TECHNICAL MANUAL

FOR

TYPE EJ SEAL

ManeBar EJ Inboard Seal

with Solid Cooled Seat for Oil Lubrication Systems

Based on Tabulated G.A. Drawings:

H 70000
H.70060

CONTENTS

1. SPECIFICATIONS/TECHNICAL DATA

WORKS ORDER NO. :
OWNER :
VESSLE NAME :
YARD :
YARD No. :

STERNTUBE/SHAFT SEALS

Aft/Outboard Seal
Type:
Size:#
Drawing No.:

Forward/Inboard Seal(s)
Type:
Size:#
Drawing No.:

STERNTUBE BEARINGS

Aft STB	Mid STB	Fwd STB
Size:#	Size:#	Size:#
Drawing No.:	Drawing No.:	Drawing No.:

INTERMEDIATE/LINE SHAFT BEARINGS

Type:
Size:#
Drawing No.:

Type:
Size:#
Drawing No.:

LUBRICATION SYSTEM

Drawing No.:

System Components

Fwd seal Tank
Drawing No.:

Aft seal Tank
Drawing No.:

Header Tank
Drawing No.:

Drain/Observation Tank
Drawing No.:

Air control unit
Drawing No.:

Lub Oil Pump set
Drawing No.:

Filter/Strainer Unit
Drawing No.:

Oil Flow Meter
Drawing No.:

Water Flow Meter
Drawing No.:

Pressure Gauge/Panel Units
Drawing No.:

Valves
Drawing No.:

BULKHEAD SEALS

Type:	Type:
Size:#	Size:#
Drawing No.:	Drawing No.:

ACCESSORIES

#
#

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2. INTRODUCTION

2.1. The equipment described in this manual and the materials selected are the result of many years of research and experience in this field.

2.2. However, the care and attention paid during installation, testing, operations and maintenance, do to a large extent determine the long term operational reliability of the equipment.

2.3. Thus, whilst it is our policy to allow the Installation and Maintenance of this equipment to be carried out by 3rd parties (in accordance with the guidance contained within this Technical Manual) we would always recommend that one of our Service Engineers is present to oversee any Installation or Maintenance.

2.4. **When using this manual refer to the general arrangement drawing(s) in Section 16,** which give the dimensions and data for the correct assembly and operation of the equipment.

2.5. There is no automatic provision to up-date this manual. However, the supply of a complete new assembly will be accompanied by the latest revision/issue Manual and Drawing(s).

2.6. For further assistance please contact one of the Deep Sea Seals companies listed below:

UNITED KINGDOM

Deep Sea Seals Ltd.
4 Marples Way
Havant
Hants PO9 1NX

Tel: 44 (0) 2392 492123
Fax: 44 (0) 2392 492470

USA

Wärtsilä Lips Inc.
3617 Koppens Way
Chesapeake
VA 23323

Tel: 1 757 385 5275
Fax: 1 757 487 3658

NETHERLANDS

Wärtsilä Propulsion Netherlands BV
Lipsstraat 52
5151 RP Drunen

Tel: 31 416 388299
Fax: 31 416 374853

JAPAN

Japan Marine Technology Ltd.
Sigma Bldg, 3-7-12 Shibaura
Minato-ku
Tokyo, 108-0023
Tel: 81 (0) 35442 2211
Fax: 81 (0) 35442 2260
Telex 232-4593

3. DESCRIPTION OF THE EQUIPMENT

3.1. ManeBar "EJ" seals are members of the "E" series family of Rubber Bodied Radial Face Type seals.

3.2. The "EJ" seals described in this Technical Manual are non-split Inboard units for use with Oil lubrication systems in Fixed or Controllable Pitch Propeller - applications.

3.3. The resilient rubber body of the "EJ" seal has an integral "face" which rotates with the shaft against a static (solid) "seat" assembly. The seat (which contains an internal cooling annulus) is fixed to the Inboard end of the sterntube. It is by the continuous rubbing contact between the rotating face and the stationary seat that the "seal" is achieved. This contact is sustained by compression of the resilient rubber body applied at Installation and maintained by the Drive Clamp Ring.

3.4. EJ seals are sized in 10 mm steps or increments as shown on the Tabulated G.A. Drawing. However every seal is finish machined to the suit the "specific" shaft diameter to which it will be fitted.

3.5. This combination provides a simple but very effective sealing arrangement capable of accommodating both radial a axial shaft movements.

4. STORAGE AND HANDLING

4.1. All assemblies and components have been carefully inspected before shipment.

4.2. Each component is suitably packed and protected to prevent damage or deterioration during shipment, transit or storage. Any specific storage or handling requirements will be clearly identified on the package label(s).

4.3. Goods should be examined on receipt to verify the contents and their condition.

4.4. Deep Sea Seals should be immediately advised of any damage or discrepancy in the scope of supply. Damage clearly due to handling in transit should be notified to the carrier along with a claim for damages (copy to us**).**

4.5. Keep goods in their original packing until just prior to installation in order to best protect them.

4.6. If goods have to be stored for long periods, they should be kept in their original packing, stored flat and unobstructed in a dry, cool and dark environment. To ensure a satisfactory life expectancy for any rubber components, exposure to sunlight, ultraviolet light and ozone should be prevented.

4.7. Care must be taken during handling to prevent any mechanical damage occurring due to dropping, crushing etc. Particular care and attention should be paid to the running/sealing surfaces of the face and seat.

5. PREPARATION

5.1. Remove all burrs and sharp edges over which the seal must pass. The surface of the shaft, local to the seal, should be clean and to the specified diameter and tolerance.

5.2. Ensure that all mating faces with the seal, i.e. the end face of the sterntube/housing is machined to the following parameters:

#	Surface finish		- 6.3 µm Ra or finer.	
#	Flatness		- 0·08 mm.	
#	Perpendicularity		Seal Size: 50 - 110 120 - 250 260 - 320	FIM (Measured outside the bolting P.C.D.) 0·2 mm 0·35 mm 0·5 mm

The forward end of the Sterntube must be machined to accept the main seat securing screws as detailed on the G.A. Drawing.

5.3. All mating surfaces should be clean with no debris or old joint material, etc. present.

5.4. Ensure that all items listed on the G.A. Drawing as "Customer Supply" e.g. joints, fasteners, are available and sized as shown on the G.A. Drawing. Note: Joints must have the same bore, overall diameter, holes etc as the seat or component to which they will be fitted. Thus the bore of the joint must be small enough to fully cover and seal the cooling water annulus in the back of the seat.

5.5. Make sure that the end of the bearing does not stand proud of the sterntube as this will distort the seat.

5.6. Due to the non-split nature of the EJ seal, the propeller shaft must be removed, withdrawn or de-coupled to allow the components of the seal to be fitted over the shaft.

5.7. It is essential that the running surface of the face and seat are protected at all times during storage, transit and installation to promote correct operation of the assembled unit. Even minor damage to these surfaces can promote leakage.

6. HEAD TANK LOCATION

For oil lubricated systems, the head tank must be positioned at such a height above the full load water line as to obtain a minimum differential pressure on the outboard seal of 0.3bar. This requirement shall override any information supplied in respect of an inboard seal.

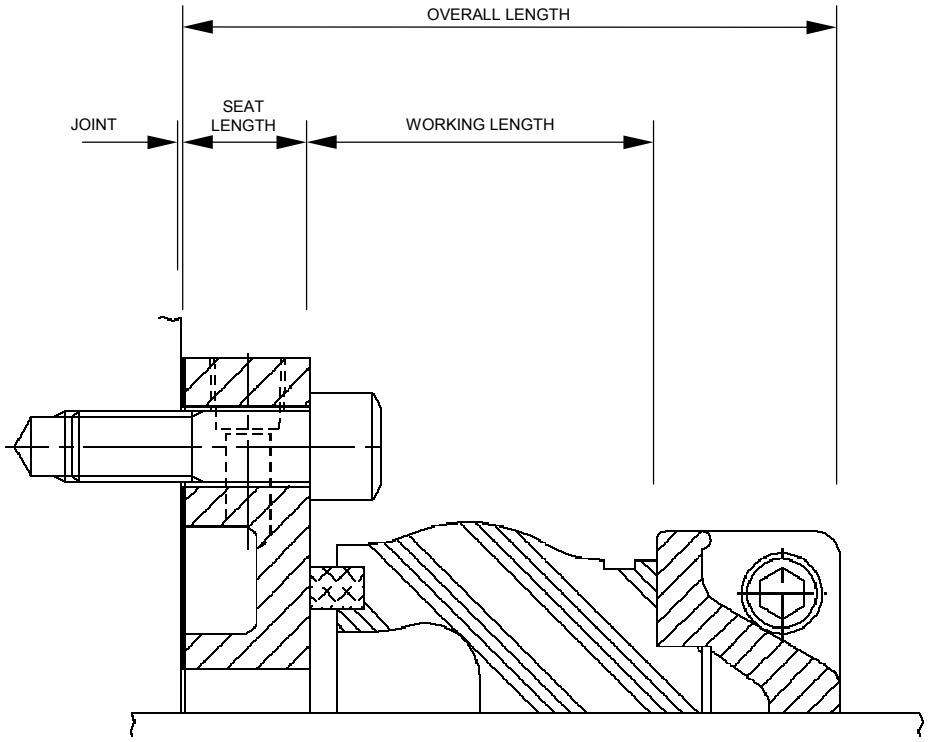
Further, the seat of the EJ oil seal must be cooled, details of these requirements also follow.

Details for both oil and water requirements should be as per TDS 1/007, copies of which follow – see Attachments Section 16

7. SPECIAL INTERFACING REQUIREMENTS

The EJ Inboard seal is designed so that when assembled with its clamp and the seat plus the shaft and propeller in their final positions, the seal is compressed by the correct amount.

EJ Seal General Dimensions



Four areas of interfacing are relevant.

7.1. The Bore/I.D. of the rubber body and drive clamp ring to the shaft

The seal will be supplied with the bore of the body and d.c.r. sized to suit the stated shaft diameter.

7.2. The Stationary Seat interface

The surface of the Sterntube to which the Seat is to be fitted must comply to the requirements of Section 5 (Preparation).

The inner diameter of the seat is directly related to the "specific" diameter of the shaft in question. The shaft diameter must be as stated (ordered) and within the tolerance shown on the G.A. Drawing.

7.3. Axial Space

Though the Inboard EJ seal does not require a "specific" Axial Space into which to fit, the space must be sufficient.

Check that inboard of the Sterntube forward surface (or the surface to which the seal is to be fitted) there is sufficient clear and unobstructed parallel shaft available to fit the seal.

The length required is the Overall length of the seal (as shown on the G.A. Drawing for the particular seal size) plus the compression to be applied to achieve the overall length.

The compression will be shown on the Drawing and is normally 6 mm across all seal sizes.

Thus the "Free Length" of the seal is Overall Length (which includes the 1·0 mm joint) plus Compression.

An available axial space at least a little in excess of this is desirable.

7.4. The connection of Services to the Seat

All connections and services (usually seat cooling water) as detailed on the relevant G.A. Drawing must be provided, ready for connection.
Section 6 and TDS 1/007 also make reference to the service connections.

8. INSTALLATION.

(Refer to relevant Drawings(s) - See Attachments - Section 16)

8.1. Axial Space

Before fitting the EJ seal, re-conform that sufficient axial space will be available in which to fit the seal as described in Section 7.3.

8.2. Shaft

As referenced in Preparation (Section 5.6), the shaft must be arranged so that the non-split components of the EJ seal can be fitted "over" it.

Care must therefore be taken to ensure that the Joint, Seat Assembly and Body Assembly of the seal (The clamp is split and can be fitted around the shaft) are correctly positioned and fitted on the shaft if this has to be done prior to the installation of the shaft in the ship. (i.e. a cone mounted propeller shaft with a solid forward coupling flange which has to be entered into the sterntube from inboard).

The shaft should now be fully entered into the Stertube Bearing until it protrudes from the other side.

8.3. Seat Installation

8.3.1. Before installing the solid seat the compressed fibre joint must be fitted to the mounting surface. A thickness of 1 mm is recommended to minimise bolt inducted distortion. On no account should a joint of more than 2 mm be used.

A rubber gasket must not be used.

Lightly grease both surfaces of the joint and position it on the Sterntube ensuring that all holes are aligned with the tapings in the Sterntube Flange forward surface. Ensure that the joint is not cut away behind the seat cooling annulus. The joint must fully cover the annulus in order to seal it.

8.3.2. Carefully remove any strips of tape protecting the seat or its openings and clean the running surface to remove any traces of dirt, debris etc. Identify Top Dead Centre for the seal and carefully position the Seat on the joint with Top Dead Centre correctly orientated. "Lightly" secure the seat assembly in place using the securing screws through the slots in the seat (not the 4 off relieved slots which are used for the compression tooling (studs + square nuts)).

8.4. Seal Body Installation

8.4.1. Where the Seal Body has not already been fitted over the shaft, it should now be fitted.

8.4.2. Ensure the Shaft is perfectly clean etc. as described before.

8.4.3. Fit the Seal Body over the Shaft with the Face towards the Seat. Use a twisting motion to fit the body over the shaft and soapy water only (not oil, grease or any other lubricant) if necessary to assist in sliding the rubber body along the shaft until the face lightly contacts the seat.

8.5. Final Positioning

8.5.1. The Shaft should now be secured into its final running position.

8.5.2. Pull the Seal Body clear of the seat to allow the seat to be centralised.

8.5.3. Centralise the Seat to the Shaft so that it concentric to within 0·5 mm. Then evenly and in a diagonally opposite sequence, tighten the securing screws to the Torque specified on the G.A. Drawing.

Do not exceed this torque.

8.5.4. Clean both the seat running surface and the face of the seal using a non-chlorinated solvent cleaner and then move the seal body again until the face is in contact with the seat.

8.5.5. Fit the split drive clamp ring around the shaft and over the spigot at the forward end of the rubber body. Note. For seal sizes #70 to #320 the Drive Clamp ring vertical surface is "knurled" where it contacts the flat surface of the rubber body.

8.5.6. Fit and evenly tighten the drive clamp ring butt securing screws (and nuts in the case of EJ sizes #50 and #60) until the clamp ring begins to grip the shaft. (Ensure that the clamp ring screws are evenly tightened and that an equal space is maintained between the butts of the two halves of the clamp.

8.5.7. Fit the compression tooling by screwing the 4 off studding bars provided into the 4 off Square nuts and fitting these onto the recessed or relieved slots in the seat.

Place one of the compression tools over each stud so that it fits and locates as shown on the G.A. drawing. Then fit one washer followed by one nut onto each piece of studding and tighten until just tight. The seal should now be at its "Free Length" (i.e. no compression yet applied). Measure between the clamp and the seat as shown on the G.A. drawing in 4 places and note the figure(s).

8.5.8. Compress the seal to its "Working length" by using the now fitted compression tooling. The Working length is the Free length less 6 mm. Thus gently and evenly compress the seal until it has been compressed by 6 mm, from the as measured "Free Length".

Continue to monitor the length of the seal at 4 positions during compression in order to ensure that that the seal body is "evenly" compressed.

8.5.9. Once the seal body has been correctly compressed, finally, evenly tighten the Drive Clamp Ring butt screws (and nuts if fitted) to the torque specified on the G.A. Drawing.

8.5.10. Remove the compression tooling including the studding and safely store all items for future use.

8.6. System Connections

8.6.1. The EJ seat has 2 threaded flush connections (inlet and outlet) as shown on the G.A. Drawing, positioned either side of T.D.C.

8.6.2. As previously referenced in Section 6 and later in Section 11, the sterntube is connected to a lubricating oil system, this is normally achieved via connections directly into and out of the sterntube itself, not via the EJ seat.

Connect the cooling water-flush and lub oil supply/drain as appropriate according to the T.D.S. schematics in Sections 6 and 11

Check before connection that all pipes are clean and free of scale internally before connecting them to the seat and sterntube.

Note: It is imperative that the cooling water flush is provided to the seal in the quantities and at the temperature shown on the G.A. Drawing and the TDS sheets as referenced in Sections 6 and 11, (the flush figure is a minimum) at all times whilst the shaft (and thus the seal) is dynamic (rotating).

8.6.3. For the system (both cooling water flush and oil) requirements with regard to pressures, flows, temperature and valve positions refer to both the G.A. Drawing and the System Drawing TDS 1/007 (Sections 6 and 11).

9. TESTING

9.1. Seat cooling water flush annulus

Refer to Section 8.6 (System Connections) regarding pipework connections.

Test the integrity of the cooling water chamber in the aft surface of the seat by closing the outlet valve, applying a pressure of 1.0 Bar and checking for leakage by closing the supply valve; the pressure may drop very slowly. If there is a rapid loss of pressure, the pipe connections and seat should be examined. If this is not the reason for the pressure drop then the seat is not being sealed to the sterntube by its joint or the seat itself is leaking (porous or damaged). Rectify any reasons for the pressure drop and re-test.

9.2. Main Seal

After the Seal Body has been fitted and compressed and with the cooling water flush and lub oil connections made as per Section 8.3 onwards, proceed to test the main seal as follows:

Apply oil pressure to the main seal via the stern tube connections (for value see General Arrangement Drawing). A small leakage between the face and seat is acceptable on static test which should decrease once the seal has 'run-in'.

10. NORMAL OPERATION

During Normal Operation with the "EJ" seal functioning within parameters, all conditions should be stable.

10.1. Stable Operating Conditions

10.1.1. Oil ingress within acceptable limits.

10.1.2. No noticeable signs of the seal overheating

10.1.3. Bearing Temperature(s) normal.

10.2. Routine Checks that should be conducted

10.2.1. Check for leakage regularly.

10.2.2. Check for signs of overheating regularly.

10.2.3. Check the cooling water flush flow rate to the seat regularly.

10.2.4. Check the position (open/closed) of the cooling water flush supply valve(s) daily.

10.2.5. Check and record the header tank level daily – refilling if necessary.

10.2.6. Check and record the bearing/stern tube lubricant temperature daily.

10.2.7. Check the operation of any supply pumps, filters etc. (if fitted) on a daily basis.

10.2.8. Check the cooling water flush flow alarm (if fitted) weekly for correct operation.

10.2.9. Check the header tank alarm(s) weekly for correct operation.

10.2.10. Check the sterntube/bearing for water ingress using the sampling cock weekly.

10.2.11. Check the face wear/length monthly. (✳ shaft stopped and locked).

10.2.12. Check for seal working length 3 monthly (✳ shaft stopped and locked).

10.2.13. Test the lubricant in accordance with the manufactures recommendations.

11. LUBRICATION SYSTEM

For an "EJ" Inboard Oil Lubricated seal, refer to Technical Data Sheet (T.D.S.) 1/007.

This defines the requirements of the system with respect to pressures and required differentials as well as flow rates and temperatures.

The two sheets of TDS 1/007 show different systems for the requirements of the oil system and the cooling water flush system for the seat. Between them they define the System Requirements.

TDS 1/007 follows – see Attachments Section 16.

12. RECOMMENDED LUBRICANT LIST

For an "EJ" Inboard seal used in an "Oil " lubrication system please refer to the following Technical Data Sheet (T.D.S.) 9/001 Sheet 4 or 4.

The T.D.S. lists recommended and acceptable oils for use with “E” series seals.

T.D.S. 9/001 Sheet 4 of 4 follows – see Attachments Section 16:

13. PROBLEM SOLVING – LEVEL ‘a’

13.1. Problems

Any problems with the “EJ” Oil lubricated) inboard seal will normally show themselves in one of two ways.

(a) The loss of lubricant from the system.

(b) Water ingress into the lubricating system.

(c) Over heating of the seal.

(Refer to the associated causes and corrective actions in Section 13.4, 13.5 and 13.6).

13.2. Evidence

Evidence that any of the above has occurred will be demonstrated in one of the following ways. (Also refer to the associated problem solving flow charts in Section 13.3 as indicated below).

i) A visible oil leak found during routine inspection of the seal (Flow chart 13.3.2).

ii) A low level alarm warning from the bearing header tank (Flow chart 13.3.3).

iii) A low flow in the seat cooling water flush supply activating the low flow alarm if one is fitted (Flow chart 13.3.4).

iv) A high bearing/sterntube temperature alarm. (Flow chart 13.3.5).

v) Water or an Emulsification found during routine testing of the bearing lubricant. (Flow chart 13.3.6).

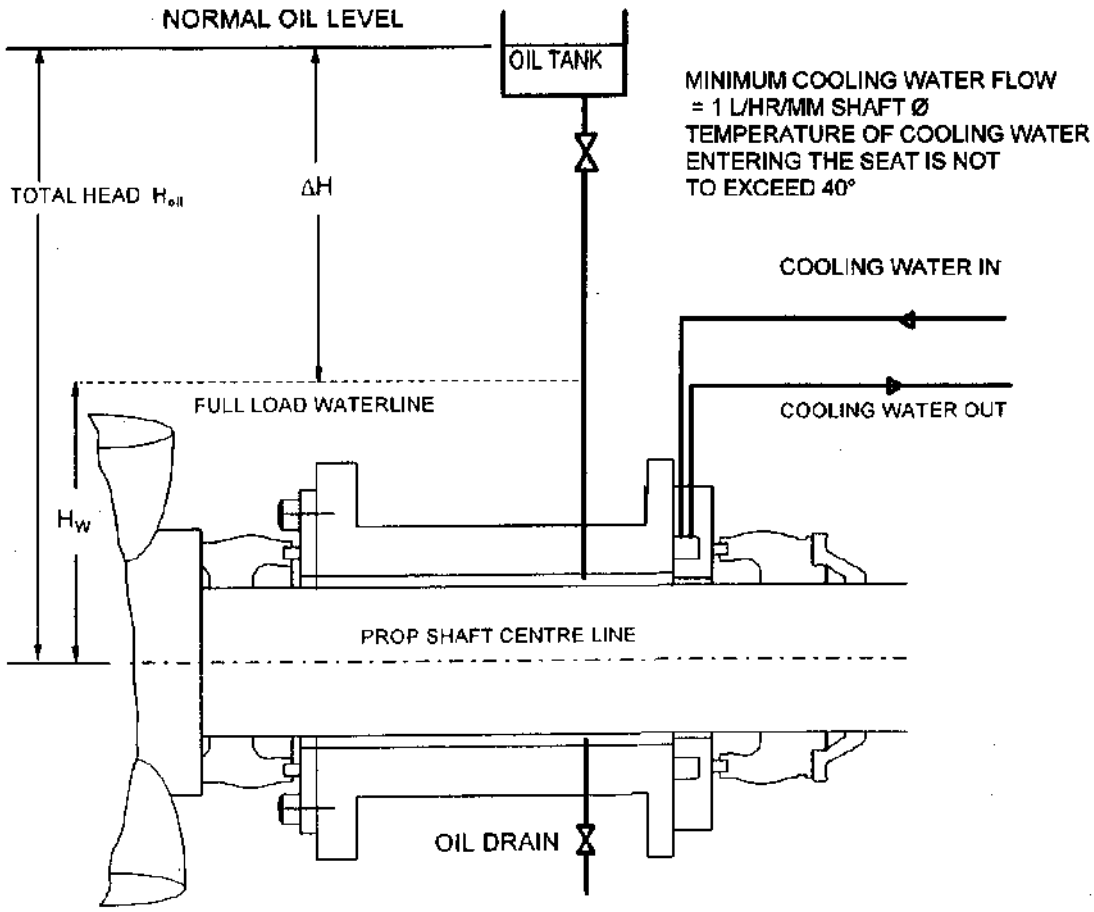
vi) An increase in the level or overflow of the bearing header tank activating the high level alarm (if one is fitted) (Flow chart 13.3.7).

vii) Noticeable signs of inboard seal overheating (Flow chart 13.3.8).

13.3. Flow Charts

Explanations of the above, including cause, effect and corrective actions now follow:

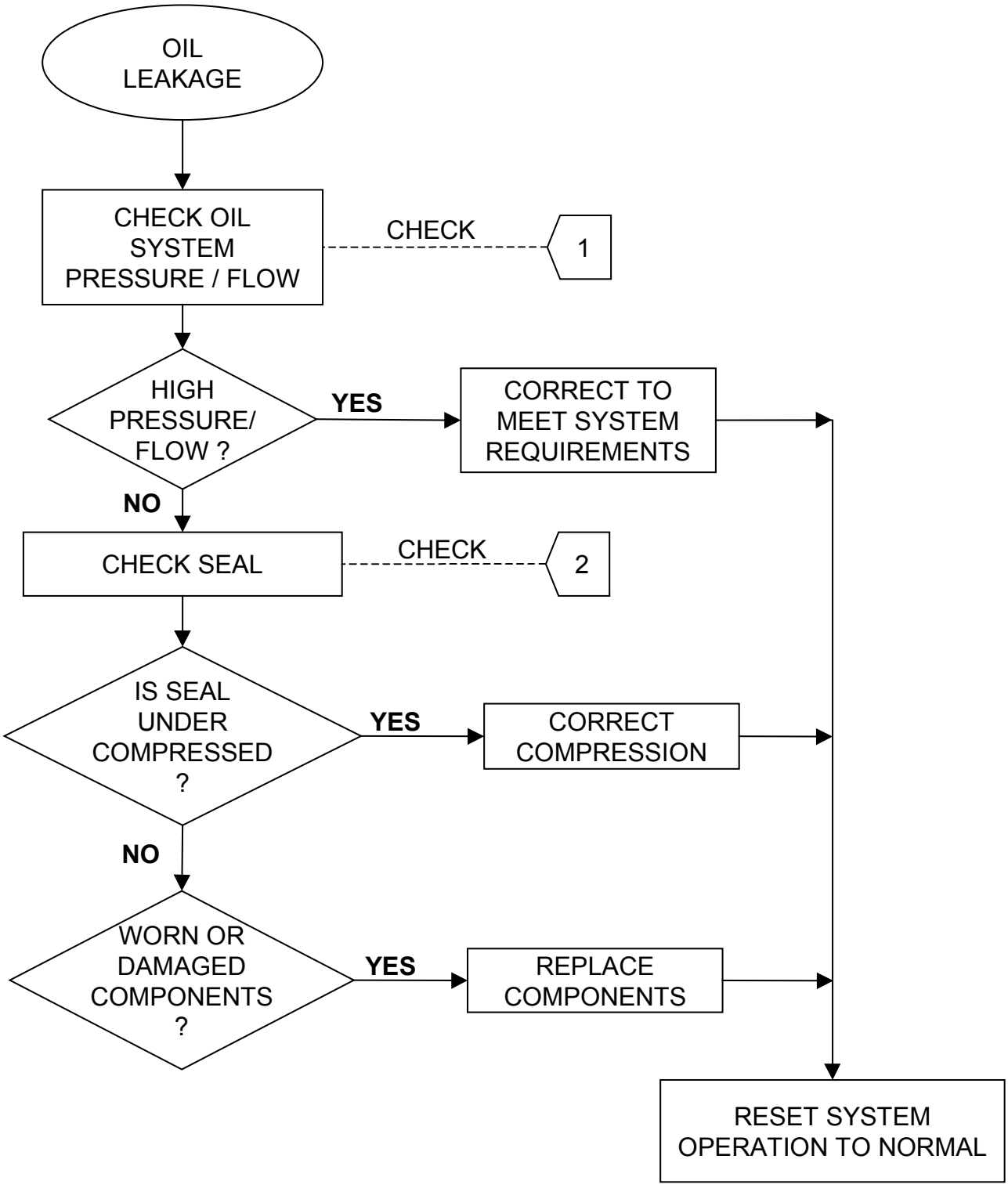
13.3.1. NORMAL OPERATION



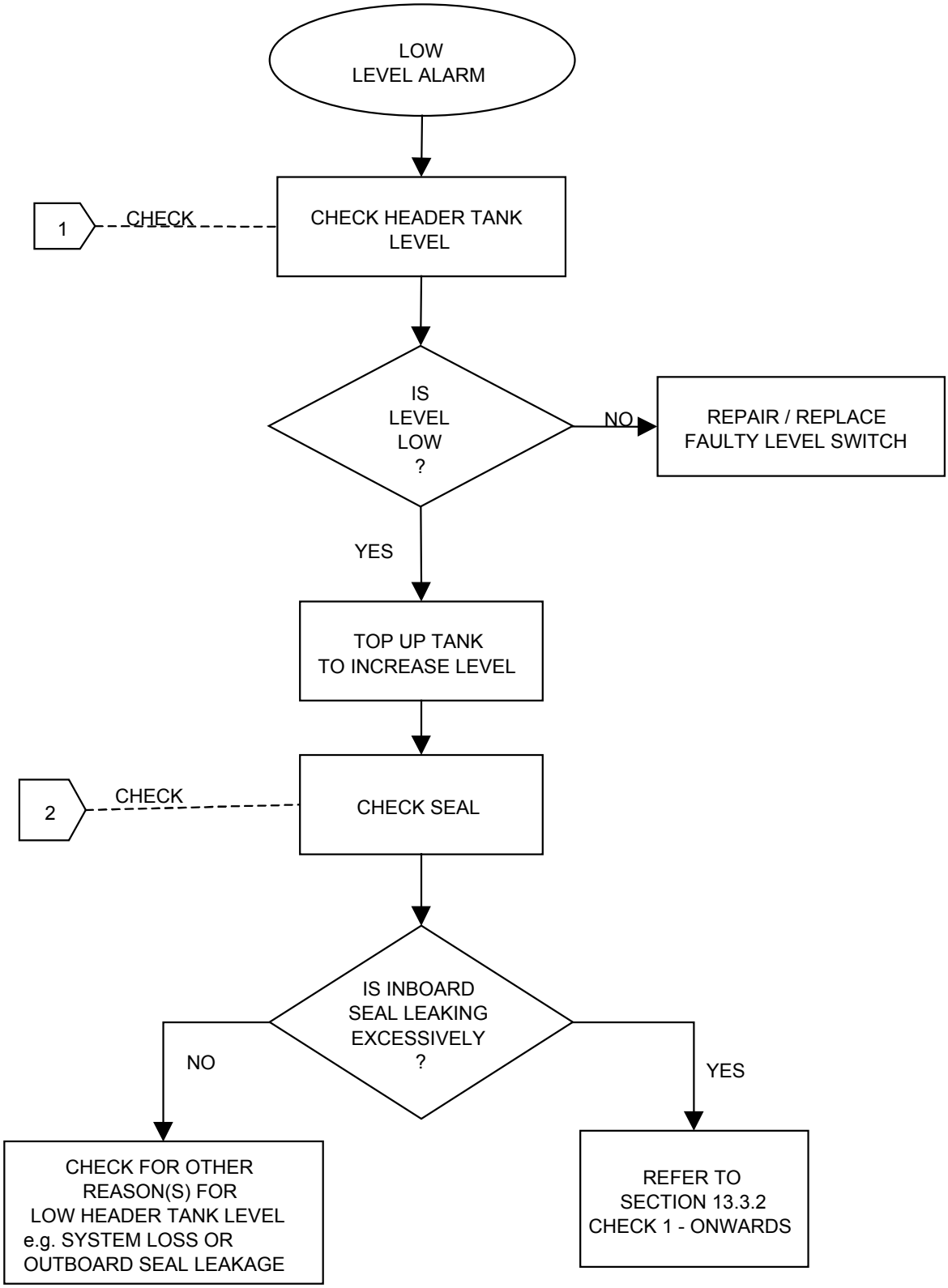
STERNTUBE MIN OIL PRESSURE = WATER HEAD + 0.3 BAR
STERNTUBE MAX OIL PRESSURE = 0.8 BAR

- **STABLE CONDITIONS**
- **NO VISIBLE LEAKAGE INBOARD**
- **LUBRICANT TANK LEVEL UNCHANGED**
- **NO SIGNS OF SEAL OVERHEATING.**
- **LUBRICANT TEMPERATURE NORMAL**
- **LUBRICANT CONDITION GOOD.**

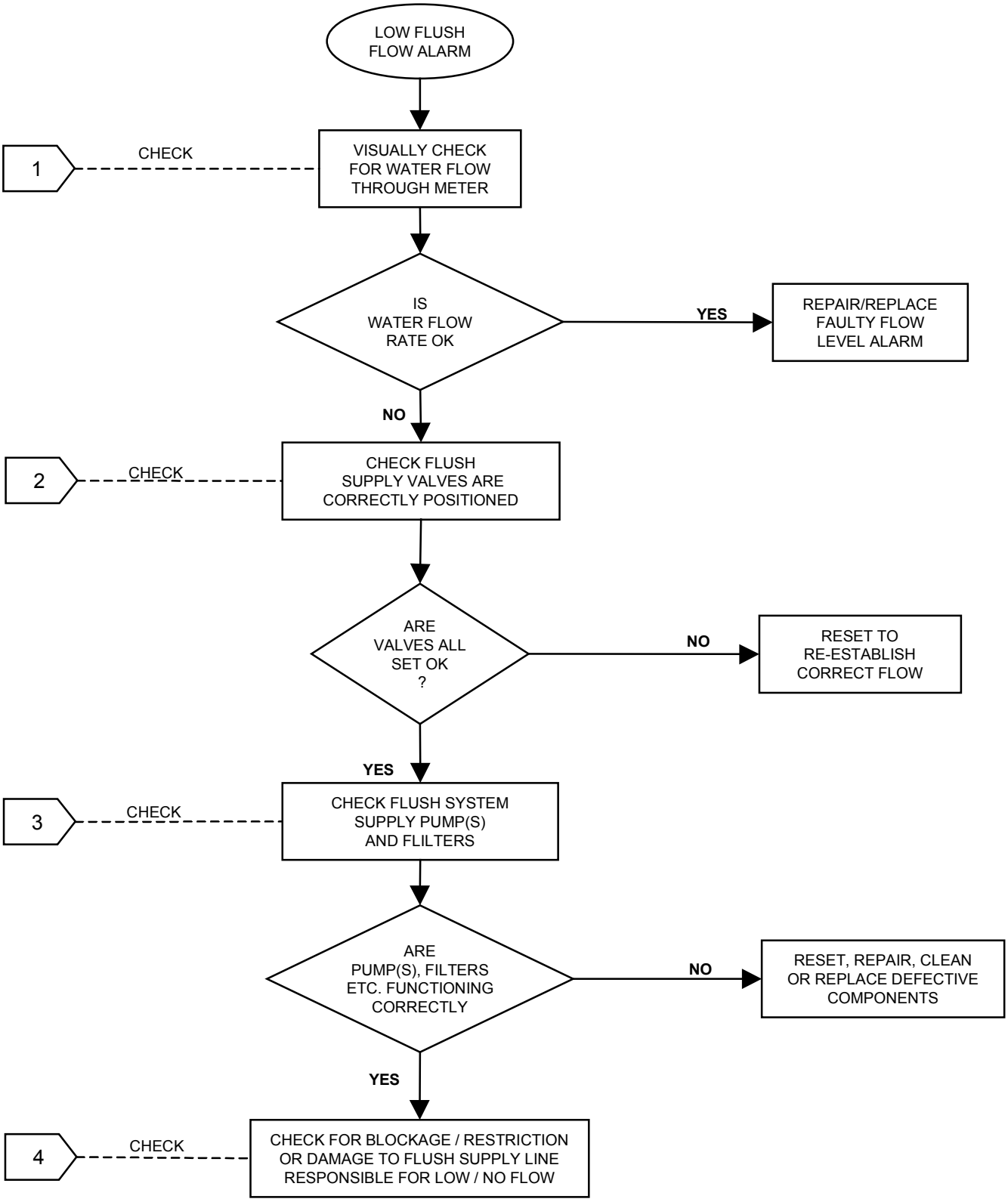
13.3.2. VISIBLE OIL LEAKAGE



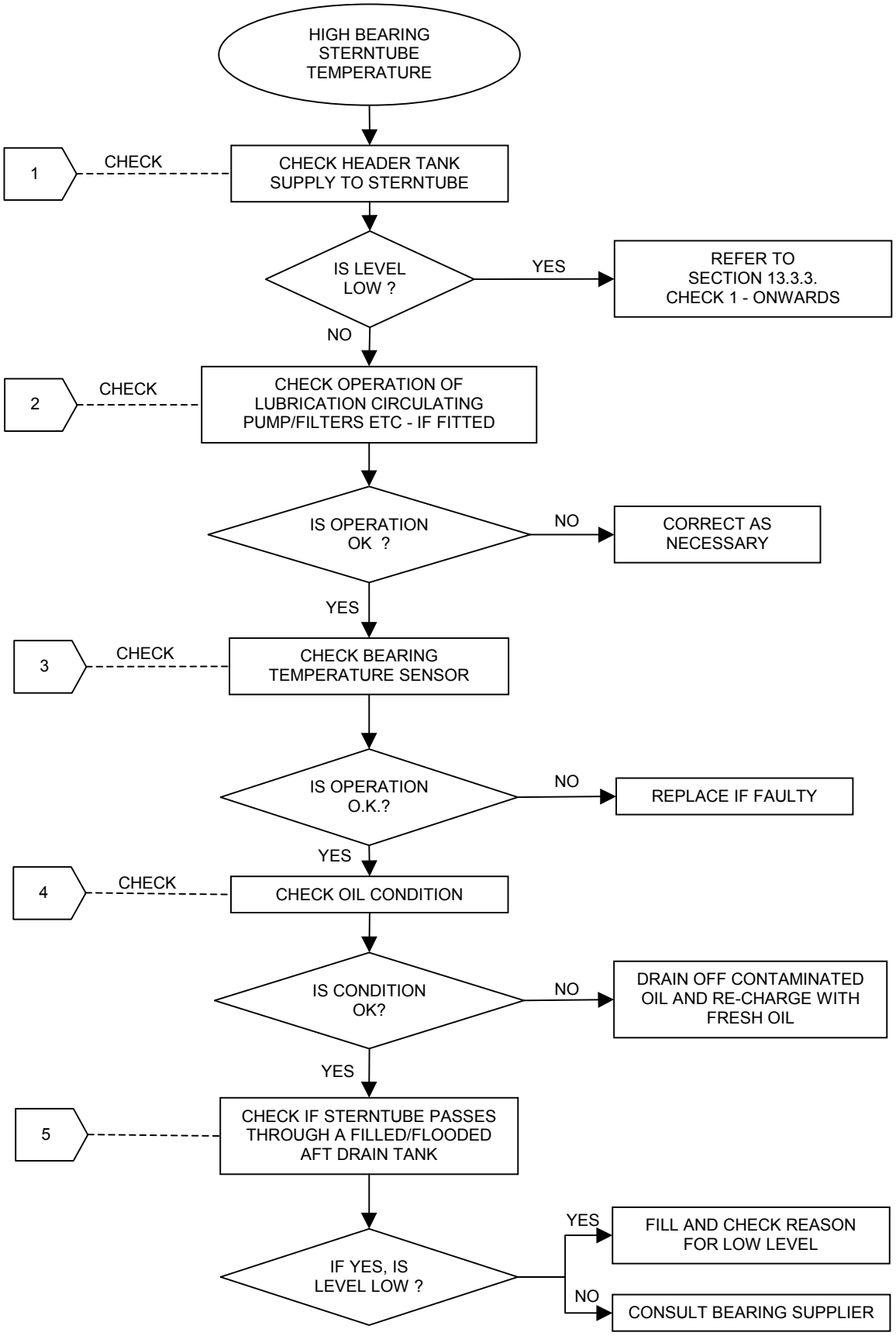
13.3.3. HEADER TANK LOW LEVEL ALARM



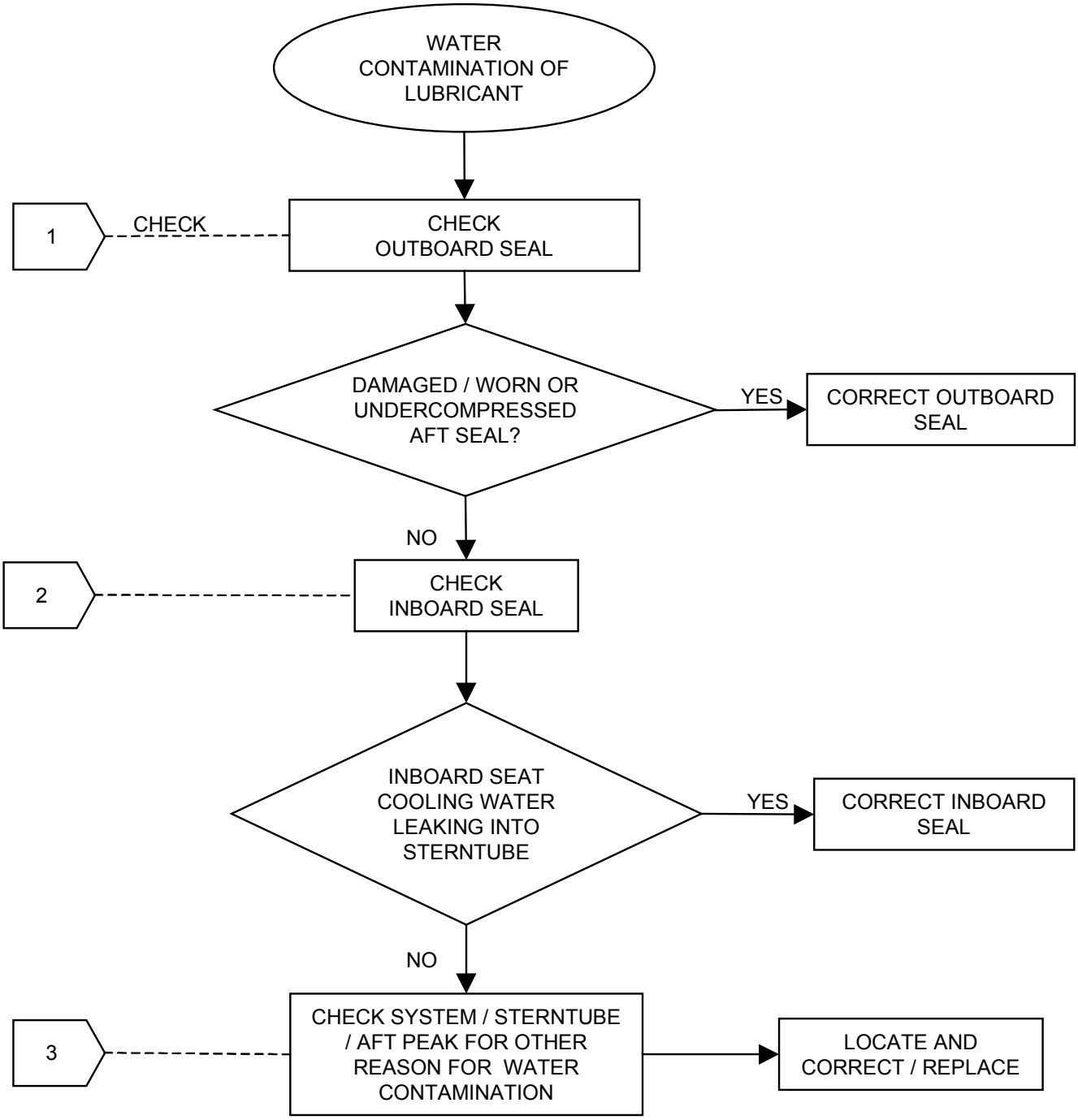
13.3.4. LOW SEAT COOLING WATER FLUSH SUPPLY FLOW ALARM



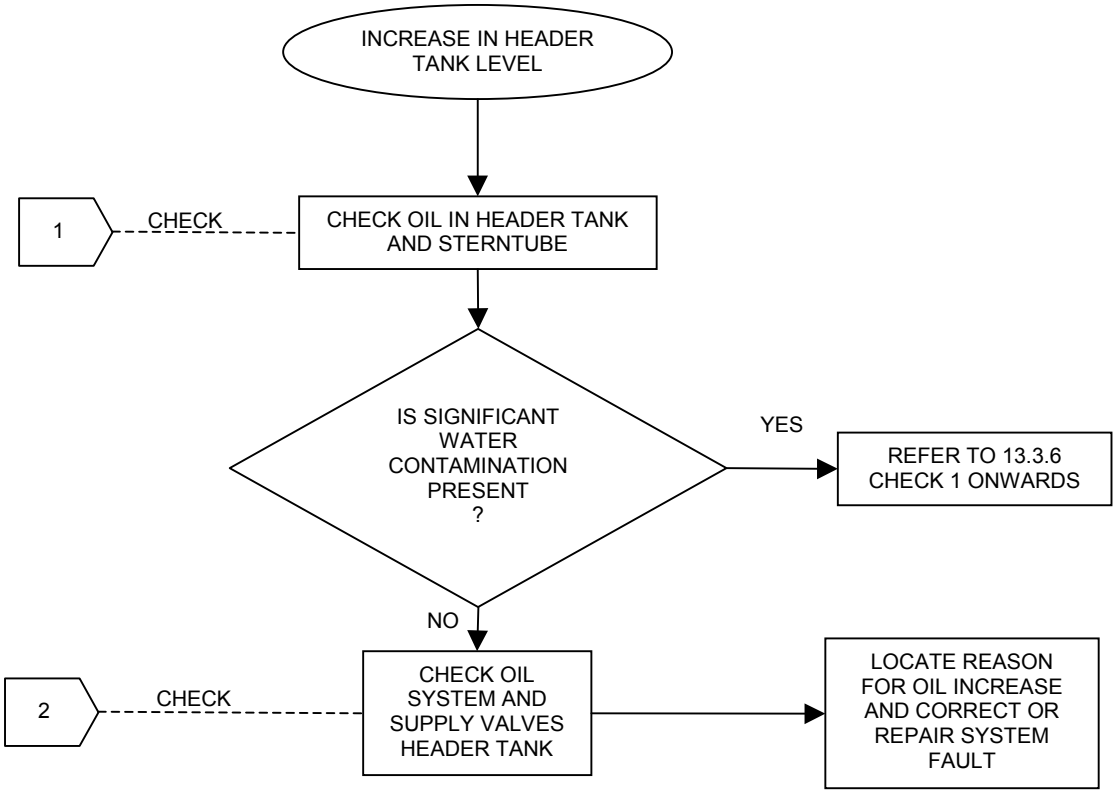
13.3.5. HIGH BEARING/STERNTUBE TEMPERATURE



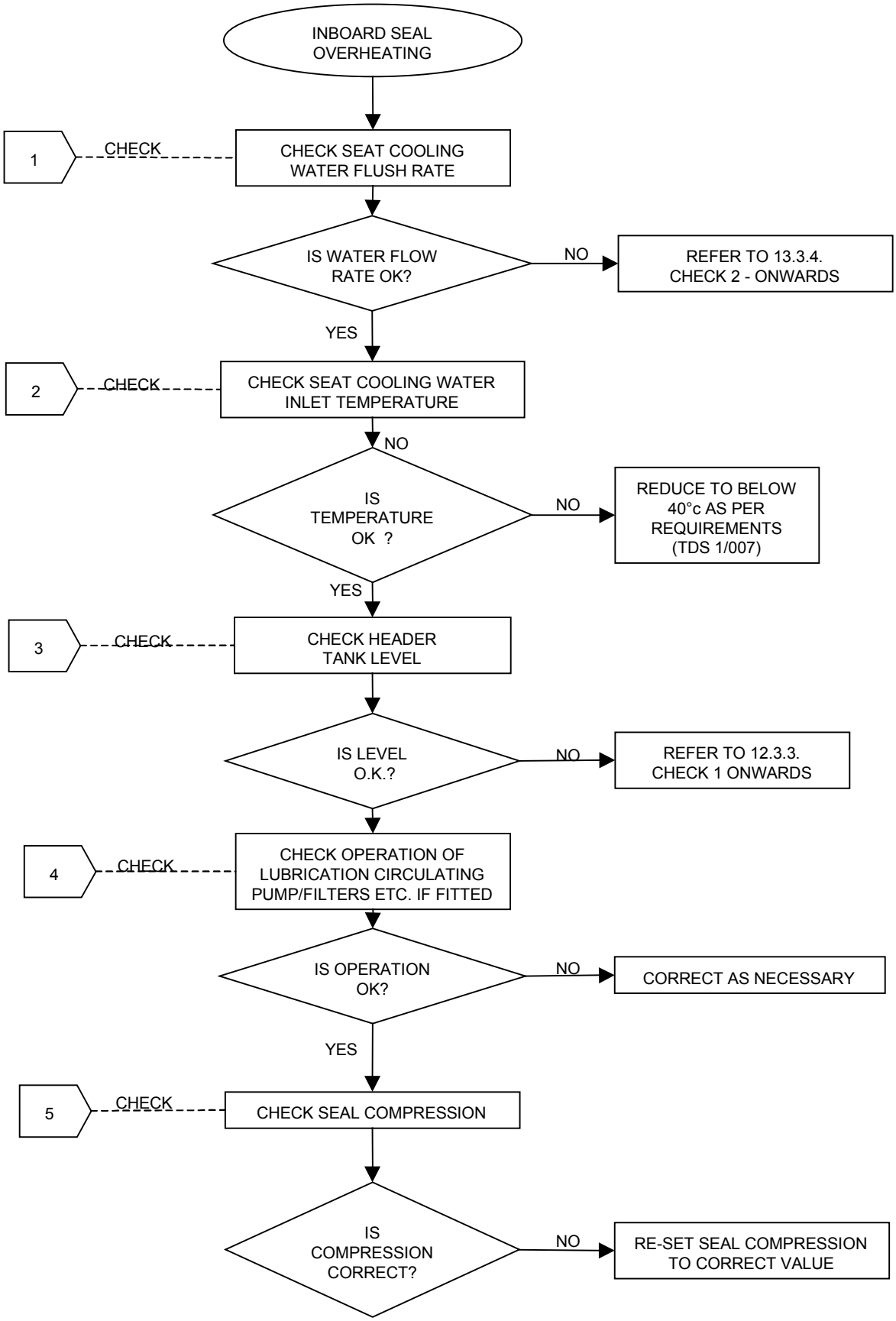
13.3.6. WATER OR EMULSIFICATION FROM BEARING TEST COCK



13.3.7. HEADER TANK INCREASE IN LEVEL OR OVERFLOW



13.3.8. OVERHEATING OF INBOARD SEAL



13.4. SECTION "A" – LUBRICANT LOSS FROM THE SYSTEM

Lubricant leakage from the Inboard seal system may be due to one or more causes. For each, a suggested course of corrective actions follows:

CAUSE		CORRECTIVE ACTION	
A1	Lubricant pressure/flow too high	a	Reduce to that stated in the Technical Manual.
A2	Loss of seal compression due to age or wear	a	As a temporary measure, increase compression by 1 or 2 mm using the compression tooling until components can be replaced.
		b	Replace the component(s) responsible for the loss of compression.
A3	Insufficient compression due to installation or axial shaft movement	a	Establish the correct compression by resetting - the drive clamp ring using the compression tooling.
		b	Determine and rectify the causes of excessive shaft movement.
A4	Debris between the face and seat.	a	Carefully remove any debris. If no damage has occurred a good seal should be re-established. If damage has occurred - refer to "A5".
A5	Damage to the inboard seal.	a	If the seal is damaged and is leaking then proceed as for 2a. having first checked and carefully removed any debris.
		b	Replace damaged components as soon as is possible.
A6	Wear or damage to the outboard seal.	a	Correct in accordance with the manufacturers instructions.

13.5. SECTION "B" – WATER INGRESS INTO THE SYSTEM

Water ingress into the lubricating system may be due to one or more causes. For each, a suggested course of corrective actions follow:

CAUSE		CORRECTIVE ACTION	
B1	Outboard seal leaking.	**a**	Correct in accordance with the Manufacturers Instructions.
B2	Inboard seal seat cooling water flush leaking into the sterntube.	**a**	As a temporary measure reduce the flush flow/pressure until the forward seal can be overhauled. The inboard seal temperature must be monitored.
		b	Replace the component(s) responsible for the water ingress (e.g. seat joint or damaged seat).
B3	The system is allowing water ingress via the sterntube/aft peak tank or ingress via the header tank / supply system.	**a**	Establish the reason and correct.

13.6. SECTION "C" - EVIDENCE OF OVERHEATING OF THE SEAL

As for lubricant loss and water ingress, overheating may be due to one or more causes.

For each, a suggested cause of corrective actions follow:

CAUSE		CORRECTIVE ACTION	
C1	Seat cooling water flush pressure/flow too low.	a	Increase to that stated in the Technical Manual.
C2	Loss of seat cooling water flush.	a	Check and re-set all flush supply valves to correct position/operation.
		b	Check supply pump(s) and filters etc. for correct operation.
		c	Check for blockage/restriction or damage to the Flush supply line(s) causing low/no flow.
C3	High seat cooling water flush temperature	a	Reduce to that stated in the Technical Manual.
C4	Low header tank level/ loss of lubricant.	a	Top up/refill header tank and correct reason for loss.
C5	Loss or reduction in lubricant flow/circulation.	a	Check operation of pump / filters (if fitted). Ensure valves etc. are correctly set and pipes are clear.
C6	Excessive compression due to installation or axial shaft movement.	a	As for "A" 3a.
		b	As for "A" 3b.

NOTE: Where corrective actions involving material replacement refurbishment or adjustment have rectified a situation, then any "temporary" measures taken such as changes in lubricant pressures should be reverted to normal.

NOTE: If these Problem Solving measures fail to rectify a situation, then assistance and further advice should be sought via one of the contact addresses given in the front of the Technical Manual.

14. MAINTENANCE

(Refer to relevant Drawing(s) - see Section 16)

14.1. The need for "Maintenance" may be determined by several factors which are performance related. Alternatively, though the performance of the equipment may be perfectly satisfactory, maintenance may be carried out as part of a planned/preventative schedule. Overhaul of the equipment may also be carried out because it is part of a system or assembly that is itself needing or due for maintenance!

14.2. Factors that normally determine the need for Maintenance are:

14.2.1. Performance :-

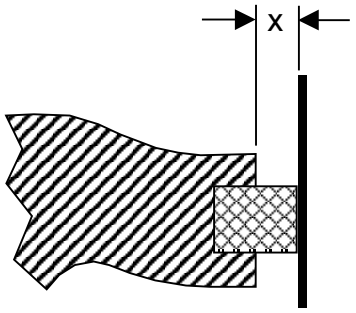
Lubricant leakage past the seal.

14.2.2. Wear :-

Normally associated with the fibre "face" in the "EJ" seal, though it does to a lesser degree affect the ni-resist seat.

Wear is important as the loss of material means a loss of compression in the rubber body which can lead to leakage.

Wear can be determined by measuring the distance between the seat and the rubber body (see below).



Condition for Seal Size:		Status
#50-#60	#70-#320	
X = 5 mm	X = 6 mm	'as new'
X > 3 mm	X > 4 mm	O.K.
X < 3 mm	X < 4 mm	Replace body assembly

Normally an oil lubricated seal experiences low levels of wear.

14.2.3. Damage:-

The seal can be damaged due to debris or physical intervention however with an Inboard Seal this is not a common reason for Maintenance.

14.2.4. Age:-

The face and seat elements have no limitation with regard to Age. Their "service life" will be governed by "Performance", "Wear" or "Damage". The life limit for the EJ **"rubber"** body is 10 years (elapsed time - not just operation) and renewal must be carried out every 2nd 4/5 year docking. However, it is more likely that for operational reasons (Performance, Wear or Damage) that the Body will be replaced "every" 4/5 year docking.

Replacement of the EJ body at least every 8-10 years is recommended as the body is compressed on fitting and provides the necessary closing force between the face and seat. Rubber loses "elasticity" over a period of time and the body will develop a "permanent set" with a subsequent loss of closing force. The rubber Inflatable seal, even if it has never been used, only tested, should as an **"emergency"** seal be replaced routinely every 4/5 years.

14.3. To replace or carry out maintenance on either the "EJ" seal body or seat assembly, the propeller shaft must be de-coupled or removed to allow removal of these non-split items.

Note : If the shaft is to be removed - the Inboard Seal must first be disassembled.

Proceed as follows:

Whenever replacing the seal body assembly, the seat should be removed and re-conditioned or replaced as required.

A new seal face should not be run against a previously used seat that exhibits any evidence of wear or grooving. If the seat cannot be restored to an "as new" surface condition by abrading (rotary motion) with a 600 grade grit paper, it must be machined to remove any wear track or pattern.

14.4. Seal Disassembly

14.4.1. With the shaft stopped, locked and de-coupled ensure that the lubricating system and the system supplying flush water to the seat are either shut down or isolated from the seal.

Now disconnect all pipe connections to the EJ seal.

14.4.2. Install the Compression Tooling in all 4 positions (as described in Section 8.5.7.) and tighten until the Tooling is gripping the drive clamp ring.

14.4.3. Slacken but do not remove the drive clamp ring securing screws (and nuts in the case of EJ seal sizes #50 and #60.

14.4.4. Gently and evenly (on all four fittings) release the compression on the seal by carefully undoing the nuts on the forward end of Compression Tooling.

When the tooling goes slack, remove the nuts, washers, tools and studs comprising the Compression Tooling from the seal and store them safely for future use.

14.4.5. Fully undo the Drive Clamp ring screws (and nuts if fitted) and remove them along with the two halves of the Drive Clamp Ring from the Shaft.

Put these carefully to one side for future re-use.

14.4.6. Remove the Rubber Body from the Shaft using a rotating motion. Use soapy water "only" to lubricate the shaft if removal is difficult.

14.4.7. Undo and remove the Screws/Bolts etc. securing the seat to the Sterntube. Retain these for future use. Now remove the seat from the Sterntube and remove it from the shaft.

14.4.8. If the Shaft is to be removed from the Sterntube, it may be removed now!

14.4.9. Finally remove the joint and any traces of it from the Sterntube and the back surface of the Seat.

14.5. Seal Reconditioning

14.5.1. Drive Clamp Ring Assembly

The D.C.R. and fasteners should be re-usable. Thoroughly clean all components. The knurling on the DCRs for seal sizes #70 and above should be cleaned using a wire brush to remove any embedded rubber or dirt and thus provide maximum grip and drive.

The DCR can be checked for distortion by bolting the two halves together and measuring the bore in several places.

To correctly measure the split clamp, **spacers** must be inserted between the butt surfaces of the two halves.

For DCRs for seal sizes #50 and #60 use spacers of 2.0 mm thickness. For all larger seal sizes use 3.0 mm spacers.

With the correct spacers in place the internal diameter of the Drive Clamp Ring should be the Shaft Diameter +0.1/ 0mm.

14.5.2. Body Assembly

The Body Assembly which incorporates the Face, is supplied as a single component and is not considered refurbishable. The Body should be replaced in line with the recommendations in Section 14.2 regarding "Performance", "Wear", "Damage" or "Age".

14.5.3. Seat Assembly

The Seat Assembly comprises the non split Seat as above.

Thoroughly clean the seat, then recondition as follows:

Remove any evidence of a running track on the sealing surface with a 600 grade grit paper using a rotary motion (paper stationary - move the Seat by hand). If the wear track cannot be removed in this manner, it can be machined. The machining process is a fine "turning" one, not grinding or lapping. The surface finish to be achieved is 1.6 µm. which should then be polished to 1.2 µm. (using a find grade grit paper as above).

The machined front surface of the seat must remain parallel to the back flange surface to within 0.08 mm for all the sizes #50 to #320.

The amount of material that may be removed from the front running surface is governed by the thickness of material remaining. Three areas are relevant, the thickness between the running surface and the annulus, between the o.d. of the two through holes to the running surface and the o.d. of the b.s.p. tapping in the holes to the running surface.

The tapped holes are where the material is at its thinnest, however as long as the machining is restricted to the diameter/area inside the main securing screw slots, then more material can be removed.

The thickness of material remaining in this area should not be allowed to fall below 5.0 mm for seal sizes #70 and upwards and 4.0 mm for seal sizes #50 and #60 after wear and machining.

Further, the “back” surface of the seat, especially the I.D. of the annulus can suffer from erosion.

Ensure that the material remaining at the back of the seat is both flat and sufficient outside of the annulus to support the seat and seal the annulus when fitted with its joint.

Replace the seat if it cannot be refurbished satisfactorily.

14.6. Seal Re-Assembly

14.6.1. With the Seat Assembly now ready for fitting, carry on with the re-assembly of the EJ seal as described in Installation from Section 8.3 (Seat Installation) onwards up to an including Section 9 Testing.

14.7. Maintenance with the Shaft fully installed.

Due to the non-split nature of the EJ Seal, the Maintenance that can be carried out with the Shaft still fitted is extremely limited. It includes:

- Opening up and cleaning of the Seal.
- Inspection and measurement of the Seal.

To proceed, follow the Seal Disassembly procedure from Section 14.4 onwards, however where reference is made to removal from the shaft of non-split items (everything except the Drive Clamp ring Assembly) this instruction cannot be complied with. The components can only be moved along the shaft in order to create access space in order to carry out:

- Cleaning/Inspection/Measurement - Standard procedures.
- Joint Replacement - Disturbing the old joint will necessitate its renewal. A correctly sized joint with all necessary holes must be made and it must then be split in one position using a dove tail cut/join in order to fit it **"around"** the shaft.
- Re-assembly - Reversal of the Installation Procedure.

15. SPARE PARTS AND THEIR STORAGE

15.1. For the "EJ" seal, as it is basically only a 3 component assembly (Body, Drive Clamp Ring and Seat Assemblies), the requirement for "Spare Parts" is limited.

15.2. The seat is considered to be a refurbishable item using a simple machining process as described in Section 14 (Maintenance).

15.3. .The Drive Clamp Ring assembly is considered re-usable.

15.4. The only component that may be held as a spare is a Body assembly. However due consideration must be given to the possibly lengthy storage of rubber components and that the rubber body can only be installed with the shaft de-coupled or removed.

15.5. All parts held as spares should be kept in their original packaging as they will have been inspected and packed prior to despatch as described in Section 4 (Storage and Handling).

15.6. All components must be protected from damage or deterioration by maintaining their original packing and careful storage to prevent physical damage (with special care being taken of any fine machined surfaces or critical components).

All spares should be stored flat and unobstructed in a dry, cool and dark environment, as described in Paragraph 4.6.

16. ATTACHMENTS

The following attachments are covered by this Technical Manual (TM EJ/04).

- Tabulated or Specific General Arrangement Drawing(s) *
- TDS 1/007
- TDS 9/001 (Sheet 4 of 4)

***Note:** This manual is written based on the General Arrangement Drawings listed on the front cover.

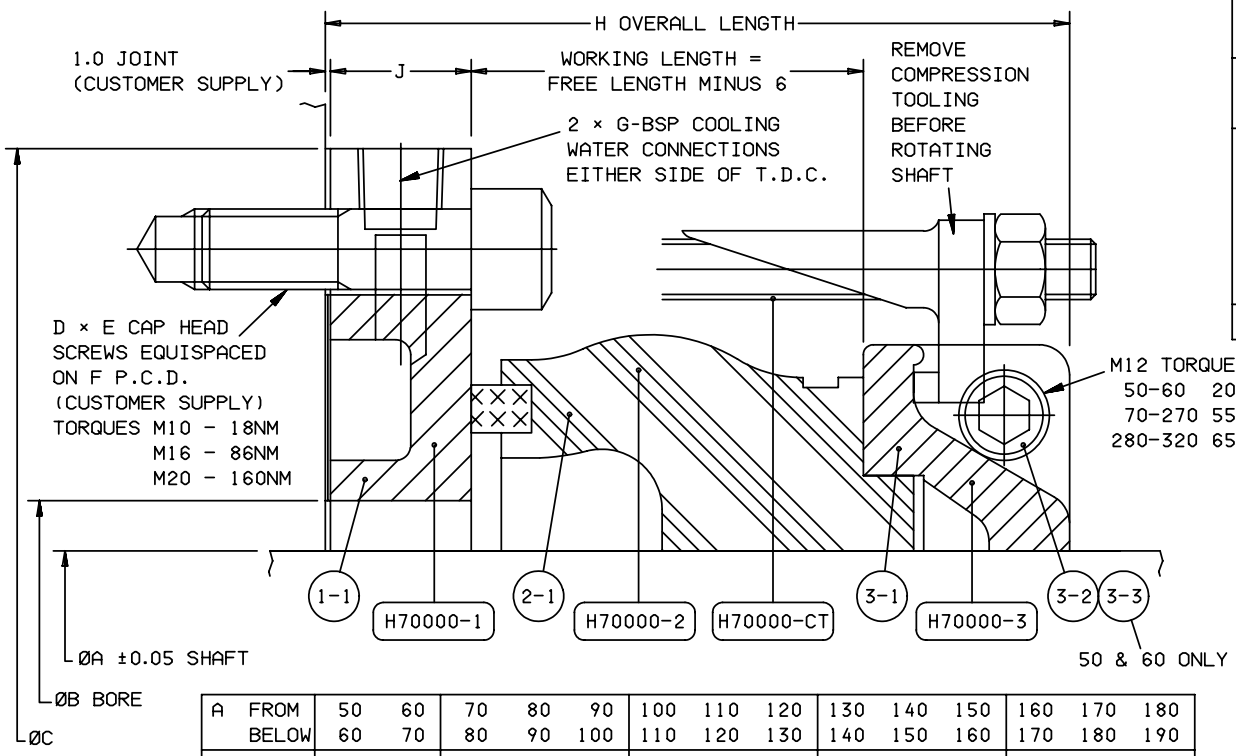
However: EJ Seals with a "specific" General Arrangement drawing which are derived from one of the listed "Tabulated" General Arrangement drawing are also covered by this Technical Manual.

In all instances the Drawing(s) specific to the application must be included after this attachment page and referenced in conjunction with this manual.

All pertinent drawings should be detailed in Section 1 (Specifications//Technical Data) of this manual and appear on the Works Order.

The attachments identified above, now follow :

DRG NO: H70000	CODE: DRAWN FOR 140-230 SIZES	50 MM FULL SIZE	1ST ANGLE PROJ



DRG POSN	DESCRIPTION	MATERIAL	QTY
H70000-1	SEAT ASSY (NON-SPLIT)		1
-1-1	SEAT (NON-SPLIT)	CAST IRON	1
H70000-2	BODY ASSY (NON-SPLIT)		1
-2-1	BODY (NON-SPLIT)	NEOPRENE	1
H70000-3	DRIVE CLAMP RING ASSY		1
-3-1	DRIVE CLAMP RING	S.G. IRON	1
	50 & 60 ONLY	STAINLESS STEEL	1
-3-2	SCREW	HIGH TENSILE STEEL	2
-3-3	NUT (50 & 60 ONLY)	HIGH TENSILE STEEL	2
H70000-CT	COMPRESSION TOOL ASSY		1

NOTES

1. ALL DIMENSIONS IN MM.
2. FOR FACTORY TEST/ASSEMBLY CRITERIA SEE TDS 16/025.

SERVICE DATA

SERVICE.....: OIL
TEMPERATURE.....: -5 TO 40°C
REV/MIN (MAX).....: SEE TABULATION
PRESSURE (MAX).....: 0.8 BAR
COOLING WATER FLUSH....: 1 L/HR/MM OF SHAFT Ø
@ MAX.TEMPERATURE OF..: 40°C
AXIAL MOVEMENT (MAX)...: 3.0
SHAFT LENGTH (MAX).....: 15M

A FROM	50	60	70	80	90	100	110	120	130	140	150	160	170	180
BELOW	60	70	80	90	100	110	120	130	140	150	160	170	180	190
B BORE	70	80	90	100	110	120	130	140	150	160	170	180	190	200
C ø	164	174	220	230	240	250	260	270	280	300	310	320	330	340
D OFF	4	4	4	4	4	4	6	6	6	6	6	6	6	6
E SCREWS	M10	M10	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16
F PCD	142	152	185	195	205	215	230	240	250	260	270	280	290	300
G BSP	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"
H LTH	119	119	131	131	131	131	131	131	131	148	148	148	148	148
J WIDTH	24	24	28	28	28	28	28	28	28	28	28	28	28	28
REV/MIN	1350	1300	1250	1120	1040	975	920	870	825	780	740	700	660	640

A FROM	190	200	210	220	230	240	250	260	270	280	290	300	310	320
BELOW	200	210	220	230	240	250	260	270	280	290	300	310	320	330
B BORE	210	220	230	240	250	260	270	280	290	300	310	320	330	340
C ø	350	360	370	380	390	405	415	425	435	445	455	465	485	495
D OFF	8	8	8	8	8	8	8	8	8	8	8	8	8	8
E SCREWS	M16	M16	M16	M16	M16	M20	M20	M20	M20	M20	M20	M20	M20	M20
F PCD	310	320	330	340	350	365	375	385	395	405	415	425	445	455
G BSP	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"
H LTH	148	148	148	148	148	148	148	152	152	152	152	152	152	152
J WIDTH	28	28	28	28	28	28	28	32	32	32	32	32	32	32
REV/MIN	605	580	550	530	510	495	475	460	455	440	430	420	410	400

John Crane Marine International

ENGINEERED SEALING SYSTEMS

CUSTOMER
GENERAL

Deep Sea Seals Limited
4 MARPLES WAY, HAVANT, HANTS. PO9 1NX ENGLAND

John Crane Marine USA
1536 BARCLAY BLVD, BUFFALO GROVE, IL. 60089 USA

USED ON
OIL LUBRICATED BEARINGS

John Crane Marine-Lips vof
LIPSSTRAAT 52, PO BOX 176, 5150 AD DRUNEN, NETHERLANDS

Japan Marine Technologies Ltd
5TH FLOOR, SIGMA BUILDING 3-7-12 SHIBAURA MINATO-KU, TOKYO 108, JAPAN

CONTRACT NO
*

TITLE
TABULATED GA OF
TYPE EJ INBOARD SEAL

DRN: G.E.B.
CHK: A.C.L.
REF: ***
MOD: 10-3-98
DATE: 10-08-82

SIZE	DRAWING NO	REVISION
A3	H70000	E

SCALE 1:1 | WEIGHT * KGS | SHEET 1 OF 1

TECHNICAL MANUAL

FOR

TYPE EK SEAL

ManeBar EK Outboard Seal

for Oil Lubrication Systems

Based on Tabulated G.A. Drawings:

H 70001
H 70008
H 70010
H 70028
H 70061

CONTENTS

1. SPECIFICATION/DATA SHEET.

WORKS ORDER NO. :
OWNER :
VESSLE NAME :
YARD :
YARD No. :

STERNTUBE/SHAFT SEALS

Aft/Outboard Seal	**Forward/Inboard Seal(s)**
Type:	Type:
Size:#	Size:#
Drawing No.:	Drawing No.:

STERNTUBE BEARINGS

Aft STB	Mid STB	Fwd STB
Size:#	Size:#	Size:#
Drawing No.:	Drawing No.:	Drawing No.:

INTERMEDIATE/LINE SHAFT BEARINGS

Type:	Type:
Size:#	Size:#
Drawing No.:	Drawing No.:

LUBRICATION SYSTEM

Drawing No.:

System Components

Fwd seal Tank	**Aft seal Tank**
Drawing No.:	Drawing No.:
Header Tank	**Drain/Observation Tank**
Drawing No.:	Drawing No.:
Air control unit	
Drawing No.:	
Lub Oil Pump set	**Filter/Strainer Unit**
Drawing No.:	Drawing No.:
Oil Flow Meter	**Water Flow Meter**
Drawing No.:	Drawing No.:
Pressure Gauge/Panel Units	**Valves**
Drawing No.:	Drawing No.:

BULKHEAD SEALS

Type:	Type:
Size:#	Size:#
Drawing No.:	Drawing No.:

ACCESSORIES

#
#

2. INTRODUCTION.

2.1. The equipment described in this manual and the materials selected are the result of many years of research and experience in this field.

2.2. However, the care and attention paid during installation, testing, operations and maintenance, do to a large extent determine the long-term operational reliability of the equipment.

2.3. Thus, whilst it is our policy to allow the Installation and Maintenance of this equipment to be carried out by 3rd parties (in accordance with the guidance contained within this Technical Manual) we would always recommend that one of our Service Engineers is present to oversee any Installation or Maintenance.

2.4. **When using this manual refer to the general arrangement drawing(s) in Section 16,** which give the dimensions and data for the correct assembly and operation of the equipment.

Where Grease lubrication is to be used, please refer to TDS 3/008 in Section 16.

2.5. There is no automatic provision to up-date this manual. However, the supply of a complete new assembly will be accompanied by the latest revision/issue Manual and Drawing(s).

2.6. For further assistance please contact one of the companies listed below:

UNITED KINGDOM

Deep Sea Seals Limited
4 Marples Way
Havant
Hants PO9 1NX

Tel: 44 (0) 2392 492123
Fax: 44 (0) 2392 492470

USA

Wärtsilä Lips Inc.
3617 Koppens Way
Chesapeake
VA 23323

Tel: 1 757 485 5275
Fax: 1 757 487 3658

NETHERLANDS
Wärtsilä Propulsion Netherlands BV
Lipsstraat 52
5151 RP Drunen

Tel: 31 416 388299
Fax: 31 416 374853

JAPAN
Japan Marine Technologies Ltd.
Sigma Bldg, 3-7-12 Shibaura
Minato-ku
Tokyo, 108-0023
Tel: 81 (0) 35442 2211
Fax: 81 (0) 35442 2260
Telex: 232-4593

3. DESCRIPTION OF THE EQUIPMENT

3.1. ManeBar "EK" seals are members of the "E" series family of Rubber Bodied Radial Face Type seals.

3.2. The "EK" seal described in this Technical Manual is a non-split Outboard unit for use with either Oil, Grease or Closed Water lubrication systems in Fixed or Controllable Pitch Propeller - Thruster or Stabiliser applications.

3.3. The resilient rubber body of the "EK" seal has an integral "face" which rotates with the shaft and propeller against a static (solid or sealing strip mounted) "seat" assembly fixed to the sterntube or thruster housing.

3.4. This combination provides a simple but very effective sealing arrangement capable of accommodating both radial and axial shaft movements.

4. STORAGE AND HANDLING

4.1. All assemblies and components have been carefully inspected before shipment.

4.2. Each component is suitably packed and protected to prevent damage or deterioration during shipment, transit or storage. Any specific storage or handling requirements will be clearly identified on the package label(s).

4.3. Goods should be examined on receipt to verify the contents and their condition.

4.4. Deep Sea Seals should be immediately advised of any damage or discrepancy in the scope of supply. Damage clearly due to handling in transit should be notified to the carrier along with a claim for damages (copy to us).

4.5. Keep goods in their original packing until just prior to installation in order to best protect them.

4.6. If goods have to be stored for long periods, they should be kept in their original packing, stored flat and unobstructed in a dry, cool and dark environment. To ensure a satisfactory life expectancy for any rubber components, exposure to sunlight, ultraviolet light and ozone should be prevented.

4.7. Care must be taken during handling to prevent any mechanical damage occurring due to dropping, crushing etc. Particular care and attention should be paid to the running/sealing surfaces of the face and seat.

5. PREPARATION

5.1. Remove all burrs and sharp edges over which the seal must pass. The surface of the shaft, local to the seal, should be clean and to the specified diameter and tolerance.

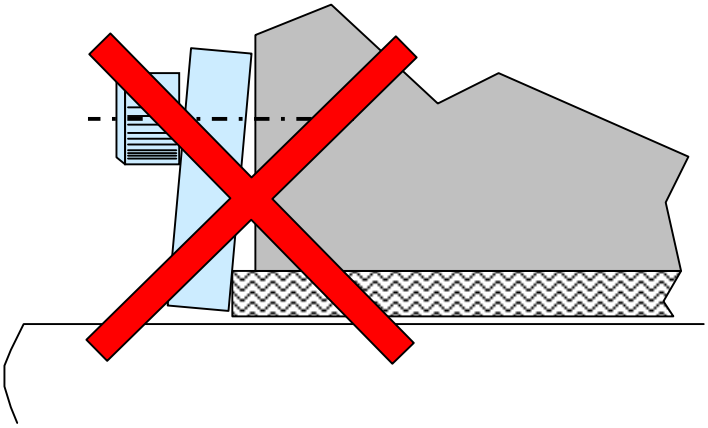
5.2. Ensure that all mating faces with the seal, i.e. the end face of the sterntube/housing and the forward face of propeller boss are machined to the following parameters:

#	Surface finish		- 3·2 µm Ra or finer (Propeller Boss) - 6.3 µm Ra or finer (Sterntube/Housing)	
#	Flatness		- 0·08 mm.	
#	Perpendicularity		Seal Size: 50 - 110 120 - 250 260 - 320	FIM (Measured outside the bolting P.C.D.) 0·2 mm 0·35 mm 0·5 mm

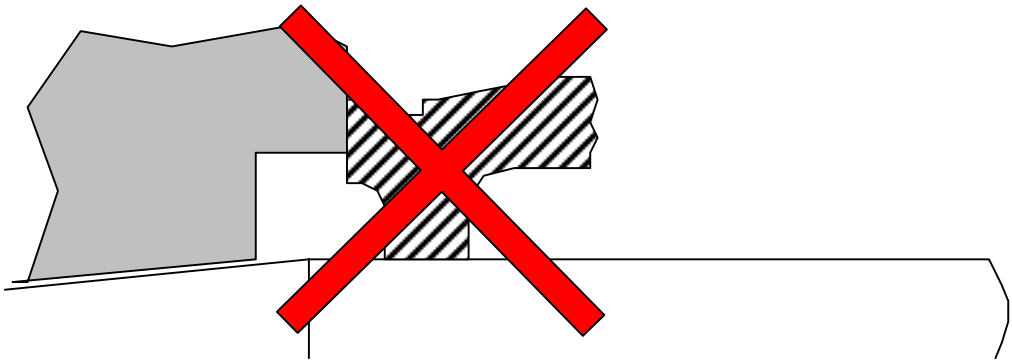
5.3. Where a sealing strip mounted seat is to be used ensure that the sterntube or housing has been machined in accordance with the General Arrangement drawing to accept the sealing strip and seat.

5.4. All mating surfaces should be clean with no debris or old joint material, etc. present.

5.5. Make sure that the end of the bearing does not stand proud of the sterntube or housing, as this will distort the seat.



5.6. Ensure that the forward face of the propeller boss/flange is not stepped where it contacts the aft end of the seal body. See 8.6 & 8.7.

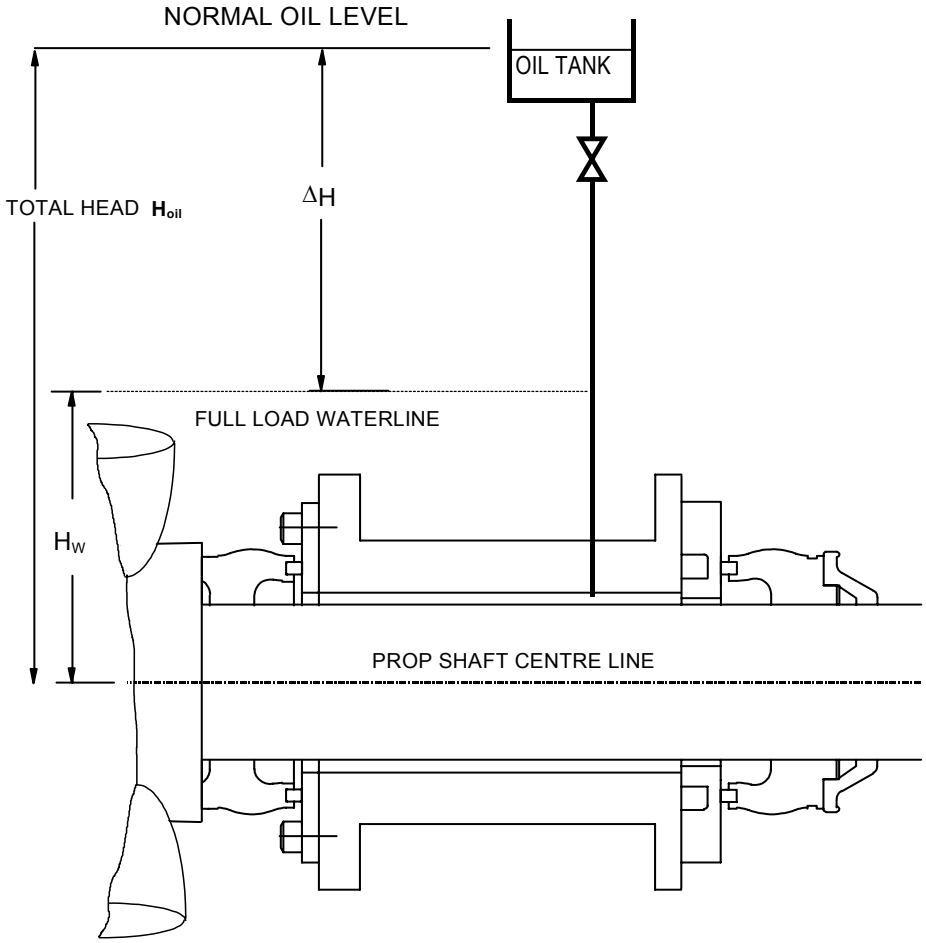


5.7. It is **essential** that the running surfaces of the face and seat are protected at all times during storage, transit and installation to promote correct operation of the assembled unit. Even minor damage to these surfaces can promote leakage.

6. HEAD TANK LOCATION

6.1. Stern Tube Applications

6.1.1. For oil lubricated systems, the head tank must be positioned at such a height above the full load water line as to obtain a minimum differential pressure on the outboard seal of 0.3 bar. See example table below and TDS 1/007 for details. This requirement shall override any information supplied in respect of an inboard seal.

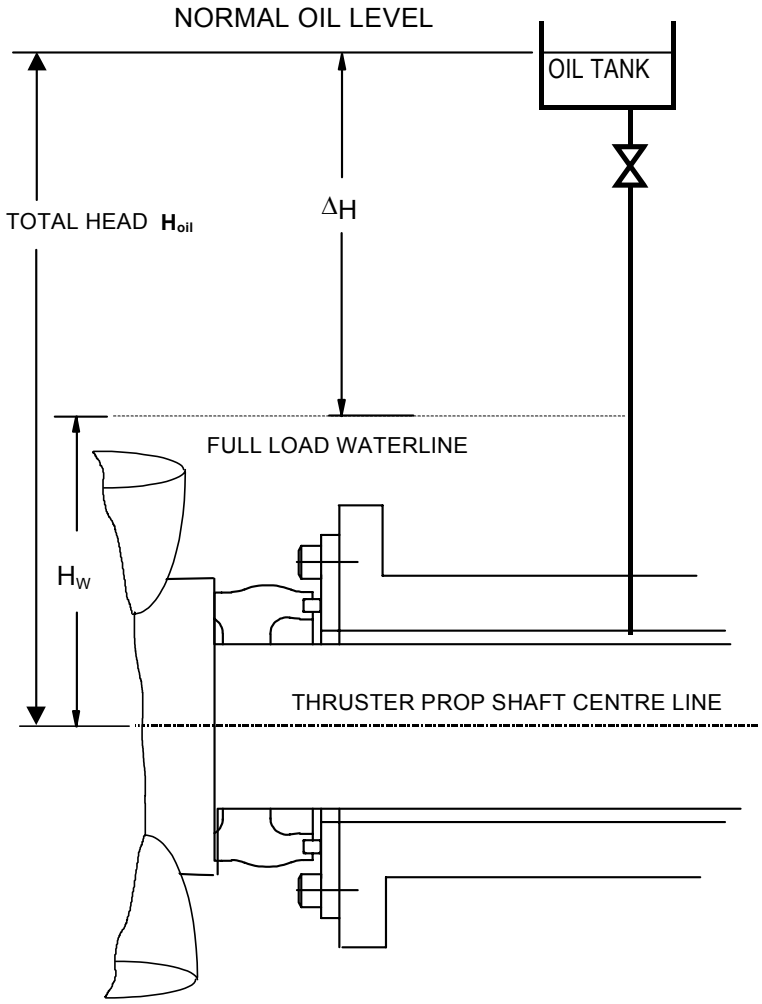


Vessel	H_W	metres	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Required	ΔH	metres	3.4	3.5	3.6	3.6	3.7	3.7	3.8	3.8	3.9
Required	H_{oil}	metres	4.4	5.0	5.6	6.1	6.7	7.2	7.8	8.3	8.9

6.1.2. Where grease is used as the lubricant, there will not be a 'head tank' but rather a system for pressurising and injecting grease into the sterntube bearing. The system must comply with the general requirements stated in TDS 3/008.

6.2. Thruster Applications

6.2.1. The head tank must be positioned at such a height above the full load water line as to obtain a minimum differential pressure on the EK seal of 0.3 bar. See example table below.



Vessel	H_W	metres	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Required	ΔH	metres	3.4	3.5	3.6	3.6	3.7	3.7	3.8	3.8	3.9
Required	H_{oil}	metres	4.4	5.0	5.6	6.1	6.7	7.2	7.8	8.3	8.9

Vessel	H_W	metres	5.5	6.0	6.5	7.0	7.5	FOR GREATER DRAFTS CONSULT DEEP SEA SEALS LTD.
Required	ΔH	metres	3.9	4.0	4.1	4.1	4.2	
Required	H_{oil}	metres	9.4	10	10.6	11.1	11.7	

6.2.2. The tank heights given in the table for "thruster" applications are applicable where the propeller is located behind the gearpod ("pusher" propeller). If the propeller is located in front of the gearpod ("tractor" propeller) the water pressure local to the seal will be increased. In these cases the oil head tank may need to be raised to maintain the correct pressure differential, otherwise water contamination of the oil may result.

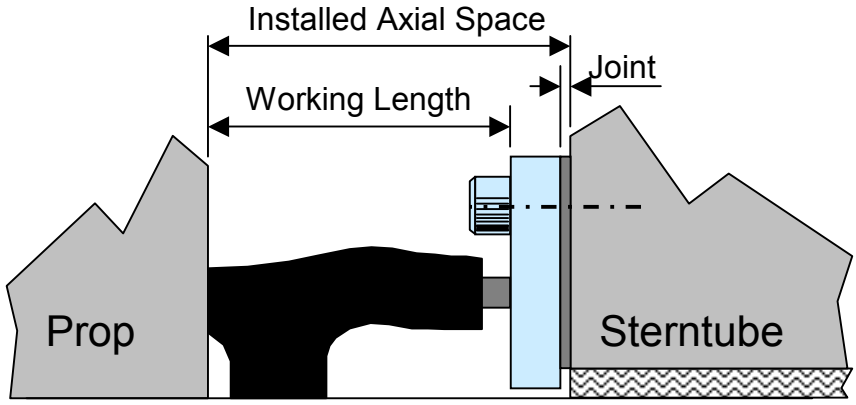
6.2.3. Similarly a tunnel thruster which operates for a significant proportion of time in "tractor" mode may also require a raised head tank.

6.2.4. If a pumped oil circulatory system is used, the maximum oil pressure at the seal must not exceed 1·4 bar with the maximum differential pressure (oil above water) not exceeding 0·8 bar, during operation. This is because an internally predominant differential pressure accentuates the ‘Bulge" of the seal body and reduces the load at the sealing interface.

7. SPECIAL INTERFACING REQUIREMENTS

7.1. Interfacing Requirements - (Solid & Resilient Mounted Seats)

The "EK" seal is designed to fit into a specific axial space so that when assembled with the seat, shaft and propeller in their final positions, the seal is compressed by the correct amount.



Three areas of interfacing are relevant.

7.1.1. The Bore/I.D. of the rubber body to the shaft -
The seal will be supplied with the bore of the body sized to suit the stated shaft diameter.

7.1.2. The Propeller Boss surface to the back of the rubber body -
This interface provides the primary drive and pressure boundary for the seal. As well as the Boss surface being flat (see sections 4·2 and 4·6) to fully support the back surface of the EK rubber body, any holes should be suitably filled.

7.1.3. The Stationary Seat interface is very important -
It is normally by varying the thickness of the seat/seat housing that the correct compression on the seal body is achieved.

7.2. Solid Seat Interfacing

7.2.1. The Stationary Seat comprises a one piece ring/plate bolted to the end of the sterntube or equivalent (e.g. thruster housing).

7.2.2. The Seat will normally be supplied to a thickness already determined (at the time of ordering) by the axial space into which the seal assembly will fit.

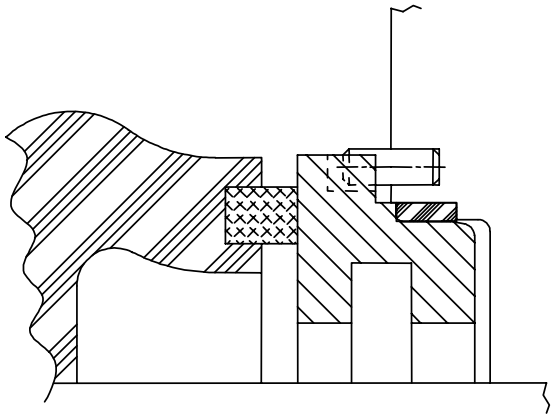
7.2.3. A surface finish of 1·6 µm Ra is achieved by a fine machining process. The seat is then polished to between 1·6 µm and 1·2 µm during manufacture. The running surface flatness tolerance is 0·04 mm and it is emphasised that this is a fine machined surface - not a "ground" one, as a ground surface can prolong the running in period.

7.2.4. The Seat should never be less than 15 mm thick. A seat of less than 15 mm thick would be more susceptible to bolt induced distortion (and hence leakage).

7.2.5. The surface of the sterntube should conform to the requirements of Section 5.

7.3. Sealing Strip Mounted Seat Interfacing.

7.3.1. Where a rubber sealing strip mounted seat is supplied, the Sterntube/Housing must be machined to accept the seat and sealing strip in accordance with Section 5.3 and the applicable G.A. Drawing. This must include the provision of Anti-Rotation pins as shown in Section 8 (Installation) and detailed in the applicable G.A. Drawing.



7.3.2. The rubber sealing strip mounted seat is a specifically designed component. The compression of the body being accounted for during design. Under no circumstances must this component be modified by the customer.

8. INSTALLATION

(Refer to relevant Drawing(s) - see Attachments - Section 16)

8.1. Axial Space

Before fitting the EK seal, the distance between the end face of the sterntube (or Thruster Housing) and the forward face of the propeller boss must be measured. This distance should then be used to re-confirm that the seat assembly is of the correct size to achieve the compressed "working length" on the seal body as shown on the General Arrangement drawing.

8.2. Solid mounted seat arrangement.

As stated earlier (in Section 7), by prior arrangement the seat will be provided of a necessary thickness to give the correct "working length" of the seal. If adjustment is required, modifications may be carried out as follows:

8.2.1. If the measured axial space is larger than originally advised, this would cause the 'EK' seal to be *under-compressed* if fitted into this increased space. Compensation can be made by use of a thicker joint (see below for limitations) or a spacer, to re-establish the correct working length of the seal.

8.2.2. Where the axial space is *less* than originally advised, this would cause the 'EK' seal to be *over-compressed* if fitted into this reduced space. Compensation can be made (to a degree) by removing material from the *back* surface of the seat. Note (as per Section 7.2.4) the *minimum* acceptable thickness of the seat is 15 mm, therefore material can only be removed from the seat, *if* it was supplied *thicker* than the 15 mm minimum. By determining the amount that the *actual* axial space is less than that originally advised, then removal of the same amount of material from the *back* surface of the seat will establish the correct compression on the seal.

8.2.3. Before installing the solid seat, a compressed fibre joint must be fitted to the mounting surface. A thickness of 1 mm is recommended to minimise bolt-induced distortion. On no account should a joint of more than 2 mm be used.

A rubber gasket must not be used.

8.2.4. Once the correct seat thickness has been obtained, remove the propeller and secure the seat and joint in position ensuring an oil tight joint is made. The seat mounting bolts/screws must be tightened progressively, diagonally and evenly to the torque specified on the General Arrangement drawing.

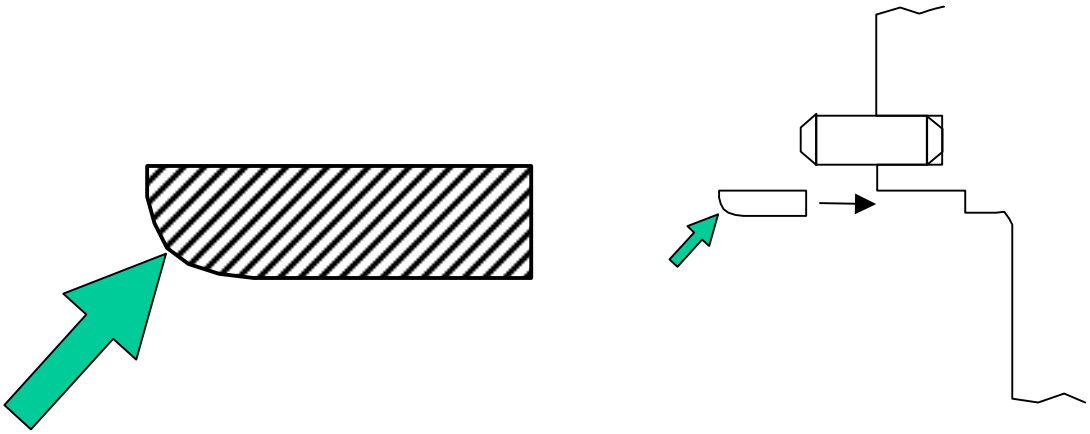
Do not exceed this torque!

8.3. Sealing Strip Mounted seat arrangement.

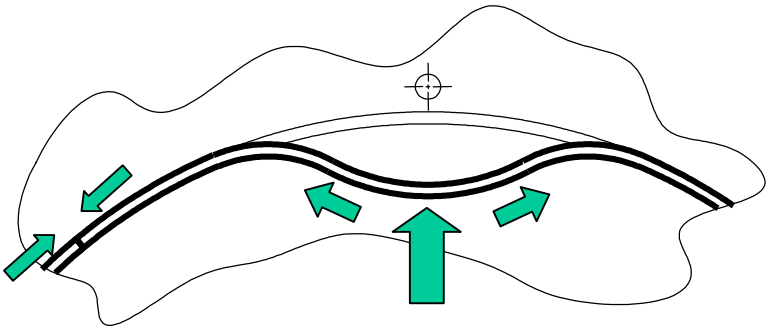
Having confirmed that axial distances and seat interfacing dimensions are as per the General Arrangement Drawing, proceed as follows:

8.3.1. Clean and grease the recess in the Sterntube/Housing.

8.3.2. Insert the Sealing Strip into the recess ensuring that the radiused edge of the strip is outboard and on the inner diameter.

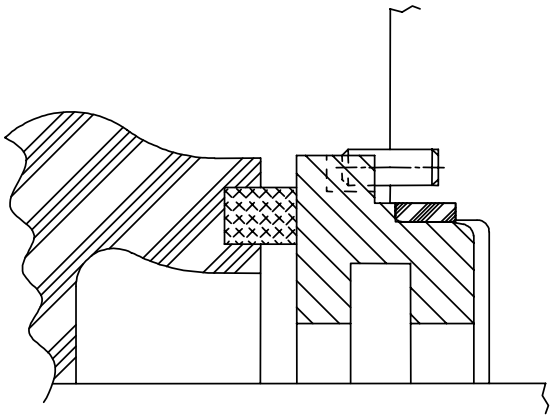


8.3.3. The Sealing Strip is provided overlength (see below). To overcome the "apparent" excess length, the strip ends should be butted together in the recess **(not glued or bonded)** and the excess rubber slowly worked round whilst exerting slight pressure on the loop.



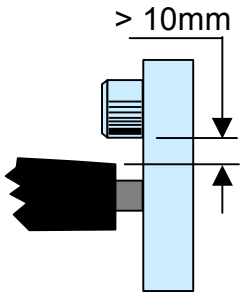
✳✳**NOTE**✳✳ As above, the Sealing Strip is supplied overlength to ensure that the ends butt hard together and that the strip fully supports the seat. **The Sealing Strip must not be cut or shortened.**

8.3.4. Fit the seat into the sealing strip, taking care to engage the anti-rotation pins in the holes in the back of the seat. The seat may require "gentle" tapping with a rubber mallet to fully engage it in the sealing strip.



8.4. Seal Mounting

Clean the shaft, seat and face using a non chlorinated solvent cleaner. If necessary lightly soap the shaft over which the seal must pass. Carefully slide the seal complete with the shroud ring into position, against the seat, ensuring that there is at least 10 mm radial clearance for the seal to rotate without fouling the seat securing bolts/screws



8.5. Face Lubrication

For normal F.P.P. and C.P.P. applications the face and seat should not be lubricated on assembly, but for thruster applications oiling is recommended (same oil as to be used for the thruster). Petroleum jelly is acceptable but grease must not be applied as it can interfere with the running-in process and may cause overheating with the potential for reduced life expectancy and performance. Solid lubricants such as molybdenum disulphide, graphite or p.t.f.e. must not be used.

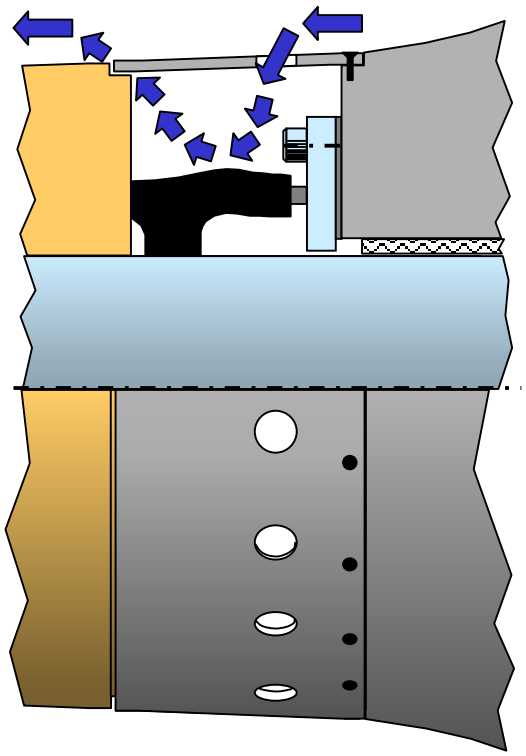
8.6. Propeller Fitting

8.6.1. Fit the propeller, ensuring that any traces of oil or grease are removed from the aft end of the seal body and the face of the propeller boss. Re-confirm that the distance between the forward face of the propeller boss and the running face of the seat, is as stated on the general arrangement drawing. Also check that the end of the seal body is fully supported by the propeller boss.

8.6.2. The aft end of the seal body is the primary drive and pressure boundary. Bore sealing cannot be guaranteed and if a keyed propeller is used it is important to ensure that the propeller cone is watertight.

8.7. Fitting the Ropeguard

After a successful test (Section 9), fit the rope guard, ensuring that it has holes at the forward end equivalent in area to two 50 mm diameter holes, to allow water flow over the seal.



9. TESTING

9.1. Static Test

Pressure test the seal and sterntube/thruster gear housing.

9.1.1. For Oil Lubrication - the seal will withstand a test pressure of 1.0 bar. An oil pressure of more than 1.2 bar may preclude a satisfactory test where there is no water outside the seal. Leakage should be zero during the static test although a slight weep from the face is permissible (this is often referred to as a bead of oil at the interface). Provided that the leak rate does not exceed 1 drop every 60 seconds this should reduce when the seal has been ‘run-in’.

9.1.2. For Grease Lubrication - the same pressures and parameters are applicable as for oil. Leakage should be zero during the static test although a slight bead of grease from the face is permissible (the 'flow' of grease will be almost imperceptible). This 'flow' will cease when the seal has run in.

9.2. Dynamic Test (Thruster Units Only)

Sometimes thruster units are tested dynamically before launch. If the seal is to be tested dynamically once installed, the following criteria should be followed.

9.2.1. Option 1

If possible the seal should be fully immersed in a suitably sized test tank containing sufficient water to cool the seal interface.

9.2.2. Option 2

If no test tank is available a suitable test rig/chamber which surrounds the complete seal interface on the thruster unit should be fitted. A cooling water flush of 1 litre/hour/mm of shaft diameter can then be pumped through the test chamber. The inlet to the test chamber should be positioned at the bottom, with the return outlet at the top. This will ensure that sufficient cooling water flow is supplied to the seal interface also ensuring that the test chamber is flooded at all times. The maximum oil/water pressure differential should not exceed 0.8 bar.

9.2.3. Option 3

If no test tank or chamber is available the seal can be operated in air, provided that a thermocouple is attached to the seat near the seal interface and the interface temperature monitored. The maximum interface temperature is 80°C. A higher temperature will cause damage to the seal resulting in operational failure when in future service.

It is recommended that cooling jets of water are used to spray the seal assembly. The sprays being positioned around the circumference of the sealing interface.

Option 3 should only be used when Options 1 and 2 are not possible. Deep Sea Seals Ltd. cannot accept any liability for failure of the seal during this type of test due to operation of the assembly outside of its design parameters.

10. NORMAL OPERATION

During Normal Operation with the "EK" seal functioning within parameters, all conditions should be stable.

10.1. Stable Operating Conditions

10.1.1. Header Tank Level steady. No change in the level should be seen.

10.1.2. Lubricant conditions good. All analysis figures should be within acceptable range according to the Lubricant Manufacturers data.

10.1.3. Bearing temperature normal.

10.2. Routine checks that should be conducted

10.2.1. Check and record Header tank level daily, refilling as necessary.

10.2.2. Check and record bearing/sterntube lubricant temperature daily.

10.2.3. Visually inspect water around Outboard seal area for leakage whenever possible.

10.2.4. Check Header Tank alarm(s) weekly for correct operation.

10.2.5. Check stern tube/bearing for water ingress using the sampling cock.

10.2.6. Test the lubricant in accordance with the manufacturers recommendations.

11. LUBRICATION SYSTEM

For an "EK" Outboard seal used in an "Oil" lubricated system, refer to Technical Data Sheet (T.D.S.) 1/007. Sheet 1. See Section 16.

This defines the requirements of the Oil system with respect to Header Tank heights, Pressures and required differential pressures.

Sheet 2 relates to the cooling requirements for an "Inboard" "E"-series seal and is not relevant to the Outboard "EK" seal.

Where grease is used as the lubricant, there is no 'recommended' system however it must comply with the general requirements stated in TDS 3/008 See Section 16.

Comment - unlike oil systems, the pressure in a grease system can vary throughout, therefore the pressure measured at the grease injection point may not be the same as the pressure at the outboard seal.

12. RECOMMENDED LUBRICANT LIST

For an "EK" Outboard seal used in an "Oil" lubricated system, refer to Technical Data Sheet (T.D.S.) 9/001 Sheet 4 of 4 See Section 16 which lists recommended and acceptable oils for use with "E" series seals.

For Grease lubricated systems, no approved list currently exists. Where acceptance is required, please refer to Deep Sea Seals Ltd. (see addresses, Section 2).
The grease should be suitable for the bearing system.
The grease should not be a Silicon, Synthetic or High Temperature grease.

Refer to TDS 9/001 Sheet 4 of 4 See Section 16.

13. PROBLEM SOLVING - Level 'a'

13.1. Any problems with the “EK” Outboard seal will normally show themselves in one of two ways:

(A) The loss of lubricant from the system.

(B) Water ingress into the lubricating system.

(Refer to the associated causes and corrective actions in Section 13.4 and 13.5).

13.2. Evidence that either of the above has occurred will be demonstrated in one of the following ways. (Also refer to the associated problem solving flow charts in Section 13.3 as indicated below).

(i) Water or an Emulsification found during routine testing of the bearing lubricant. (Flow chart 13.3.2).

(ii) A low level alarm warning from the bearing Header Tank. (Flow chart 13.3.3).

(iii) A visible leak/discharge outboard into the water. (Flow chart 13.3.4).

(iv) An increase in the level or overflow of the bearing Header Tank activating the high level alarm if one is fitted. (Flow chart 13.3.5).

(v) A high bearing-lubricant temperature alarm. (Flow chart 13.3.6).

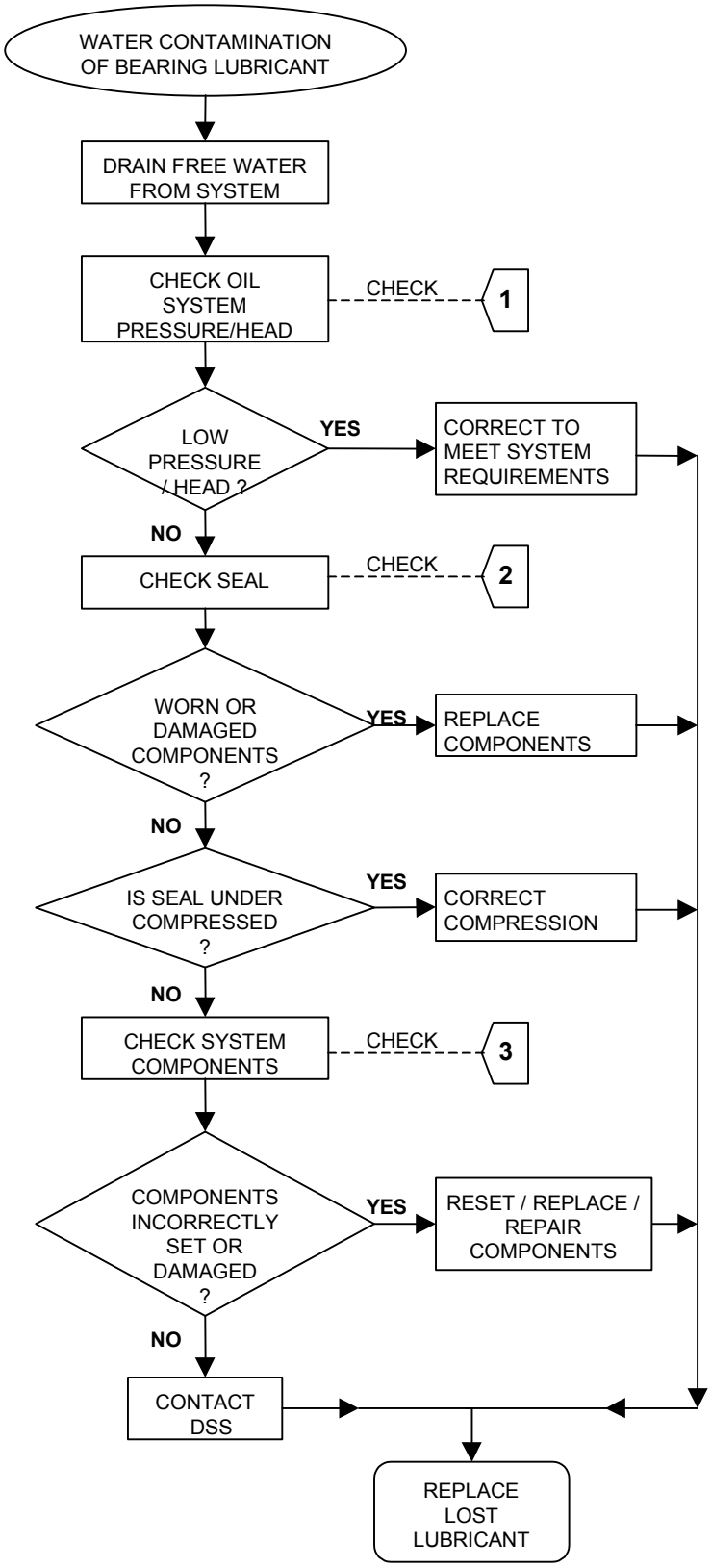
13.3. "Flow Charts"

Explanations of the above, including cause, effect and corrective actions now follow:

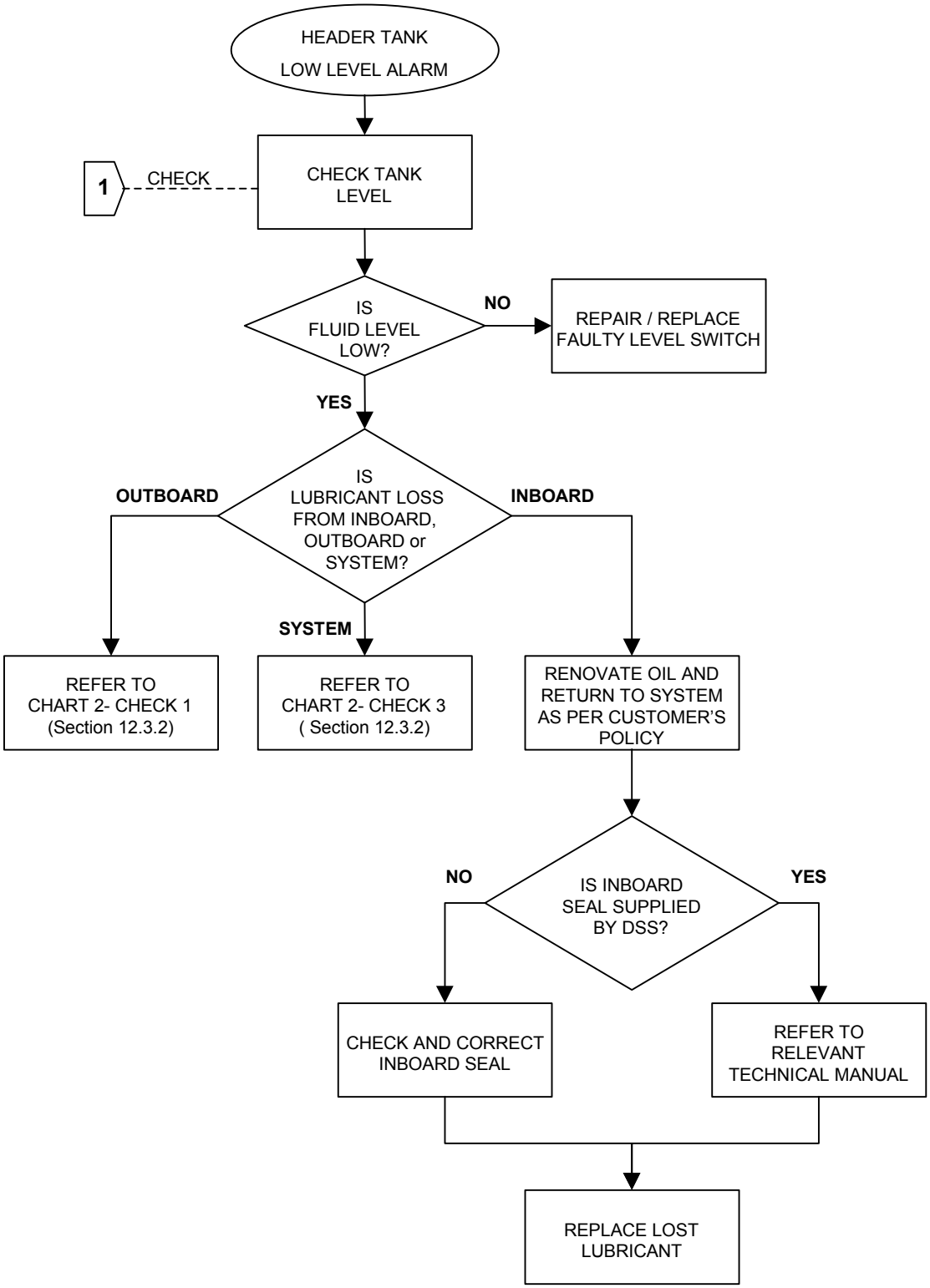
13.3.1. Normal Operation

For Normal Operating Conditions, refer to Section 10 (in conjunction with Head Tank locations shown in Section 6).

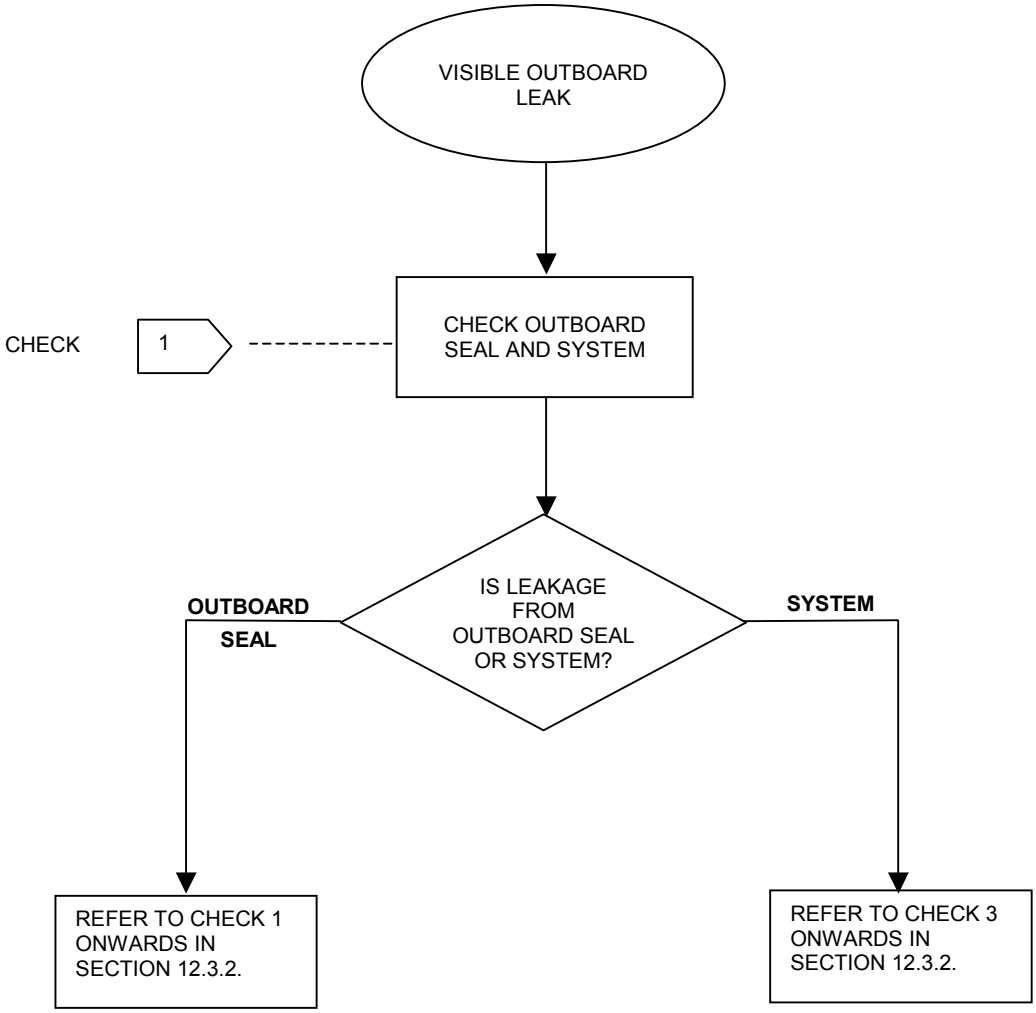
13.3.2. WATER/EMULSIFICATION DISCHARGE FROM BEARING TEST VALVE OR COCK.



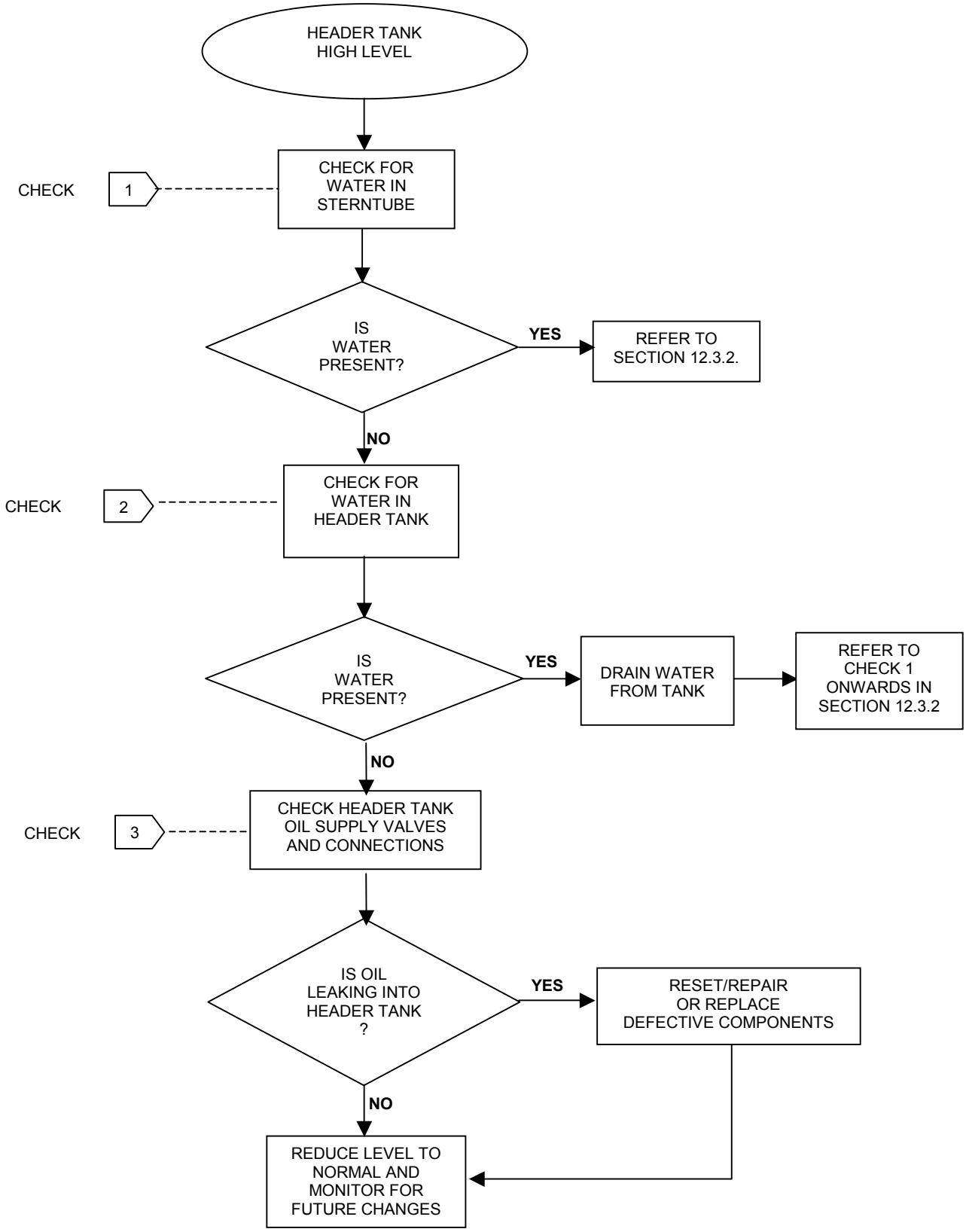
13.3.3. HEADER TANK LOW LEVEL ALARM.



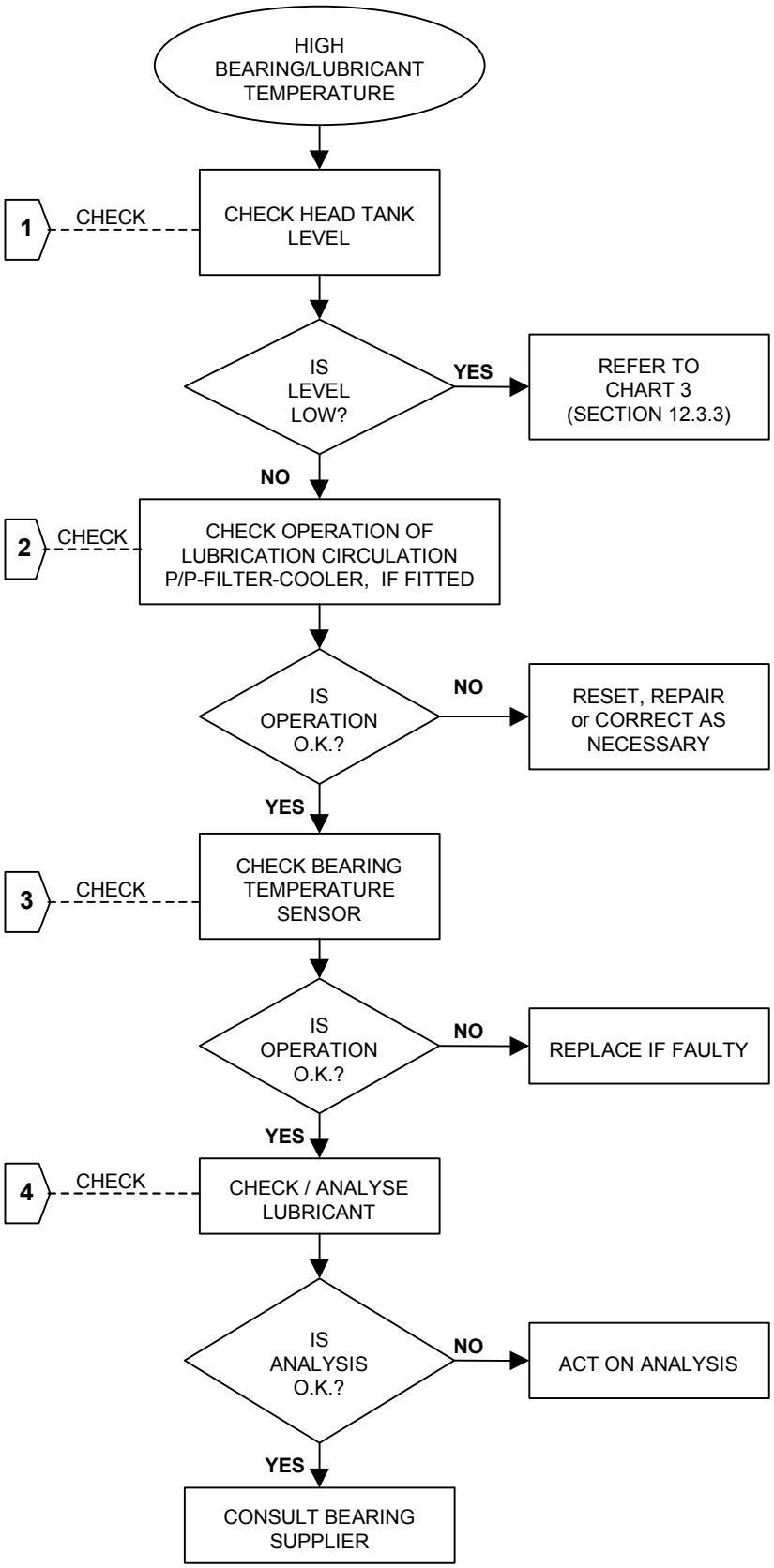
13.3.4. VISIBLE LUBRICANT LEAK OUTBOARD



13.3.5. HEADER TANK OVERFLOW OR INCREASE IN LEVEL



13.3.6. HIGH BEARING - LUBRICANT TEMPERATURE



13.4. Section “A” - The loss of lubricant from the system!

Lubricant loss via the Outboard seal may be due to one or more causes. For each, a suggested course of corrective actions follow:

CAUSE		CORRECTIVE ACTION	
A1	Lubricant pressure too high.	**a**	Reduce to that stated in the Technical Manual.
A2	Loss of seal compression due to age or wear.	**a**	Reduce the lubricant pressure (a little at a time) to establish a "balance" with the water. This reduces leakage and still protects the bearing.
		b	Temporarily (for "oil") if "a" does not stabilise the situation, the oil can be changed to one designed to operate with a leaking outboard seal (e.g. Vickers Hydrox 550).
		c	Replace the component(s) responsible for the loss of compression.
A3	Insufficient Compression due to installation or axial shaft movement	**a**	As for 2a.
		b	As for 2b.
		c	Establish the correct compression using a thicker joint or spacer behind the seat or housing. Alternatively fit a thicker seat or housing.
		d	Determine and rectify the causes of excessive shaft movement.
A4	Debris (e.g. Line, net or rope).	**a**	As for 2a.
		b	Carefully remove any debris. If no damage has occurred a good seal should be re-established. If damage has occurred - refer to "A5".
		c	As for 2b.
		d	Improve the ropeguard/net cutter arrangements etc. to prevent re-occurrence.
A5	Damage to the outboard seal.	**a**	If the seal is damaged and is leaking then proceed as for 2a. having first checked for and carefully removed any debris.
		b	As for 2b.
		c	Replace damaged components as soon as is possible.
		d	As for 4d.

13.5. Section “B” - Water Ingress into the Lubricating system!

As for lubricant loss, water ingress may be due to one or more causes (basically identical to those responsible for lubricant loss).

For each, a suggested course of corrective actions follow:

CAUSE		CORRECTIVE ACTION	
B1	Lubricant pressure too low.	**a**	Increase to that stated in the Technical Manual.
B2	Loss of seal compression due to age or wear.	**a**	As for "A" 2a - but - "increasing" the pressure to establish a "balance".
		b	As for "A" 2b.
		c	As for "A" 2c.
B3	Insufficient compression due to installation or axial shaft movement.	**a**	As for "B" 2a.
		b	As for "A" 2b.
		c	As for "A" 3c.
		d	As for "A" 3d.
B4	Debris (e.g. line, net or rope).	**a**	As for "B" 2a.
		b	As for "A" 4b - However if damage has occurred, refer to "B" 5.
		c	As for "A" 2b.
		d	As for "A" 4d.
B5	Damage to the Outboard Seal.	**a**	If the seal is damaged and is leaking then proceed as for "B" 2a. having first checked for and carefully removed any debris.
		b	As for "A" 2b.
		c	As for "A" 5c.
		d	As for "A" 4d.

NOTE: Where corrective actions involving material replacement, refurbishment or adjustment have rectified a situation, then any “temporary” measures taken such as changes in lubricant type or pressure should be reverted to normal.

NOTE: If these Problem Solving measures fail to rectify a situation, then assistance and further advice should be sought via one of the contact addresses given in the front of the Technical Manual.

14. MAINTENANCE

(Refer to relevant Drawing(s) - see Attachments - Section 16.)

14.1. The need for "Maintenance" may be determined by several factors which are performance related. Alternatively, though the performance of the equipment may be perfectly satisfactory, maintenance may be carried out as part of a planned/preventative schedule. Overhaul of the equipment may also be carried out because it is part of a system or assembly that is itself needing or due for maintenance!

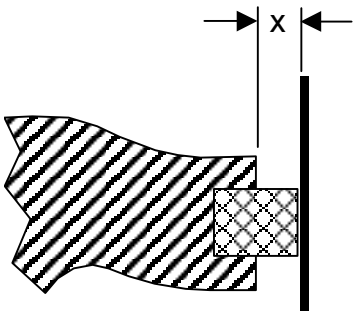
14.2. Factors that normally determine the need for Maintenance are:

14.2.1. Performance :-

Loss of lubricant from the system or water ingress into the system.

14.2.2. Wear :-

Normally associated with the fibre "face" in the "EK" seal, though it does to a lesser degree affect the ni-resist seat.
Wear is important as the loss of material means a loss of compression in the rubber body, which can lead to leakage.
Wear can be determined by measuring the distance between the seat and the rubber body (see below).



Condition for Seal Size:		Status
#50-#60	#70-#320	
X = 5 mm	X = 6 mm	'as new'
X > 3 mm	X > 4 mm	O.K.
X < 3 mm	X < 4 mm	Replace body assembly

Normally an oil lubricated seal experiences low levels of wear, however, operation in abrasive conditions, may lead to higher wear rates than when operating in clean water.

14.2.3. Damage:-

The seal can be damaged due to debris or physical intervention - usually associated with fishing line, nets, rope, wire etc. connected with a poorly designed / fitted or damaged rope guard.

14.2.4. Age:-

The face and seat elements have no limitation with regard to Age. Their "service life" will be governed by "Performance", "Wear" or "Damage".

The life limit for the EK **"rubber"** body is 10 years (elapsed time - not just operation) and renewal must be carried out every 2nd 4/5 year docking. However, it is more likely that for operational reasons (Performance, Wear or Damage) all rubber components will be replaced "every" 4/5 year docking.

Replacement of the EK body at least every 8-10 years is recommended as the body is compressed on fitting and provides the necessary closing force between the face and seat. Rubber loses "elasticity" over a period of time and the body will develop a "permanent set" with a subsequent loss of closing force.

14.3. To replace or carry out maintenance on either the "EK" seal body or seat assembly, the propeller must be removed to allow removal of these non-split items.

Note : Shut off the oil supply to the bearing and drain the oil from the sterntube/housing assembly, before commencing removal procedures.

14.4. Whenever replacing the seal body assembly, the seat should be removed and re-conditioned or replaced as required.

A new seal face should not be run against a previously used seat that exhibits any evidence of wear or grooving. If the seat cannot be restored to an "as new" surface condition by abrading (rotary motion) with a 600 grade grit paper; it must be machined to remove any wear track or pattern.

See section 7.2.3. for the machining finishes and tolerances. If more than 1·0 mm needs to be machined off of a seat which is already at its minimum thickness, then it should be replaced due to the loss of compression as previously referenced. See Section 8.2.3 with reference to maximum joint thickness.

14.5. Fit or refit the seat and body assemblies as per Section 8, Installation.

14.6. Replace the Propeller in accordance with Section 8.6 & 8.7.

14.7. Pressure test the seal as per Section 9 (Testing).

14.8. Refit the Rope Guard - See Section 8.7.

15. SPARE PARTS AND THEIR STORAGE

15.1. For the "EK" seal, as it is basically only a 2 component assembly (Body Assembly and Seat Assembly), the requirement for "Spare Parts" is limited.

15.2. The seat assembly is considered to be a refurbishable item using a simple machining process as described in Section 14 (Maintenance). The only component that might be held as a "spare" is a body assembly. However due consideration must be given to the possibly lengthy storage of a rubber component.

15.3. All parts held as spares should be kept in their original packaging as they will have been inspected and packed prior to despatch as described in Section 4 (Storage and Handling).

15.4. All components must be protected from damage or deterioration by maintaining their original packing and careful storage to prevent physical damage (with special care being taken of any fine machined surfaces or critical components).

All spares should be stored flat and unobstructed in a dry, cool and dark environment, as described in Paragraph 4.6.

16. ATTACHMENTS.

The following attachments should accompany this Technical Manual (TM EK/01).

- Tabulated or Specific General Arrangement Drawing(s) ✳
- TDS 1/007
  TDS 3/008
  TDS 9/001 Sheet 4 of 4 (ManeBar Recommended / Acceptable Oils Listing).

✳ **Note:** This manual is written based on the "Tabulated" General Arrangement Drawings listed on the front cover.

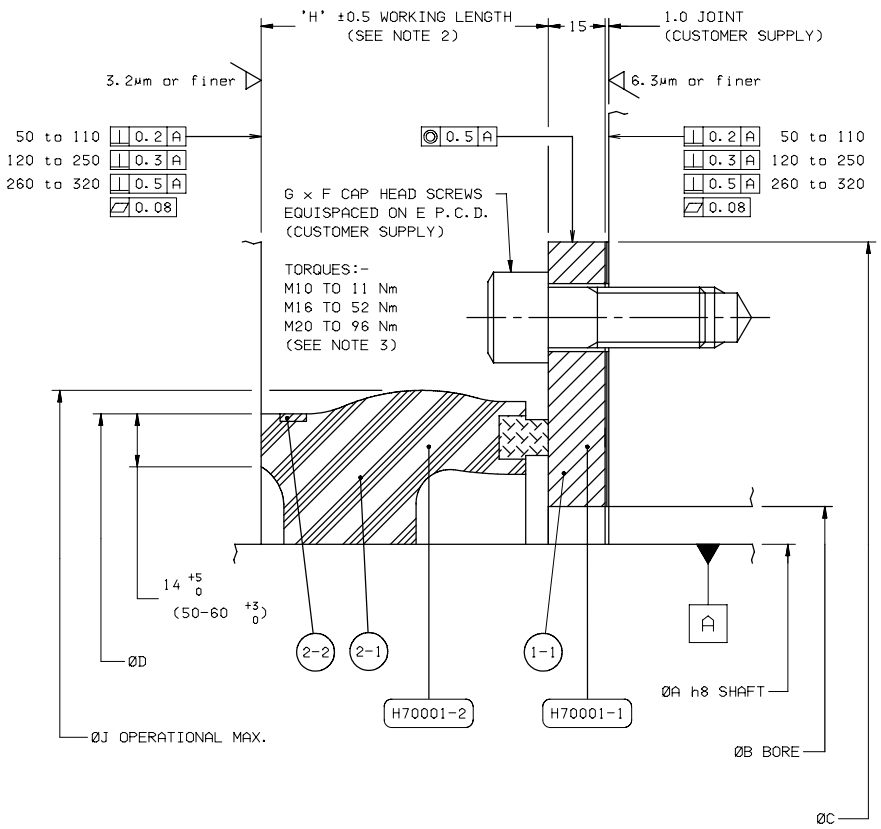
However, EK seals with a **"specific"** General Arrangement Drawing that are derived from one of the listed "Tabulated" Drawings, are also covered by this Technical Manual.

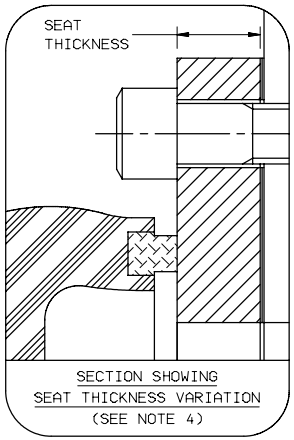
In all instances the Drawing(s) specific to the application must be included after this attachment page and referenced in conjunction with this manual

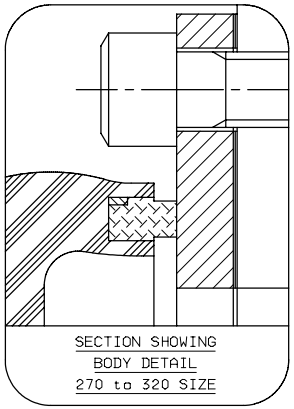
The attachments referenced above, now follow:

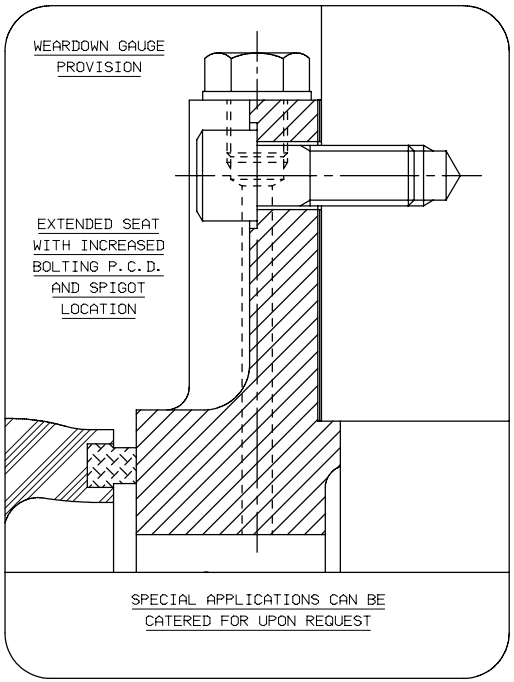
DRG NO: H70001	CODE: DRAWN AS FOR 140 - 230	TDS 16/026	50 MM FULL SIZE	3RD ANGLE PROJ

DRG POSN	DESCRIPTION	MATERIAL	QTY
H70001-1	SEAT ASSY (NON-SPLIT)		1
-1-1	SEAT (NON-SPLIT)	NI-RESIST	1
H70001-2	BODY ASSY (NON-SPLIT)		1
-2-1	BODY (NON-SPLIT)	NEOPRENE	1
-2-2	SHROUD RING	BRONZE	1
H70001-TM	TECHNICAL MANUAL	TM-EK/01	1









NOTES

1. ALL DIMENSIONS IN mm.
2. THRUSTER APPLICATIONS WORKING LENGTH = 'H' + 2.0
3. TIGHTEN SCREWS DIAMETRICALLY OPPOSITE IN EVEN STAGES TO ACHIEVE TORQUE FIGURES STATED.
4. SEAT MINIMUM THICKNESS SUPPLIED IS 15mm BUT A GREATER THICKNESS MAY BE SPECIFIED AS REQUIRED, WITH THE WORKING LENGTH REMAINING AS DIMENSION 'H'.
5. CUSTOMER MUST PROVIDE A SUITABLE ROPEGUARD TO PROTECT THE SEAL.

SERVICE DATA

SERVICE.....: OIL (SEE TDS 9/001)
TEMPERATURE.....: -5 TO 40°C
OIL PRESSURE (MAX).....: 0.8 BAR
SEAWATER PRESSURE (MAX).....: 0.5 BAR
DIFFERENTIAL PRESSURE (MIN).....: 0.3 BAR
SHAFT AXIAL MOVEMENT (MAX).....: +1 -2 (+ MEANS SEAL IS COMPRESSED)
SHAFT RADIAL MOVEMENT (MAX).....: ±5.0
SHAFT LENGTH (MAX).....: 10 METRES

A FROM	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	FROM A
BELOW	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	BELOW
B BORE	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	BORE B
C Ø	164	174	220	230	240	250	260	270	280	300	310	320	330	340	350	360	370	380	390	405	415	425	435	445	455	465	485	495	Ø C
D Ø	112	122	136	146	156	166	176	186	196	209	219	229	239	249	259	269	279	289	299	309	319	329	339	349	359	369	379	389	Ø D
E PCD	142	152	185	195	205	215	230	240	250	260	270	280	290	300	310	320	330	340	350	365	375	385	395	405	415	425	445	455	PCD E
F SCREWS	M10	M10	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M16	M20	M20	M20	M20	M20	M20	M20	M20	M20	SCREWS F
G No OFF	4	4	4	4	4	4	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	No OFF G
H LTH	62	62	62	62	62	62	62	62	62	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	LTH H
J Ø MAX	127	139	153	163	179	186	192	206	219	231	241	255	261	272	281	297	307	314	326	333	344	353	359	371	382	389	399	412	Ø MAX J
REV/MIN	1350	1300	1250	1120	1040	975	920	870	825	780	740	700	660	640	605	580	550	530	510	495	475	460	455	440	430	420	410	400	REV/MIN

John Crane-Lips

MARINE PROPULSION SYSTEMS

CUSTOMER: GENERAL

USED ON: OIL LUBRICATED BEARINGS

CONTRACT: ***

DRN: G.E. BARRETT

CHK: A.C. LANE

REF: DSS

MOD: 6-SEPT-2000

DATE: 10-AUG-1982

John Crane-Lips EMA

SEALS & BEARINGS

4 MARPLES WAY
HAVANT
HAMPSHIRE
PO9 1NX
ENGLAND

CLASS: ABS BV DNV KR NKK

TITLE: TABULATED GA OF TYPE EK OUTBOARD SEAL

SIZE	DRAWING NO	REVISION
A2	H70001	K

SCALE 1:1 SHEET 1 OF 1

DEEP SEA SEALS LTD.*

4 Marples Way
Havant
Hants. PO9 1NX

Telephone: Havant (0705) 492123
Telex: 86122
Fax: (0705) 492470

FITTING INSTRUCTIONS

FOR

maneBar

TYPE EJ AND EK SEALS

*A subsidiary of Crane Packing Ltd., a member of the Tube Investments Group in association with the John Crane-Houdaille of USA

world wide interchangeability

FITTING INSTRUCTIONS
FOR
TYPE EJ AND EK SEALS

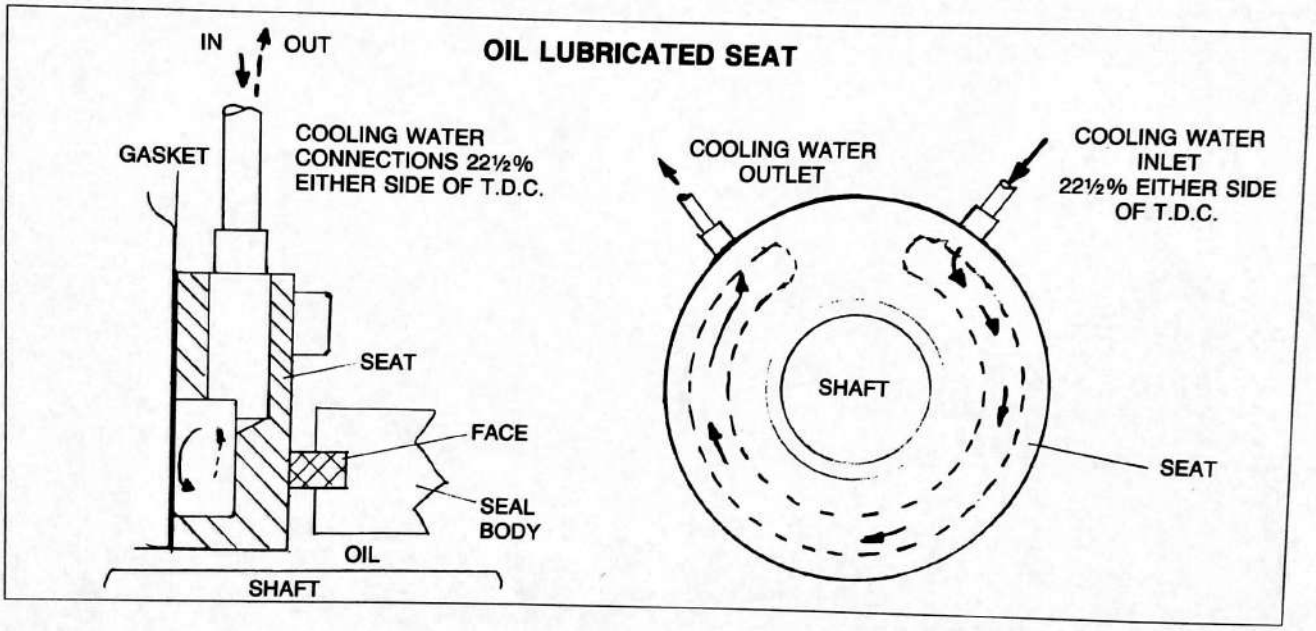
on oil or water lubricated stern bearings

INTRODUCTION

'maneBar' seals can be used with all stern shaft bearing lubrication systems — in conventional oil lubricated bearings, closed fresh water systems, grease lubricated bearings and with conventional sea water flush bearing systems.

The seal is achieved by a continuous rubbing contact between the rotating face of the seal and the stationary seat. This contact is sustained by the compression of the elastomer seal body.

NOTE: Due to heat generated by this method of sealing it is imperative cooling water is supplied to the seals at all times during running to prevent overheating and subsequent seal failure.



PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE COMMENCING INSTALLATION OF SEALS

These instructions cover the installation of the following units

Seals and clamps are sized in 10mm steps and can readily be modified to intermediate sizes. For example, a 100mm seal will accommodate shaft diameters from 100mm to 109.9mm.

When a shaft size is specified accurately, such modifications will normally be carried out before despatch, but machining instructions are available upon application if required.

SECTION III

INSTALLATION OF OIL LUBRICATED EK SEAL (OUTBOARD)

CONTENTS OF CARTON

	No. off
Outboard EK seal	1

BEFORE FITTING

On new installations, fit the propeller on the shaft and measure the distance between the stern tube and propeller boss. In the case of a retrofit, this should be done before the propeller is removed.

TABLE A

Seal size mm	Compressed length of seal, mm	Free length of seal, mm
50-130	62	70
140-329	76	84

The extra length between the stern bush and the propeller flange should be made up with a good quality cast iron seat (not supplied by Deep Sea Seals) and a suitable gasket. (Fig. 8).

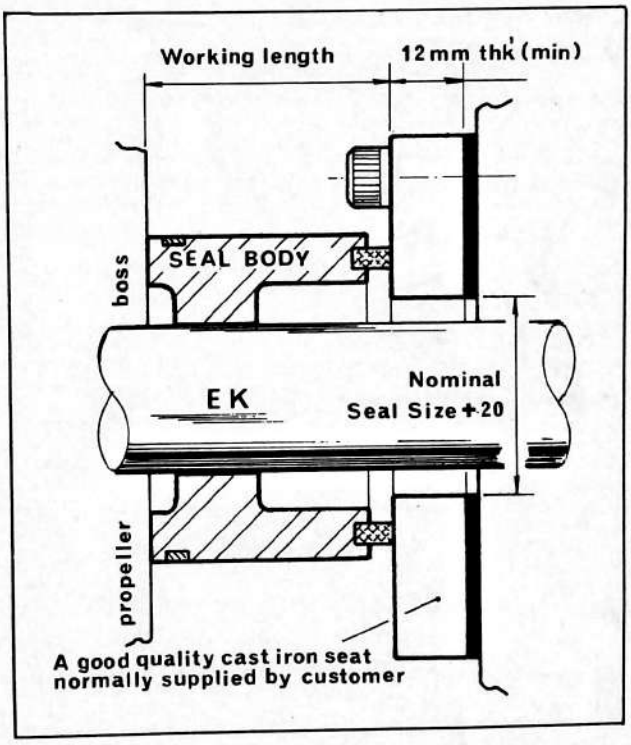


Fig. 8

INSTALLATION PROCEDURE

Fit gasket and cast iron seat ring to the stern tube with non-corrosive securing bolts, ensuring an oil and watertight joint. The seal should have sufficient clearance to rotate without fouling the bolts. Ideal (minimum) clearance 10mm.

Clean seat, shaft and running face. Coat the seal running face with a light film of grease and position the seal against the seat. Check that the bronze shroud ring is located in the recess in the rubber body, and remains there during the installation.

Secure the propeller in position and ensure that the compressed length of the seal is as shown in Table A.

TESTING

Fill the stern tube with lubricating oil and apply a maximum oil pressure of 1 bar (14.5lb/in^{2}g). At this pressure, no leaks should be apparent although slight dampness may be visible where the face contacts the seat.