

TG100

Seal Installation Manual

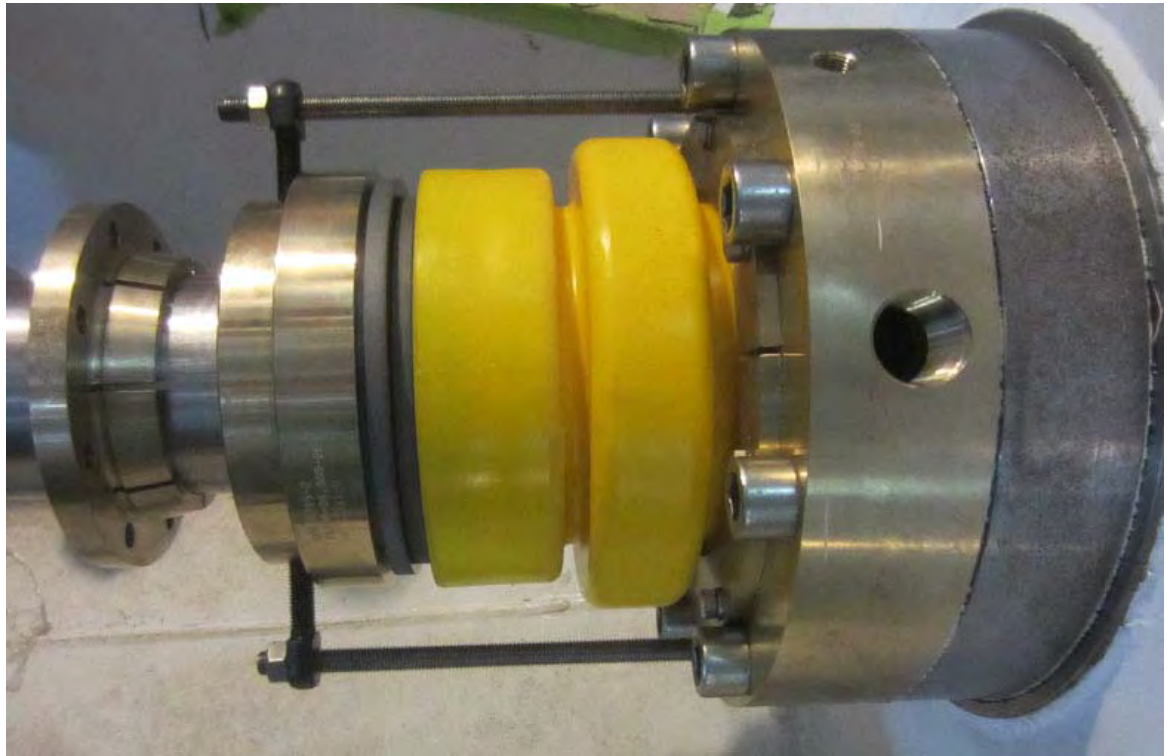


Table of Contents

- 1.0 TG100 SEAL - GENERAL DESCRIPTION 1
- 2.0 TG100 SEAL - TYPICAL FACTORY SHIPMENT 1
- 3.0 TG100 SEAL - APPLICATION AND SPECIFIED USAGE 2
- 4.0 TG100 SEAL - TYPICAL INSTALLATION CONFIGURATION 2
 - TG100 SEAL SIZES AND DIMENSIONAL INTERFACES WITH THE VESSEL..... 2
 - TG100 SEAL - SIZING DIMENSIONS TABLE 3
- 5.0 TG100 SEAL - TYPICAL INSTALLATION..... 4
 - STEP 1: VERIFY THAT THE PROPER CONDITIONS ARE ENSURED BEFORE INSTALLING THE TG100 SEAL 4
 - STEP 2: INSTALL TG100 SEAL ON NEW BUILD VESSELS VS. RETROFITS 4
 - STEP 2A: INSTALL TG100 SEAL AS A REPLACEMENT FOR CONVENTIONAL STUFFING BOX 4
 - STEP 3: INSTALL STATIONARY SEAL HOUSING 5
 - STEP 4: INSERT THE PROPELLER SHAFT 6
 - STEP 5: INSTALL ROTATING SUBASSEMBLY 6
 - STEP 6: INSTALL THE WEDGE RING 6
 - STEP 7: CONNECT TO WATER PIPING, FITTINGS AND VALVES..... 7
 - STEP 8: CONNECT THE PRESSURIZED AIR SUPPLY TO AIR CONTROL PANEL AND SEAL..... 9
- 6.0 TG100 SEAL - FINAL CHECK BEFORE VESSEL IS LAUNCHED (SHIP IS ON DRY DOCK)..... 9
- 7.0 TG100 SEAL - OPERATION AFTER VESSEL IS LAUNCHED (SHIP IS IN WATER) 10
- 8.0 APPENDIX: SUPPLEMENTARY FIGURES..... 11
 - TG100 SEAL - PERPENDICULARITY AND CONCENTRICITY REQUIREMENTS 11
 - TG100 SEAL - RECOMMENDED INSTALLATION TORQUE (N-M) 11
 - TG100 SEAL – TYPICAL AIR PIPING DIAGRAM 12

The information contained in this document is based on Thordon’s expertise in researching, developing, manufacturing and testing Bearing and Seal Systems worldwide. Only persons having technical training and skill should use this information at their discretion and risk. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without the prior written permission of Thordon Bearings Inc.

DISCLAIMER:
The company reserves the right to change or amend the information presented in this Seal Installation and Operation Guide without notice.
 Revised: March 14, 2016

Table of Figures

Figure 1: Stationary Seal Subassembly and Rotating Subassembly	1
Figure 2: Seal water ports on Stationary Seal Housing and elastomeric bellows - detail	1
Figure 3: Sizing Dimensions of Standard TG100 Seals.....	3
Figure 4: Adaptor Plate Installation.....	5
Figure 5: Stationary Seal Housing Installation (Bellows removed).....	5
Figure 6: Stationary Seal Housing bolted on bulkhead/adaptor plate, with installation rods mounted on seal housing.....	6
Figure 7: Rotating Subassembly alignment and installation	6
Figure 8: Wedge Ring alignment and installation	7
Figure 9: Both seal water ports (supply & vent) located on the Stationary Seal Housing – detail.....	8
Figure 10: Water supply to TG100 seal via engine pump or water scoop connected from hull or sea chest ...	8
Figure 11: Water supply from stern tube scoop will flow through TG100 elastomeric bellows	9
Figure 12: TG100 Seal - Adaptor Plate Perpendicularity and Concentricity tolerances	11
Figure 13: Typical Air Piping Diagram for one TG100 Seal	12

Table of Tables

TABLE 1: Seal Sizing Dimensions	3
TABLE 2: Recommended Installation Torque	11

1.0 TG100 SEAL - GENERAL DESCRIPTION

TG100 is a new water lubricated mechanical face seal for 85 to 305 mm (3.375"-12") shaft diameters, specifically designed for operation in abrasive water. With the introduction of the TG100 propeller shaft seal, workboats` no longer have to put up with the maintenance hassles and shaft wear commonly experienced with stuffing box use. The TG100 uses the highest quality Silicon Carbide (SiC) seal faces designed to last the life of the vessel, and operate with ease in both clean and abrasive waters. It is also equipped with a pneumatically deployed emergency seal that can also be used for safe return to port. TG100 seals are certified by ABS, DNV, LR, BV, CCS and RRR.

2.0 TG100 SEAL - TYPICAL FACTORY SHIPMENT

Standard TG100 Seal shipment - consists of the following components preassembled and factory-tested, ready to install:

Qty. 1 - Stationary seal subassembly with seal housing elastomeric bellows and stationary face

Qty. 1 - Rotating subassembly with rotary face

Qty. 1 – Emergency seal air control panel assembly

Qty. 1 - Installation Toolkit: 2 Allen wrench sockets, mounting ring bolts (quantity included depends on seal size), 2 threaded installation rods, 2 installation rod nuts, 2 threaded mounting ring installation rods, 2 lifting eye nuts, 4 TG100 nameplate screws, Loctite[®] 242

Spare parts included: 2 wedge ring bolts, 2 mounting ring bolts, 2 TG100 nameplate screws

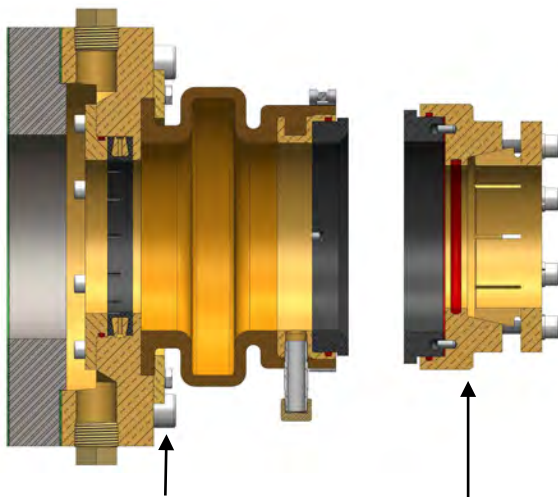


Figure 1: Stationary Seal Subassembly Rotating Subassembly

Note: Check the package and observe any transport damage. Remove the seal from the crate and ensure all components are present, before installation.

TG100 Seal Options - can be ordered separately and will be packaged and shipped in separate crates.

- Adaptor plate and gasket - may be required for certain installations to match mounting boltholes existing on the vessel
- Emergency repair kit for vessel in water replacement includes split stationary, and rotary faces, and o-rings (cord)
- Dynamic seal refurbishment kit for vessel in drydock with shaft removed, includes non-split stationary and rotary faces, o-rings and rotor cushion gasket and o-ring

Other items required for TG100 Seal installation (not supplied by Thordon)

- Lithium grease or equivalent

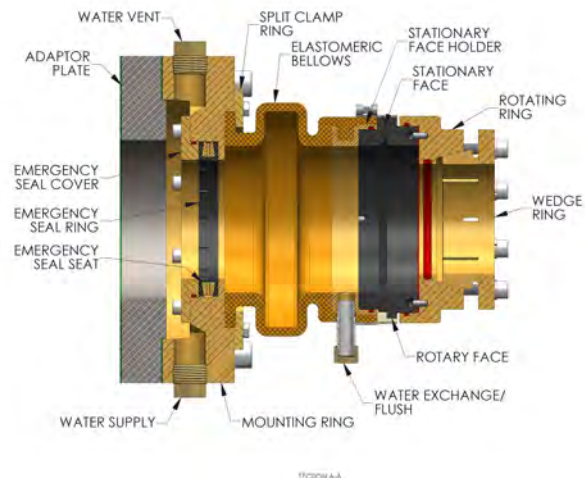


Figure 2: Seal water ports on Stationary Seal Housing and Elastomeric Bellows - detail

3.0 TG100 SEAL - APPLICATION AND SPECIFIED USAGE

TG100 Seal use is intended only for sealing rotating propeller shafting against water ingress inside the vessel. Any other or additional usage shall be considered as “not specified”. The “specified use” also implies following the installation, operating and maintenance instructions described in this manual. Usage not in accordance with these specifications shall lead to the loss of all warranty rights.

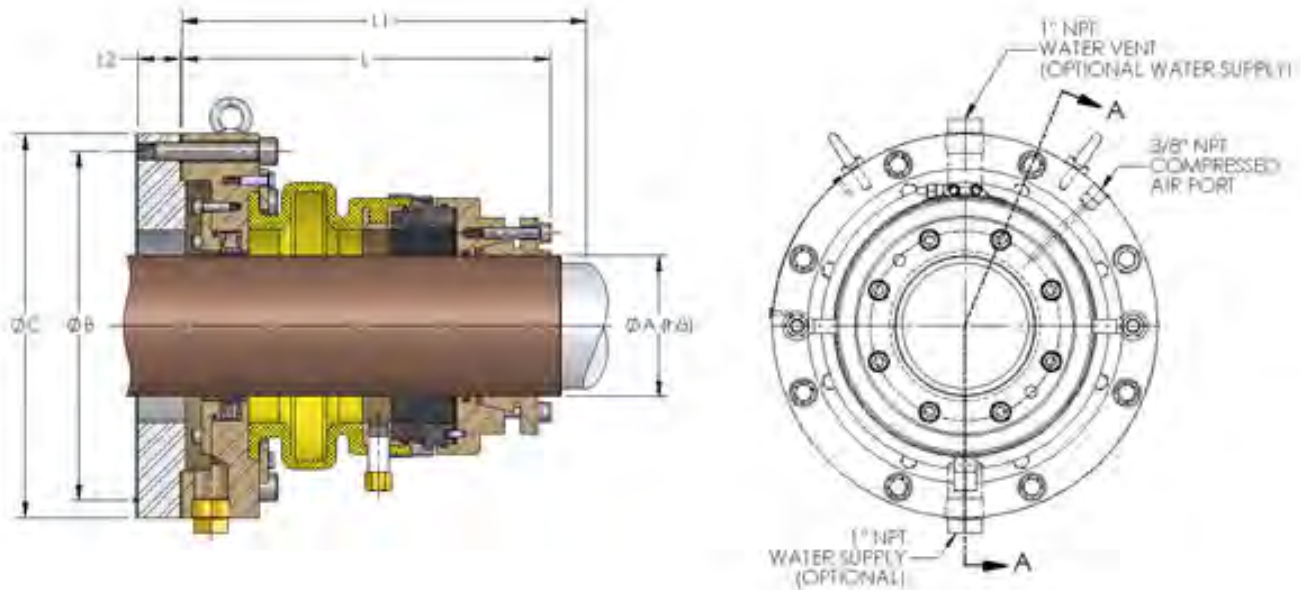
4.0 TG100 SEAL - TYPICAL INSTALLATION CONFIGURATION

TG100 Seal Sizes and Dimensional Interfaces with the Vessel

The TG100 Seal is fabricated in nine nominal sizes, from #00 to #08, covering the shaft diameter ranges presented in Table 1.

TG100 seals are typically ordered fully finished and ready to install based on a specific shaft diameter.

The mounting bolt circle on the bulkhead of the vessel’s hull needs to match the specification of TG100 Seals. Table 1 shows the mounting bolt circle for standard shaft size increments. For simplicity, all standard Thordon TG100 Seals are designed for either eight (8) or twelve (12) mounting bolts, either size M16 or M20 size, depending on the seal dimensions.



Note: Dimension L1 = L + 76.2 mm (L + 3") for seal sizes #00 to #04, and L + 100 mm (4") for seal sizes #05 to #08.
 Dimension L2 = 36 mm (1.42") for seal sizes #00 to #04, and 40 mm (1.57") for seal sizes #05 to #08

Figure 3: Sizing Dimensions of Standard TG100 Seals

TG100 Seal - Sizing Dimensions Table

Seal Size	Seal Nominal Range	Shaft Diameter Range over Liner φA		Seal Mounting Bolt Circle Dia. φB		Seal Overall Diameter φC		Seal Overall Length (w/o Adaptor Plate & Gasket) L			No. of Bolts G	Approx. Weight
		inch	mm	inch	mm	inch	mm	inch (free)	mm (free)	mm (compressed)		
00	3.500 (88.9)	3.375 - 3.875	85.73 - 98.43	10.630	270.00	11.811	300.00	12.480	317	309	8 x M16	86 (39)
01	4.000 (101.60)	3.875 - 4.625	98.43 - 117.48	10.630	270.00	11.811	300.00	12.480	317	309	8 x M16	84 (38)
02	4.750 (120.65)	4.625 - 5.750	117.48 - 146.05	11.811	300.00	12.992	330.00	12.480	317	309	8 x M16	97 (44)
03	5.875 (149.23)	5.750 - 6.875	146.05 - 174.63	12.992	330.00	14.173	360.00	12.933	328.5	320.5	8 x M16	121 (55)
04	7.000 (177.80)	6.875 - 8.000	174.63 - 203.20	14.567	370.00	15.748	400.00	13.130	333.5	327.5	8 x M20	148 (67)
05	8.250 (209.55)	8.000 - 9.000	203.20 - 228.60	15.551	395.00	16.929	430.00	14.134	359	351	8 x M20	196 (89)
06	9.250 (234.95)	9.000 - 10.000	228.60 - 254.00	16.732	425.00	18.110	460.00	14.134	359	351	8 x M20	220 (100)
07	10.250 (260.35)	10.000 - 11.000	254.00 - 279.40	18.110	460.00	19.685	500.00	14.843	377	369	12 x M20	271 (123)
08	11.250 (285.75)	11.000 - 12.000	279.40 - 304.80	19.291	490.00	20.866	530.00	14.843	377	369	12 x M20	291 (132)

Table 1: Seal Sizing Dimensions

5.0 TGI00 SEAL - TYPICAL INSTALLATION

The TG100 Seal is supplied machined to the final shaft diameter and ready to install. For installation on your vessel, please follow the procedures listed below.

Step 1: Verify that the proper conditions are ensured for installing the TGI00 Seal

- 1) **Check that adequate space exists for installing the TGI00 Seal;** Measure the dimensions below and compare with TG100 Seal installation dimensions presented in Table 1 in Section 4.0. before fitting.
 - Measure shaft diameter to ensure that Seal ID (A) matches the shaft.
 - Measure horizontal distance between old stuffing box and tailshaft coupling OR the distance between the bulkhead and tailshaft coupling to ensure that seal overall length (L) is smaller than the existing space (dimension L1 shows the minimum space required).
 - Measure vertical space around the sterntube flange, to ensure that the Seal Overall Diameter (C) is smaller than the existing space, so there is no interference with vertical structures in the way of the seal.
- 2) **Ensure that the seal subassemblies can be installed along the propeller shaft:**
 - The TG100 Seal is shipped from the factory with non-split Silicon Carbide (SiC) rings, which means that the seal components must be assembled along the drive shaft from the forward end, when the shaft is partially withdrawn. If sealing rings require replacement due to damage or wear, they can be replaced with new split SiC rings that fit into the existing seal housing. The new split rings can be ordered from the factory as an option, and easily installed to replace the damaged or used ones, without removing the shaft coupling.
 - For vessels where the shaft is designed to be withdrawn from outboard, the forward end of the shaft is commonly connected to the engine or intermediate shaft with a hydraulic coupling, or removable mechanical coupling. This makes the installation simple; the seal being put on the shaft when it is partially withdrawn.

3) Ensure that the propeller shaft is in good condition:

- Decide if a liner is needed; many propeller shafts require a liner or non-corrosive surface coating to protect the shaft from corrosion. Standard TG100 Seals are designed to suit a range of shaft diameters with size increments matching conventional stuffing box sizes; the seals can replace them without using additional shaft sleeves if the static o-ring that seals the rotating subassembly to the shaft will seal against a shaft surface that is not worn.
- Inspect the various surfaces of the shaft and ensure that they are not worn, not out-of-round, and clean. If needed, repair the shaft by clad welding and machine to the correct dimension so it matches the nominal seal size.

4) Ensure that the sterntube system is in optimum condition:

- Check entire sterntube for presence of damage, corrosion or dirt.
- Check the true running and rectangularity of the sterntube front face in respect to the shaft when shaft is coupled, prior to fitting the seal.

Step 2: Install TGI00 Seal on newbuild vessels vs. retrofits

What is different?

The TG100 Seal is designed to be fitted from the inboard of the vessel. There are two possible differences in the installation on newbuilds compared to stuffing box replacements:

- 1) On new vessels the stern tube flange or bulkhead can be finished (drill and tap) to suit the TG100 Seal dimensions so an adaptor plate is not required.
- 2) If the shaft is made from a marine-grade stainless steel material (e.g. Aquamet), there is no need for a shaft sleeve in way of the seal. If the shaft is carbon steel, the non-corrosive sleeve used for the forward bearing should be extended forward (beyond the bearing into the hull) so it provides a surface for securing the TG100 Seal Rotating subassembly.

Note: Proceed directly to Step 3 when installing the TG100 Seal on a newbuild vessel.

Step 2a: Install TGI00 Seal as a replacement for conventional stuffing box

The following steps are recommended for replacing a conventional stuffing box with a TG100 Seal.

Install the Adaptor Plate

An optional adaptor plate is usually required to match the TG100 Seal standard bolt circle to that used for mounting a regular stuffing box, or different type of seal. The adaptor plate has two bolt circles: the inner circle is used for mounting to the bulkhead or stern tube flange – these should be drilled by the shipyard; the outer circle is used for attaching the Stationary Seal Housing – which is pre-drilled from the factory.

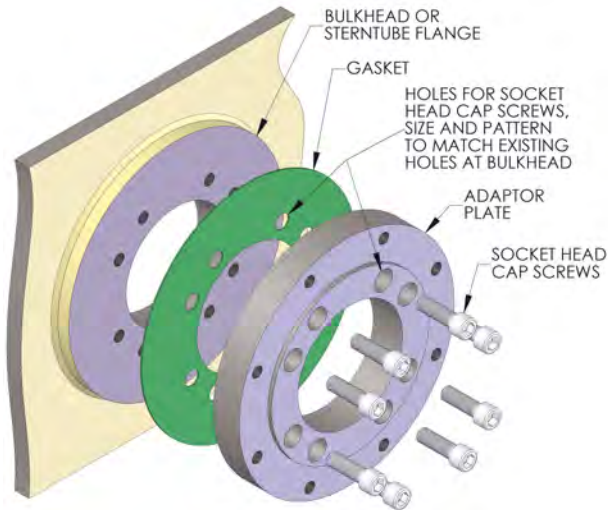


Figure 4: Adaptor Plate Installation

Disconnect the coupling and partially withdraw the propeller shaft prior to TG100 Seal installation. The adaptor plate (Fig-4) should be fitted to mate with the existing holes on the bulkhead or stern tube flange (the adaptor plate holes may be drilled on site based on the pattern existing on the vessel's bulkhead or stern tube flange). Adaptor plate can be field machined to final size and then bolted or welded onto the existing stern tube flange or bulkhead.

CAUTION: With the stern tube bearing installed and tailshaft connected to engine or gear box flange, check the perpendicularity and concentricity between shaft and the adaptor plate, as well as if the shaft is out-of-round. For the standard requirements on perpendicularity, concentricity and out-of-round tolerance please refer to Fig-12 in APPENDIX.

Note: Ensure that the adaptor plate gasket is installed between the adaptor plate and the stern tube / bulkhead flange, when not welded.

Step 3: Install Stationary Seal Housing

Note: On the surface of the outside diameter of the Stationary Seal Housing, there are three radial threaded holes. The two plugged holes (1"

NPT) are for connecting to water supply. The third hole (3/8" NPT) is for connecting the pressurized air to the emergency seal. Please keep them plugged during the initial phase of the installation, so the threads are protected.

Place the seal housing gasket (supplied) on the vessel's bulkhead or adaptor plate; ensure that the mounting holes are aligned.

Note: Apply a thin layer of sealant on the bulkhead or adaptor plate side of the Seal Housing Gasket so it stays in place until installed.

Install the Stationary Seal Housing to the bulkhead or adaptor plate. Rotate the housing to ensure that the water supply and venting ports are oriented vertically and the two installation rod holes are oriented in horizontal position; ensure that the mounting holes are aligned with the gasket and the adaptor plate.

Note: All Stationary Seal Housings are factory fitted with two lifting eye bolts at the top of the seal housing; use a sling or chain to support the weight of the housing, and facilitate the alignment of the mounting bolts. Remove the lifting eye bolts after completing the installation, and store them in a safe place, together with the installation toolkit.

Using the mounting bolts provided (either eight or twelve depending on the seal size) attach the Stationary Seal Housing to the bulkhead or adaptor plate, as shown in Fig-5.

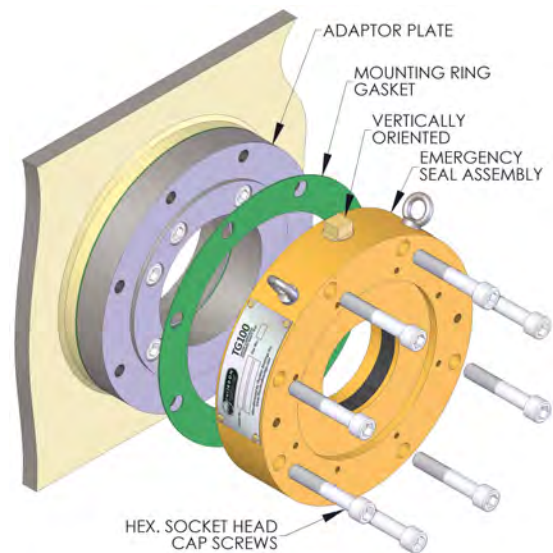


Figure 5: Stationary Seal Housing Installation (Bellows removed)

Torque the bolts to the specified installation torque. For the standard requirement for mounting bolts torque, please refer to Table 2 in the APPENDIX.

Note: Apply Loctite[®] 242 or 243 (or equivalent) on the mounting bolt threads, then torque them.

If the elastomeric bellows assembly was shipped separately, or was initially removed for ease of installation, attach it back on the Stationary Seal Housing using the bolts provided.

Install the two threaded rods (provided in the Installation Toolkit) in the respective position on the Stationary Seal Housing, as shown in Fig-6.

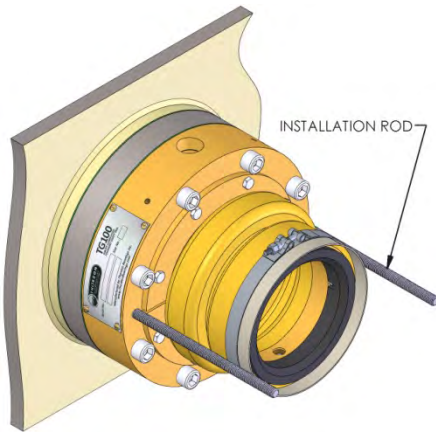


Figure 6: Stationary Seal Housing bolted on bulkhead/adaptor plate, with installation rods mounted on seal housing

Step 4: Insert the Propeller Shaft

Carefully insert the propeller shaft from outboard through the sterntube and draw through Stationary Seal Housing. It is good practice to protect the stationary sealing ring from entering in direct contact with the shaft, so ensure that the shaft is inserted towards the engine coupling by keeping it centered in relation to the Stationary Seal Housing.

Step 5: Install Rotating Subassembly

Apply a thin layer of lithium grease (or equivalent) on the shaft surface where the Rotating Subassembly will be installed to ensure easy sliding of the Rotating Subassembly along the shaft. Slide the Rotating Subassembly including the wedge ring over the shaft with care, so that the rotating sealing ring does not touch the shaft.

CAUTION: Ensure that the grease does not contact the SiC sealing rings – they both must remain clean and dry. Use extreme care when handling the SiC sealing rings during installation so that they are not hit or damaged in any way.

Bring the propeller shaft into its final position; connect the shaft coupling to tailshaft and connect coupling to engine or gearbox coupling. Align the shaftline prior to bolting the Rotating Subassembly. Ensure that the shipyard or vessel personnel perform this work before starting to clamp the wedge ring.

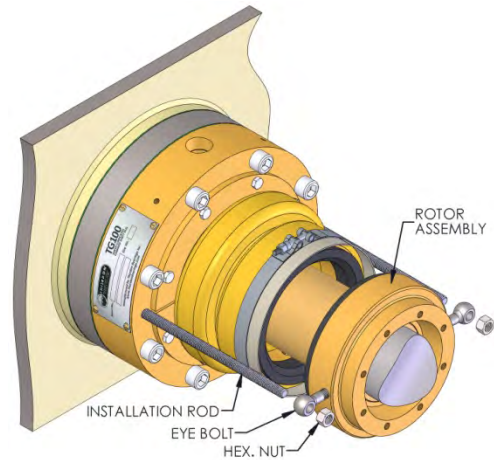


Figure 7: Rotating Subassembly alignment and installation

Arrange the Rotating Subassembly so the holes in the two eye bolts align with the threaded rods. Push the Rotating Subassembly by hand, gently and slowly, along the shaft until the stationary and rotating sealing faces come in contact.

Note: Before closing them, use a soft cloth or paper towel with organic alcohol solvent to cleanup both SiC ring surfaces; make sure that there are no solid particles trapped in between, and that no damage has occurred to either SiC rings during installation. If damage to the SiC rings is observed, contact Thordon Bearings.

There are two M12 nuts provided in the installation toolkit to be used with the installation rods (Fig-7). Tighten these nuts to compress the yellow elastomeric bellows approximately 8 mm to 10 mm (5/16" to 3/8") for seal sizes #0 to #4, and 12 mm to 14 mm (1/2" to 9/16") for seal sizes #5 to #8. Count the number of turns or measure the distance to ensure that both sides are equally compressed, taking care to move the nuts approximately the same distance by cross-wise tightening.

Step 6: Install The Wedge Ring

The wedge ring is the only part making tight contact with the propeller shaft surface. Since the wedge ring has a non-split design, it requires a relatively good

quality of shaft surface in terms of size, roundness and surface roughness condition; no corrosion is allowed.

Note: Apply a thin layer of grease on the shaft surface and slide the wedge ring onto the shaft until it touches the rotating ring, then close the sealing faces.

Align the bolt circles and insert the eight wedge ring bolts provided (as shown in Fig-8). Tighten, and then torque the wedge ring bolts in a diagonal staggered manner to the prescribed torque using a torque wrench 30 Nm (22 ft-lbs) to lock the position of the rotating ring.

Note: Use Loctite[®] 242 or 243 (or equivalent) when tightening all wedge ring bolts, to prevent them from loosening.

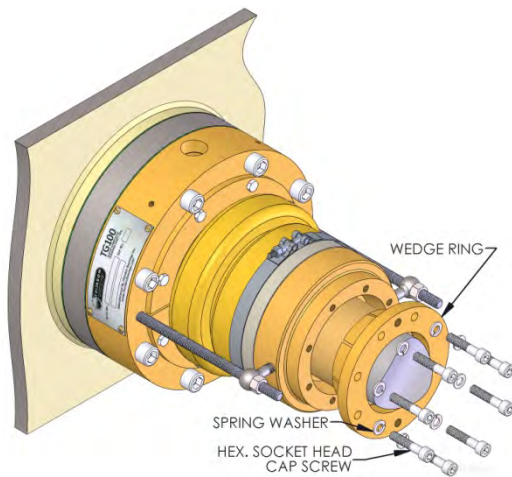


Figure 8: Wedge Ring alignment and installation

The spring force of the yellow Elastomeric Bellows will push the two mating SiC wear surfaces in contact, and will hold them together for smooth running.

Upon completing the installation, release the nuts on the installation rods. Remove the rods and the eye bolts; store them in the Installation Toolkit for future use during maintenance or repair operations.

Step 7: Connect to Water Piping, Fittings and Valves

A cooling water supply must be available for the TG100 to ensure optimum seal functionality when operating at elevated temperatures or in harsh environments. Three water connection ports are provided on the TG100 Seal – two 1” NPT at the top

and bottom of the Stationary Seal Housing, and one 3/8” NPT at the bottom of the elastomeric bellows.

Note: The piping, fittings, valves and other water handling components are not supplied in the Thordon installation package, and should be provided by the shipyard. The water inflow can be connected to the water supply/drain fitting on the Stationary Seal Housing through hard piping line so the water coming from the sea chest, hull mounted scoop, pump (or other type of water supply) installed on the vessel will go through the flow sight gauge. If the water connection is made to the 3/8” NPT water exchange/flush port on the elastomeric bellows, the piping must be done via a water hose that is flexible enough to allow the Rotating Seal elements to move axially, but not be so long as to get in the way of crew working in the area. For Classed vessels, the hose material must meet the Class Society’s safety requirements.

There are two typical water connections for TG100 Seal as follows:

Note: Remove the applicable plugs from the Stationary Seal Housing and/or elastomeric bellows to connect the water valves (not supplied by Thordon); certain plugs must be removed based on the chosen water connection schematic, depending on the application (see below).

1) Water supply to Stationary Seal

Housing – used when operating time is mostly in clean, blue water operation (ocean going). Use the Stationary Seal Housing water ports (shown in Fig-9) to fit the water connections. Use the supply/drain port (at the bottom of the housing) for water inlet and the vent port (at the top of the housing) for venting the air that may be “trapped” in the elastomeric bellows; incoming water will be released freely through the sterntube. This connection suits better for controlling the temperature within the seal, supplying colder water to the Stationary Seal Housing.

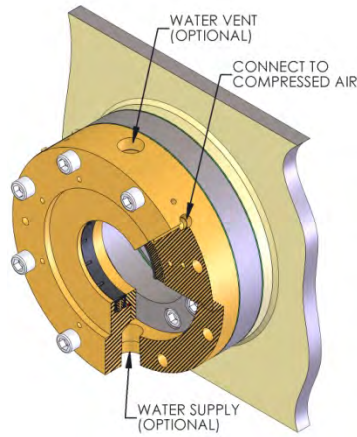


Figure 9: Both seal water ports (supply & vent) located on the Stationary Seal Housing – detail

Connect the water supply line (not part of the installation package) from the hull scoop, sea chest or optional pump to the inlet of the flow sight (1" NPT female), using appropriate size bronze or stainless steel fitting, then connect the flow sight outlet to the seal water inlet so you can observe that there is flow of water to the Seals. If a water pump is used, and it is not self-priming, ensure that it is located below the level of the water source, so it will not run dry in case it has lost its water column; also ensure that the pump inlet is connected to a COLD water source (NOT WARM, i.e. after it cools down the engine). If the vessel will run in dirty waters, install a filter (100 microns) before the pump inlet. This typical arrangement is shown in Fig-10.

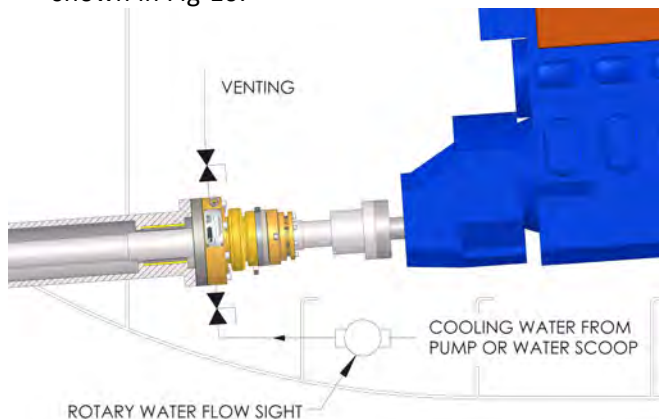


Figure 10: Water supply to TG100 seal via engine pump or water scoop connected from hull or sea chest directly into seal housing

ATTENTION:

- If a single pump is used to supply water to multiple seals (e.g. for twin or multiple propeller shafts), ensure that the pump output line is divided such that the lines going to each seal are (approximately) of equal length.
- If the same pump is used to provide cooling water for the TG100 Seal, and for the stern tube bearings, ensure that the pump is capable to deliver a minimum water flow of 3.8 l/min (1 Gal/min) for EACH 25.4 mm (1") of shaft diameter, and has a head pressure able to compensate for the vessel's draft, and the pressure drops over the filtration system (if existent), supply pipelines and fittings that may restrict the water flow. Pay attention when calculating the size of pipelines in this case: e.g. the water flow required to lubricate and cool down a TG100 Seal and the bearings for a 101.6 mm (4") shaft will be 15 l/min (4 Gal/min); for a 305 mm (12") system you will need 45 l/min (12 Gal/min) of water. Consult with Thordon Engineering for properly sizing the water lubrication pump for your installation.
- If your vessel operates in dirty/abrasive waters and the water quality is a concern, consult with Thordon for obtaining information about a Water Quality Package sized for your vessel.

- 2) **Water supply close to Rotating Subassembly** – used when operating time is mostly in dirty, abrasive waters (e.g. rivers and coastal estuaries). Incoming water is from the sterntube scoop. Incoming water is from sterntube scoop; use the pluggable 3/8" NPT water exchange/flush port on the elastomeric bellows) for water outlet; connect flow sight. Use the vent port (at the top of the Stationary Seal Housing) for venting the air "trapped" in the elastomeric bellows. Install an optional valve at the drain port (at the bottom of the Stationary Seal Housing) for flushing the seal. This arrangement is shown in Fig-11.

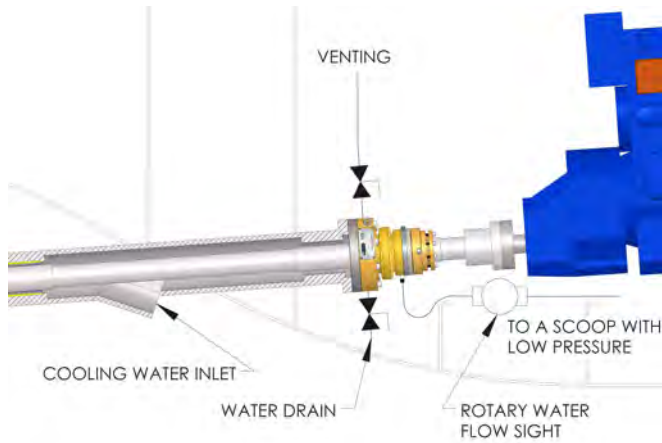


Figure 11: Water supply from stern tube scoop will flow through TG100 elastomeric bellows via scoop to low pressure

This water supply connection provides the option for routine preventive maintenance to extend the TG100 service life by keeping the seal internal cavities clean. Open the water Drain Valve on the Stationary Seal Housing at regular maintenance intervals to flush the accumulated mud or other debris.

Step 8: Connect the Pressurized Air Supply to Air Control Panel and Seal

Each TG100 Seal is provided with an Air Control Panel assembly to regulate and channel the compressed air supplied from the vessel to operate the TG100 emergency seal. The required minimum pressure for normal operation is 0.827 MPa (120 psi). The regulator on the air control panel has a built-in pressure gauge. It is pre-assembled on a mounting panel, together with an air supply and an air relief valve that can be operated independently, to achieve the pressures required for the operation of the emergency seal.

- Connect the vessel compressed air supply through a main air shut-off valve (not supplied by Thordon in the installation package), to the 1/4" NPT female port on the inlet of the air pressure regulator, using an adequate length of flexible air hose or hard piping (not part of installation package).

Note: All air fittings, hoses and pressure regulator are supplied in "Imperial" sizes. Air control components with "metric" sizes are special order; please specify your requirement for metric when placing your order.

- Connect the air supply valve 1/4" NPT female port through a length of 1/4" ID flexible air hose (not part of the installation package) to the 3/8" NPT female air port on the Stationary Seal Housing.

The typical air supply circuitry is presented in the Air Piping Diagram shown in Fig-13 in APPENDIX.

- Check to see if the emergency seal is operative by fully deploying, and then fully venting it. Instructions on how to control the air valves to activate the emergency seal in either maintenance /repair or safe return to port modes are shown on the diagram, and on the air control panel labels.

Note: For vessels with two/more propellers, the compressed air supply can be split to feed two or more air control panels; ensure min. 0.827 MPa (120 psi) at each panel so it can be controlled individually to operate each TG100 Seal independently.

6.0 TG100 SEAL - FINAL CHECK BEFORE VESSEL IS LAUNCHED (SHIP IS ON DRY DOCK)

Do these final checks before the vessel is launched:

- 1) Check the perpendicularity of the wedge ring using a dial gauge; should be within the limits shown Fig-12.
- 2) Verify that the Seal connection to water piping is done correctly to provide water supply to the Stationary Seal Housing and that appropriate size bronze or stainless steel fittings and valves are installed correctly.
- 3) Verify that the seal connection to the vessel's compressed air piping is done correctly so pressurized air is provided to the air control panel and the emergency seal.
- 4) Ensure that the regulator on air control panel is set to 0.827 MPa (120 psi) pressure; modify this setting lowering it to 0.48 MPa (70 psi) ONLY when you want to operate the emergency seal in the safe return to port mode.

7.0 TGI00 SEAL - OPERATION AFTER VESSEL IS LAUNCHED (SHIP IS IN WATER)

Do these checks once the vessel has been launched:

- 1) Check the seal visually for tightness; observe if any leakage occurs at the SiC rings interface. If there is water leaking, the sealing rings may need to be cleaned. Engage the emergency seal and shut off the water supply to the seal.
- 2) With the shaft turning bleed all air from the seal's elastomeric bellows using the vent port on seal housing; ensure that it is full with water, so no hot air pockets are created.
- 3) With the vessel running in steady state, check the temperature of the sealing rings every hour for a period of 6 hours; the temperature should be 6-8°C (10.8-14.4°F) above the water temperature.
- 4) With vessel manoeuvring forward/reverse, observe any vibration/noise at seal level; check if the shaft axial/radial movement is compensated by the seal's elastomeric bellows.
- 5) Re-install the Thordon splash guard onto the elastomeric bellows using the clamp ring provided.

8.0 APPENDIX: SUPPLEMENTARY FIGURES

TG100 Seal - Perpendicularity and Concentricity Requirements

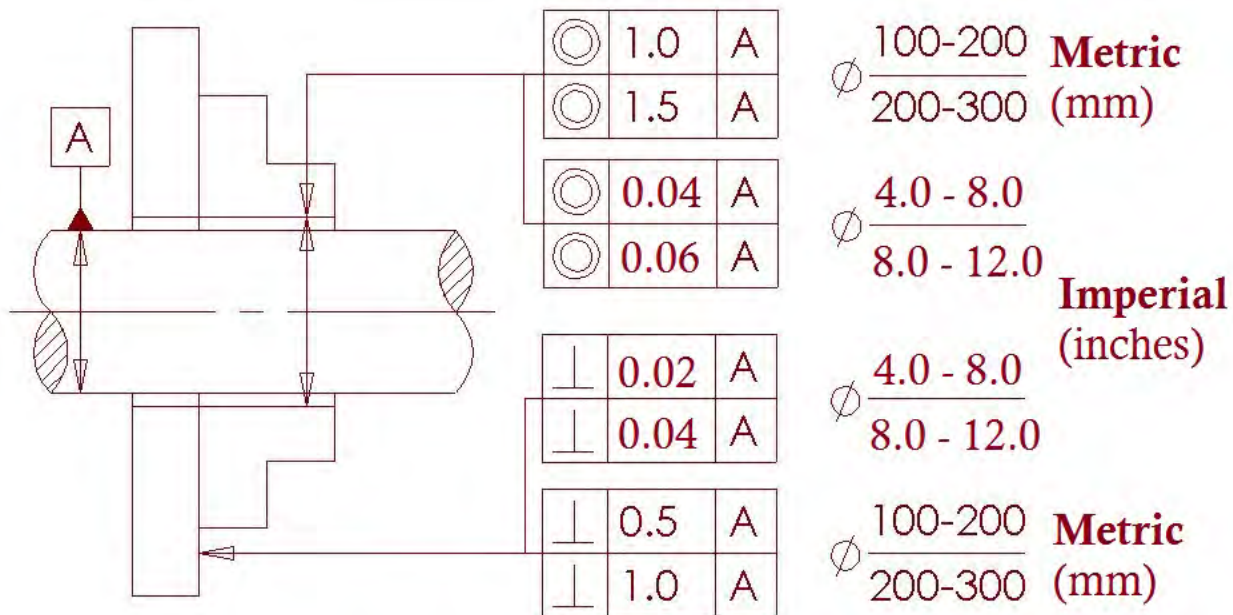


Figure 12: TG100 Seal - Adaptor Plate Perpendicularity and Concentricity tolerances

The standard requirements on perpendicularity and concentricity for installing the adaptor plate are shown below:

Note: The acceptable out-of-round tolerance for the propeller shaft is less than 0.05mm (0.002”).

TG100 Seal - Recommended Installation Torque (N-m)

All Thordon-supplied fasteners are Grade A4-70, with a tensile strength of 700 MPa (101,500 lb/in²).

The recommended torque for installation of TG100 Seals are listed below; set your torque wrench to the closer value:

Bolt Size	M8	M10	M12	M16	M20
Torque (N-m)	14	28.5	49	121	237
Torque (in-lbs)	125	250			
Torque (ft-lbs)			36	90	175

Table 2: Recommended Installation Torque

Note: Metric Torque values are given in Newton-meters (N-m).

Imperial Torque values for bolt sizes up to M10 are given in inch-pounds (in-lbs), and for bolt sizes M12 and larger in foot-pounds (ft-lbs).

All Torque values are shown for “lubricated torque” as Loctite[®] threadlocking compound (or equivalent) shall be applied at bolt installation.

