CURVETECH HTE380 THRUSTER

HTE380BA-45

TECHNICAL MANUAL

SMD Reference : HTE 380BA-45.DOC

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1 INTRODUCTION

This document describes the installation operation and maintenance of the HTE 380 Curvetech Thruster. Curvetech thrusters have been designed to propel the new generation of high-powered ROV's, ploughs and similar underwater platforms. Other thrusters in the SMD Curvetech range are the HT 750, HT 500, HT 420, HTE 300 and HT 230. Please contact SMD for further information on these products.

The HTE 380 is fitted with a 380mm, diameter high pitch propeller and a fixed displacement motor with a displacement of 45 cc/rev.

The low revving, high torque thruster design provides exceptionally high efficiency and approximately equal forward and reverse thrust. The thruster is fitted with an integral mounting pedestal, which can be readily interfaced to the customer's equipment.

2 SAFETY

2.1 SMD Statement on Product Safety

SMD view system safety as a critical property of all equipment that they manufacture.

SMD strive to:

- Remove or minimise hazards inherent in a system to the greatest practical extent.
- Provide control measures for residual hazards.
- Provide the users with the required information and warnings to avoid, or take precautions against, residual hazards.

Client Responsibilities

- Ensure that all personnel have read the required documentation to ensure they are operating safely.
- Equipment supplied by SMD is as safe as practicality permits regarding standard operation, maintenance and direct access to equipment, however due to the variations in installation SMD cannot foresee all hazards once installed on the clients vessel, therefore SMD shall not be liable for safety in the area where the equipment is installed, or for any deviations from standard operations or installation.
- During standard operations, it is unnecessary for personnel to be in close proximity to the machinery apart from when routine operational maintenance is carried out.
- It is the client's responsibility to provide adequate safety measures and procedures for the protection of personnel, including guards or other means to prevent unauthorised access to equipment.
- As the equipment is normally operated in a marine environment, safety measures pertaining to this must be taken into account and incorporated in the client's safety procedures.
- Training on the equipment and compliance with safety procedures are the responsibility of the client.
- All personnel must observe established safety procedures

2.2 Recommended Safety Precautions

Safety guidelines for handling, installing, operating and maintaining SMD equipment are given below. Specific precautions for protection of personnel and equipment are also provided.

The client is urged to incorporate these safety guidelines into their own safety procedures and make sure that all personnel are fully aware of these.

2.3 General Precautions

Safety devices provided by SMD are primarily intended for the protection of personnel and secondarily for the protection of the equipment.

Only suitably qualified and competent personnel should install, operate or maintain this equipment.

Personnel must fully understand and follow safe operating procedures at all times during the operation and maintenance of the equipment covered by these manuals.

The person in charge of operations must always have a clear view of the deck equipment.

When operations are conducted at night or in poor visibility, ensure that the equipment and immediate area around it are adequately illuminated.

Ensure that the work area is easily accessible without obstruction.

Route cables and hoses through separate protection channels or conduits wherever possible.

Ensure that all guard, guardrails and other protective devices are in position before commencing any operation.

Never wear loose clothing when working with moving machinery.

When there is uncertainty that a circuit is de-energised, it must be considered “live” at all times. This may be taken to mean electric or hydraulic circuits.

Isolate, lock-off and tag all electrical power sources before making any connections or disconnections or working on circuits.

Many critical components of the equipment may be subject to wear or damage and other deterioration, which reduces their normal useful life.

The equipment design provides safety margins taking into account normal wear and tear, however, in the case of extreme wear duty or known overload; the appropriate steps should be taken to rectify any problem and return the system to within its original specification.

If replacement is neglected, components can reach a point where they constitute a safety hazard; similarly, failure to maintain mechanisms necessary to assure correct and proper operation may also constitute a safety hazard.

Safety guidance may also be found in the relevant proprietary information manuals.

2.4 Specific Precautions

The equipment is manufactured from various types and grades of steel and aluminium.

On no account should welding be undertaken on any of the equipment without implementing approved weld procedures appropriate to the materials involved; failure to do this could endanger life and invalidate the certification of manufacture.

Hydraulic relief valves are one of the most important safety features and must never exceed manufacturer's recommended settings.

Only suitably qualified and competent personnel may perform any testing and re-adjustment of pressure relief devices.

Written records of inspection and maintenance activities should be maintained and regularly updated.

2.5 Warnings and Cautions

⚠ WARNING - Statements outline minimum safety requirements to be observed when operating the equipment and during maintenance procedures.

Ignoring these warnings could result in serious injury or death of personnel.

⚠ CAUTION - Statements call particular attention to a step in a procedure that, if not followed, could result in damage to, or destruction of, equipment.

3 SPECIFICATION

⚠ WARNING

Only operate the thruster momentarily on deck as the thruster maximum rpm will be exceeded when operated off load (in air).

3.1 Specification

General		
Part number		HTE380BA-45
Description		Hydraulic Thruster c/w Rexroth Type KFA-45 Motor
Hydraulic Motor Manufacturer		Rexroth (SMD Part Number OV 3145)
Motor Type		Fixed displacement Motor 45cc Splined Shaft
Displacement		45cc/rev.
Measurements		
Propeller Diameter		390mm
Dimensions		Refer to Figure 5
Weight	Air	27.0 kg
	Seawater	12.0 kg
Connections		
Motor Connections		Supply/Return lines ¾" BSPP
Case Drain Connection		¼" BSPP
Bearing Housing Connection		$^{1}/_{8}$" BSPP
Pressures		
Pressure	Continuous	300 bar
	Intermittent	350 bar
Flow		Up to 50 LPM. Refer o chart (Figure 3).
Thrust		Refer to performance charts (Figure 3 and Figure 4).
Miscellaneous		
Hydraulic Oil Type		Mineral Oil, Shell Tellus or equivalent. Viscosity Range = 6-300 centistokes at the fluid operating temperature with 15-30 centistokes normally recommended.
Maximum Recommended Bulk		50°C Oil Temperature.
Mounting Method		Integrated Pedestal

3.2 Performance Characteristics

The hydraulic system pressure and available flow determines the thrust produced by the HTE 380 thruster. To assist the customer in identifying the thrust performance when fitted to his system, the attached performance characteristics are provided.

To identify thrust, calculate the pressure available at the thruster motor considering all pressure drops in the system. From the appropriate graph, read off thrust at the calculated motor pressure and read off flow at this thrust. This gives the pressure, thrust and flow operating point of the thruster. As forward and reverse thrust is approximately equal, this operating point is valid for both directions of operation.

The performance data provided is for a single thruster operating in open water at a depth, which eliminates the effect of cavitation. Restriction of the water flow through the thruster due to the platform frame, buoyancy or other assemblies will reduce the thrust from the open water thrust data. Allowance should be made for this de-rating when designing the system.

4 INSTALLATION

4.1 Thruster Mounting

The thruster is mounted off the main pedestal base, please refer to Figure 5.

The recommended fasteners for the pedestal base mounting are M12 or ½ inch 316 stainless steel bolts, washers and nyloc nuts tightened to a torque of 35 Nm.

Considerable force can be transferred from the thruster through the pedestal to the platform mounting brackets and the customer must ensure bracket is adequate.

4.2 Motor Hydraulic Connections

Refer to the attached Nomograph (Figure 1) for selection of tube bore diameter of pressure lines. Thruster maximum flow should be identified from the performance data from Figure 3. Oil velocity should be no more than 8 m/s in the A/B pressure lines at full flow. Csae drain lines should be 10mm (3/8”) minimum.

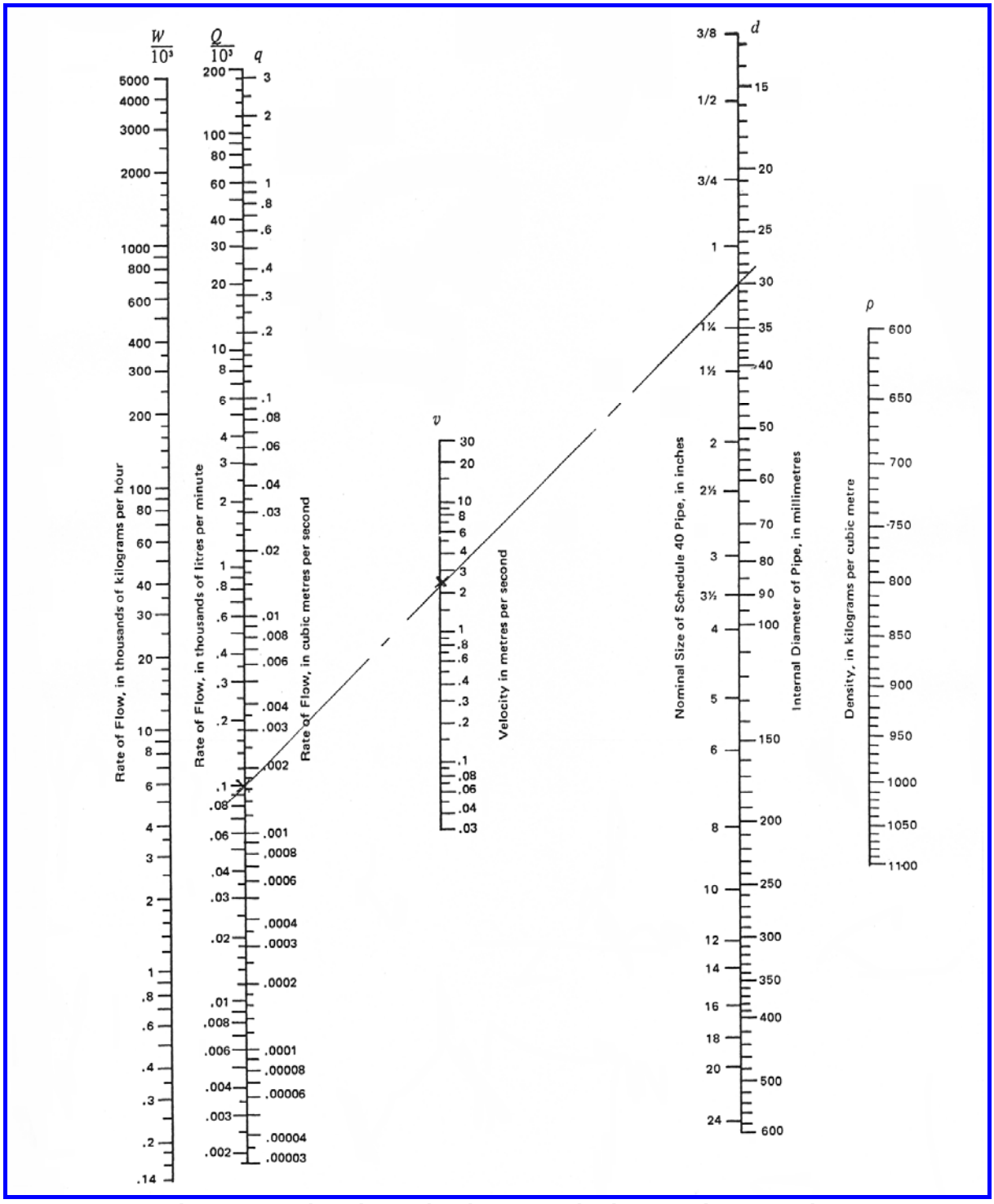


Figure 1 - Tube Size Selection By Velocity Vs. Flow Requirements

4.2.1 Supply/Return Line Connections

The 2 supply/return line ports are designed to mate with a ½" BSPP fitting. The flange mating face dimensions are shown on Figure 5.

Suitably pressure rated st/st hydraulic pipe or hydraulic hose can be used to connect to the motor. If pipe is used, considerable care must be taken in mounting the thruster to ensure vibration etc does not damage the pipe coupling. Hydraulic hose tails

approximately 0.5m long are more convenient and overcome potential problems with direct hard piping. The hose should be routed to minimise the water flow restriction through the thruster. Hydraulic hose will reduce pressure spikes before they reach the motor and are flexible enough to allow service and bleeding of the motor and bearing housing by unbolting the thruster to align it for bleeding without disconnecting the supply/return lines. This is useful for thrusters fitted in certain configurations.

4.2.2 Case Drain Connection

The case drain returns oil, which has leaked through the motor assembly, to the motor case. This oil must be returned to tank (LP reservoir) to ensure the case drain pressure remains below the motor return line pressure.

A 3/8 inch hydraulic hose should be used and connected to the 9/16”UNF case drain port on the motor. This hose should be a minimum of 0.5m long to match the main hoses and should be similarly routed to minimise water flow restriction through the thruster.

The standard motor shaft seal can accommodate up to 2.0 bar (29 psi) pressure from the case drain oil to the bearing housing oil and 0 bar pressure from the bearing housing oil to the case drain oil. Please contact SMD if alternative pressure rating is required.

The following considerations should be noted.

1. The drain line must be connected in a way, which ensures all air can be bled from the motor and hose.
2. For installations where the motor shaft is vertically mounted, the thruster should be bled to remove all air before mounting the thruster as it is very difficult to remove all air after the thruster is mounted.
3. There are special considerations associated with the case drain in multiple motor installations and the following should be addressed.

The case drains should not be commoned together unless the pipe is increased in size to take into account the extra flow from the additional case drains. Negligible backpressure at the case drain must be maintained.

Failure to comply introduces the possibility of pressurising a motor case to a level higher than return port pressure, which may result in the separation of the rotating assembly from the camplate, which will damage the motor. This could occur, for example, if the motor is unloaded whilst other motors in the system are functioning normally.

4.2.3 Bearing Housing Connection

The bearing housing must be oil filled for lubrication and pressure balance to the ambient pressure. In order to provide pressure balance with the ambient pressure the bearing housing oil feed must be connected to a hydraulic pressure compensator or to the hydraulic system reservoir, which should already be pressure balanced. This, results in the bearing housing pressure being at ambient plus the small pressure (typically 5-15 psi) generated by the pressure compensator.

As shown in Figure 5, the bearing housing has a 1/8” BSPP port, which can be used for the pressure balance connection. There are 4 additional ports to ensure that all air can be bled from the bearing housing prior to operation. This may take say 15

minutes and will be assisted by hand turning the propeller. The bleed point must be uppermost to ensure trapped air pockets are not created.

The recommended methods of bearing housing pressure compensation are shown on Figure 7 & Figure 8.

Option 1 - Figure 7, shows the bearing housing connection branched from the motor case drain and option 2 - Figure 8 shows the bearing housing separately compensated. Separate compensation can be either an individual compensator for each thruster or a single compensator commoned to each thruster bearing housing.

Option 1 - Figure 7, has the advantage of low cost installation and negligible differential pressure across the motor shaft seal but the disadvantage of contamination of the main system hydraulics if the propeller shaft seal allows water ingress.

Option 2 - Figure 8, has the advantage of no contamination of the main system hydraulics, if the propeller shaft seal allows water ingress, but the disadvantage of higher installation cost and the possibility of differential pressures between the motor case drain and the bearing housing which exceeds the rating of the motor shaft seal. If the motor shaft seal pressure is exceeded oil will flow between the bearing housing and motor case drain. The majority of our customers favour this option.

As an aid to inspecting the condition of the bearing housing oil, the customer may consider fitting either clear hose or a viewing bowl to the line between the bearing housing and compensator. It is also recommended that a low-level alarm is fitted to the bearing housing compensator.

4.3 Thruster Seals

⚠ WARNING

Only operate the thruster momentarily on deck as the thruster maximum rpm will be exceeded when operated off load (in air).

The thruster has rotary seals on the propeller shaft to seal between the seawater and the bearing housing oil and on the motor shaft to seal between the bearing housing oil and motor case drain oil.

Static seals are also fitted to the bearing housing ports, the bearing housing seal retainer, the bearing housing and motor interface, the motor main and case drain ports, the motor back plate and the motor valve block blanking plates.

The locations of seals are shown on the thruster general assembly drawing Figure 6.

The propeller shaft rotating seal arrangement is shown in Figure 6. It consists of a PTFE seal facing towards the seawater and a nitrile lip seal facing towards the bearing housing oil. The seals are mounted back to back and run on the same seal ring mounted on the shaft. This provides a pressure rating of 2.5 bar (36 psi) from bearing housing to seawater and 10 bar (145 psi) from seawater to bearing housing.

⚠ CAUTION

The void between the 2 back to back seals must be completely filled with grease to ensure no air is trapped between the seals.

The motor shaft seal consists of a single lip seal with backing washer which can accommodate zero pressure from the bearing housing to the motor case drain and 2 bar (29 psi) pressure from the motor case drain to the bearing housing.

An 'O'-Ring is fitted to the motor back plate. A differential pressure of 2 bar (29 psi) across the 'O'-Ring should not be exceeded.

Options to the standard pressure rating of rotary seals and 'O'-Rings are available. Contact SMD for details of the options available.

Refer to section 5 - Maintenance Procedures, for guidance on changing seals.

5 MAINTENANCE PROCEDURES

5.1 General Maintenance

Inspection of the condition of the thruster should be performed between each deployment of the system. The following should be considered in association with the customer's standard inspection procedures.

- Pedestal fixing to the frame.
- Fatigue of brackets.
- Thruster fasteners secure.
- Damage to hoses/piping.
- Leaks/damage to hydraulic fittings.
- Compensator oil level.
- Physical damage to propeller, nozzle, etc.
- Leaks at seals.
- Excessive noise during operational test.
- Ensure all air is bled from the motor and bearing housing.
- Propeller shaft play.
- Damage to protective coatings.

5.2 Hydraulic Motor

Except for replacement of the thruster motor shaft seal, maintenance and repair by the customer is not recommended. A faulty unit should be returned to SMD as advised in section 7.1.

5.3 Bearing Housing

Maintenance tasks on the bearing housing can be grouped into the following:-

- Replace the Bearing Housing Shaft Seal.
- Replace the Bearing Housing Seals and Seal Ring.
- Replace Bearings Mounted in the Bearing Housing.

Bearing Life : The bearing system is designed for in excess of 20,000 hours of continual operation. Water ingress, contamination and external mechanical force on the shaft can significantly reduce this life. It is suggested all bearings are replaced after 4000 hours of operation.

Shaft Seal Life : It is recommended the shaft seals and seal wear ring are replaced after 1000 hours of operation. The seal ring is part of the shaft assembly but is identified in the parts list under consumable spares and tools.

5.3.1 Bearing Housing Shaft Seal Replacement

The replacement of bearing housing shaft seals requires seal kit KT 3001-2. Seals can typically be replaced with the thruster mounted on the vehicle. If the seal wear ring is to be replaced go to the next procedure 'BEARING HOUSING SEALS AND SEAL RING REPLACEMENT'.

- Refer to Figure 9, Figure 10, Figure 11, & Figure 6
- Remove the propeller cap and fixing nut. Items 7, 8, 6, 4, 5.

- Using the propeller puller bar tool (OV 3047) draw the propeller (3/2) from the shaft (2/8) and remove the key (3/1).
- Verify the bearing housing compensator has been drained.
- Remove the seal retainer (2/3) by removing the screws (2/6) and washers (2/7) and jacking the seal retainer (2/3) from the bearing housing using the screw's (2/6) in the threaded holes of the seal retainer (2/3).
- Inspect the seal ring (2/8/4) for wear. If grooves have formed on the ring it is recommended the seal ring is replaced as described in procedure sections 5.3.2, 0 and 5.3.4.
- If the seal ring is not worn take items 2/2/61, 2/2/62, 2/2/13 and 2/3 to a work bench to replace the seals and refer to Figure 10.

1) Hold seal ring lightly in a vice and tap out old seals using a soft hammer and tool 3. Remove old hydraulic sealant and other residue.

2) Lightly smear hydraulic sealant on the outer ring of the PTFE seal (2/2/62) and the seal mounting area of the seal retainer. Using the insertion tool (OV 3050) and a vice push the PTFE seal (2/2/62) correctly orientated, fully into the seal retainer. Remove excess hydraulic sealant with a clean cloth.

3) Pack the back face of the PTFE seal with seawater resistant grease (typically Advanced Lubrication SW2 grease). Ensure all air pockets are removed.

4) Push the lip seal (2/2/61) correctly orientated against the PTFE seal as shown. Use the tool (OV 3050) and a vice to push the lip seal fully home against the PTFE seal.

5) Remove excess grease with a clean cloth and smear extra grease to fill all voids on the inner face of both seals. Ensure adequate grease, so no air pockets will remain when the seals are pushed onto the shaft seal ring.

6) Replace 'O' ring (2/2/13) fitted to the seal retainer and return to the thruster.

7) Gently align the screw holes of the seal retainer with the bearing housing threads and evenly push the lip seal onto the seal ring.

8) Fit the washers and screws (2/6, 2/7) and evenly screw the seal retainer to the bearing housing as shown in Figure 6.

9) Replace the propeller key (3/1) and propeller (3/2) and the washer (5) and nut (4).

10) Replace the propeller cap (6, 8, 7)

11) Ensure the following :-

Fasteners Torque:	**Nm**	**lb f ft**
Item 7	6	4
Item 9/2	50	35
Item 4	50	35
Item 11	8	5.5
Pedestal Mounting Bolts	85	60

Figure 2 - Torque Fasteners

- Complete thruster assembly, check assembly is mechanically secure and shaft rotation is satisfactory.

5.3.2 Bearing Housing Seals and Seal Ring Replacement

For replacement of the seal ring it is necessary to remove the thruster pedestal / bearing housing and the thruster motor for maintenance in the workshop. If the motor is connected using flexible hose the motor can be left connected to the vehicle if desired.

1) Refer to the drawings attached Figure 9, Figure 10, Figure 11, & Figure 6

2) Remove the propeller cap and fixing nut. Items 7, 8, 6, 4, 5.

3) Using the propeller puller bar tool (OV 3047) draw the propeller (3/2) from the shaft (2/8) and remove the key (3/1).

4) Verify the bearing housing compensator has been drained.

5) If the motor is to stay attached to the vehicle, remove the screws, spring washers (9/2, 9/3) holding the motor to the bearing housing.

6) Pull the motor (9/1) apart from the bearing housing and remove the 'O' ring (2/2/12).

7) If the motor is to be left attached to the bearing housing, note the orientation of the motor ports and mark hoses and ports for re-connection. Drain the main system reservoir before disconnecting the main and case drain hoses.

8) Remove the seal retainer (2/3) by removing the screws (2/6) and washers (2/7) and jacking the seal retainer (2/3) from the bearing housing using the screw's (2/6) in the threaded holes of the seal retainer (2/3).

5.3.3 Seal Replacement

1) Hold seal ring lightly in a vice and tap out old seals using a soft hammer and tool 3. Remove old hydraulic sealant and other residue.

2) Lightly smear hydraulic sealant on the outer ring of the PTFE seal (2/2/62) and the seal mounting area of the seal retainer. Using the insertion tool (OV 3050) and a vice push the PTFE seal (2/2/62) correctly orientated, fully into the seal retainer. Remove excess hydraulic sealant with a clean cloth.

3) Pack the back face of the PTFE seal with seawater resistant grease (typically Advanced Lubrication SW2 grease). Ensure all air pockets are removed.

4) Push the lip seal (2/2/61) correctly orientated against the PTFE seal as shown. Use the tool (OV 3050) and a vice to push the lip seal fully home against the PTFE seal.

5) Remove excess grease with a clean cloth and smear extra grease to fill all voids on the inner face of both seals. Ensure adequate grease, so no air pockets will remain when the seals are pushed onto the shaft seal ring.

6) Replace 'O' ring (2/2/13) fitted to the seal retainer and return to the thruster.

5.3.4 Shaft Wear Ring Replacement

1) If the motor is attached, remove the screws, spring washers (9/2, 9/3) holding the motor to the bearing housing.

2) Pull the motor (9/1) apart from the bearing housing and remove the 'O' ring (2/2/12).

3) Remove the rear, bearing retainer (2/9) by removing the long bleed screw (2/11) and unscrewing the retainer (2/10).

4) Pull the shaft out from the rear of the bearing housing and remove the thrust washer and roller bearing (2/4)

5) Take the shaft and slide the collar retainer (DI 3402) over the seal ring (2/8/4). Fit the seal ring removal collars (tool 4) to the seal ring with the lip engaged between the seal ring and the adjacent bearing inner ring. Slide the collar retainer over the removal collars.

6) Using the seal ring puller (OV 3046) pull the seal ring off by placing the puller legs behind the collar retainer and the jacking screw against the propeller end of the shaft.

7) Clean the shaft thoroughly and de-grease to remove all sealant or other residue from the area of the seal ring.

8) Apply LOCTITE 601 or equivalent retaining compound to the shaft where the seal ring will fit.

9) Fit the seal ring insertion collars (tool 6) to the new seal ring (2/8/4) and slide the collar retainer (tool 5) over the insertion collars.

10) Slide the new seal ring and tools onto the taper end of the shaft.

11) VERIFY NEW SEAL RING (2/8/4) ORIENTATION IS CORRECT WITH LARGEST CHAMFER AT THE PROPELLER END OF THE SHAFT.

12) Fit the spline peg (tool 7) to the spline of the shaft.

13) Fit the seal ring puller legs behind the collar retainer and position the puller screw against the shaft spline peg.

14) Draw the new seal ring up the shaft using the puller ensuring the seal ring moves evenly on the shaft until the seal ring butts against the bearing inner ring.

15) Remove all tools from the shaft, clean all residues and inspect the new assembly.

5.3.5 Reassembly

Refer to Figure 9, Figure 10, Figure 11, & Figure 6.

1) Ensure the following during assembly, which is the reverse of the disassembly procedure.

2) New ‘O’ rings (2/2/12, 2/2/13) fitted

3) No air is trapped in the area between the 2 shaft seals and the seal ring.

4) Complete thruster assembly is mechanically secure and shaft rotation is satisfactory.

5.3.6 Replace Thruster Bearings

Refer to Figure 6.

It is recommended that a bearing housing with worn or corroded bearings should be replaced with a new bearing housing assembly and the old unit returned to SMD for refurbishment.

If it is impractical to return the assembly, the customers engineering workshop should replace the bearings considering the following:-

1) Manufacture suitable removal and insertion tools for use with a hand or hydraulic press.

2) Ensure the housing and shaft, are cleaned prior to fitting new bearing rings/bearings.

3) Install bearings with a suitable bearing fit compound.

5.4 Storage

Thrusters are shipped assuming they will be fitted to a system within 12 weeks. This assumes no extraordinary storage conditions as no special precautions are taken for long term storage.

If the thruster is to be stored for longer than 12 weeks, the customer should fill the motor and bearing housing with hydraulic oil. The propeller should be rotated by hand every month. If the thruster is stored for more than 12 months it is advised the rotary seals be replaced prior to operation.

6 PARTS LISTS

For the parts lists see “GENERAL ARRANGEMENT DRAWINGS on page 23”

7 SERVICE AND SPARE PARTS

7.1 Service Returns Procedure

- The thruster should be suitably packaged and returned to SMD freight-paid, after advising SMD of the required service work.
- A maintenance/failure report by the customer is required.
- A quotation for service/repair will be provided by SMD.
- An order to service/repair the unit is required before work can commence.

7.2 Spare Parts

Refer to the attached parts list and general assembly drawing. Ordering by SMD part number reduces the risk of wrong parts being provided.

8 DISTRIBUTORS

Contact SMD Limited for a current list of distributors:-

- Telephone :- ++44 (0) 191 234 2222.
- Fax :- ++44 (0) 191 234 8599.
- E-mail :- info@smd.co.uk
- Web Site :- http://www.smd.co.uk
- Address :- Soil Machine Dynamics Limited.
  Turbinia Works
  Davy Bank
  Wallsend,
  Tyne and Wear,
  United Kingdom.
  NE28 6UZ.

SMD have a network of distributors that can provide in-field support for Curvetech Products in their relative areas.

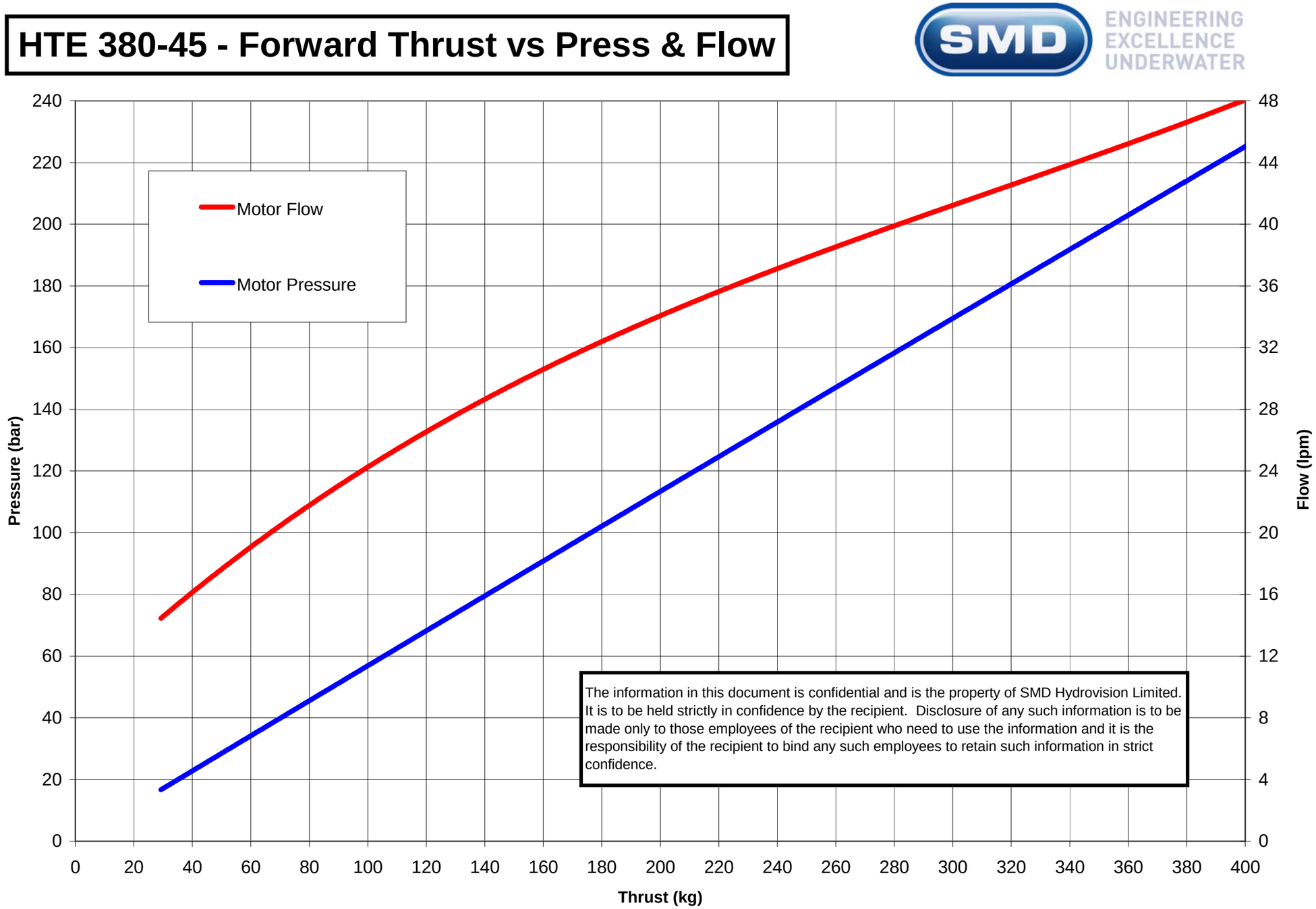


Figure 3 - HTE380 Thruster Performance (Pressure & Flow vs. Thrust)

HTE 380 - Forward Thrust vs Power

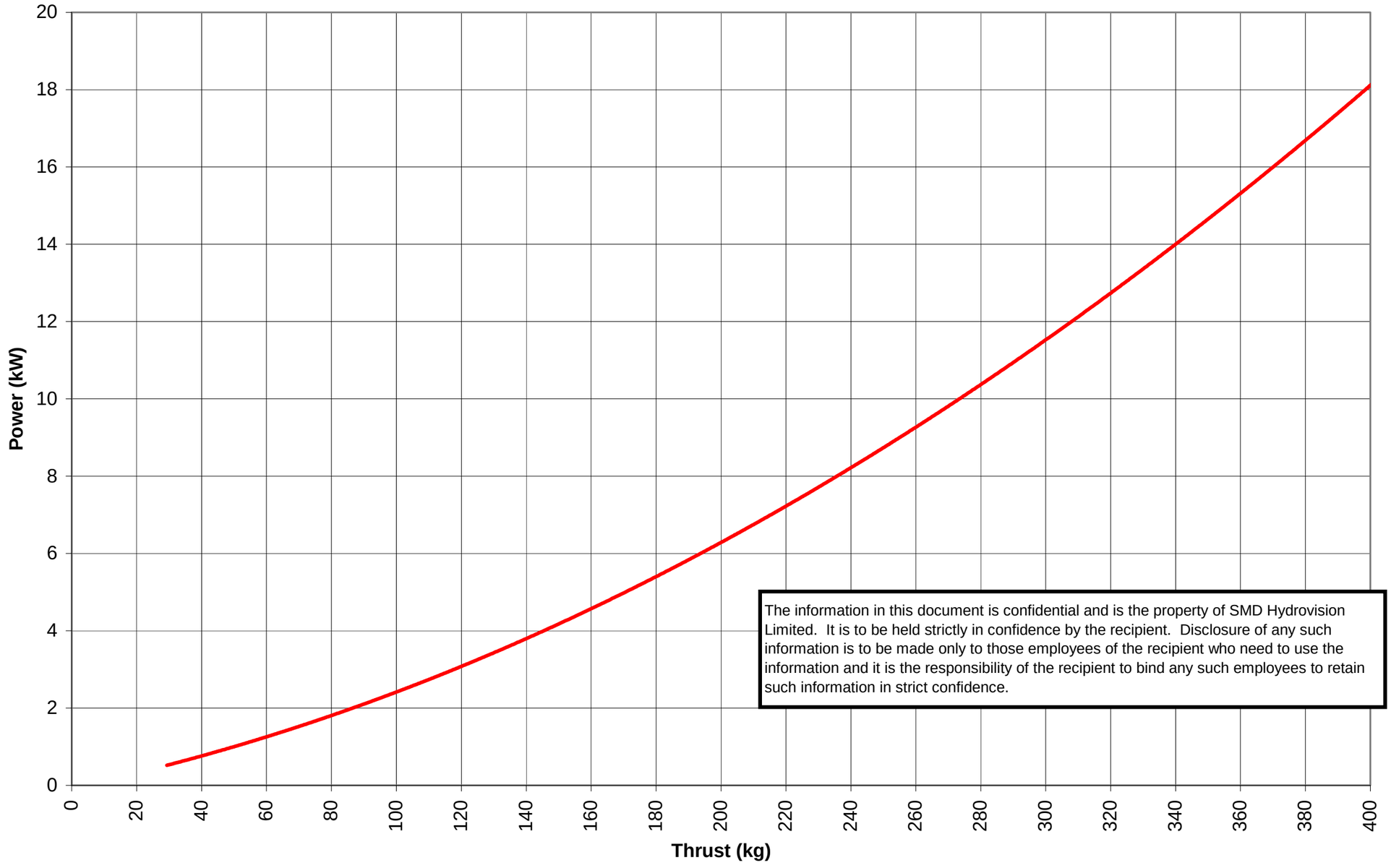


Figure 4 - HTE380 Thruster Performance Power vs. Thrust

9 GENERAL ARRANGEMENT DIAGRAMS

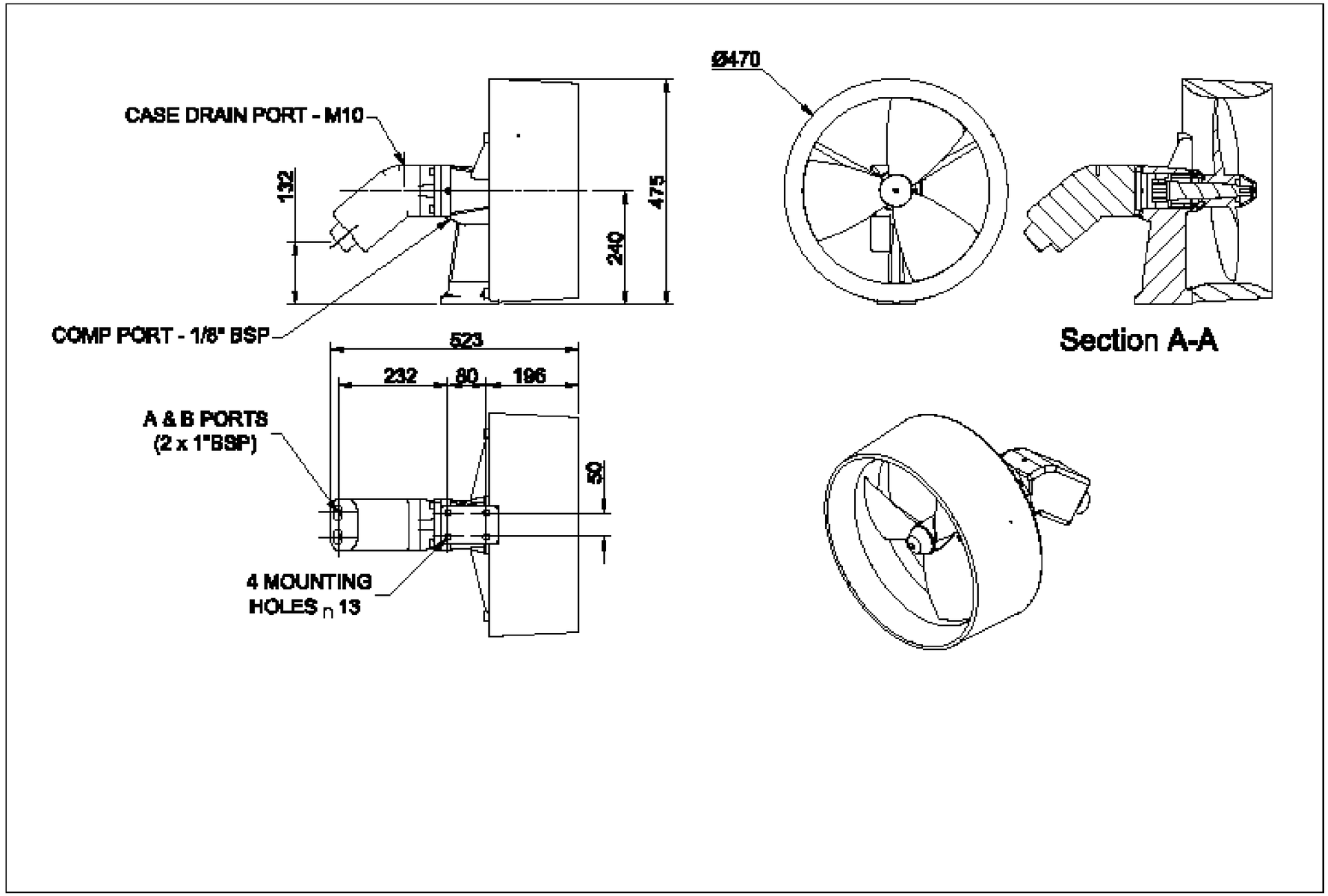
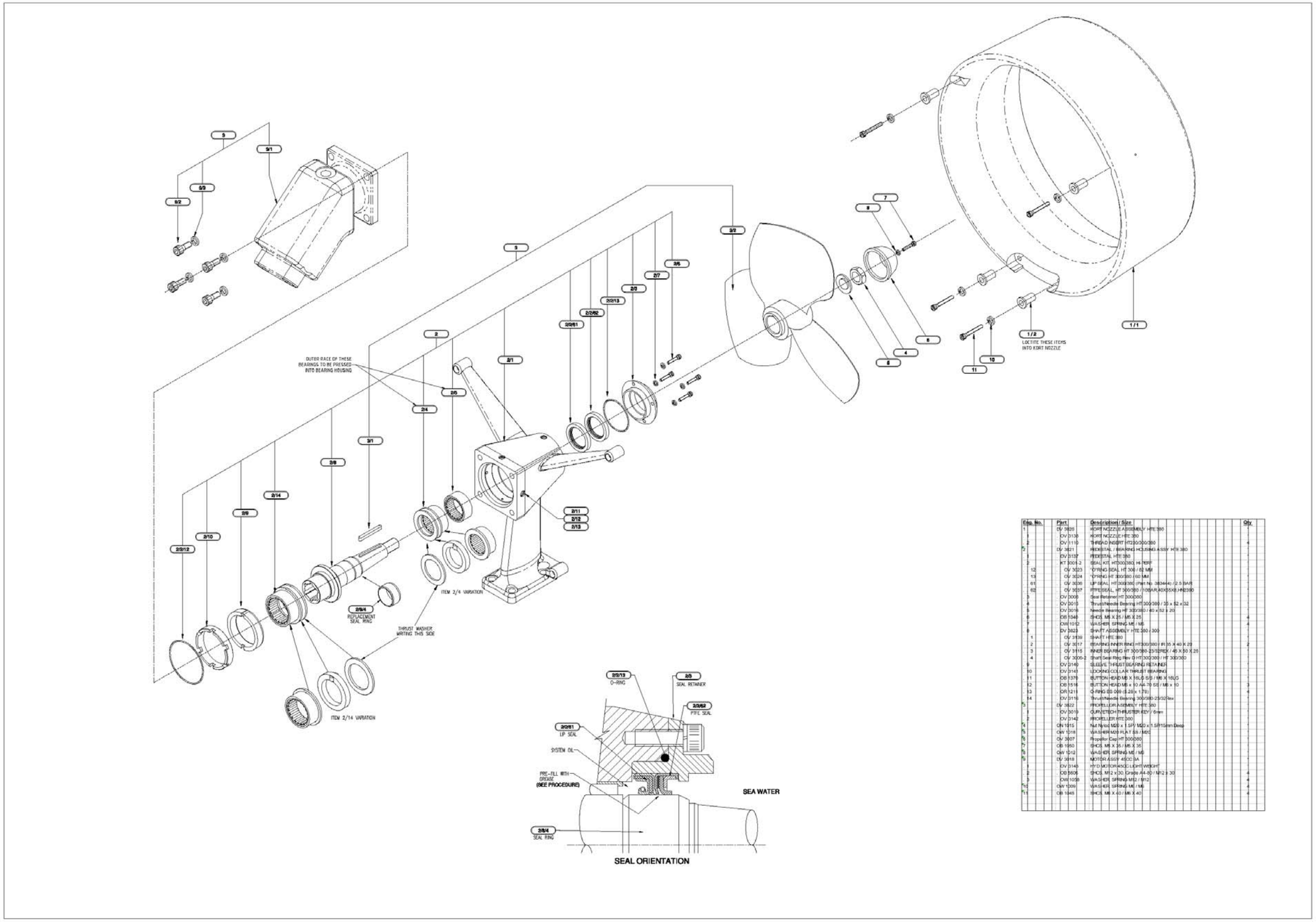


Figure 5 - HTE380 Installation



Dwg. No.	Part	Description / Size	Qty
1	OV 3825	KORT NOZZLE ASSEMBLY HTE 380	
1	OV 3130	KORT NOZZLE HTE 380	
2	OV 1110	THREAD INSERT HT2300/380	4
2	OV 3821	PEDESTAL / BEARING HOUSING ASSY HTE 380	
1	OV 3137	PEDESTAL HTE 380	
2	KT 3001-2	SEAL KIT, HT300/380, HI TEMP	
12	OV 3023	O'RING SEAL, HT 300 / 62 MM	
13	OV 3024	O'RING HT 300/380 / 60 MM	
61	OV 3036	LIP SEAL, HT 300/380 (Part No. 3834/44) / 2.5 BAR	
62	OV 3037	PTFE SEAL, HT 300/380 / 108ARJ60X65XR-HR2380	
3	OV 3008	Seal Retainer HT 300/380	
4	OV 3010	Thrust Needle Bearing HT 300/380 / 35 x 52 x 32	
5	OV 3016	Needle Bearing HT 300/380 / 40 x 52 x 20	
6	OB 1048	SHCS, M8 X 25 / M6 X 25	4
7	OW 1012	WASHER, SPRING M8 / M8	4
8	DV 3823	SHAFT ASSEMBLY HTE 380 / 300	
1	OV 3139	SHAFT HTE 380	
2	OV 3017	BEARING INNER RING HT300/380 / IR 35 X 40 X 29	2
3	OV 3115	INNER BEARING HT 300/380-23/32REK / 45 X 50 X 25	
4	OV 3006-2	Shaft Seal Ring Rev D HT 300/380 / HT 300/380	
9	OV 3140	SLEEVE THRUST BEARING RETAINER	
10	OV 3145	LOCKING COLLAR THRUST BEARING	
11	OB 1376	BUTTON HEAD M8 X 16LG S/S / M8 X 16LG	
12	OB 1516	BUTTON HEAD M8 x 10 A4-70 SS / M8 x 10	3
13	OR 1211	O-RING ES 089 (1.28 x 1.78)	4
14	OV 3116	Thrust Needle Bearing 300/380 23/32 lkw	
5	DV 3822	PROPELLOR ASSEMBLY HTE 380	
1	OV 3015	CURV PITCH THRUSTER KEY / 6mm	
2	OV 3140	PROPELLER HTE 380	
4	CN 1015	Nut Nyloc M20 x 1.5P / M20 x 1.5P15mm Deep	
5	CW 1018	WASHER M20 FLAT SS / M20	
6	OV 3007	Propellor Cap HT 300/380	
7	OB 1060	SHCS, M8 X 35 / M8 X 35	
8	CW 1012	WASHER, SPRING M8 / M8	
9	DV 3818	MOTOR ASSY 460C 3A	
1	OV 3149	HYD MOTOR 460CC LIGHTWEIGHT	
2	OB 5606	SHCS, M12 x 30, Grade A4-80 / M12 x 30	4
3	CW 1059	WASHER, SPRING M12 / M12	4
10	CW 1009	WASHER, SPRING M6 / M6	4
11	OB 1045	SHCS, M6 X 40 / M6 X 40	4

Figure 6 - HTE380 Thruster Exploded View

NOTE:-
FOR RECOMMENDED PRESSURE
SUPPLY & RETURN LINE BORES
REFER TO STANDARD
NOMOGRAPHIC FLOW CHART

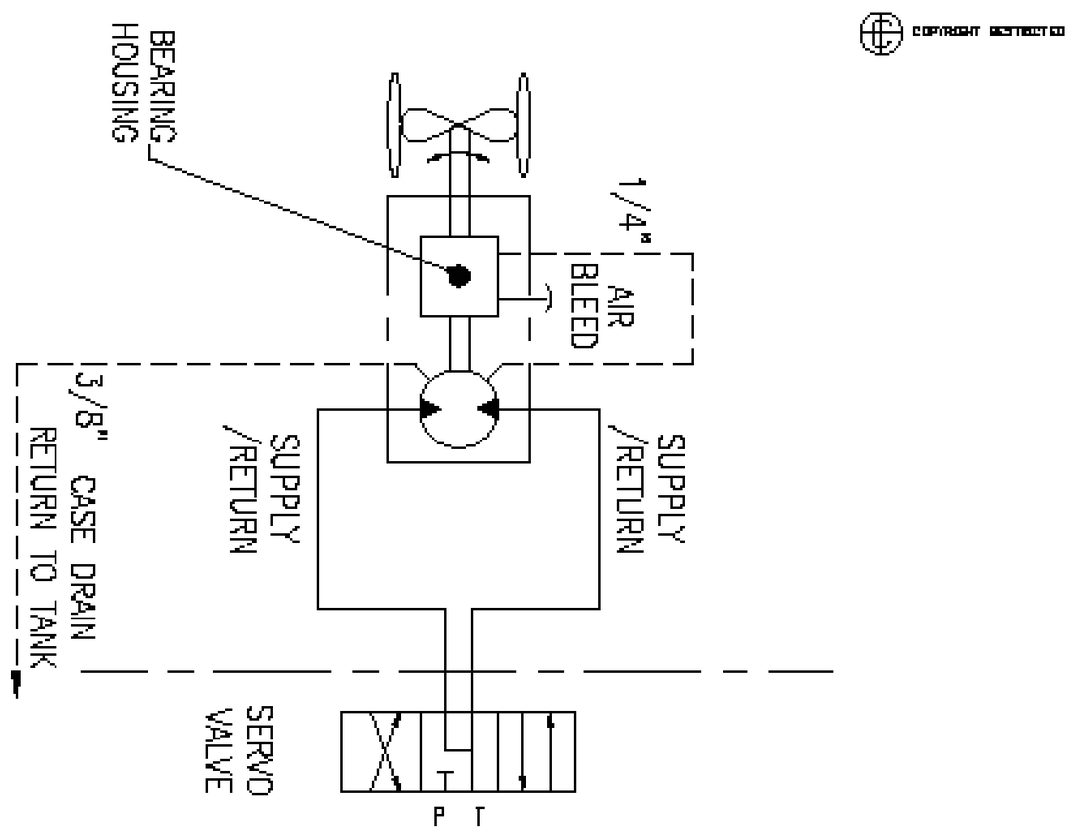


Figure 7 - Option 1, Bearing Housing Lub'n Branched From Case Drain

NOTE:–
FOR RECOMMENDED PRESSURE
SUPPLY & RETURN LINE BORES
REFER TO STANDARD
NOMOGRAPHIC FLOW CHART

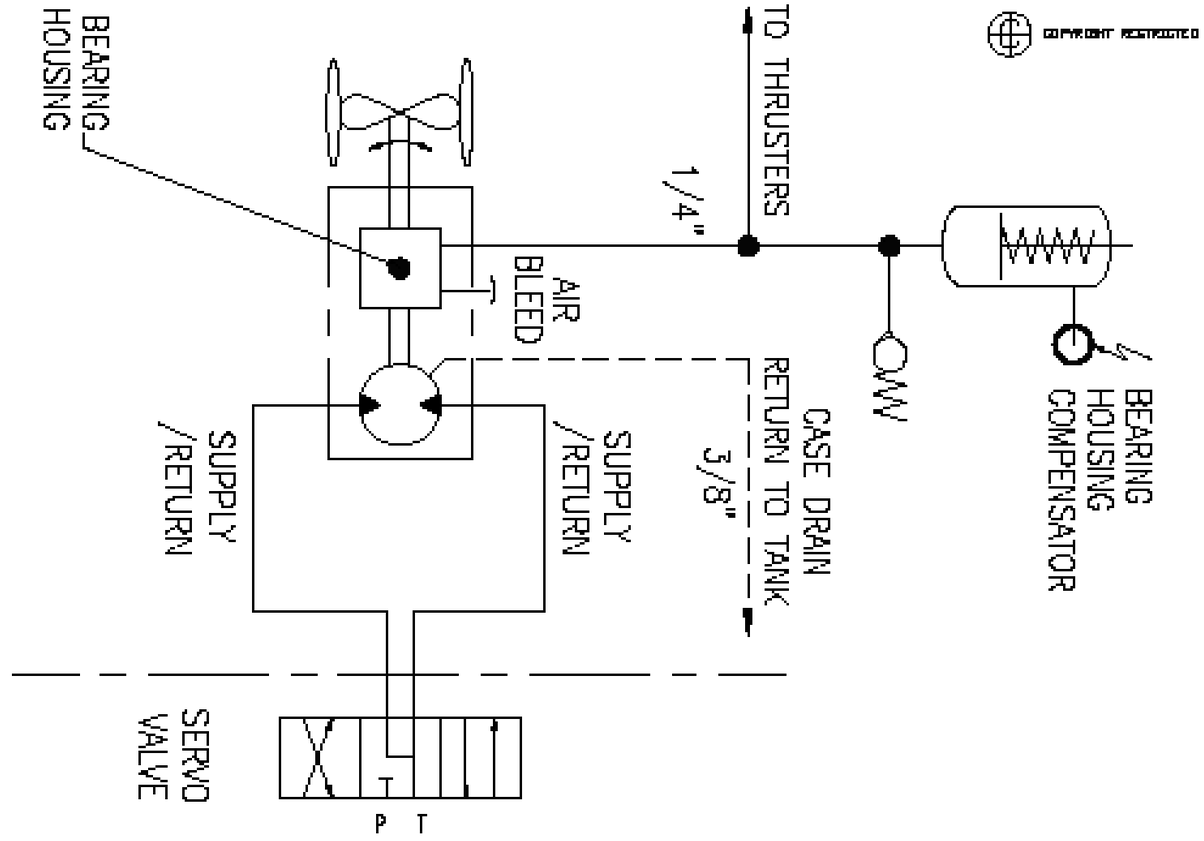


Figure 8 - Option 2, Separate Bearing Housing Lubrication Supply

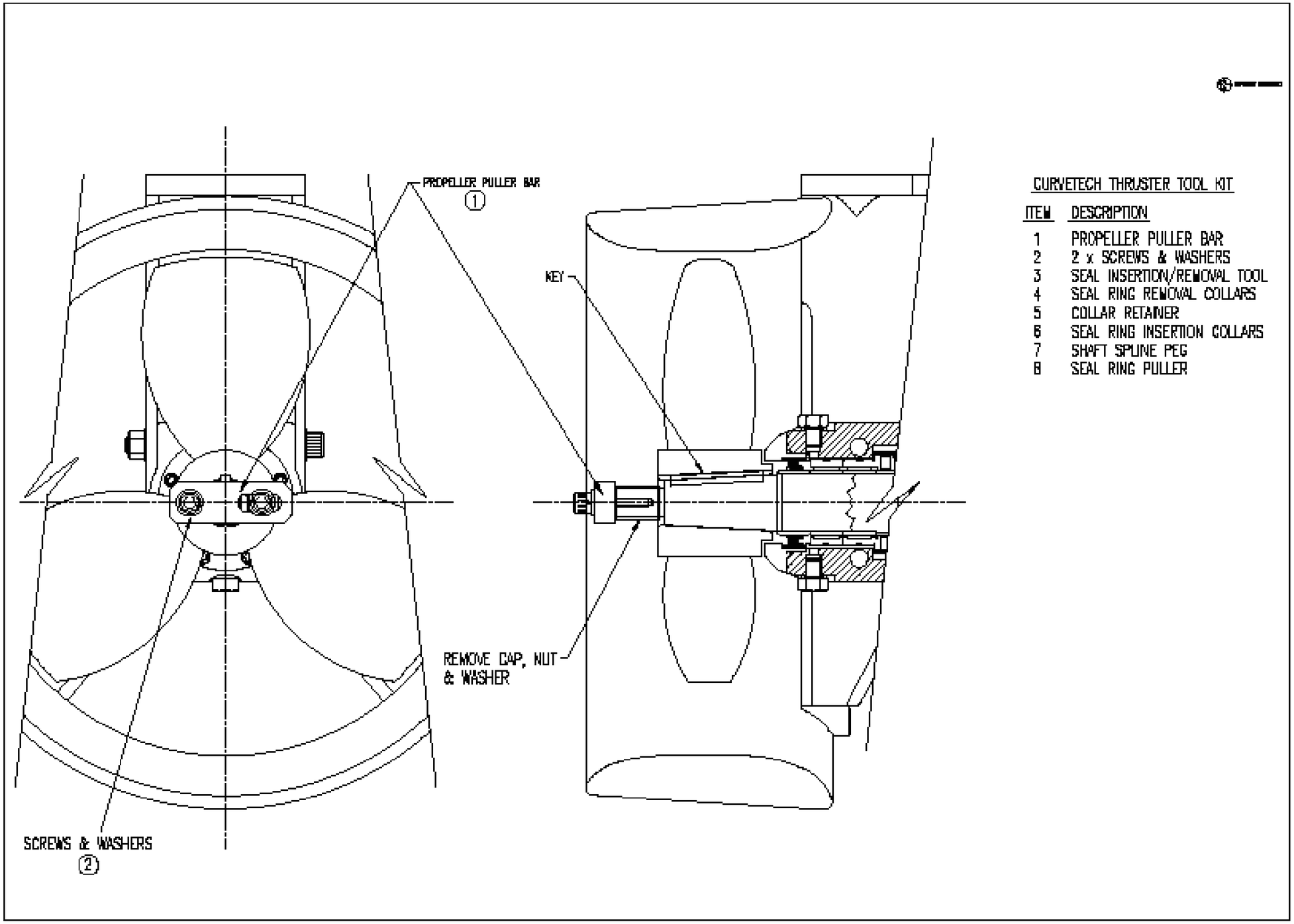


Figure 9 - Curvetech Thruster Propeller Removal

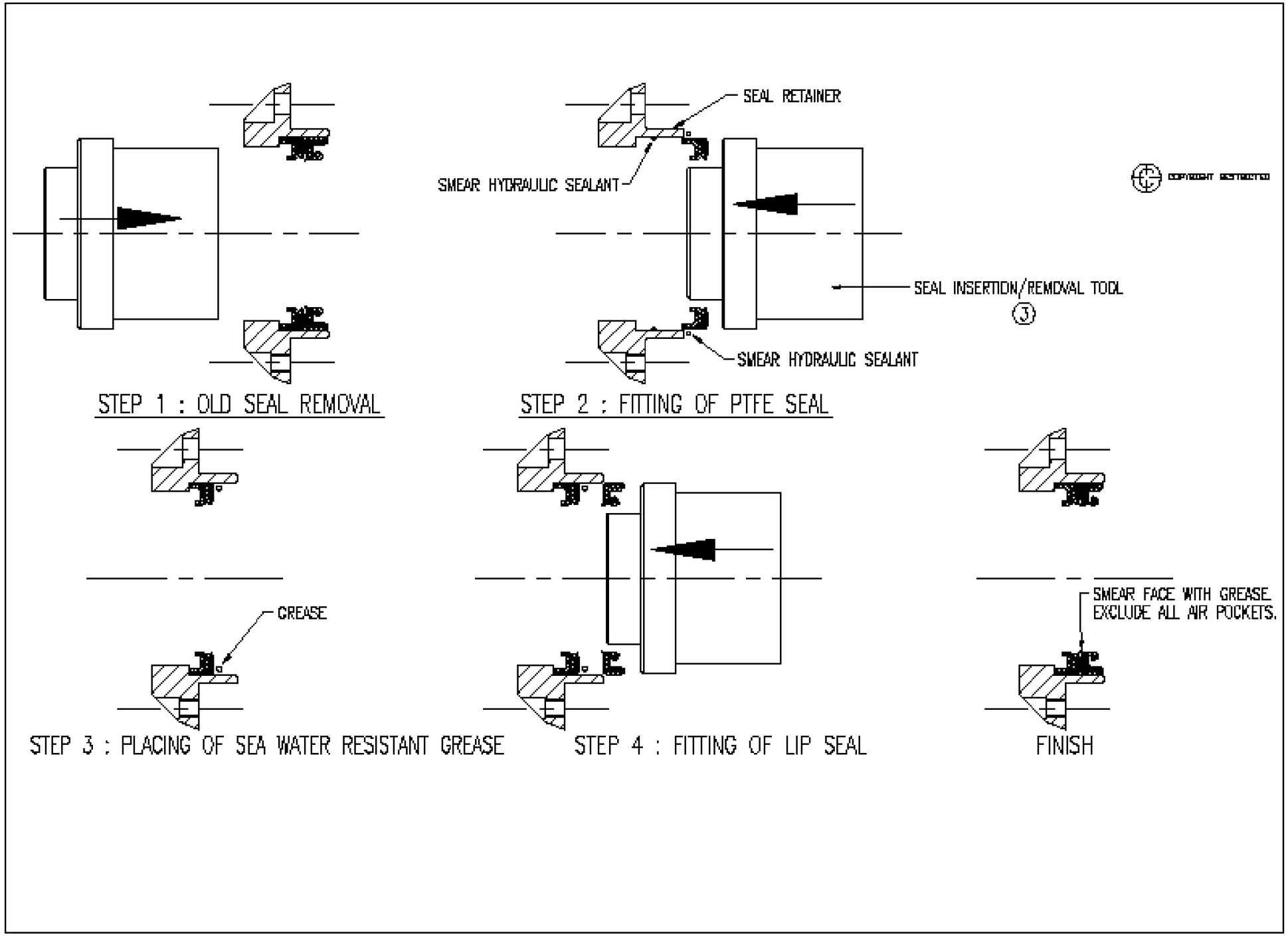


Figure 10 - Curvetech Thruster Removal & Fitting Of Seals Into Seal Retainer

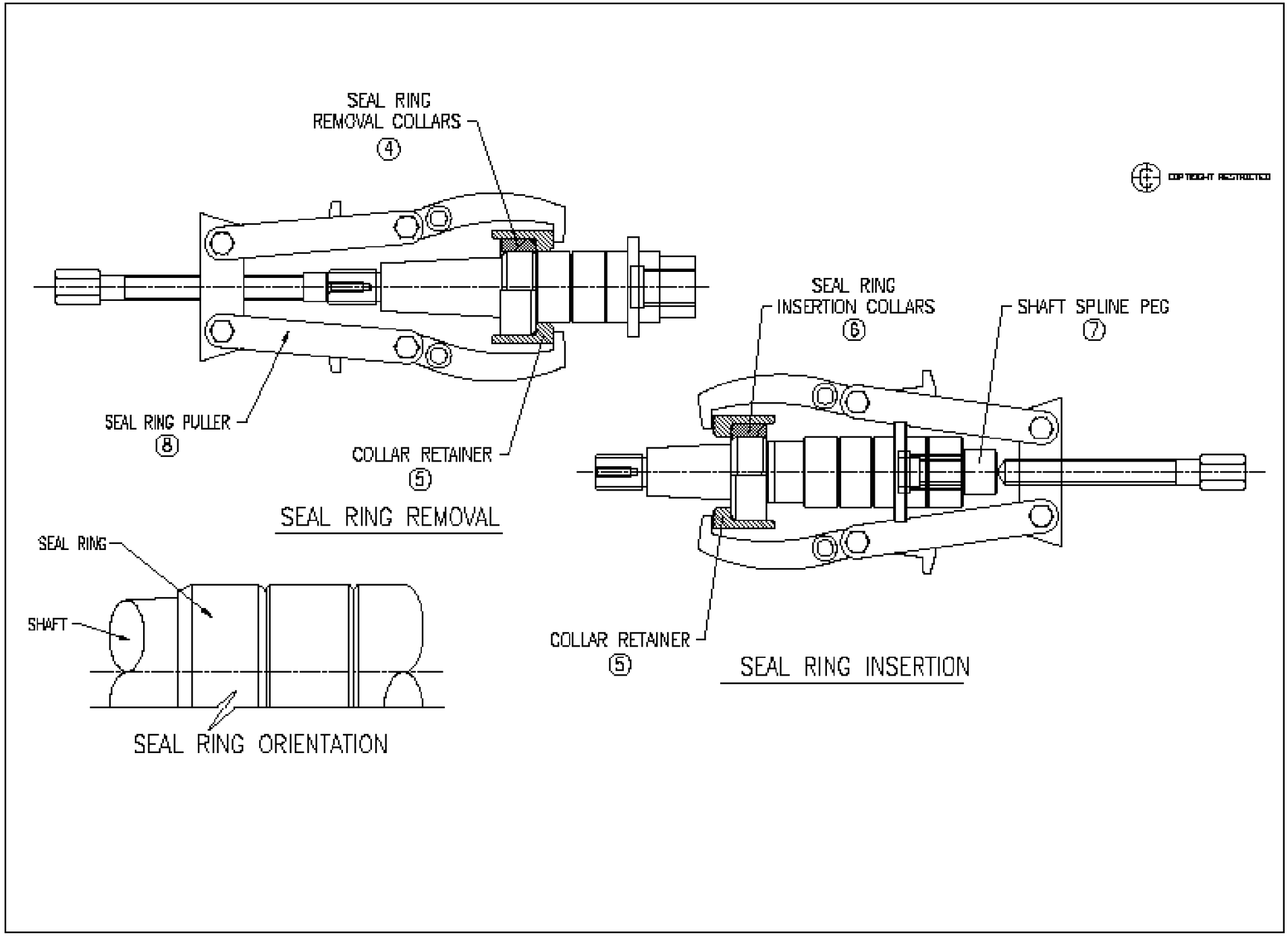


Figure 11 - Curvetech Thruster Seal Ring Removal & Replacement