal carriers have been properly and adequately Greased.
	Verify the seal carrier bolts have been correctly installed with Loctite TM
	Verify the system has been completely filled and purged with SCS Shaft Oil
	Verify propeller Nuts are correctly installed with locking tabs and bolts
	Verify underwater gear has been painted per the manual
	Verify the Shaft pocket face is clean, smooth, uniform in thickness and Perpendicular to the shaft
	Verify the Nuts and Lock Washers on the Isolator mounting studs are Installed with Marine Adhesive Sealant as per the manual
Warranty. This m	his Post-Installation checklist is important to the validity of the SCS Limited out to be completed by the Builder/ yard managers/Engineers and is not at any time to esponsibility of SCS Sales/Service personnel.
Installation Yard/I	Manufacturer Name:
Authorized Signat	ure:
Date:	

SEAT PRQUE INSTALLATION MANUAL CONTINUED

18). ADDENDUM

System Specifications, Information Charts and Additional Bulletins.

SEATORQUE SHAFT SYSTEMS FASTENER APPLICATION AND TOOL REQUIREMENT GUIDE

COUPLING BOLT	Tool Required: Torque Wre	ench**			
SEE SPECIFIC TORQUE SETTINGS IN THE INSTALLATION MANUAL TORQUE CHART.					
Shaft Size	Bolt Specification	Socket Size			
ST/M3-100	3/8"-24	9/16			
ST4/M4-175/200/250	5/8"-18	15/16			
ST4/M4-275/300	3/4"-16	1-1/8			
ST4/M4-350	1"-14	1-1/2			
ST4/M4 400	1 1/4"-12	1-7/8			

^{**}NOTE: Torque Wrench Should be regularly Calibrated for Accuracy

U-JOINT BOLTS	Tool Required: Torque Wr	ench**		
SEE SPECIFIC TORQUE SETTINGS IN THE INSTALLATION MANUAL TORQUE CHART.				
U-Joint Size	Bolt Specification	Socket Size		
2c	5/16-24	1/2		
5c	3/8-24	9/16		
7c/8.5c	1/2-20	3/4		
10c	5/8-18	15/16		

^{**}NOTE: Torque Wrench Should be regularly Calibrated for Accuracy

SEAL CARRIER BOLTS ** SEE BELOW	Tool Required : Allen Key	
Shaft Size	Bolt Specification	<u>Key Size</u>
ST/M3-100	M5	4mm
ST4/M4-175/200/250	M6	5mm
ST4/M4-275/300/350	M8	6mm
**VERY IMPORTANT - USE RED LOCTIT	TE™ 271 or BLUE 2701 ON AL	<u>.L</u>
PROPELLER SEAL CARRIER BOLTS		
HAND TIGHTEN FIRMLY		

THRUST HOUSING STUD NUTS (M4 S	TYLE ONLY) Tool Requir	<u>red: Torque Wrench</u>
SEE SPECIFIC TORQUE SETTINGS IN	THE INSTALLATION MANUAL	L TORQUE CHART.
Shaft Size	Nut Specification	Socket Size
ST/M3-100	M8	13mm
ST4/M4-175	M10	17mm
ST4/M4-200/250/275/300/350	M12	19mm

^{**}NOTE: Torque Wrench Should be regularly Calibrated for Accuracy

TRANSMISSION ADAPTERS Tool Required: Wrench

MADE TO ORDER AND SUPPLIED WITH STUDS OR BOLTS, LOCK NUTS AND FLAT WASHERS
TO BE WRENCH TIGHTENED AS TIGHT AS POSSIBLE



Document Library TS Data Sheet 06520, 05220

Rev: 2 Status: Active

Effective: 04/1/2006 Supersedes: 07/06/2000

3M™ Marine Adhesive/Sealant Fast Cure 5200

3M Part No.(s)

06520 05220 3M Part Descriptor(s)

10 cartridge (295 ml) – White 3 fl. oz. tube (90 ml) - White

Description

A fast curing, one-part polyurethane that chemically reacts with moisture to deliver strong, flexible bonds with excellent adhesion to wood and fiberglass. Forms watertight, weather-resistant seals on joints and boat hardware above and below the waterline. In addition, its flexibility allows for dissipation of stress caused by shock, vibration, swelling or shrinking.

Features

- Tough/flexible polyurethane polymer
- Non-shrinking
- One-part moisture cure
- Non-sagging formula
- Fast cure formula

Typical Physical Properties

Container 10 fl. oz. (295 ml) cartridge

3 fl. oz.(90 ml) tube Polyurethane

Base Polyurethane Density lbs/Gallon (Appx.) 11.0 lbs/gallon

Color White Solids Content (Appx.) 97%

Consistency Medium paste

Service Temperature - °F -40°F (-40°C) to 190°F (88°C)

Shore A Hardness (cured) 60 Specific Gravity 1.21

Coverage (10 oz.) 1/8 inch (0.3175 cm) bead = 120 lineal feet (36.6 m)

Performance Properties

A 1/8 inch (0.3175 cm) dumbbell specimen with a 1/8 inch (0.3175 cm) square cross section was tested at 2.0 inches/minute (5.08 cm/minute).

Relative Humidity	Temperature	Tensile Strength psi (kg/cm ²)	Elongation (%)
50%	70°F (21°C)	1000 (70.3)	874

Cure:

	Relative Humidity	Temperature	Time	Cure Depth
Open Time	50%	70°F (21°C)	1 hour	N/A
Open Time	90%	90°F (32°C)	15 min.	N/A
Full Cure	50%	70°F (21°C)	24 hours	1/8 inch (0.3175
				cm)

Cleanup:

For cleaning Fast Cure 5200 before it is cured, use a dry cloth to remove the majority of sealant, followed by a cloth damp with General Purpose Adhesive Cleaner*, P. N. 08984, toluene or acetone. Cured Fast Cure 5200 can be removed mechanically with a knife, razor blade or sanding.

Limitations -

- Alcohol should not be used in preparation for bonding as it will stop the curing process.
- Heat resistance Maximum 190°F (88°C). Due to the decreased value in bond strength at elevated temperatures, we do not recommend use of this product above 190°F (88°C).
- Do not apply at temperatures below 40°F (4°C) or on frost covered surfaces.
- Fast Cure 5200 is not recommended for use as a teak deck seam sealer. Extended exposure to chemicals (teak cleaners, oxalic acid, gasoline, strong solvents and other harsh chemicals) may cause permanent softening of the sealant.
- 3MTM Marine Adhesive/Sealant Fast Cure 5200 is not recommended for the installation of glass, polycarbonate or acrylic windows that are not also mechanically fastened with a system designed by the manufacturer. Inconsistent adhesion of these unprimed substrates, specific design of the window and movement due to thermal expansion and flexing, may cause application failure.
- When using 3MTM Marine Adhesive/Sealant Fast Cure 5200 with metals it may be necessary to prime the surface to achieve adequate adhesion and durability of the bond. Scotch-WeldTM Structural Adhesive Primer EC-1945 B/A may be used for priming of most metals.

Applications

Typical bonding and sealing applications include:

- Fiberglass deck to fiberglass hull
- Wood to fiberglass
- Portholes
- Deck fittings
- Moldings
- Trunk joints
- Between struts and planking
- Stern joints and hull planking

Structural bonding and sealing of:

- Wood
- Fiberglass
- Gelcoat
- Primed metal



MARINE PROPULSION SYSTEMS

SHAFT SPECIFICATIONS

					- [
			0)	SHAFT AND	SHAFT AND CASING SPECIFICATIONS	PECIFICAT	SNOI					
Shaft Model		100	175	200	225	250	275	300	350	400	450	200
Diameter	Inch	1.00	1.75	2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00
	mm	25.40	44.45	50.80	57.15	63.50	69.85	76.20	88.90	101.60	114.30	127.00
Shaft Model		100	175	200	225	250	275	300	350	400	450	200
Shaft Material		AQ 22™										
				4	AQ 22 HS TM							
Torsional	PSI	86,600	70,000									
Yield	(Кра)	265	483									
**Shaft Mode	Į.	100	175	200	225	250	275	300	350	400	450	200
Torque	Ft/Lbs	867	1,292	1,928	2,746	3,764	5,011	6,508	10,340	15,446	21,980	30,131
Capacity	(Nm)	405	1,756	2,620	3,731	5,115	6,809	8,843	14,050	20,988	29,867	40,943
Shaft Model		100	175	200	225	250	275	300	350	400	450	200
Casing	Inch	1.66	2.375	2.875	3.5	3.5	4	4	4.5	5.5	5.5	6.5
00	(mm)	42.16	60.33	73.03	88.90	88.90	101.60	101.60	114.30	139.70	139.70	165.10
ANSI Pipe Size		1 1/4	2	2 1/2	3	3	3 1/2	3 1/2	4	2	2	9
Shaft Model		100	175	200	225	250	275	300	350	400	450	200
Thrust Bearing	Lbs/F	3,880	6,850	10,400	13,700	13,700	21,600	21,600	25,900	23,700	33,700	65,700
Capacity	>	17300	30,543	46,371	61,085	61,085	608'96	96,309	115,482	105,673	150,260	292,941
	(Ka/F)	1,732	3.058	4.643	6.116	6.116	9.643	9.643	11,563	10.580	15.045	29,330

** Torque Capacities calculated at Safety Factor of 5

Recommended Iubricant - Seatorque SCS 75W-90 - Full Synthetic, Extreme Pressure, Shock Proof, Extended Marine service. meeting or exceeding, API GL-5, Mil PRF-210SE



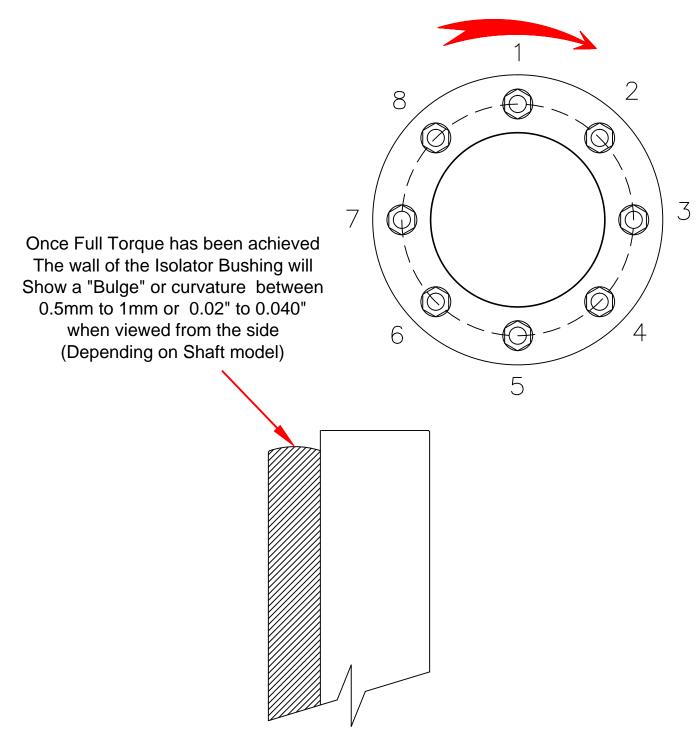
Recommended Torque Values for all Fasteners Used In a Seatorque System												
Shaft Model		100	175	200	225	250	275	300	350	400	450	500
Shaft Coupling Bolt	(Nm)	27	115	115	115	115	136	136	136	203	tba	tba
To Shaft	Ft/Lbs	20	85	85	85	85	100	100	100	150	By appl	ication
(Pretorque to 50%) - Lubricated	Bolt	3/8-24	5/8-18	5/8-18	5/8-18	5/8-18	3/4-16	3/4-16	1-14	1 1/4-12		
Shaft Model		100	175	200	225	250	275	300	350	400	450	500
M4 Isolator	(N <i>m</i>)	7	20	20	27	27	27	27	27	34	tba	tba
Stud Nuts	Ft/Lbs	5	15	15	20	20	20	20	20	25	By appl	ication
Mounting Bushings Only		(Tighten nu	ts sequencia	ally in clock	pattern at va	lue shown ι	ıntil nuts tur	n less than	one flat - Us	e a calibrate	d Torque Wr	ench)
CARDAN SHAFT		DIN Mod	lel									
(Universal Joint)		2C	5C	7C	8.5C	10C	12.5C					
Bolt	(Grade)	(8)	(8)	(8)	(8)	(8)	(10.9)					
Diameter	Inches	5/16-24 UNF	3/8-24 UNF	1/2-20 UNF	1/2-20 UNF	5/8-18 UNF	M18-1.5					
Pre-Torque Setting		2C	5C	7C	8.5C	10C	12.5C					
Lubricated	(N <i>m</i>)	19	54	88	88	136	203					
	Ft/Lbs	14	40	65	65	100	150					
Final Torque Setting		2C	5C	7C	8.5C	10C	12.5C					
Lubricated	(N <i>m</i>)	27	68	115	115	203	271					
	Ft/Lbs	20	50	85	85	150	200					
Transmission Adapter												
-		SAE				METRIC						
Min/Max	Stud Size	7/16"	5/8"	3/4"	1"	M10	M16	M18	M20	M22	M24	
Torque	(N <i>m</i>) Min	54	171	285	569	33	142	190	285	379	522	
Settings	Max	79	244	407	813	47	203	271	407	542	745	
Threads Dry	Ft/Lbs Min	40	126	210	420	24	105	140	210	280	385	
	Max	58	180	300	600	35	150	200	300	400	550	
PROPELLER NUT TORQUE	Recommend	ded For 1:1	6 Ratio SAI	E J755 Sha	ft Tapers -	DRY THRE	ADS					
Shaft Model		100	175	200	225	250	275	300	350	400	450	500
	(N <i>m</i>)	7	318	436	573	637	799	982	1272	1745	2127	2728
	Ft/Lbs	5	235	322	423	470	590	725	939	1288	1570	2013
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M4 ISOLATOR TIGHTENING SEQUENCE

Torque to full value listed in the Torque Chart in this manual on each nut in a "Clock Sequence"

Continue to tighten around the nuts in sequence until all Nuts meet the Required Torque setting.

Required Torque is achieved when no nuts turn more than one flat this is usually achieved after 6 to 10 times around the Clock.





<u>Product Update – 2012</u> <u>Optional Temperature Sensor Kit</u>

The Above product update applies to SCS Shaft Systems From ST/M3-175 Through ST/M3-400 Models supplied after November 2011:

This Product update applies to new equipment shipped with Optional Temperature Sensors after November 2011, no changes are required for units already in service prior to Nov 2011.

Due to design dimensional limitations only the 275, 300 & 350 Systems could be fitted with an internal sensor mounting pocket. This new feature allows all systems produced after November 2011 to install the optional SCS Oil Temperature Sensor Kit.

Sensor Block Attachment point.



Fig 2). Shown with Hi-Accuracy Analog Sensor



Half Fill Sensor Port with Shaft Oil

All 2012 Series thrust Housing Faceplates - Sensor Block Mounts to ¼-20 tapped hole as shown in Fig 1).

Optional Sensor block is supplied with mounting hardware and choice of standard analog, Hiaccuracy Analog and Hi-Accuracy Digital temperature probes depending on monitor system and or Gauge panel.

Prior systems already in service without temperature sensor ports can be updated, for further information please contact SCS factory direct or an authorized SCS distributer.