TWIN DISC
INCORPORATED

Service Manual

Arneson Surface Drive™

Model:
ASD 15A1S

Document Number: 1020619

NOTICE

Twin Disc, Incorporated makes no warranty or guaranty of any kind, expressed, implied or otherwise, with regard to the information contained within this manual. Twin Disc, Incorporated has developed this manual through research and testing of the information contained therein. Twin Disc, Incorporated assumes no responsibility for any errors that may appear in this manual and shall not be liable under any circumstances for incidental, consequential or punitive damages in connection with, or arising out of, the use of this manual. The information contained within this manual is subject to change without notice.

Document Number
1020619

July, 2002

Arneson Surface Drive™ Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY
COMMERCIAL SURFACE DRIVE UNITS

A. Twin Disc, Incorporated warrants all assembled products and parts (except component products or parts on which written warranties issued by the respective manufacturers thereof are furnished to the original customer, as to which Twin Disc, Incorporated makes no warranty and assumes no liability) against defective materials or workmanship *for a period of twenty-four (24) months from the date of original shipment by Twin Disc, Incorporated to the original customer, but not to exceed twelve (12) months of service, whichever occurs first.* **This is the only warranty made by Twin Disc, Incorporated and is in lieu of any and all other warranties, express or implied, including the warranties of merchantability or fitness for a particular purpose and no other warranties are implied or intended to be given by Twin Disc, Incorporated.** Warranty is transferable from original owner of vessel in the event that title is legally transferred via sale of vessel or other legal proceedings. Warranty period will be the duration of remaining term left from original date of issue and will in no way be extended for any reason.

The customer is not to rely upon any tests or inspections by Twin Disc, Incorporated or on Twin Disc, Incorporated*s application engineering. Twin Disc , Incorporated is not responsible for any specific application, installation or performance standard. Any analysis program by Twin Disc, Incorporated based upon customer supplied information is done solely as an accommodation to the customer and is not to be interpreted or construed as an approval for specific application or installation or a guarantee of performance. Twin Disc, Incorporated cannot be held liable or responsible for incorrect information supplied or deviations from project specifications provided. Among the condition which will affect performance and as to which no warranty or representation is made are the following: vessel weight, center of gravity, rated horsepower and torque reduction, ratio of gearbox or drive units, propeller size and selection. Final specifications are assumed to include all information submitted at the time of order. Any changes or modifications to project must be communicated to Twin Disc, Incorporated*s in writing prior to completion of manufacturing and delivery. Twin Disc, Incorporated reserves the right to change or cancel order based upon any new information submitted if information is contrary to acceptable parameters of Twin Disc, Incorporated*s program.

B. **The exclusive remedy provided by Twin Disc, Incorporated whether arising out of warranty within the applicable warranty period as specified, or otherwise (including tort liability), shall at the sole option of Twin Disc, Incorporated be either the repair or replacement of any Twin Disc, Incorporated part or product found by Twin Disc, Incorporated to be defective and the labor to perform that work and to remove and reinstall (or equivalent credit). In this context, labor is defined as the flat rate labor hours established by Twin Disc, Incorporated in the published Twin Disc Flat Rate Schedule, required to remove, disassemble, inspect, repair, reassemble, reinstall and test the Twin Disc, Incorporated product only. Authorized reasonable travel and living expenses will be considered for payment. Under no circumstances, including a failure of the exclusive remedy, shall Twin Disc, Incorporated be liable for economic loss, consequential, incidental or punitive damages.** The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in-warranty repair.

2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.

3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.

4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.

5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.

6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

7. Twin Disc, Incorporated does not warranty any products used for race or competition type circumstances. Racing applications are clearly not covered by any warranty policy or terms.

C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer*s and subsequent purchaser*s employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.

E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no-charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE

(Hourly Labor Rate Must be Acceptable to Twin Disc, Incorporated.)

COMMERCIAL SURFACE DRIVE UNITS:

Description of Flat Rate Labor (hours allowed for function to the right =>)	ASD 6	ASD 8	ASD 10	ASD 11	ASD 12	ASD 14	ASD 15	ASD 16
Removal and Reinstallation	2	3	3	3	4	6	8	8
Recondition complete unit and test for leaks	5	6	6	6	6	6	8	8
Replace front oil seal	1	1	1	1	1	1	1	1
Replace input shaft	1	3	3	3	3	4	4	4
Replace input gear/sprocket	1	3	3	3	-	-	-	-
Replace Chain	1	4	4	4	-	-	-	-
Replace H-Joint	2	2	2	2	3	3	3	3
Replace thrust ball	2	2	2	2	3	3	3	3
Replace retainer ring	2	2	2	2	2	2	2	2
Replace propeller shaft	2	3	3	3	3	4	4	4
Replace thrust tube	2	3	3	3	4	5	6	6
Replace rear oil seal	1	1	1	1	1	1	1	1
Replace steer cylinder	1	1	1	1	1	1	1	1
Replace power steer pump	1	1	1	1	1	1	1	1
Replace trim pump	1	1	1	1	1	1	1	1
Replace Ball Boot	2	2	2	2	2	2	2	2
Replace and align driveline	1	2	2	2	2	3	3	3

Table of Contents

Introduction

General Information

This publication provides service information for the Twin Disc model ASD 15A1S Arneson Surface Drive. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA.

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unaccepted maintenance/ working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

To prevent accidental starting of the engine when performing routine maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in this manual regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment and, if observed, minimum repairs (aside from normal wear) will result.

Ordering Parts and Obtaining Services

⚠ WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts from the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department, Twin Disc, Incorporated, Racine, Wisconsin 53405-3698, USA by e-mail at service@twindisc.com.

Rebuilding Service

Twin Disc may provide a complete rebuilding service for surface drives and hydraulic cylinders. Call or write Twin Disc, Incorporated for information on services, pricing and scheduling.

Twin Disc, Incorporated
1328 Racine Street
Racine, Wisconsin 53403 USA

Telephone: (262) 638-4000
Fax: (262) 638-4480

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

The ASD 15A1S is an in line steerable propulsion system that supports and drives a surface piercing propeller at variable depth positions.

Nameplate

The nameplate identifies the model, bill of material (BOM) , and the serial number of the unit. These numbers are necessary to identify the correct parts for the surface drive. See Figure 1.

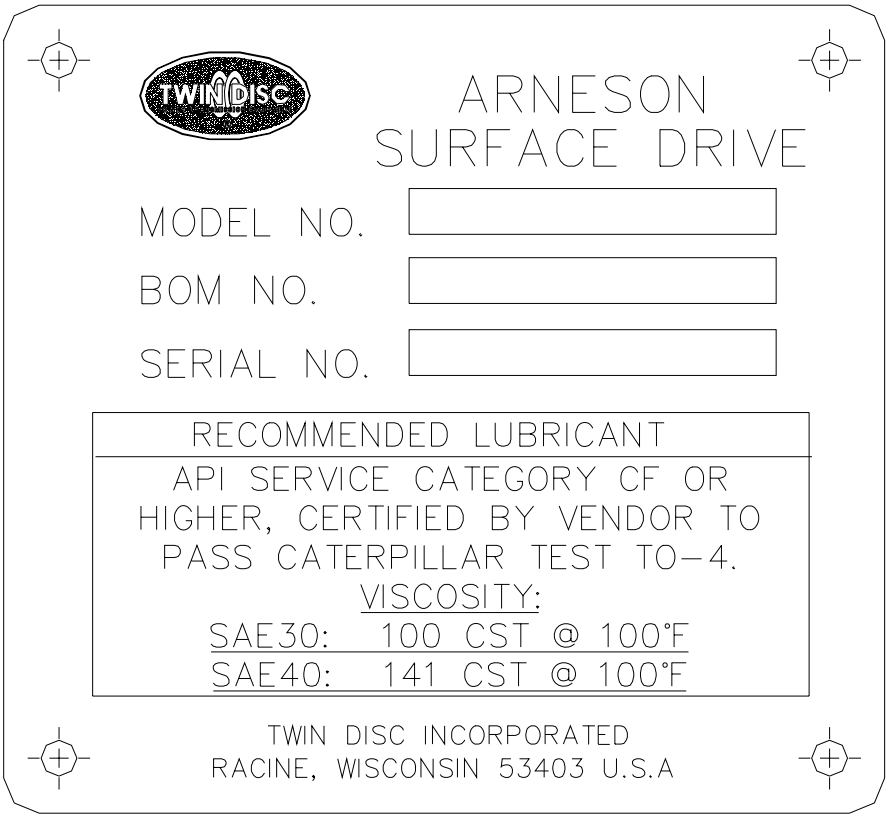


Figure 1. Nameplate for Arneson Surface Drive

Construction Features

Arrangement

The ASD 15A1S is arranged as two major subassemblies; the thrust socket assembly and the thrust tube assembly. The thrust socket assembly is fixed to the vessel's transom, and the thrust tube pivots on the socket.

Housings

The ASD 15A1S is comprised of three housings; the thrust tube, the thrust ball, and the thrust socket. The thrust tube and thrust socket are of aluminum alloy material. The thrust ball is stainless steel.

Bearings

The input (engine driven) shaft is supported and located by two tapered roller bearings. The bearing clearance for the input shaft is set by use of a single shim pack between the rear bearing sleeve and the socket housing. The propeller shaft is supported by two tapered roller bearings on the input end, and by a spherical roller bearing on the output end. The bearing clearance on the two tapered roller bearings is controlled by the use of a single shim pack between the thrust ball and the forward bearing cone.

Shafts

Both of the shafts are heat treated stainless steel material.

U-joint Assembly

The U-joint assembly is a constant velocity universal joint assembly that is spline connected to the input shaft and the propeller shaft. It is located and retained to the input shaft to prevent axial float. The output spline is sized to slip freely on the propeller shaft, allowing relative axial movement at the universal joint output end only.

Drive Lubrication Features

The lubrication system consists of an oil reservoir that is located in the boat, a valve to allow removal and filling of the drive with an external pump, and hoses, clamps, and push lock couplings. The reservoir is mounted a minimum of 254 mm (10 in.) above the ASD 15A1S centerline, and the internal drive cavity completely filled with appropriate oil. The reservoir is filled to one third full to allow for expansion and agitation of the oil during operation.

Drive Oil Capacity

The approximate capacity of the drive and reservoir is 38 to 57 liters (10 to 15 gallons).

Lubrication Specifications

The lubricating oil is specified as API Service category CF or higher, certified to meet Caterpillar Test TO-4, SAE 30 (100 cst @ 100° F) or SAE 40 (141 cst @ 100° F).

Power Steering and Trim Lubrication Specifications

Hydraulic fluid such as Dexron III automatic transmission fluid should be used for the power steering and power trim hydraulic systems.

Specifications

Maximum operating speed: 2500 rpm

Oil type and viscosity: API Service category CF or higher, certified to meet Caterpillar Test TO-4, SAE 30 (100 cst @ 100 degrees F) or SAE 40 (141 cst @ 100 degrees F).

Oil capacity: 38 to 57 liters (10 to 15 gallons)

Approximate Dry weight of ASD 15A1S: 454 kg (1000) lbs.

Approximate Dry weight of ASD 15A1S steering cylinder: 67 kg (150) lbs.

Approximate Dry weight of ASD 15A1S trim cylinder: 138 kg (300) lbs.

Approximate Dry weight of ASD 15A1S tie bar assembly: 45 kg (100) lbs.

Torque Values for Fasteners

Table 1. Torque Specifications for Fasteners used in ASD 15A1S

P/N	DESCRIPTION	DRY TORQUE VALUE	
		N-m	Ft-lb
MA1124C	SCREW (COVER)	4	3
MA1124A	SCREW (FIN)	17	12
MA1123A	SCREW (BALL)	170	125
MA1124B	SCREW (RETAINER COVER)	60	40
1020183	NUT (PROP)	1140-1285	800-900
1020184	NUT, JAM (LOCK) (PROP)	860-1000*	600-700*
MA1052C	SCREW (U-JOINT FIXATION)	42 max**	30 max**
MA1052K	SCREW (BEARING SLEEVE)	55	40
MA996D	SCREW (COMPANION FLANGE)	100	75

* APPROACH LOWER TORQUE VALUE, THEN CONTINUE UNTIL COTTER PIN SLOT IN NUT ALIGNS WITH HOLE IN SHAFT

** fROM TOP OF PLUG TO O.D. OF YOKE TO BE NOT LESS THAN 2.2 MM. DO NOT EXCEED LISTED TORQUE

Removal from Vessel

Prior to Removal

Removal and disassembly should not begin until the drive unit exterior and work area have been thoroughly cleaned.

Detailed illustrations of special tools are located in Special Tools. References will be made when a special tool is required.

As parts are disassembled, inspect for damage, wear and burrs. See Cleaning and Inspection for details.

Note: There are two methods to service an ASD 15A1S:

1. The first method as described below explains the removal of the thrust tube assembly, while keeping the thrust socket mounted to the transom. This method is used when service is required on the thrust tube section and no major repairs are required in the thrust socket assembly.

2. The second method that follows covers the removal of the surface drive from the transom followed by the disassembly of the thrust tube from the thrust socket.

Removal of Thrust Tube While Thrust Socket Remains Mounted to Transom

⚠ WARNING

Always disconnect the battery cables and remove the key from the ignition before beginning this procedure.

⚠ CAUTION

Support the thrust tube with a block and tackle, forklift or other system capable of carrying the weight of the thrust tube. Do not allow the thrust tube to angle down to the point where the ball/thrust tube assembly makes contact against the thrust socket. Severe damage to the ball and the socket could result.

1. Disconnect the battery cables and remove the key from the ignition.

2. Support the drive with a block and tackle, forklift or other system capable of carrying the weight of the entire drive. Do not allow the thrust tube to angle down to the point where the ball/thrust tube assembly makes contact against the thrust socket.

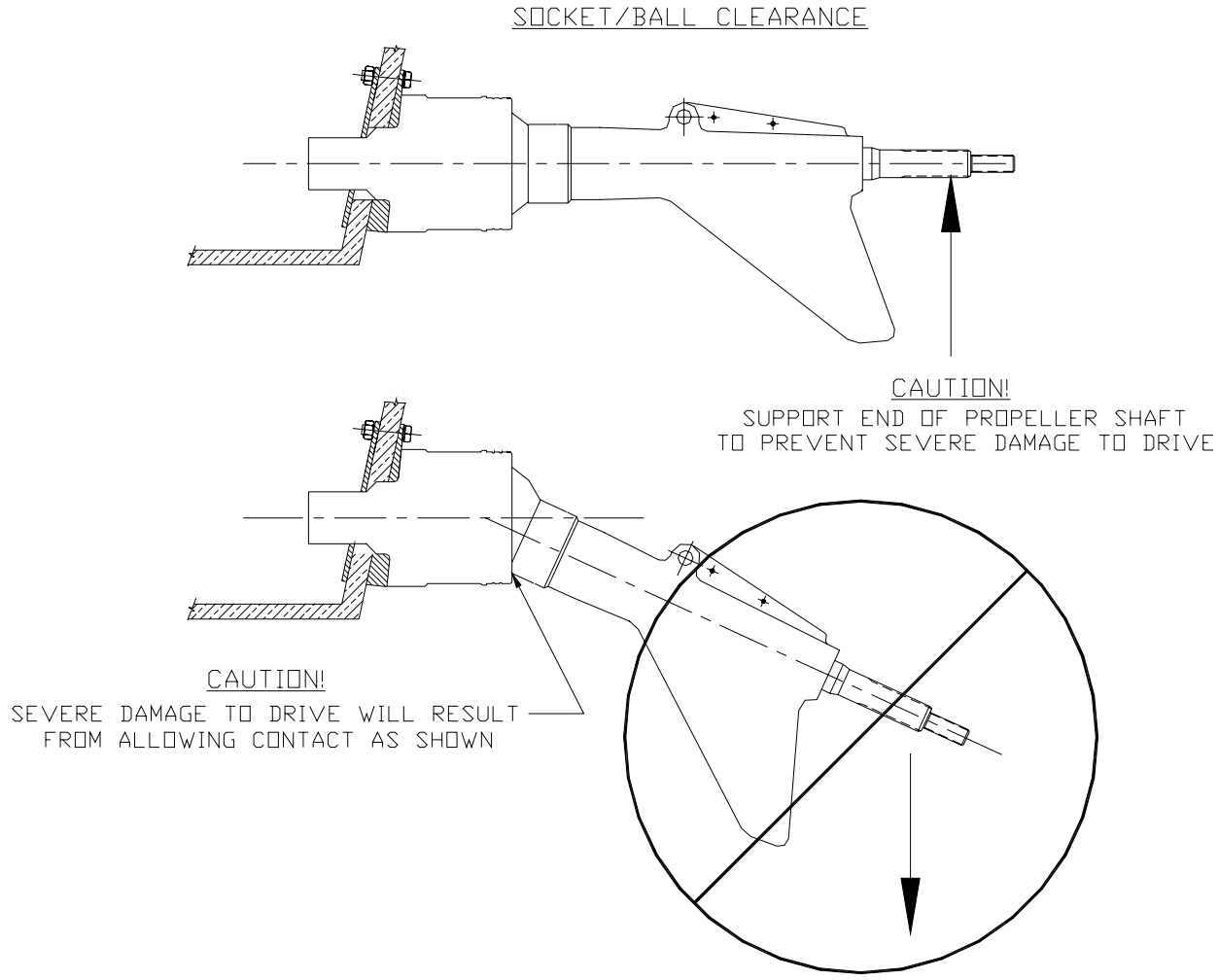


Figure 2. Protect Ball from Damage

3. Remove the cotter pin and jam nut. Loosen the propeller nut until it is flush with the end of the shaft to prevent damage when the propeller moves from the tapered pilot. Remove the propeller from the splined shaft using suitable pullers, soft blocks and mallets as necessary, allowing the propeller to stop against the spacer and propeller nut. Remove the propeller nut, spacer, and propeller from the rear end of the propeller shaft.

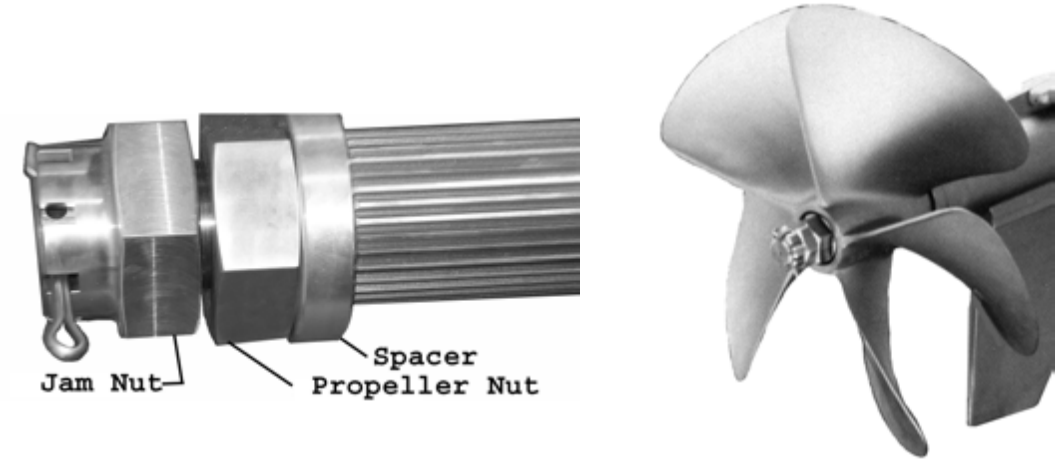


Figure 3. Propeller Retaining Parts (left), and Propeller Installed (right)

4. Drain the oil from the unit through the drain holes in the housings or from the lower oil reservoir hose inside the boat.

5. Disconnect the steering cylinder from the trim cylinder yoke pin. Disconnect the tie bar from the tie bar pin. Remove the trim cylinder yoke pin and the tie bar pin.

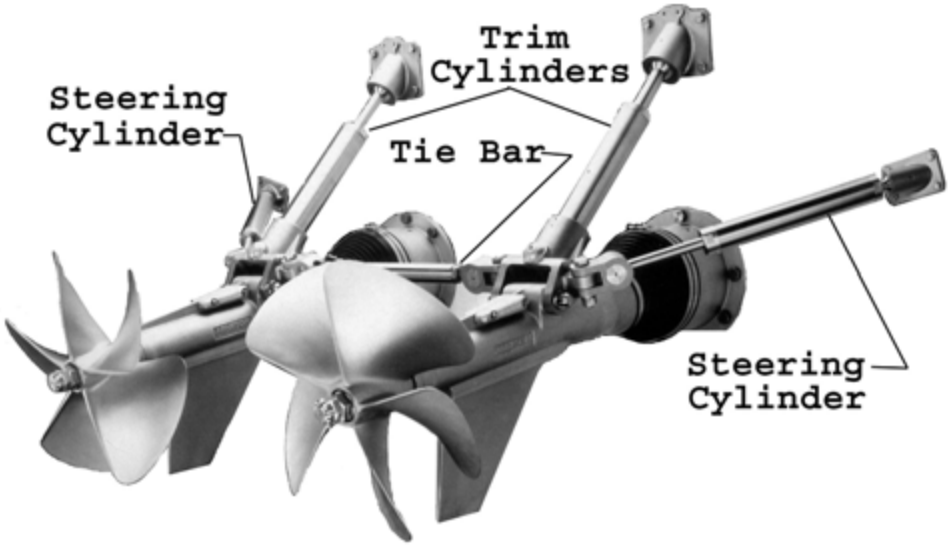


Figure 4. Rear View of Dual Installation Showing Cylinders and Tie Bar

6. Remove the circle clamps on the boot and push the boot back over the thrust tube. Consider placing a container under the thrust socket to catch the normal oil spillage as the unit comes apart.

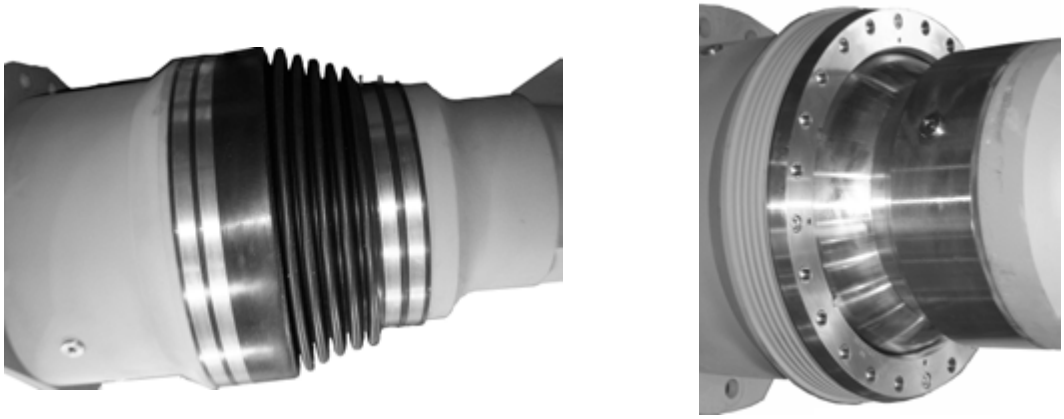


Figure 5. Remove All clamps (left), and Slide Boot Back Over Thrust Tube (right)

7. Remove the retainer (wear sleeve) cover bolts.

8. Remove the retainer (wear sleeve) cover, shims and rear ball retainer.

Figure 6. Remove Retainer Cover, Shims, and Retainer

9. Remove thrust tube from socket with caution, taking care that the ball comes out of the socket evenly. Protect ball and socket with plastic bags to avoid contamination by dirt and dust.

10. The forward thrust ball retainer may come out of the socket along with the thrust ball. Do not drop the forward thrust ball retainer. The forward retainer can be reused if it is not damaged or worn.

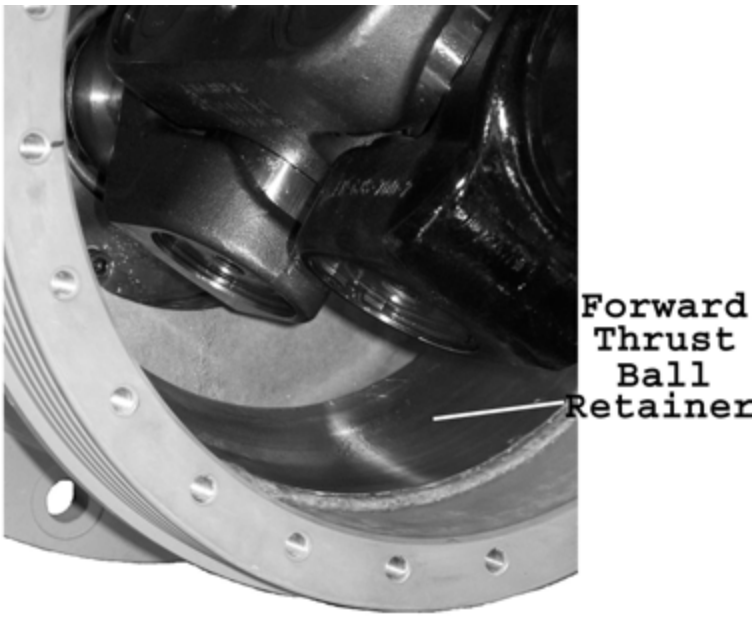


Figure 7. Inner (forward) Thrust Ball Retainer with Packing

11. Store thrust tube securely without anything touching the ball.

Complete Removal of Surface Drive from Transom

⚠ WARNING

Always disconnect the battery cables and remove the key from the ignition before beginning this procedure.

⚠ CAUTION

Support the surface drive with a block and tackle, forklift or other system capable of carrying the weight of the surface drive. Do not allow the thrust tube to angle down to the point where the ball/thrust tube assembly makes contact against the thrust socket. Severe damage to the ball and the socket could result.

1. Remove the battery cables and remove the key from the ignition.

2. Support the drive with a block and tackle, forklift or other system capable of carrying the weight of the surface drive. Do not allow the thrust tube to angle down to the point where the ball/thrust tube assembly makes contact against the thrust socket.

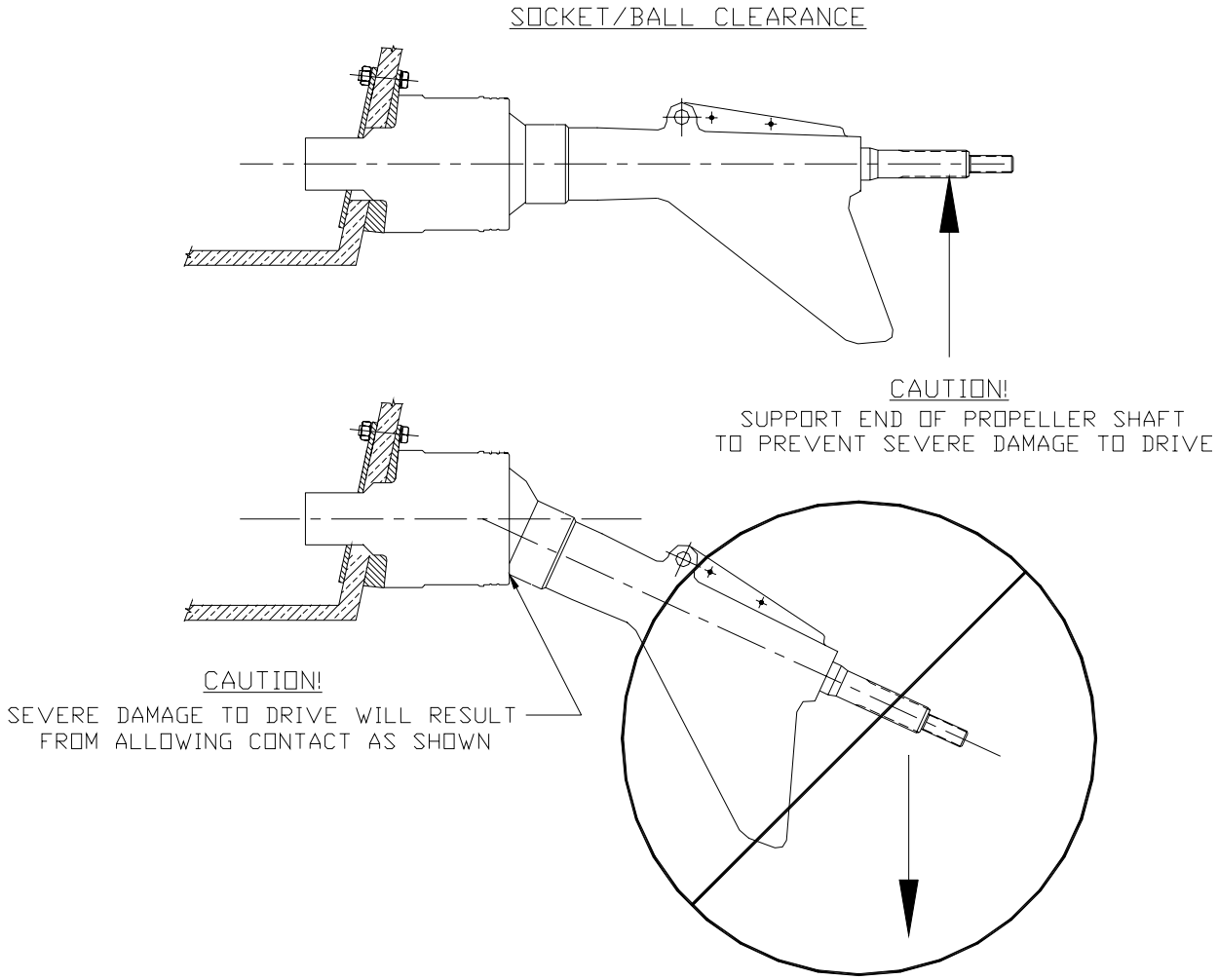


Figure 8. Protect Ball from Damage

3. Remove the cotter pin and jam nut. Loosen the propeller nut until it is flush with the end of the shaft to prevent damage when the propeller moves from the tapered pilot. Remove the propeller from the splined shaft using suitable pullers, soft blocks and mallets as necessary, allowing the propeller to stop against the spacer and propeller nut. Remove the propeller nut, spacer, and propeller from the rear end of the propeller shaft.

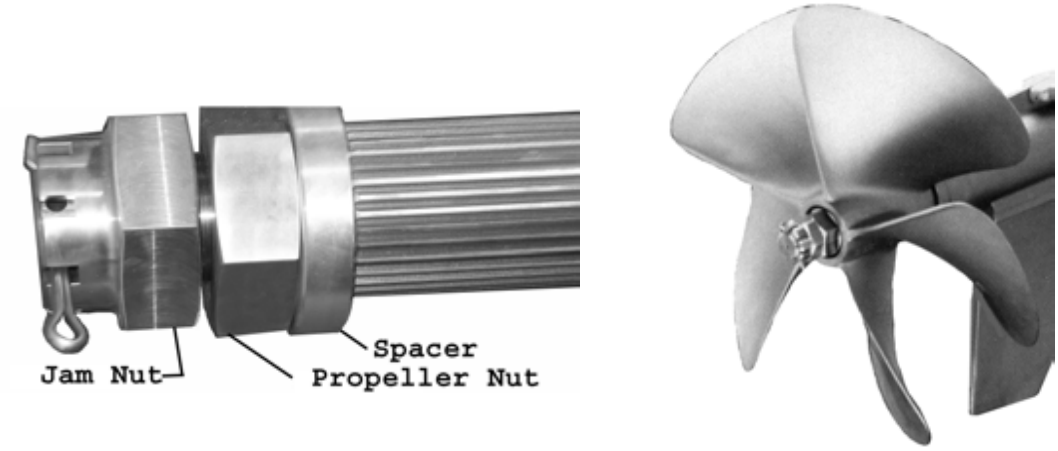


Figure 9. Propeller Retaining Parts (left), and Propeller Installed (right)

4. Drain the oil from the surface drive through the drain holes in the housings or from the lower oil reserve hose inside the boat.

5. Disconnect the steering cylinder from the trim cylinder yoke pin. Disconnect the tie bar from the tie bar pin. Remove the trim cylinder yoke pin and the tie bar pin.

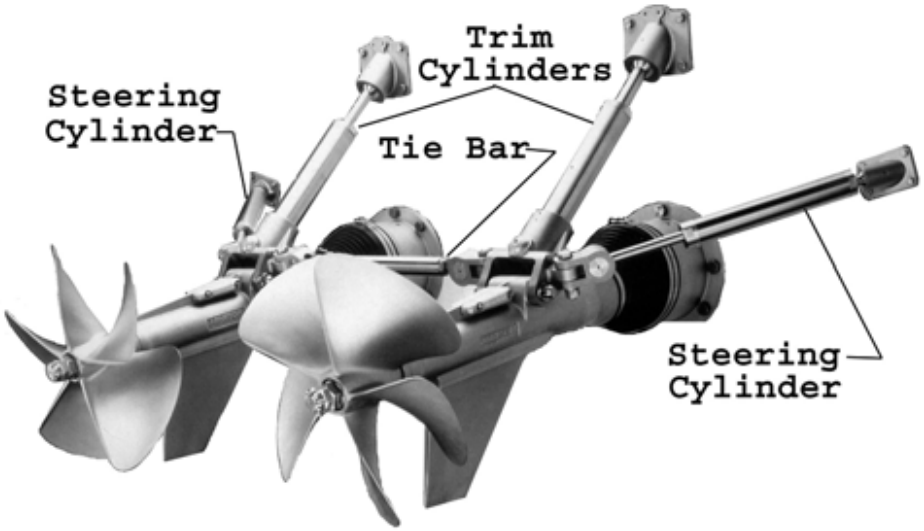


Figure 10. Rear View of Dual Installation Showing Cylinders and Tie Bar

6. Disconnect the driveline companion flange. Remove the retainer washer bolts and the retainer washer from the end of the surface drive input shaft. Additional removal of driveline components may be required to allow access to the companion flange retainer washer.

⚠ WARNING

Do not cradle the surface drive on the prop shaft or input shaft. Damage to the unit could result.

7. Properly support both the socket and thrust tube to prevent the surface drive from falling upon removal of the mounting bolts.

8. Remove the socket mounting nuts, washers, backing plate and bolts. The surface drive should now slide away from the transom. Take care not to damage the input shaft spines during the removal of the surface drive.

9. Place surface drive on suitable blocks or stands. Make sure to support both the socket and thrust tube.

Installation

General

Note: For Reinstallation of repaired units to the transom from which it was removed, see the instructions at the end of Assembly in this manual.

Note: Please read this Installation Manual all the way through, and become thoroughly familiar with its contents before commencing installation procedures.

Installation Requirements

The installation of the surface drive must comply with all prevailing manufacturer's instructions and requirements as defined in this manual.

Twin Disc, Incorporated will not be responsible for surface drives that have been improperly installed, or where such installations shall be deemed to be unsafe or structurally unsound. Such improper installation shall immediately void all Twin Disc, Incorporated warranties.

Rated Capacity

The ASD 15A1S is designed for a maximum intermittent torque loading of 11,500 foot-pounds applied at the input shaft flange. Please verify that output of the power unit to be used does not exceed this torque rating. Consult Twin Disc, Incorporated for applications exceeding this capacity, or if the installation is intended for commercial or heavy duty use.

Reduction Ratio and Propeller

Gearbox reduction ratio and propeller pitch/diameter selection are based on hull design, normal operating weight and rated engine performance. Twin Disc, Incorporated is prepared to provide preliminary recommendations, but actual propeller requirements may change in service.

Packing List

Consult packing list and verify that all listed items have been received, and are undamaged.

Note: All internal components of the surface drive must be protected from the damaging effects of dirt, grit, and dust prior to installation. Take care to insure these components are kept clean by the use of plastic, or other clean covering. Care must be taken not to damage the surface of the thrust ball, trim and steering cylinder rods, or exposed portion of the propeller shaft. Nicks and scratches can cause premature seal failure and subsequent oil leaks.

Structural Strength of Mounting

The vessel structure in the area of the transom, and the transom itself, bears the entire weight of the surface drive and the torque and thrust loads generated by the propeller(s). A solid mounting base and a properly designed transom structure is essential for the successful installation of surface drives. If the transom and mounting base is not sufficiently strong, it is possible to damage the surface drive or the vessel itself. Twin Disc, Incorporated will not be responsible for surface drives that have been improperly mounted, or where mounting is deemed to be unsafe or structurally unsound. Such mounting will void all Twin Disc, Incorporated warranties.

Mounting Requirements

The ASD 15A1S propeller requires “clean” water flow to operate at a proper efficiency. The bottom of the vessel hull should be clean and clear of any obstructions such as water intakes, speedometer sensors, etc. for an area at least eight inches (21 cm) each side of the propeller tips, and at least six feet (1.83 meters) forward of the transom.

The optimum mounting angle for ASD 15A1S is six degrees to the vessel’s baseline. Correct mounting of the unit may require a supplementary wedge. When ordering the ASD 15A1S, be sure to specify existing transom angle, deadrise angle of hull, and whether it’s a single or twin installation. Application inquiries can be correctly answered only if accompanied by an Application Data Sheet that is available from the dealer or the factory.

Inboard and outboard surfaces of the transom must be parallel to within 1/4" (6.35 mm). Transom outboard surface must be flat to within 1/16" (1.59 mm). Transom inboard surface must be flat to within 1/8" (3.18 mm) in way of the surface drive socket.

⚠ CAUTION

If the surface drive is installed with an incorrect mounting angle, serious performance deficiencies could result.

Mounting Hardware

All mounting hardware used, other than that supplied by Twin Disc, Incorporated, must be of stainless steel, and must meet Twin Disc, Incorporated standards. Flat washers must be used under all nuts and bolt heads. Thread lubricant must be used with all mounting hardware, to prevent galling and/or seizing. All bolt holes through fiberglass material should be cleaned to prevent seizing by glass fiber residue.

All through-hull fittings and bolts, gaskets and mating flanges must be installed using recommended amounts of bedding compound suitable for underwater use. Follow manufacture's instructions with regard to surface cleaning and preparation.

Note: Twin Disc, Incorporated recommends that accepted standard installation and construction practices for marine components be followed throughout. The American Boat and Yacht Council publication, Safety Standards for Small Craft, provides useful general guidelines. This publication may be obtained from:

The American Boat and Yacht Council
P.O. Box 806
Amityville, New York 11701 USA

Thrust Unit Installation

In order to maximize drive efficiency, the lower 50% of the propeller should be immersed in the water when running at planing speeds. Because the flow pattern from a planning hull tends to move upward several inches from transom to the output end of the drive, a straight edge running aft from the hull bottom to the propeller will normally be *even with* or, for the larger drives *below* the *lower edge* of the thrust tube at its aft end. The thrust socket/ball must be positioned out of the water under planing conditions, which is the intent of these installation procedures. All through-transom holes must be drilled perpendicular to the transom outer surface to allow the mounting bolts/washers to seat flush against the drive flange.

⚠ CAUTION

The drive unit must be supported, as shown in Figure 11, at all times prior to trim cylinder final installation. Do not allow the ball joint/thrust tube to bottom against the thrust socket, as shown in Figure 12, as this can cause damage to the ball and socket bearings. The supporting mechanism must be capable of carrying the unit's weight, approximately 1000 pounds.

Note: When transom angle is other than 6 degrees to the vessel baseline and a wedge is to be used to mount the drive, Template 1019886G should be applied to the wedge and not directly to the transom.

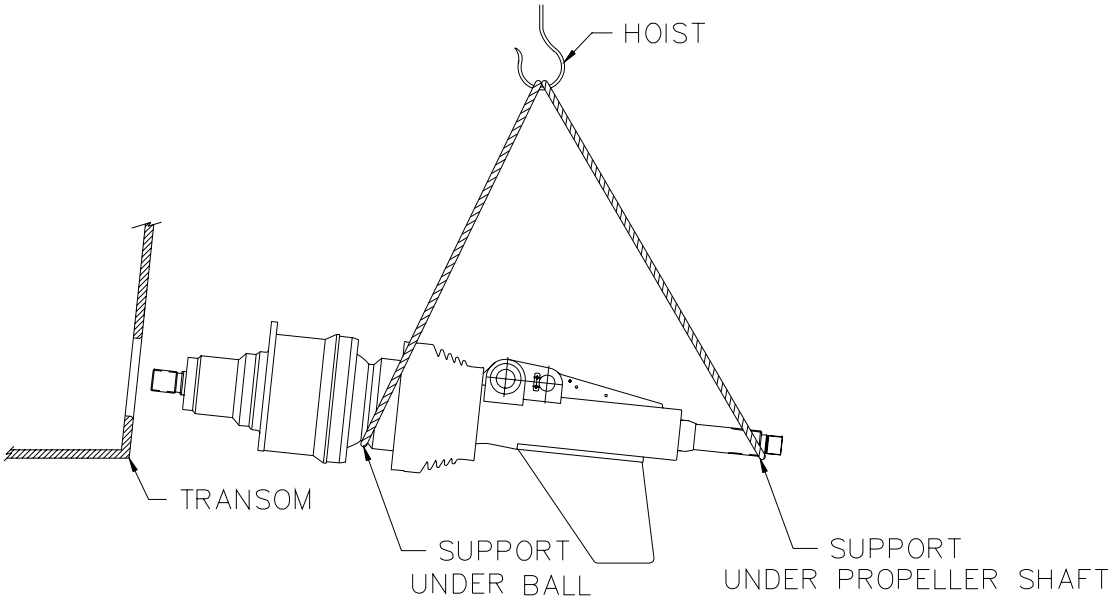


Figure 11. Support Unit for Installation

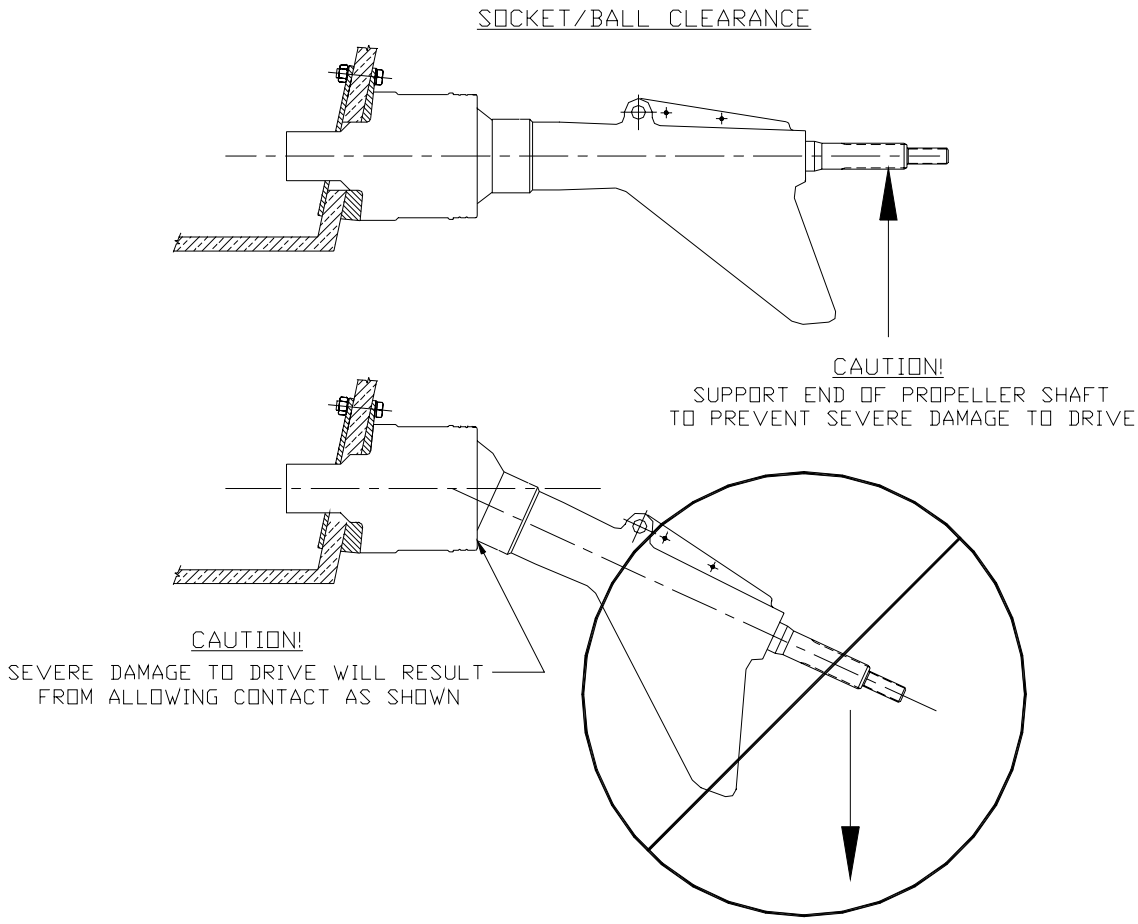


Figure 12. Protect Ball from Damage

1. Locate a vertical line(s) on the transom through the intended drive centerline(s) as follows: For twin drive installations, it is recommended that drive centerlines be located in-line with the engine centerlines. For applications requiring offset drive mounting, contact Twin Disc, Incorporated, for recommendations. If at all possible, drive mounting holes should avoid stringers and other hull fittings that preclude the use of through-bolts. See Figure 13.

2. Template 1019886G duplicates the cross section of the thrust socket and wedge (if applicable) and is used to locate the drive centerline for 1 inch socket clearance*.

   Note: When transom angle is other than 6 degrees to the vessel baseline and a wedge is to be used to mount the drive, Template 1019886G should be applied to the wedge and not directly to the transom.

   * Twin Disc, Incorporated may advise distance to be larger.

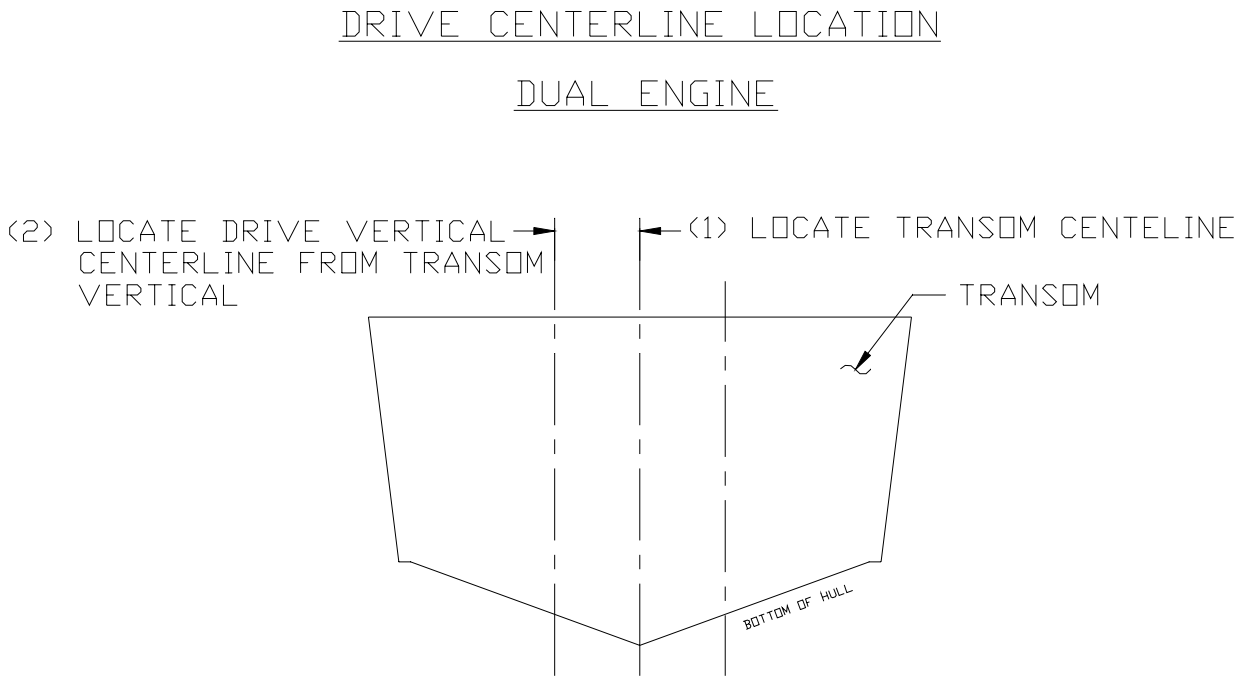


Figure 13. Drive Centerline Location

3. Use Template 1019886G to locate and mark drive centerline(s) as shown in Figure 14.

   A. For single drive installations, position centerline of Template 1020306 on transom centerline. Locate and match “Points C” on transom Template 1020306. Mark centers for mount holes (13), and lubrication holes (2).

   B. For twin drive installations, locate and match “Points C” on transom and Template 1020306. Rotate template until cutaway area on the thrust socket flange is parallel to the hull deadrise as shown in Figure 14. Locate and mark centers for mount bolts (13) and lubrication holes (2).

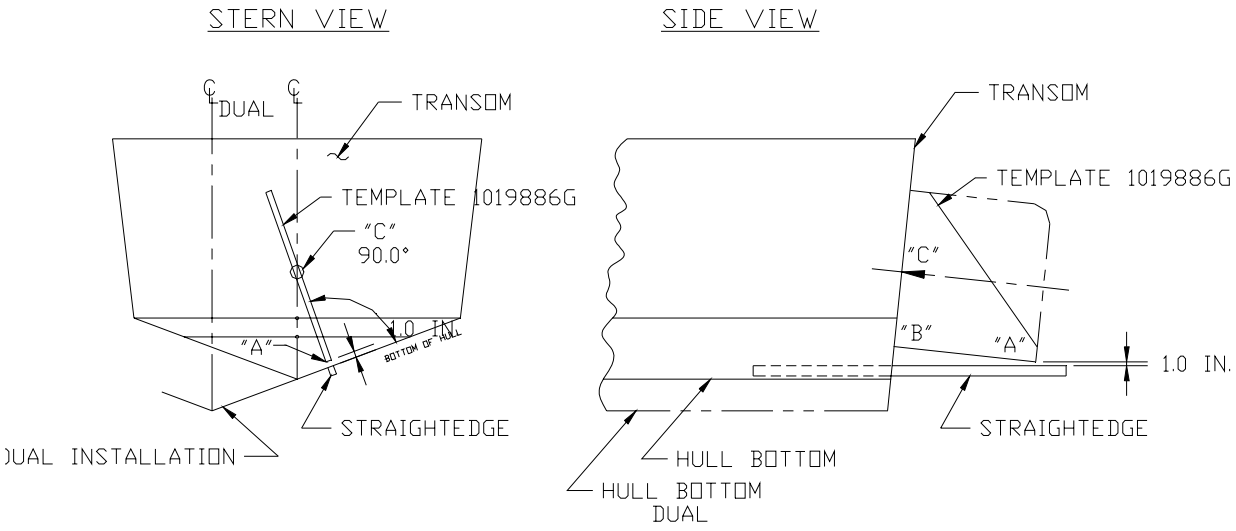


Figure 14. Mark Hull using Template 1019886G

C. Drill a pilot hole through the intended drive centerline (Point C). This pilot hole will be used for locating the actual drive through-hole and should be sized for the hole saw to be used in Step D.

The hole should be drilled at an angle to the transom that will make it parallel to the socket centerline. Template 1019886G can be used to orient the drill as shown in Figure 15.

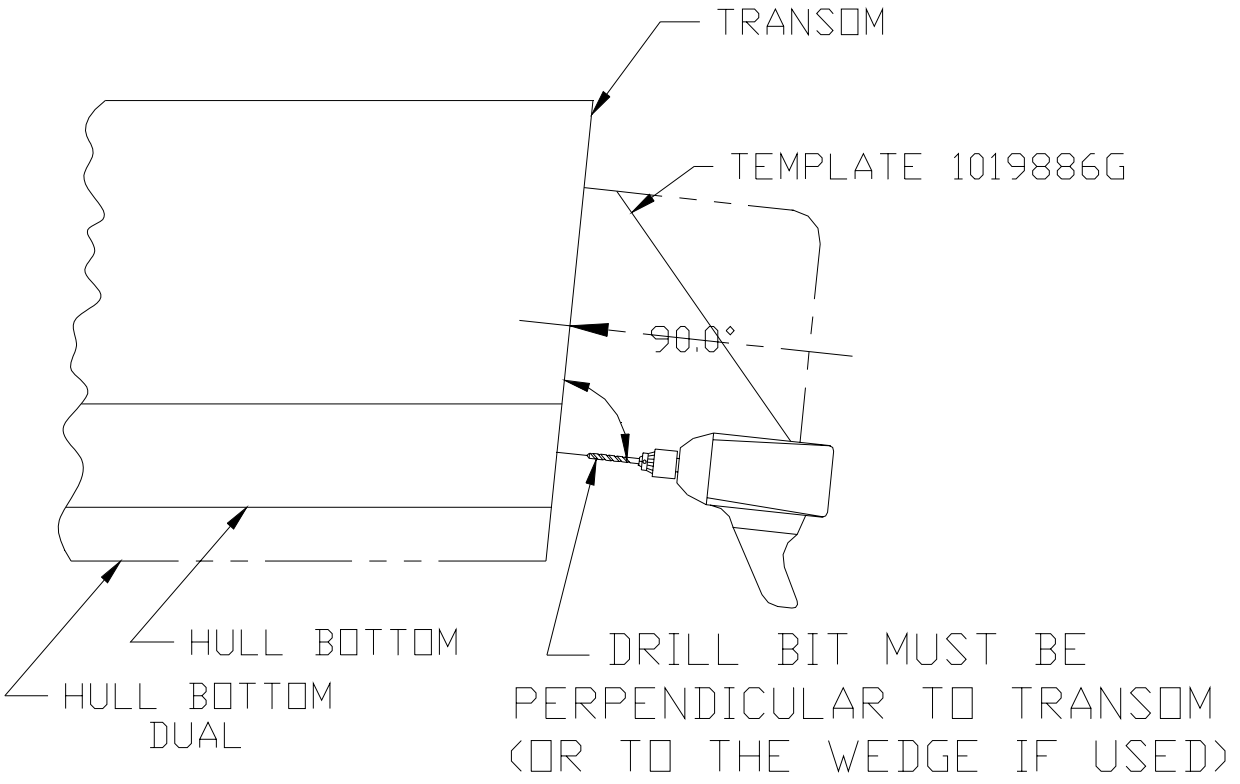


Figure 15. Drill Holes

D. Follow the pilot hole with a 305 mm (12 in) hole saw at the same angle used in Step C.

E. Hold the thrust unit in place and verify 1" clearance* from the edge of the thrust socket to the plane of the vessel's bottom. See Figure 16. Verify that the drive flange hole pattern matches the hole pattern marked on the transom from Template 1020306.

Note: The cutaway area on the thrust socket flange should be aligned parallel with the hull deadrise.

* The 1 inch clearance must be with the main drive boot in place.

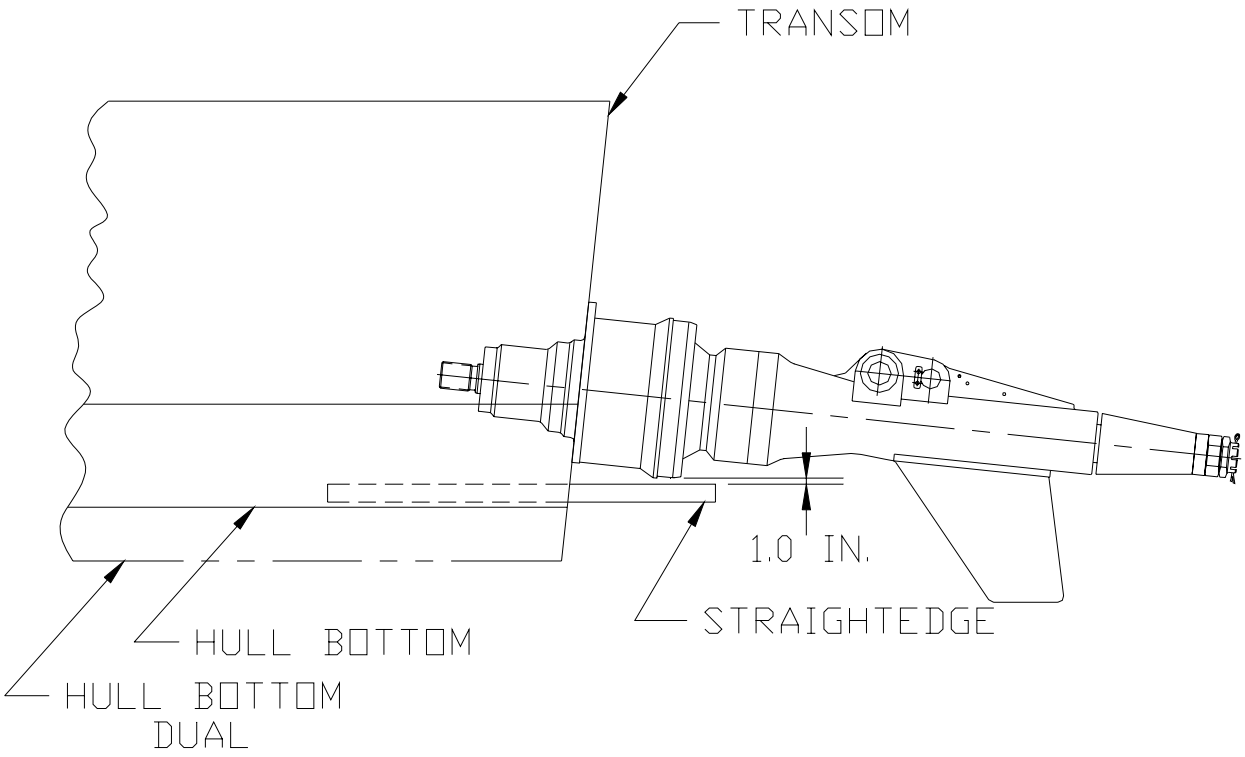


Figure 16. Measure for Clearance

F. Remove the drive unit and drill (13) 26.5 mm (1.16 in) diameter holes and (2) 38 mm (1.5 in) lubrication holes using Template 1020306. Holes should be drilled perpendicular to the transom.

G. Mount the basic drive unit (trim and steering cylinders not installed) using the backing plate and 1" diameter stainless steel bolts, nuts and washers as shown in Figure 17. Uniformly torque the nuts to 320 N-m (235 ft.-lbs.) using the tightening sequence on Figure 18.

Note: The backing plate must be oriented with the spot-faced holes outward and with the stamped *top* upward*. Use thread lubricant to prevent seizing.

*Spot-faced holes are only on backing plates for drives with wedges.

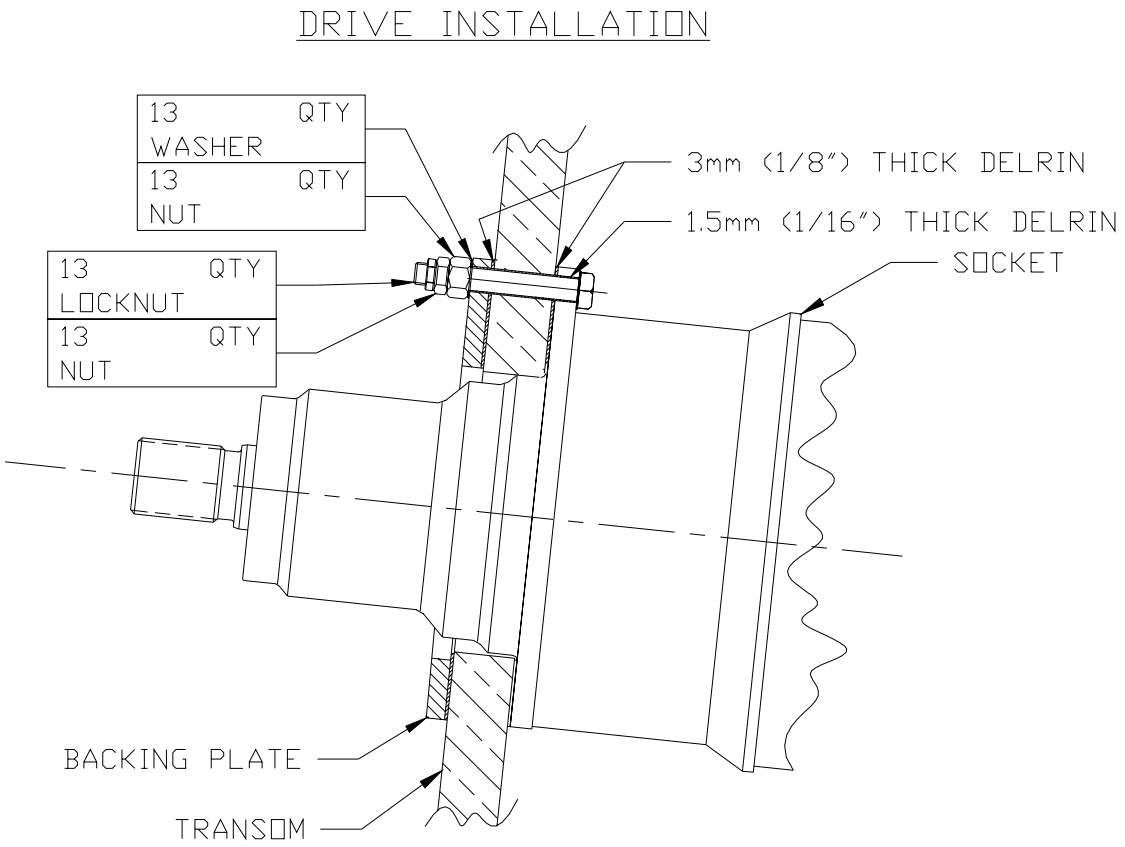
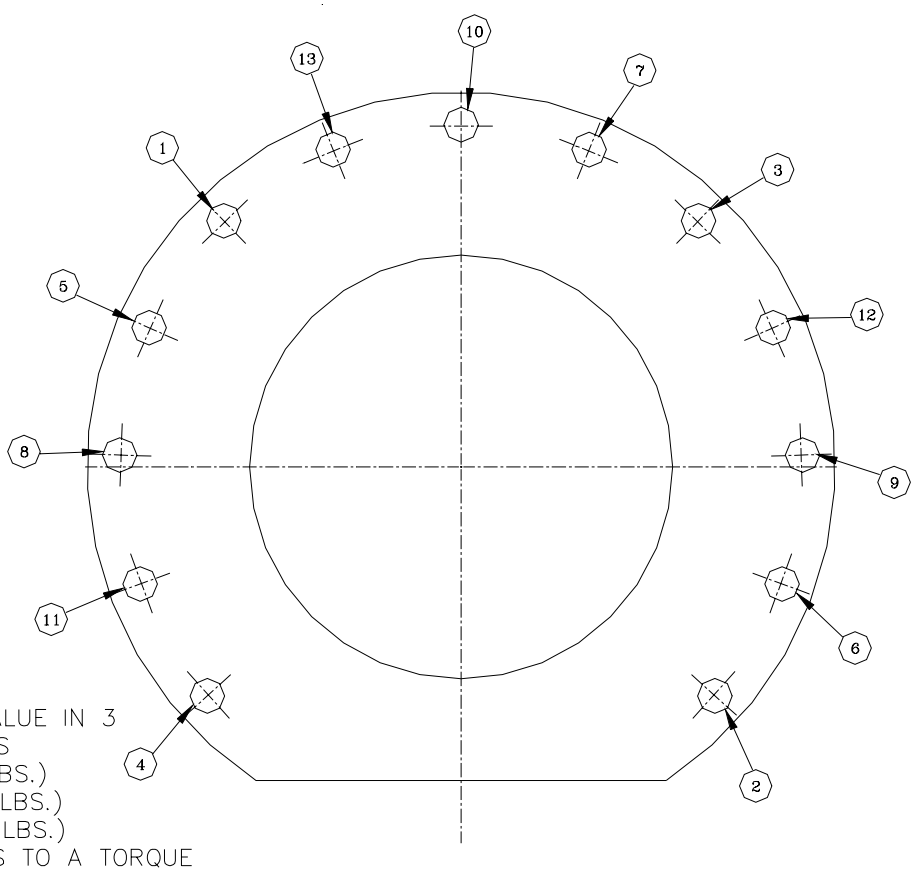


Figure 17. Drive Installation

H. Install the input flange (companion flange) onto the input shaft. See Figure 18. Torque the flange retainer bolts to 100 N-m (75 ft-lbs.)



NOTE:

1) TORQUE TO FULL VALUE IN 3 STAGES AS FOLLOWS
   100 N–m (80 FT–LBS.)
   220 N–m (160 FT–LBS.)
   320 N–m (235 FT–LBS.)
2) RECHECK ALL BOLTS TO A TORQUE VALUE OF 320 N–m (235 FT–LBS.)

Figure 18. Torque Sequence for Socket to Hull

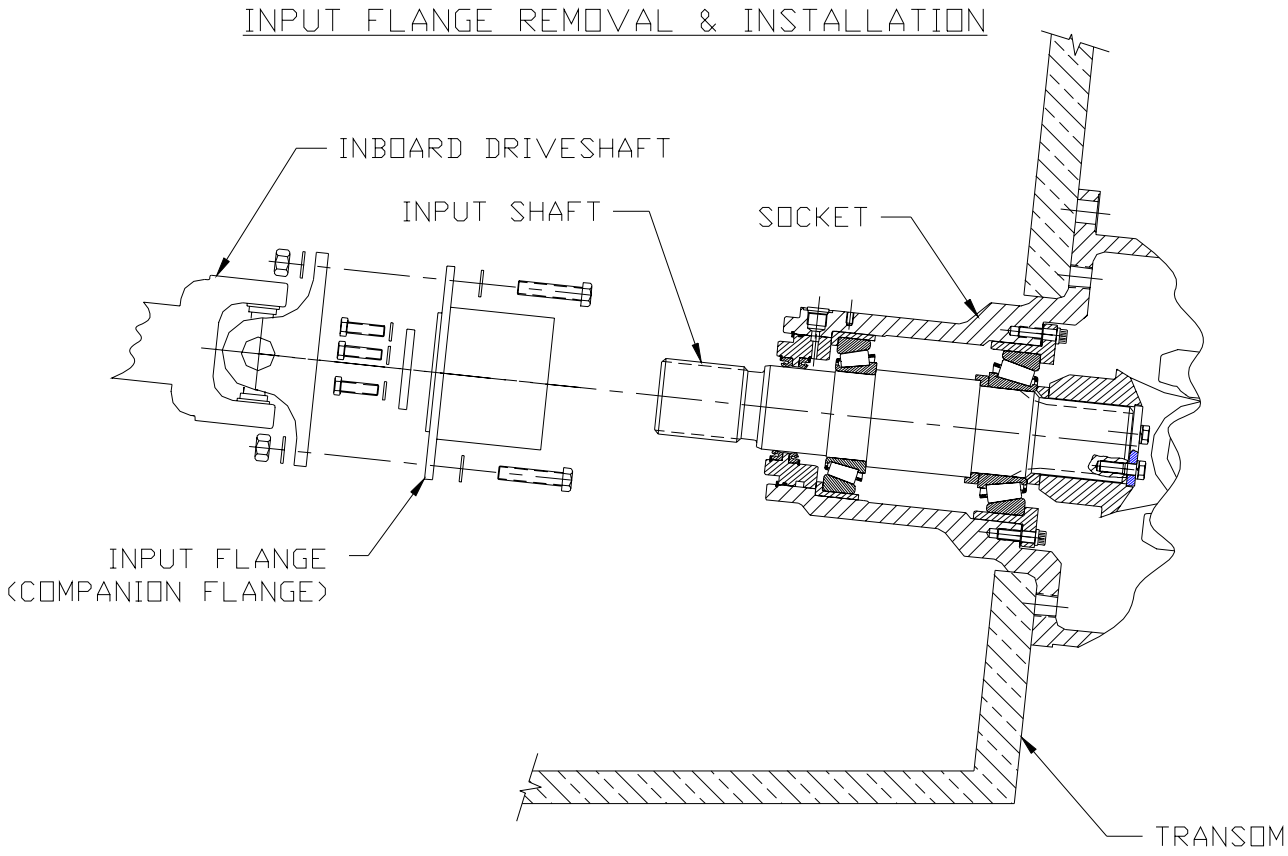


Figure 19. Input Flange Removal and Installation

Trim Cylinder Installation

The trim cylinder provides the capability to position the drive at differing trim angles depending on operating conditions. The following procedure sets the trim cylinder at mid-travel. See Figures 20 and 21 for assembly instructions for the cylinder ends.

1. Connect the trim cylinder to the thrust tube using the supplied mounting hardware. See Figure 20.

2. Loosen the hose clamps on one end of the drive unit protective boot and rotate the thrust tube housing as required to locate the fin in the vertical plane.

ASSEMBLY NOTES:

1) APPLY A THIN COAT OF LUBRICANT BETWEEN MATING SURFACES OF BALL/BRACKET/NUT. LUBRICANT TYPE MUST BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS RED LITHIUM GREASE. MARKETED BY THE ZEP CORP., ATLANTA, GA, USA. UNLESS OTHERWISE STATED, DO NOT LUBRICATE COMPONENT THREADS. INSTALL THREADED PARTS WITH LOCTITE AS SPECIFIED IN THESE NOTES. CLEAN THREADS PRIOR TO APPLYING LOCTITE.

2) PLACE BRACKET OVER THREADED END OF ROD. ENSURE BALL AND ROD THREADS ARE CLEAN, THEN THREAD BALL ONTO ROD. TORQUE TO SPECIFIED VALUE. INSERT SET SCREWS MA1133D INTO BALL, TORQUE AS SPECIFIED.

3) ALIGN SLOT IN BALL WITH HOLE IN BRACKET. INSTALL PIN 1020218 AND TORQUE SCREWS MA960R TO SPECIFIED VALUE. LUBRICATE NUT (1020216) AND BRACKET THREADS AND SCREW NUT INTO BRACKET UNTIL HAND TIGHT. TORQUE TO SPECIFIED VALUE. BACK THE NUT (IF NECESSARY) UNTIL PIN 1020219 CAN BE FULLY INSERTED. TORQUE SCREWS MA960R TO SPECIFIED VALUE.

4) COAT THE * MARKED THREADS WITH LOCKTITE THREAD LOCKER 242. (T42 BLUE SEMI-PERMANENT).

5) COAT THE ** MARKED THREADS WITH LOCKTITE THREAD LOCKER (T70 RED PERMANENT).

6) USE PIPE SEALANT ON HYDRAULIC FITTING THREADS.

7) TORQUE VALUES

	P/N	DESCRIPTION	TORQUE VALUES
**	1020217	BALL	215-285 N-m (150-200 FT-LB)
*	MA960R	SCREW	15 N-m (10 FT-LB)
	1020204	YOKE	SEE NOTE 4)
	1020206	CAP	SEE NOTE 5)
*	MA1133D	SET SCREW	7 N-m (5 FT-LB)
*	1020238	PISTON	140 N-m (100 FT-LB) SEE NOTE 1)
	1020216	NUT	70 N-m (50 FT-LB) MAX.
*	MA1133C	SET SCREW	15 N-m (10 FT-LB)
**	1020211	ROD	15 N-m (10 FT-LB)
	MA996AK	CAP SCREW	25 N-m (18 FT-LB)

11) HYDRAULIC FITTINGS SHALL BE SCREWED HAND TIGHT AND WRENCHED AN ADDITIONAL 1.5-2.5 TURNS UNTIL ALIGNED. USE PIPE SEALANT SPARINGLY.

HYDRAULIC PORT THREAD SIZE: 3/8-18 NPTF

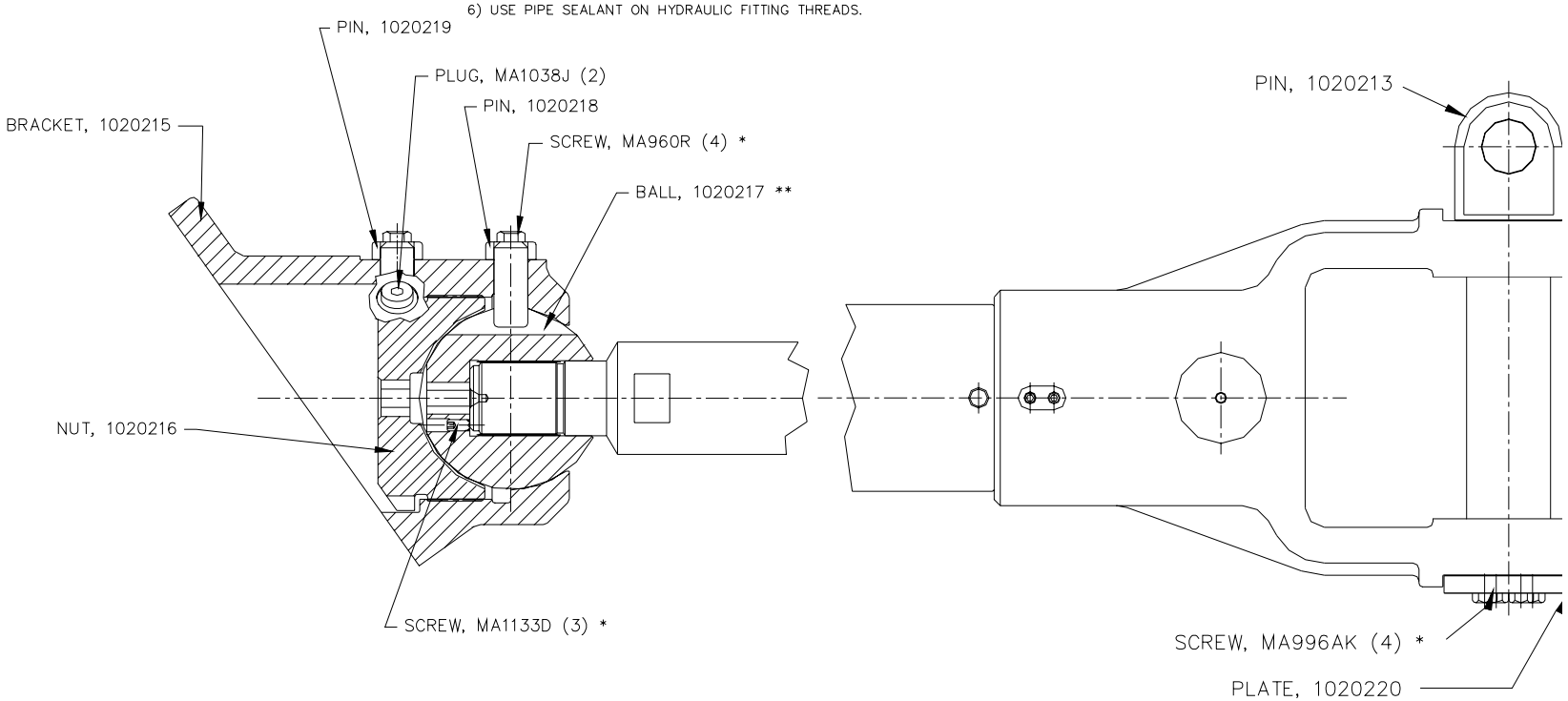


Figure 20. Trim Cylinder Assembly

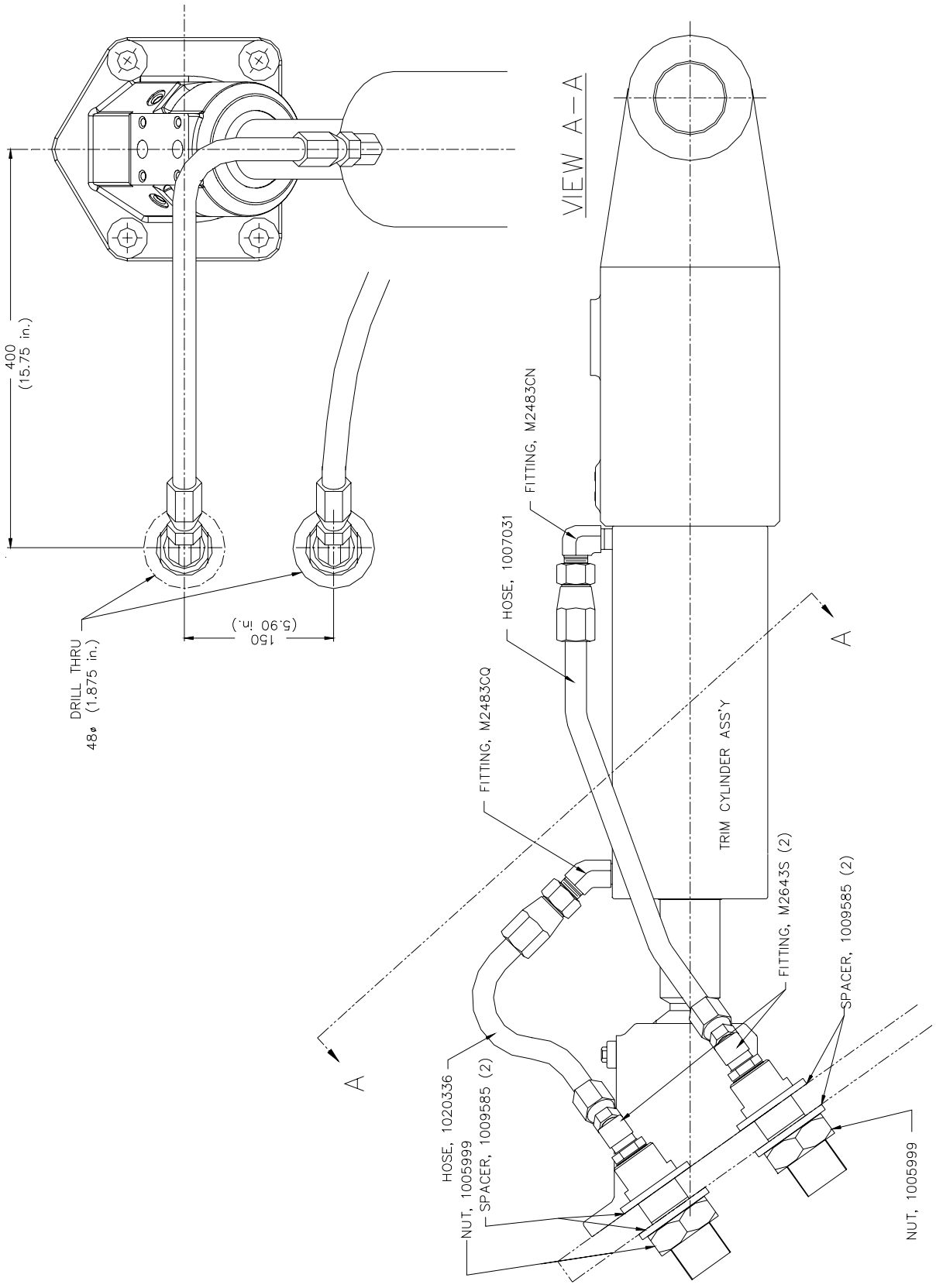


Figure 21. Trim Cylinder

3. Position the drive unit at the center trim height. This is determined by setting the drive unit ball joint in the exact center of the socket. Determine this measurement using the Thrust Ball Centering Gauge supplied with the package. See Figures 22 and 23. Lay the tool against the ball shoulder and adjust the unit so that the tool fits evenly all the way around the circumference of the socket. This assures that the unit is in line with the socket and input shaft so that the entire unit is in a straight line. This is referred to as the *neutral running angle*.

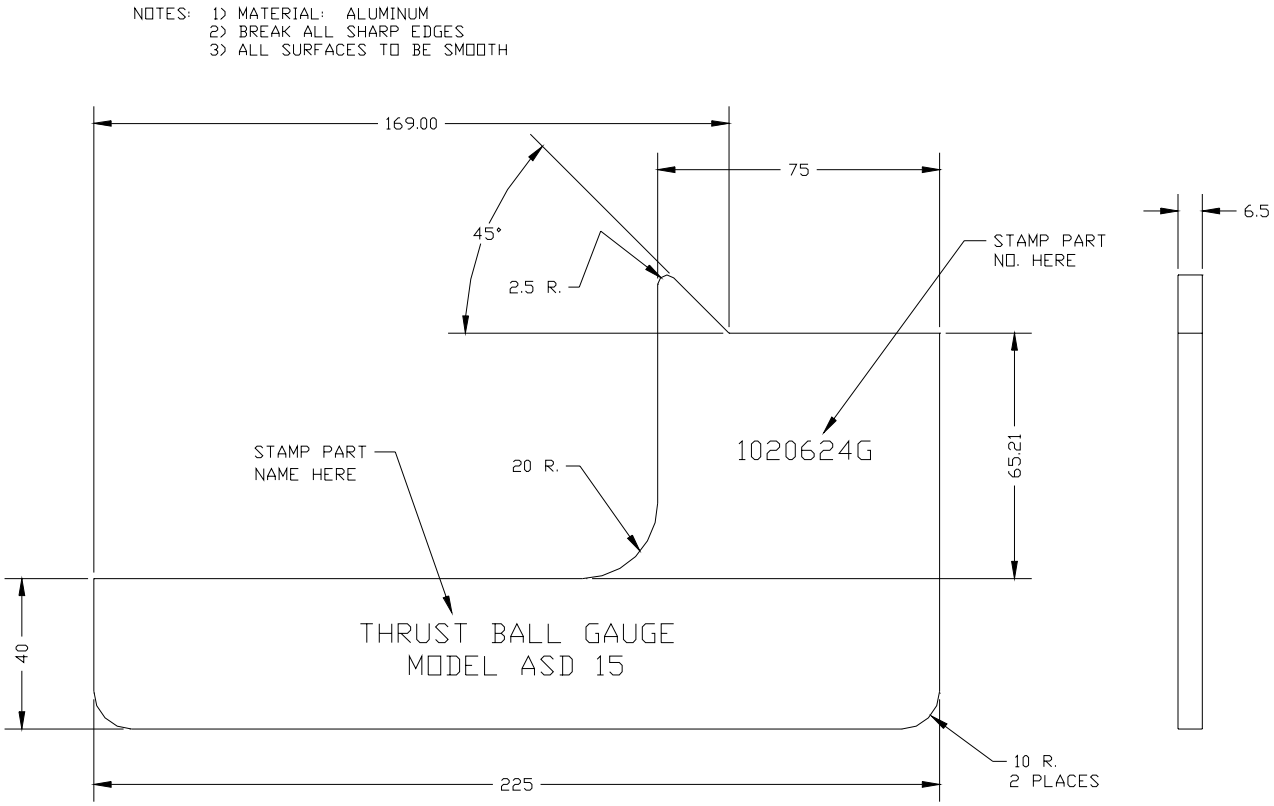


Figure 22. Centering Gauge

4. After the neutral running angle is determined, lay the trim cylinder bracket against the transom, making sure that the cylinder is at the center travel location. The center of the transom bracket should be aligned with the center of the drive centerline.

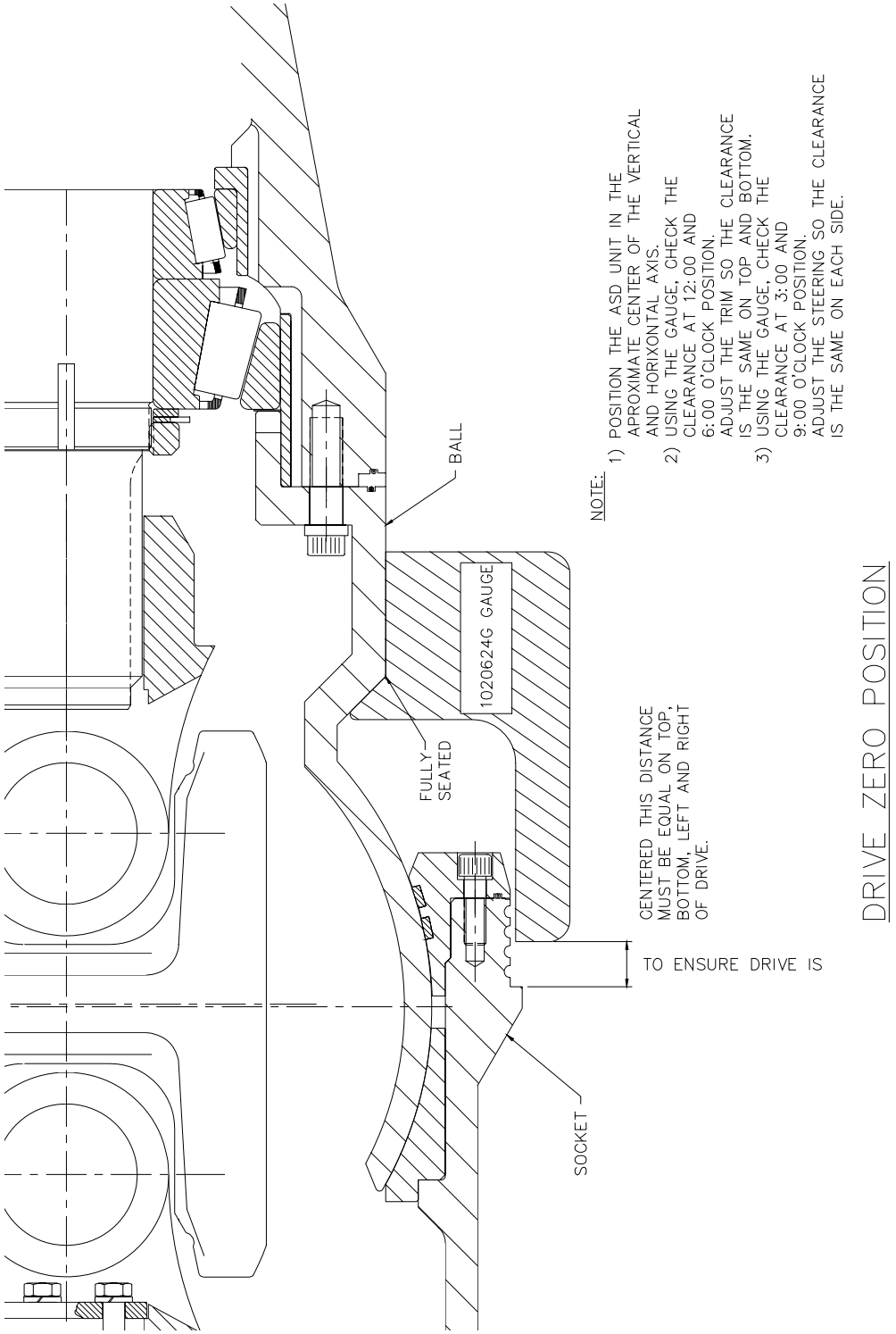


Figure 23. Center the Thrust Ball in the Socket

5. Transfer the bracket hole pattern and drill the 22mm (0.875") mounting holes in the transom. Stainless steel 19mm (0.75") diameter bolts, nuts and washers are required for this installation. Install the bolts, backing plate, washers and nuts. Torque nuts to 122 N-m (90 ft.-lbs). Use thread lubricating compound to prevent seizing. Apply a generous layer of marine transom sealant under the bracket, and in the fastener holes in the transom to prevent water leakage.

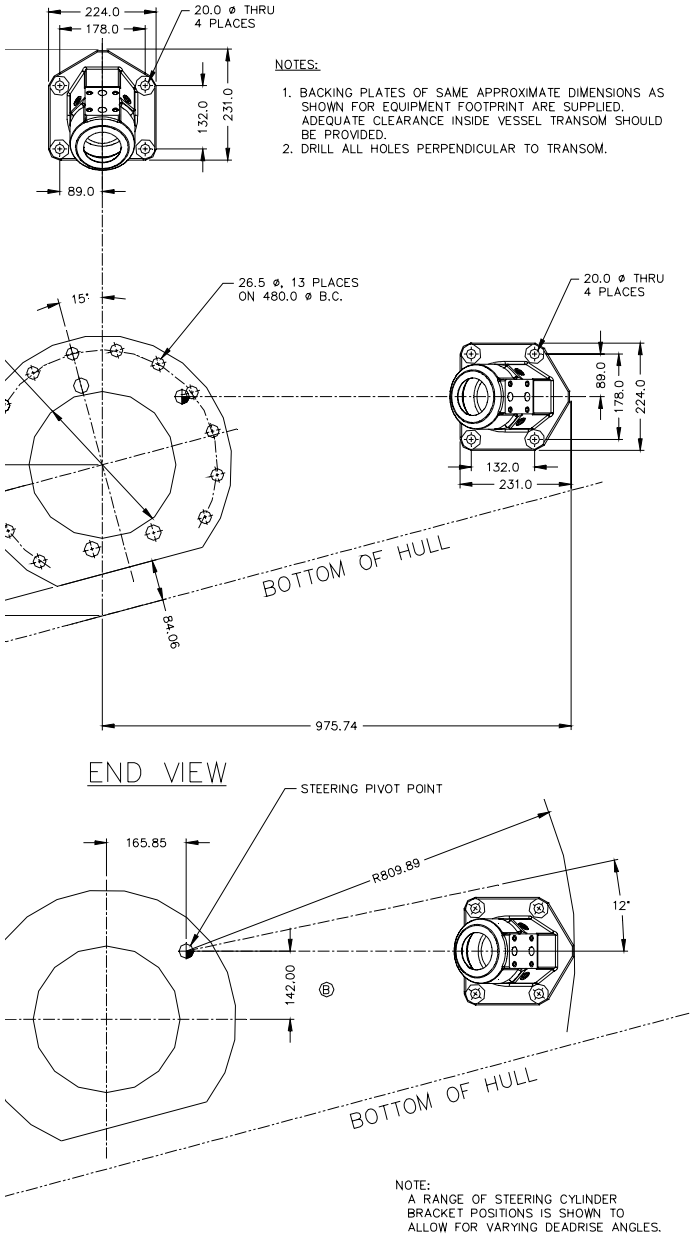


Figure 24. Transom Layout Dual Drive

Steering Cylinder Installation

The following installation procedure positions the steering cylinders to allow maximum steering capability without damage to the drive. The steering cylinders should reach both travel limits just prior to the ball/thrust tube contacting the socket (at all trim cylinder positions).

1. On single drive installations, the steering cylinder must be located to offset the effects of the propeller torque. If propeller rotation is clockwise as viewed from the rear, the cylinder must be located on the starboard side. The cylinder must be on the port side for counterclockwise rotation.

   On twin drive installations, each of the steering cylinders may be located to the left or right side of their drive centerline, as space permits.

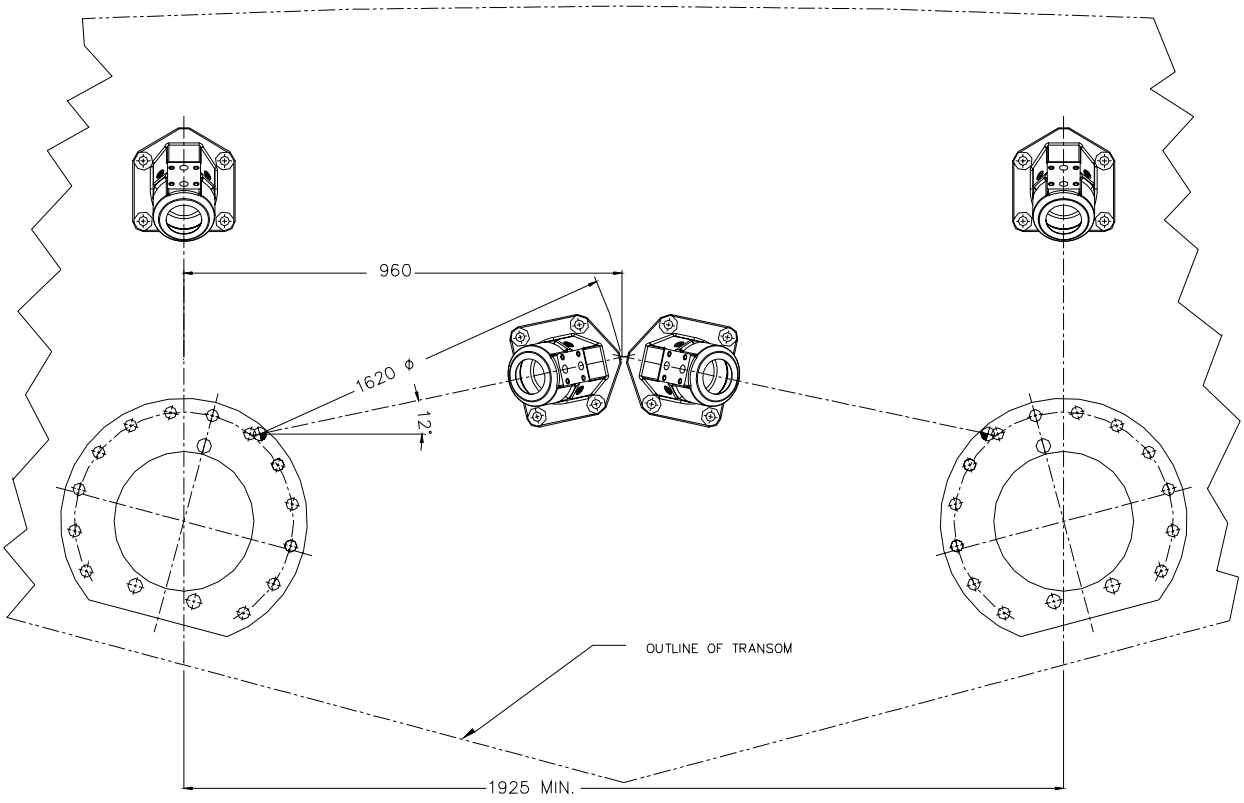


Figure 25. Transom with Optional Inboard Steering

2. Position the drive in the neutral trim position and parallel to the vessel centerline. See Figure 23. Attach the steering cylinder clevis to the trim yoke pin with the hardware supplied. See Figure 26. Torque nut to 57 N m (40 ft.-lbs).

3. Set the steering cylinder to the mid-travel location and position the steering cylinder mounting bracket on the transom. See Figure 24. The height and orientation of the mounting bracket should be such that the mounting bracket, the clevis, and the rod end are as close to centered as possible. For hulls with moderate deadrise, this height is usually dictated by clearance from the hull bottom.

   Note: If at all possible, the mounting bracket holes should avoid stringers, the hull bottom and any hull fittings that preclude the use of through bolts. Mark the location/orientation of the mounting bracket with a straight line approximately 12” long.

4. Slide the ball protective boot back from the thrust socket. The trim cylinder should be supporting the weight of the thrust tube. Remove the plastic gauge from the steering cylinder and compress the steering cylinder completely. Push the drive in the direction of the steering cylinder, allowing a 1/2" clearance between the thrust ball and socket. Place the steering cylinder bracket against the transom and mark the location. Do not re-adjust the trim cylinder. Mark the bracket outline on the transom.

5. Pivot the drive horizontally in the other direction, extend the cylinder completely, and repeat the procedure. Do not adjust the trim cylinder. Let it swing with the thrust tube. Mark the steering cylinder bracket outline on the transom.

6. Position the mounting bracket at the center of these two marks. Transfer the bracket hole pattern and drill the 22mm (0.875”) mounting holes in the transom. Stainless steel 19mm (0.75") diameter bolts, nuts and washers are required for this installation. Torque nuts to 122 N-m (90 ft.-lbs). Use thread lubricating compound to prevent seizing. Apply a generous layer of marine sealant under the bracket and within the fastener holes in the transom to prevent water leakage.

1) APPLY A THIN COAT OF LUBRICANT BETWEEN MATING SURFACES OF BALL/BRACKET/NUT, PIVOT PIN/CLEVIS, AND CLEVIS PIN/CLEVIS. LUBRICANT TYPE MUST BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS "RED LITHIUM GREASE" MARKETED BY THE ZEP CORP., ATLANTA, GA, U.S.A. UNLESS OTHERWISE STATED, DO NOT LUBRICATE COMPONENT THREADS. INSTALL THREADED PARTS WITH LOCTITE AS SPECIFIED IN THESE NOTES. CLEAN THREADS PRIOR TO APPLYING LOCTITE.

2) INSERT PREVIOUSLY LUBRICATED PIVOT PIN INTO CLEVIS AND THREAD IT ONTO ROD. TORQUE AS SPECIFIED. DIMPLE THE ROD THROUGH THE M8 PIVOT PIN HOLE (THE SMALLER OF THE TWO) USING 6.5MMø DRILL. DIMPLE MUST BE FULL 6.5MMø. INSTALL SET SCREW MA1133B, TORQUE AS SPECIFIED.

3) LIGHTLY LUBRICATE SPHERICAL SURFACES OF BALL AND BRACKET USING ABOVE GREASE. KEEP GREASE AWAY FROM THREADS. PLACE BRACKET OVER THREADED END OF CAP. ENSURE BALL AND CAP THREADS ARE CLEAN , THEN THREAD BALL ONTO CAP USING LOCKTITE AS SPECIFIED. TORQUE TO SPECIFIED VALUE. INSERT SET SCREWS MA1133D INTO BALL, TORQUE AS SPECIFIED.

4) ALIGN SLOT IN BALL WITH HOLE IN BRACKET. INSTALL PIN 1020218 AND TORQUE SCREWS MA960R TO SPECIFIED VALUE. LUBRICATE NUT THREADS (1020216) AND SCREW NUT INTO BRACKET UNTIL HAND TIGHT. TORQUE TO SPECIFIED VALUE. BACK THE NUT UNTIL PIN 1020219 CAN BE FULLY INSERTED. TORQUE SCREWS MA960R TO SPECIFIED VALUE.

5) TORQUE VALUES

	P/N	DESCRIPTION	TORQUE VALUES
**	1020261	BALL	215-285 N-m (150-200 FT-LB)
*	MA960R	SCREW	15 N-m (10 FT-LB)
	1020237	CAP	SEE NOTE 3)
	1020236	CAP	SEE NOTE 3)
*	MA1133D	SET SCREW	7 N-m (5 FT-LB)
	1020238	PISTON	SEE NOTES
*	1020240	PIN	110-140 N-m (75-100 FT-LB)
*	MA1133B	SET SCREW	15 N-m (10 FT-LB)
	MA1048F	NUT	57 N-m (40 FT-LB)
	1020216	NUT	70 N-m (50 FT-LB) MAX.

6) COAT THE * MARKED THREADS WITH LOCTITE THREAD LOCKER 242. (T42 BLUE SEMI-PERMANENT).

7) COAT THE ** MARKED THREADS WITH LOCTITE THREAD LOCKER (T70 RED PERMANENT).

8) USE PIPE SEALANT ON HYDRAULIC FITTING THREADS.

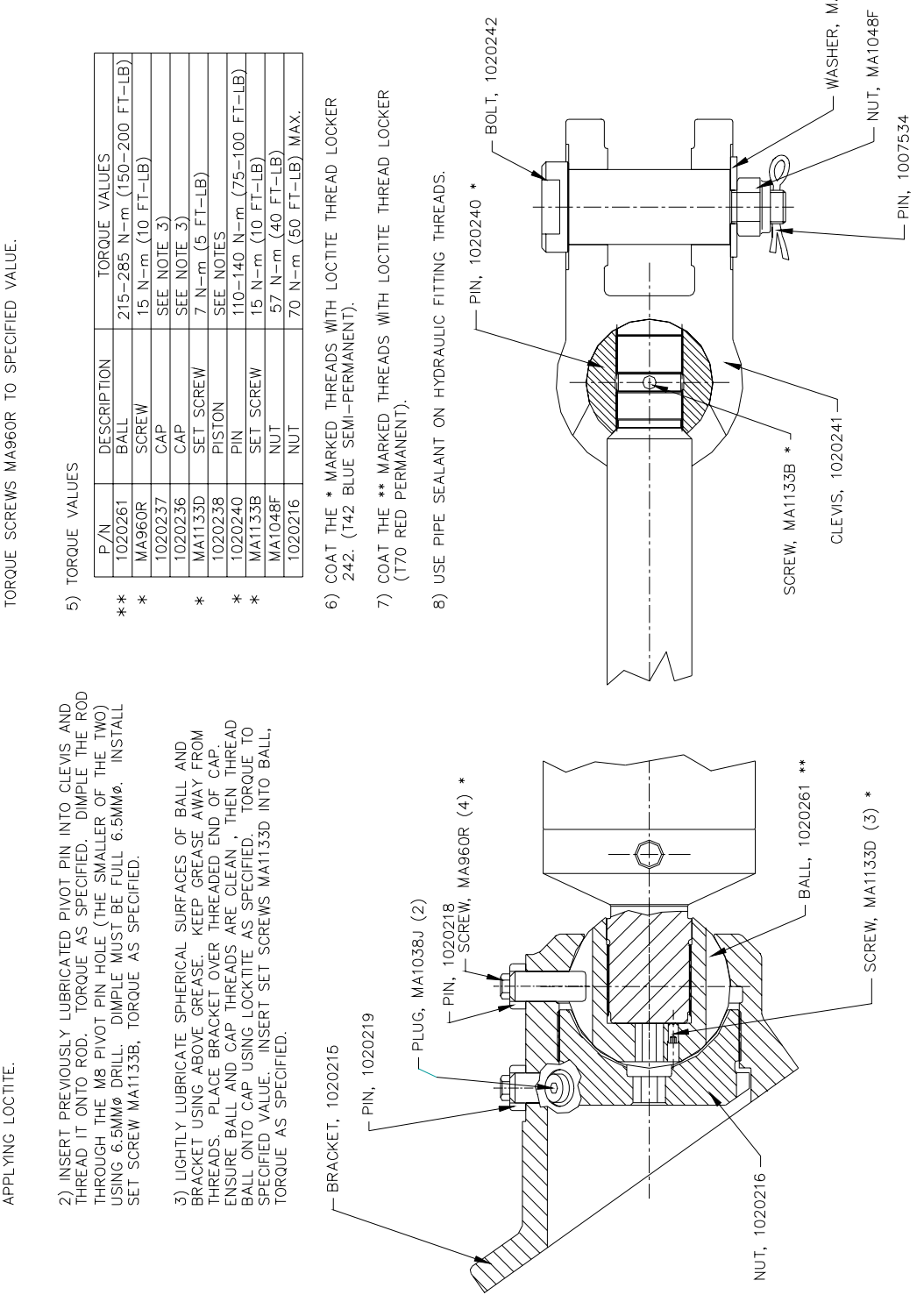


Figure 26. Steering Cylinder

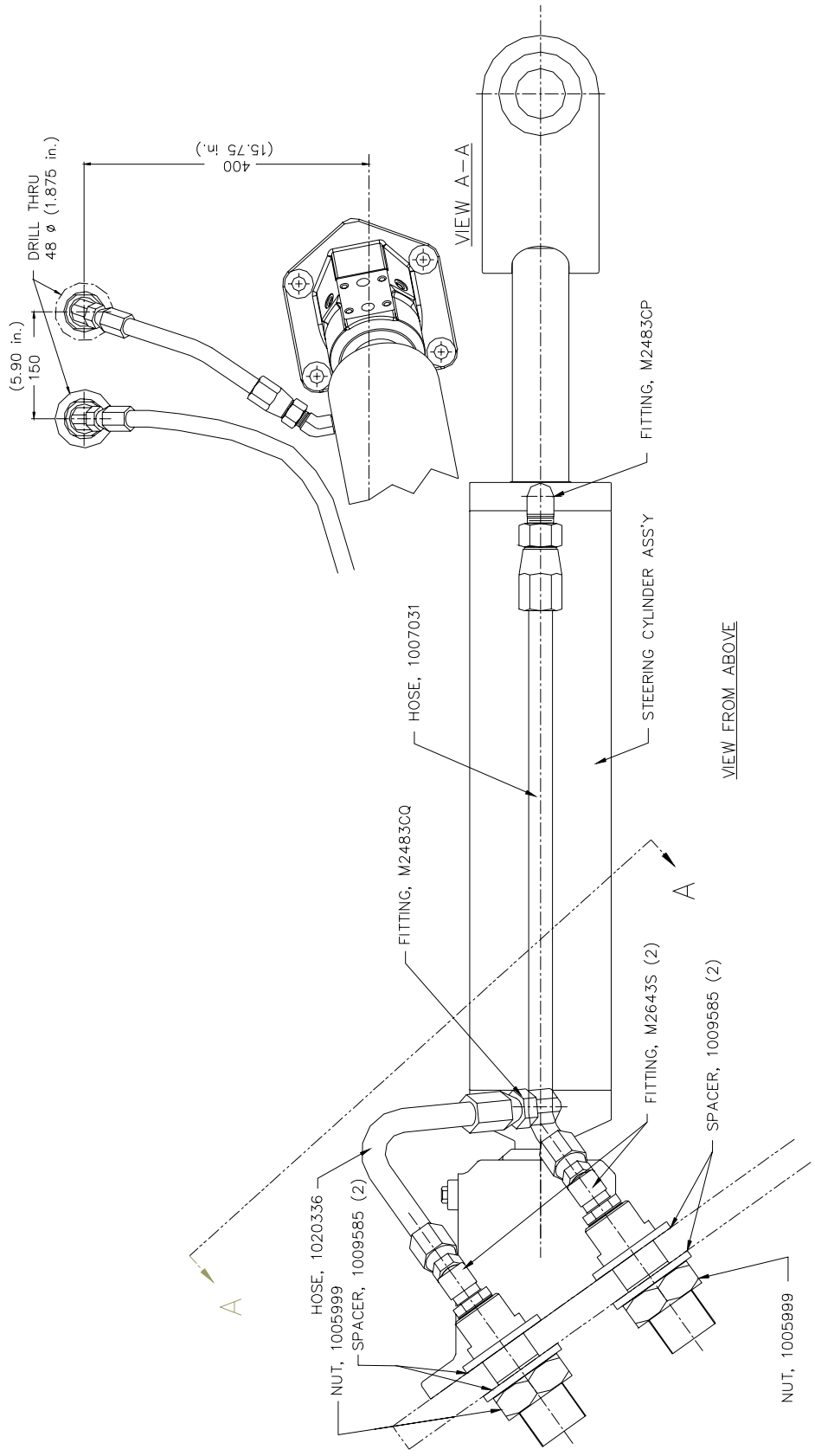


Figure 27. Steering Cylinder

7. Position the holes for the thru-hull hydraulic fittings as shown.

⚠ CAUTION

Minor adjustments in location are allowed to clear framing, however the hoses must be free to move without stress for the full range of horizontal and vertical drive movement. Excessive stress on the hoses will lead to hydraulic failure and void the warranty. The hoses provided have a minimum bend radius of 90mm (3.50 in) for both steering and trim cylinders.

8. Once the hole locations are established, drill 48mm (1.875 in) through holes. Apply a generous amount of marine sealant when installing the thru-hull fittings. Install the fittings with the threaded ends inboard and the flanged ends against the outside of the transom. Torque the nuts to 75 N-m (50 ft-lb). Connect the hoses and fittings as shown.

9. A steering tie bar is required for twin drive installations. When ordering the tie bar, specify drive centerline-to-centerline distance. Installation of the tie bar is per Figure 18 using the mounting hardware provided. Adjust the length of the tie bar as required to make the drive thrust housings parallel. Torque tie bar jam nuts as shown on Figure 28. Comply with all requirements and torque values shown in Figure 28.

10. Slip the thrust ball boot back over the socket and tighten the boot clamps. Verify that the boot is not twisted.

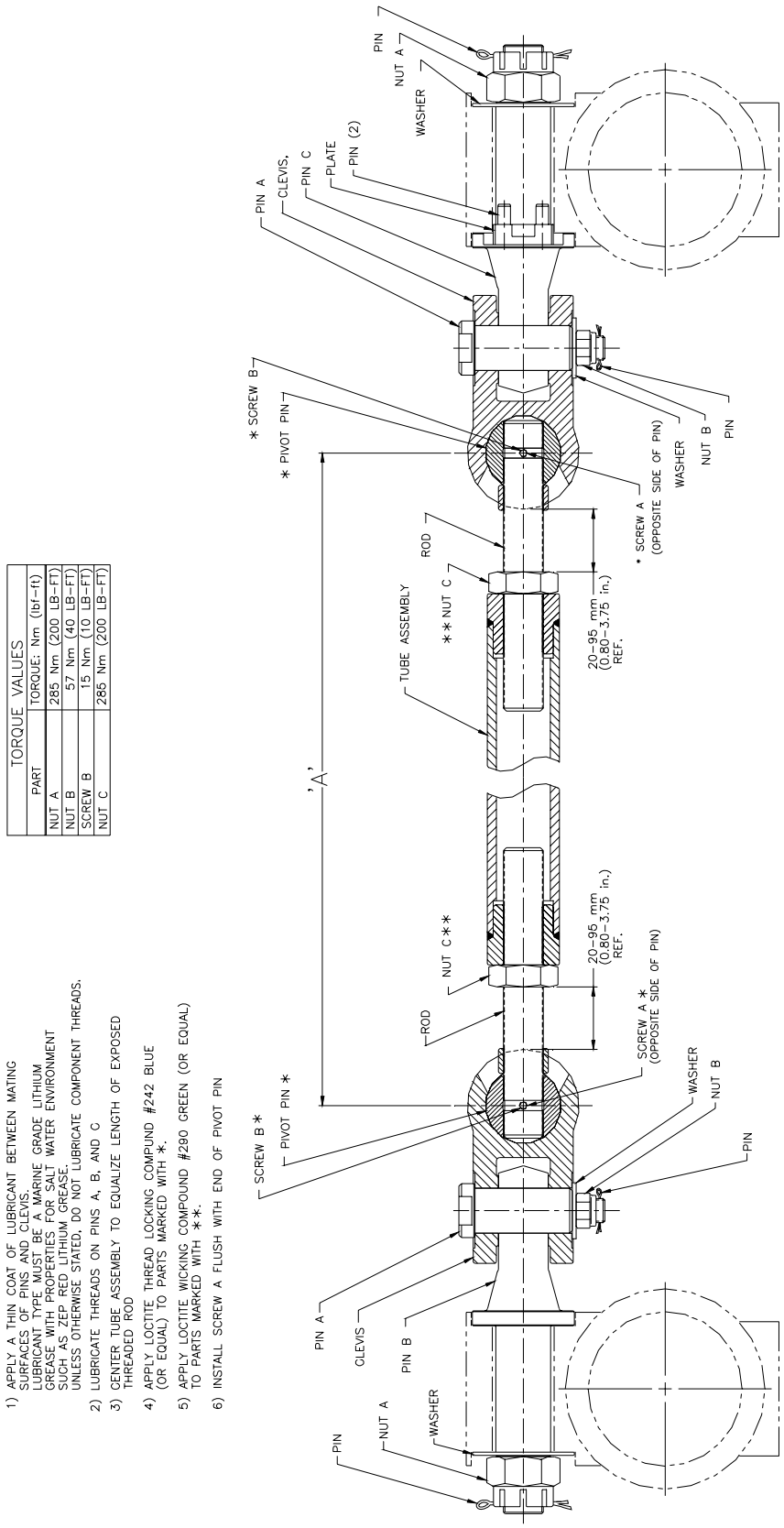


Figure 28. Tie Bar Assembly

Driveline Installation

The driveline between the transmission output shaft and the surface drive input shaft must be properly aligned for maximum life and minimum vibration.

1. The transmission output shaft centerline must be parallel to the surface drive input shaft centerline or if offset, the angle between the transmission output shaft centerline and the driveline must equal the angle between the driveline and the surface drive input shaft centerline. The angular offset between the transmission output shaft centerline and the driveline centerline must not exceed the recommendation of the driveline manufacturer. The angular offset between the transmission output shaft centerline and the driveline centerline must be within one half degree of the angular offset between the driveline centerline and the surface drive input shaft centerline.

2. Both ends of a two piece driveline must be in phase with each other. The correct orientation of the yoke arms on each end of the driveline is for them to be parallel to each other. Most drivelines contain a “slip spline” between the two ends, and the male and female sides of the slip spline may be capable of assembly at random angular positions. It is very important to maintain the two yoke ends parallel when reassembling the driveline after service.

3. Examples of proper and improper alignment are shown in Figure 31.

A method of alignment is listed here to aid in proper alignment or checking an existing installation for proper alignment. The surface drive input shaft centerline will be fixed as it is located and bolted to the vessel's transom. The engine and marine transmission must be adjusted so that the output shaft centerline is parallel to the surface drive input shaft centerline, and the offset angle is within the proper limits.

1. Fabricate pointer plates that can be mounted to the same transmission output flange adapter that the driveline will connect to, and to the surface drive input flange that the driveline will connect to.

2. Fabricate inner hollow tubes and outer hollow tubes, and weld pointers (indicator ends) onto inner shafts.

3. Drill a hole in same length outer tube and then weld a nut to the tube. This will be used as the retention device for the inner tube once the inner tube is slid into the outer tube.

4. Weld the tube assemblies to the plates, making sure that the tube to plate runout is zero. This will allow for adjustment of both shafts to identical lengths. Make sure there is a tight fit between the outer tube and inner tube (the closer the fit the more accurate the alignment will be).

5. Bolt one pointer onto the transmission output shaft flange. Bolt the other pointer onto the surface drive input shaft flange. These pointers are an extension of the shaft centerlines on which they are mounted. If the installation requires that the transmission output shaft centerline is not parallel to the surface drive input shaft centerline, adjust both pointers to the same lengths so the pointed end (indicator reference end) of the inner shafts are in close proximity to each other. Once this is completed use a dial indicator making sure that the run out on the pointers are no greater then 1.59mm (.0625 inch). It will be necessary to check runout on both shafts by turning them each 360°. The engine and transmission package must be adjusted so that the pointer ends meet each other.

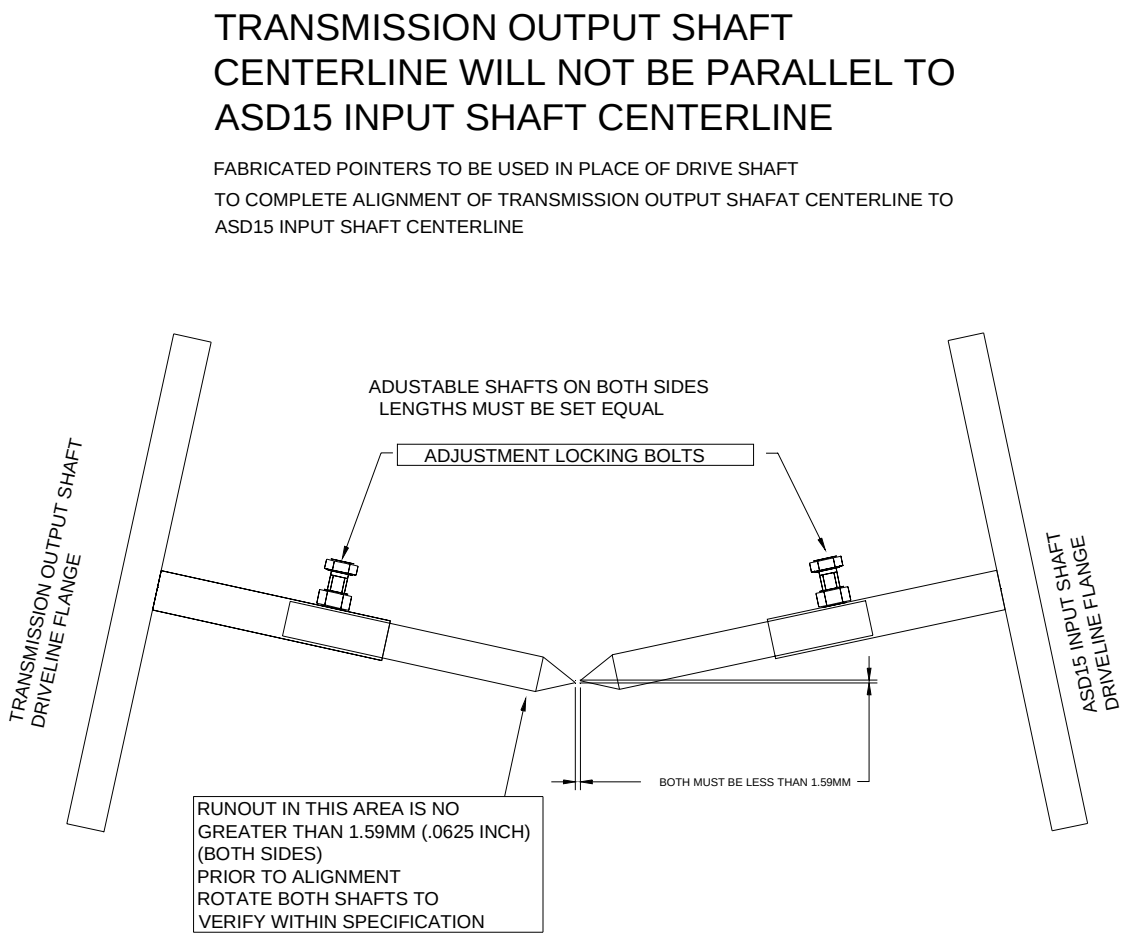


Figure 29. Remote or Island Mounted Alignment Tool, Shafts not Parallel

6. If the engine and transmission package can be adjusted so that the transmission output shaft centerline will be parallel to the surface drive input shaft centerline, the engine and transmission package must be adjusted so that the two rods are parallel to each other. The rods can be lengthened as long as the runout is within the allowable limits to ease in the adjustments.

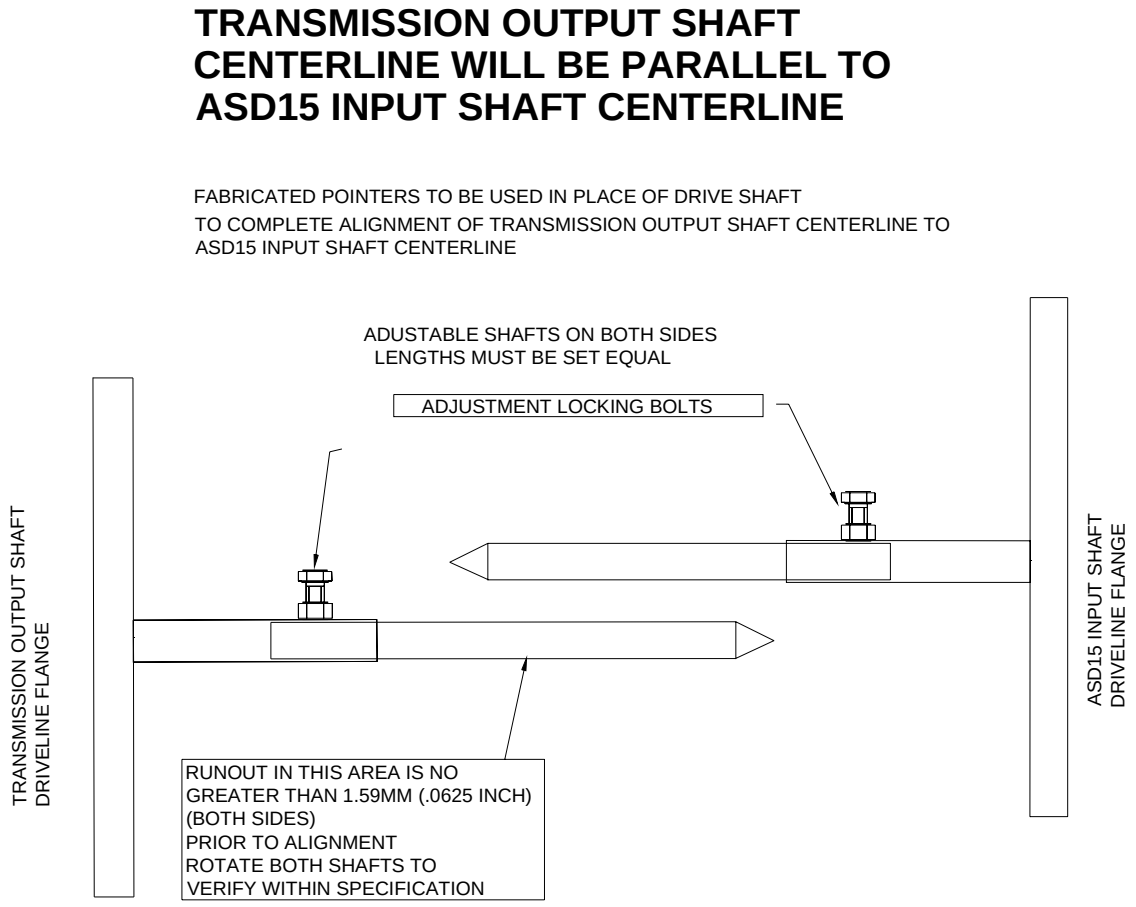


Figure 30. Remote or Island Mounted Alignment Tool, Shafts Parallel

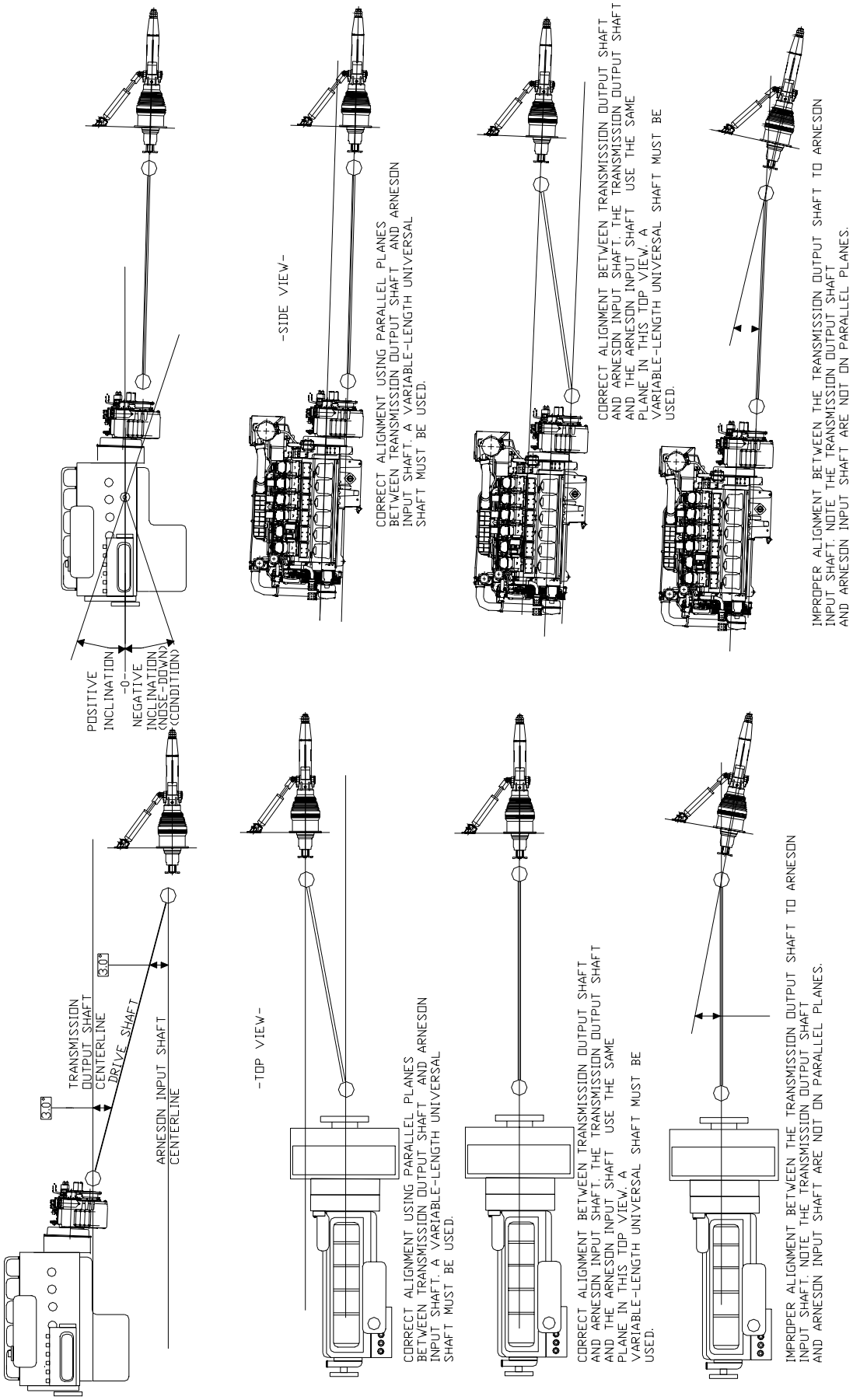


Figure 31. Examples of Proper and Improper Alignment

Lubrication

The ASD 15A1S is supplied with an internal lubrication system that can be serviced inside the vessel. A non-pressurized type of lubrication system is standard equipment on the ASD 15A1S, and is described below.

Internal Lube Kit

The Internal Lube Kit is used for the ASD 15A1S drives. This kit, shown in the schematic diagram of Figure 32 includes an oil reservoir, hose, clamps and necessary hose fittings and plugs supplied by Twin Disc, Incorporated The customer provides the necessary support brackets for the reservoir. All components are to be internally clean to prevent oil contamination.

Reservoir mounting: Mount reservoir 254mm (10 in) or higher above surface drive centerline as shown in Figure 32. Support reservoir on bottom and secure to the vessel's structure. Connect 19mm (0.75 in) hose as shown in Figure 32.

Before starting the lubrication filling process, lower drive unit by extending the trim cylinder. This will aid in bleeding air from thrust tube. Remove the top plug from the thrust socket. Fill the drive unit with proper oil until approximately 4" from top outside opening in thrust socket. Allow 5 minutes for air to escape; recheck oil level.

Note: Similarly, the drive can be filled through the upper hose inside the vessel.

Fill reservoir to the level to about half full leaving some tank air space for oil expansion. Replace all fill plugs and check the fittings. The capacity of the reservoir/drive system is approximately 10-15 gallons.

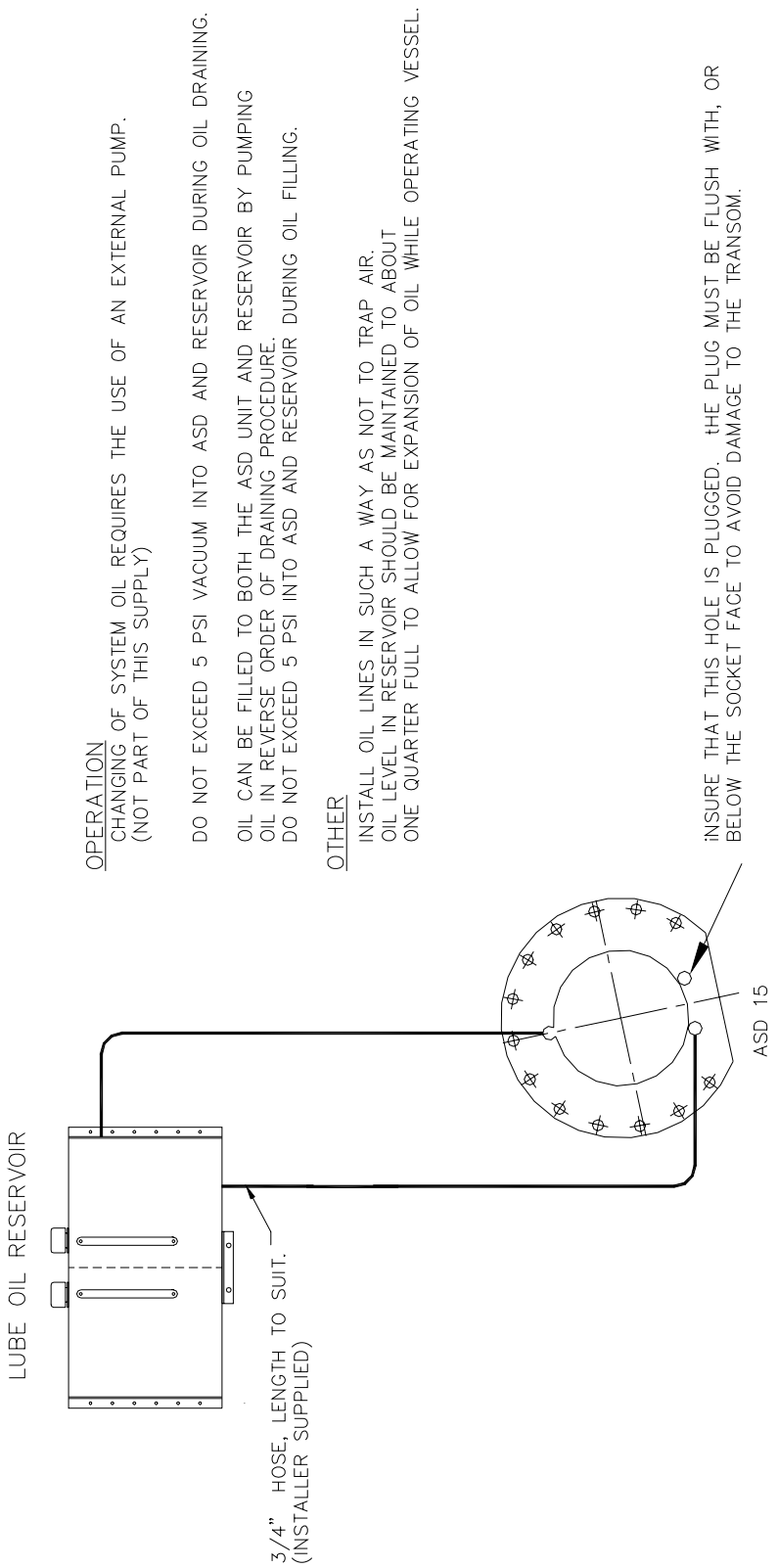


Figure 32. Lubrication System

Lubricants

Recommended oil is SAE 30 or SAE 40 meeting API Service Category CF or higher, certified by the vendor to meet Caterpillar Test TO-4 specifications. During operation, the lube oil level will rise in the oil reservoir due to the displacement of oil from within the drive unit into the reservoir. *This is normal*. The oil level will return to the original levels when the unit is not running or idling.

Propeller Installation - Routine Maintenance

1. Apply a thin coat of anti-seize lubricating compound to the propeller shaft as shown in Figure 33.

2. Install the propeller, thrust washer, propeller nut, lock nut, on the shaft as shown in Figure 25. Torque the propeller nut to 1220 N-m (900 ft.-lbs). Torque the jam (lock) nut to 860 to 1000 N-m (634 to 738 ft.-lbs). Approach the lower value, then continue until a cotter pin slot in the nut aligns with the hole in the shaft. Install the cotter pin.

   Note: The propeller nut should be re-torqued following the following schedule.

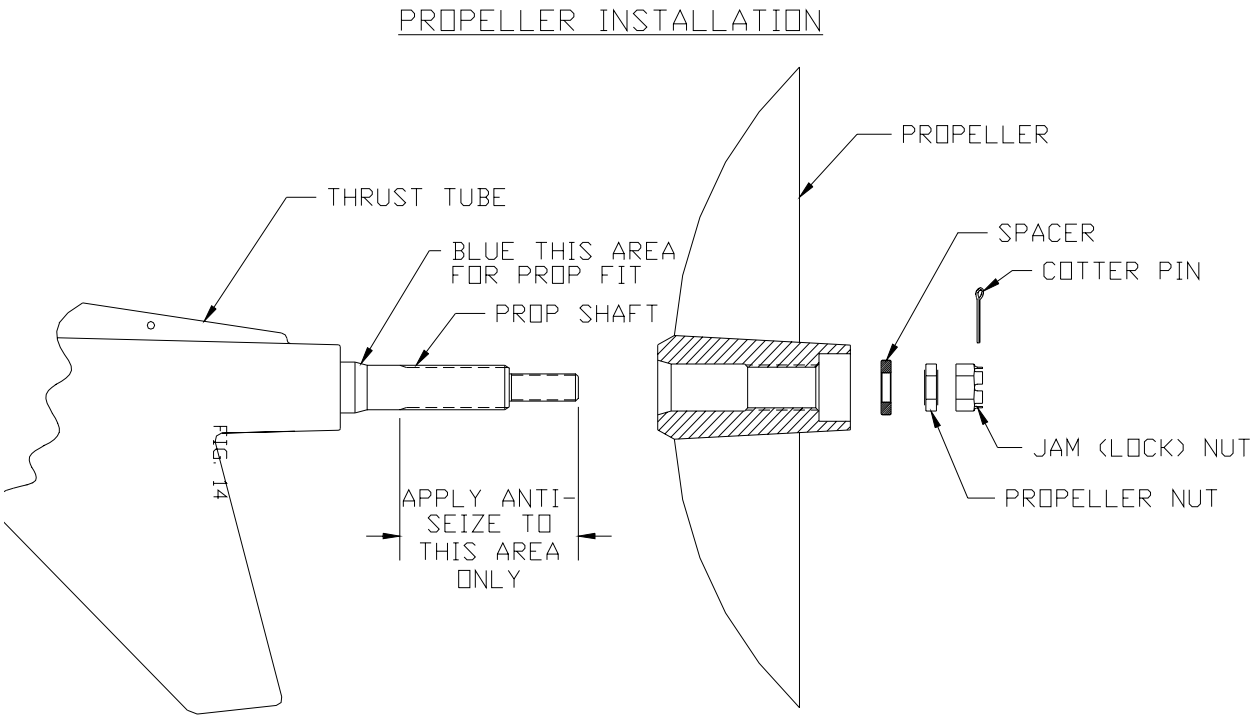


Figure 33. Propeller Installation

3. The propeller nut and lock nut must be checked for torque retention to the above values after initial use or within 10 hours of operation.

4. The propeller nut torque **MUST** be checked in the following operational interval

   A. The propeller nut torque must be checked in accordance with step 2 after an additional 250 hours of operation. If the torque is correct, go to step B. If the torque is incorrect, re-torque the nut and repeat step A.

   B. The propeller nut torque must be checked in accordance with step 2 after an additional 500 hours of operation. If the torque is correct, go to step C. If the torque is incorrect, re-torque the nut and repeat step B.

   C. The propeller nut torque must be checked in accordance with step 2 after an additional 1000 hours of operation. If the torque is correct, go to step D. If the torque is incorrect, re-torque the nut and repeat step C.

   D. The propeller nut torque must be checked in accordance with step 2 after an additional 1500 hours of operation. If the torque is correct, go to step E. If the torque is incorrect, re-torque the nut and repeat step D.

   E. Continue to increase the interval in increments of 1500 hours until the regular “haulout” interval of the vessel is reached.

   F. If at any point in steps A through F, the “haulout” interval of the vessel is reached or surpassed, the torque check interval may be established to be the same as the “haulout” interval. Record the final interval for reference.

Propeller Installation - New Applications

First time installation of new propellers will require a check to verify proper mating of the tapered shoulder on the propeller with the tapered shoulder on the shaft. Mismatched tapers may result in a damaged or broken propeller shaft and a lost propeller. Follow the procedure below to check the propeller to shaft fit:

1. Clean the taper on the forward end of the propeller hub and the tapered shoulder of the shaft with alcohol or other cleaner and wipe dry.

2. Apply a layout dye to the shaft taper as follows. Use a machinist's layout dye such as Dykem "Steel Layout Blue" Dykem part number DX100 marketed by ITW Dymon Company, 805 E. Old 56 Highway, Olathe, KS 66061 USA.

3. Apply the layout fluid to the shaft taper as thinly and evenly as possible over the entire tapered surface. The more evenly the dye is applied, the more accurate will be the reading. Allow the dye to dry completely before proceeding.

4. Slide the propeller onto the shaft until the male and female tapers touch. Install the propeller nut and torque the nut to 200 N-m (150 ft-lbs). Verify that the propeller is securely seated on the shaft taper.

5. Remove the propeller nut, and slide the propeller away from the shaft, being careful not to disturb the layout dye on the shaft and on the propeller hub internal (female) taper.

6. Evaluate the contact pattern on both tapers. See Figure 34 for guidance on acceptable contact patterns. The surfaces should match approximately 80% of the total tapered area.

   Note: It is important that the contact should be biased toward the larger diameter end of both tapers. If contact is predominant at the small end, the shaft may be over-stressed locally and may fail. Contact Twin Disc if the taper contact pattern is not in accordance with Figure 34.

8. Once the contact is confirmed to be acceptable, clean the dye from the tapers with the above solvent and re-install the propeller as outlined in the previous section.

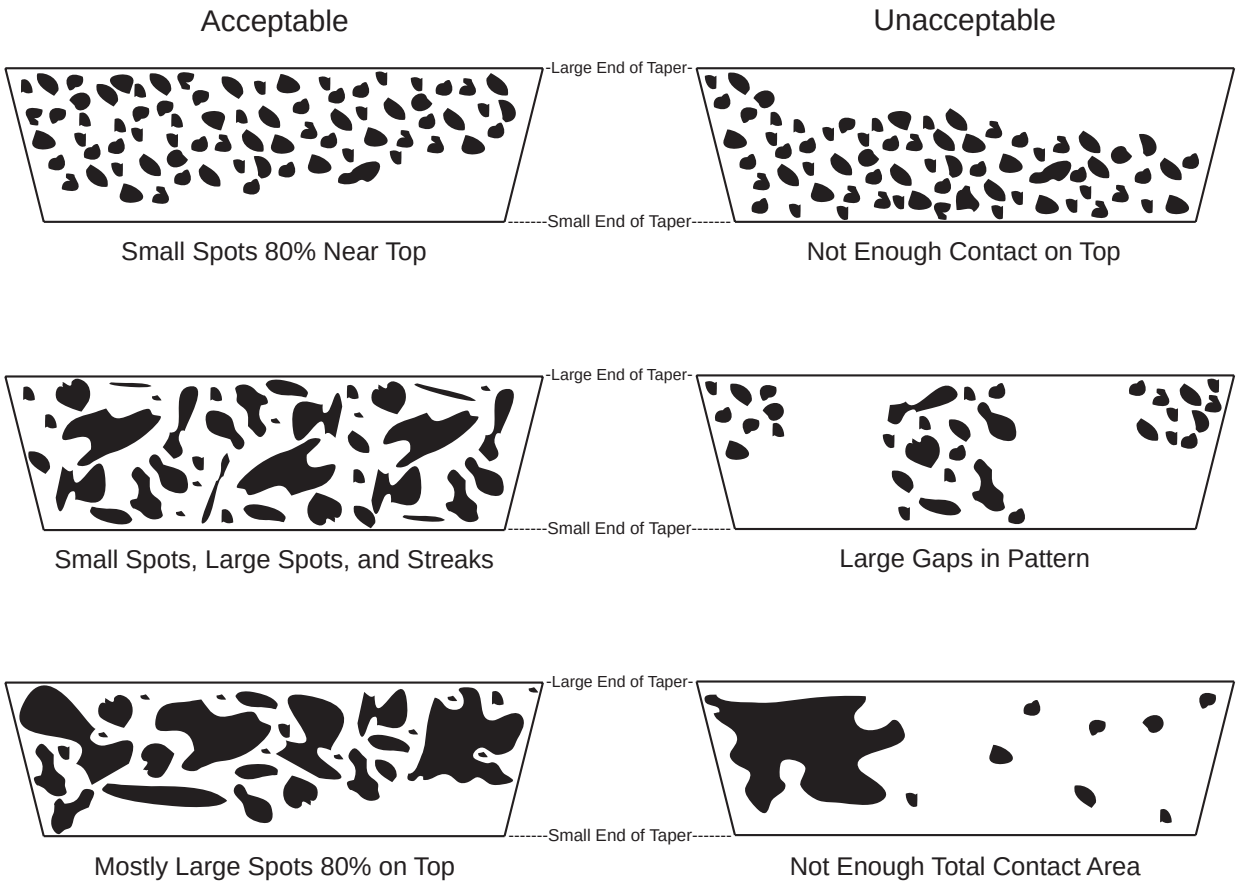


Figure 34. Dye Contact Pattern Samples

Corrosion Protection

As with any marine outdrive, a cathodic corrosion protection system should be installed.

Follow American Boat and Yacht Council (ABYC) recommendations found in Project E2.

All electrically isolated components have been supplied with tapped holes to facilitate installation of a bonding system.

Twin Disc, Incorporated recommends the usage of the proper Electrolysis Kit for ASD 15A1S for cathodic protection. Reference instructions available from Twin Disc, Incorporated for system installation and details.

The ASD 15A1S is coated with a quality marine primer during assembly. An additional top coating of finish epoxy is required to adequately protect the surface drive from galvanic corrosion, chemical attack, or mechanical erosion. The finish epoxy will be most effective if it is rated as a “barrier” coating, indicating that it is impervious to electrical penetration. A final coating of anti-fouling bottom paint is recommended to protect the drive from marine growth.

The cylinders should be similarly coated with a paint system that is qualified for stainless steel. Care must be observed to keep all coatings away from piston rods. Bottom paint may be applied as the final step to reduce marine growth.

Several recommended Marine Paint suppliers are listed as follows:

"Hycote 151"
Somay Products, Inc.
4301 N. W. 35th Street
Miami, Florida 33142-4382
USA
Phone: 001-305-633-6333
Fax:: 001-305-638-5524
www.somay.com

"Pettit Marine Paint"
Kop-Coat Marine Group
36 Fine Street
Rockaway, New Jersey 07866
USA
Phone: 001-800-221-4466
www.kop-coat.com
www.petitprod.com

International Coatings Ltd. Interlux)
24/30 Canute Road
Southampton, Hampshire, SO14 3PB
UK
Phone: 44 (0)23 8022 6722
44 (0)23 8022 2090
yacht.uk@yachtpaint.com

Anti-fouling Protection

It is recommended that a suitable antifouling paint be applied to minimize marine growth.

Troubleshooting

Table 2. Troubleshooting

Problem	Probable Cause	Remedy
Propeller does not turn	Transmission malfunction. Broken transmission coupling. Broken drive coupling. Broken internal U-joint.	Repair or replace Repair or replace Repair or replace Repair or replace
Trim / steering function failure	Low hydraulic oil. Leak in hydraulic line. Leak in cylinder. Trim control switch failure. Trim control solenoid failure. Hydraulic pump failure. Steering helm malfunction.	Check for leak in the hydraulic system. Replace Replace Replace Replace Repair or replace. Repair or replace.
Excessive drive noise or vibration	Misaligned inboard driveline. Propeller damage. Low drive oil level. Failed bearing or U-joint. Air in trim cylinders.	Align * See Driveline Section Repair or replace. Check for leak. Repair or service the system. Remove drive and repair. Bleed hydraulic system.
Water in drive oil. (The oil looks milky and brown.)	Leak in thrust ball/socket seal. Leak in thrust tube rear oil seal. Loose oil fill or drain plug.	Tighten Remove and replace the seal Tighten or remove and replace the drain plug.

Periodic Visual Inspection

- ❑ Check the propeller for any signs of damage daily. Repair or replace as necessary.
- ❑ Check the Cathodic Protection frequently on new vessels (once a week for a month) and at least every six months thereafter. Replace zinc anodes when eroded to one half of full size. Check all bonding wires and fittings. Replace if required.
- ❑ Inspect the oil lines for leaky connections, cracks, or other damage. Replace damaged lines.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.
- ❑ Check the condition of the Paint and Coating frequently on new vessels (once a week for a month) and at least every six months thereafter. Clean any blemishes or corrosion and repair damaged coatings.

Operation

General

The following information is intended for use by the vessel operator. It will help the operator understand the operation of the ASD 15A1S, and applies to the surface drive only. The vessel's operator manual must be referred to for procedures applicable to other vessel functions, and for the operation of the control system for this drive.

The ASD 15A1S provides positive steering and a means for adjusting the depth of the surface piercing propeller while under way.

Prior to Daily Use

Verify that the surface drive has adequate lubrication, and that the hydraulic steering reservoir and trim pump reservoir are properly filled. The lube oil reservoir must not be filled more than 1/4 full when cold with the drive stopped. The level will rise during operation due to temperature increase and rotation of internal parts.

Surface Drive Operation

For optimum performance, the surface drive should be trimmed so that the center of the propeller hub is at the waterline under operating conditions. Underway adjustments may be required when the vessel trim changes due to fuel consumption, loading, etc.

The surface drive should not be trimmed up to such a degree that the engine is allowed to operate higher than the maximum speed recommended by the engine manufacturer.

⚠ CAUTION

A change in trim while underway may cause a change in steering direction.

Transmission forward/reverse shifting should be accomplished at engine idling speed to avoid unnecessary impact loads that could damage the surface drive.

Preventative Maintenance

General Maintenance

There are two oil systems on the ASD 15A1S. Lubrication oil is contained in a closed system that is comprised of a reservoir that is connected to the front of the drive. Oil fills the area inside the drive and surrounds the propeller shaft, the input shaft, and the constant velocity universal joint that connects the two shafts. Oil is maintained in the reservoir at a level that allows for expansion due to agitation by the rotating shafts. The hydraulic steering and trim oil system is a self contained hydraulic system supplied by others. It is used to operate the trim cylinder and the steering cylinders of the surface drive.

Proper maintenance of the Cathodic protection system is very important in preventing deterioration of the ASD 15A1S.

Periodic clean up and maintenance of all painted or coated surfaces is also very important in obtaining long service life from the surface drive.

Lubrication

Lubrication oil should be checked daily. The reservoir should be approximately 1/4 full when cold with the drive stopped, to allow for expansion from agitation during operation. A milky appearance could be an indication that water has been ingested. Do not operate the drive for extended periods with contaminated oil.

Periodic oil sample analysis can be helpful in identifying the presence of water or other contaminants that could indicate impending failure.

Oil should be changed after the first 200 hours of operation, and every 500 hours or twelve months, whichever comes first thereafter.

When the vessel is waterborne, drain the lubrication oil by removing the lower hose that is attached to the drive inside the vessel. Drain and vent ports are provided on the drive to assist draining when the vessel is dry-docked.

Steering and Trim Hydraulic Oil System

Oil Level

The oil level should be checked daily or every 10 hours.

Oil and Filter Change Interval

The oil filter (if equipped) in the Steering System should be changed whenever the engine filters are changed. The oil should be changed if contaminated. An oil analysis can be helpful in avoiding problems from continued operation with contaminated oil.

Type Oil Recommended

See Description and Specifications.

Overhaul Interval

A complete overhaul of the unit should be made at the same time that the engine is overhauled.

Periodic Visual Inspection

- ❑ Check the propeller for signs of damage daily. Repair or replace as necessary.
- ❑ Check the Cathodic Protection System at least every six months. Replace zinc anodes when 50% consumed or if excessive corrosion is seen. Check all bonding wires and fittings. Replace if required.
- ❑ Inspect the oil lines for leaky connections, cracks, or other damage. Replace damaged lines.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.

Check the condition of the Paint and Coating every six months. Clean any blemishes or corrosion and coat with antifouling paint.

⚠ CAUTION

Do not apply paint or other coatings to sacrificial anodes.

Table 3. Maintenance Checklist

Location and Action	Beginning each day of operation	After first 200 hours of operation	First 500 hours of operation, but not to exceed a 12 month period	2000 hours
Lube oil: Check visually	X			
Hydraulic reservoir fluid level: Check visually	X			
Hydraulic oil filter: Replacement			X	
Propeller: Check for damage	X			
Propeller nut: Torque check	See Propeller Torque Schedule on next page			
Socket, trim cylinder, steering cylinder: Check transom fasteners			X	X
Hydraulic system: Perform manual and emergency operation		X	X	X
Drive oil change: As indicated by analysis		X	X	X
Hydraulic and drive system oil: Check for leakage	X			
Hydraulic system: Cycle lock to lock	X			
Thrust Ball retaining ring bolts: Torque to 60 N-m (40 Ft-lbs)			X	X
Propeller Shaft Seal: Apply grease	Whenever the vessel is hauled out, remove the pipe plug located at the aft end of the thrust tube, and install the grease fitting (M268) that is supplied with the drive. Pump grease into the fitting until clean grease is seen emerging between the seal and the propeller shaft or from the gap in front of the propeller. Use a quality marine rated grease such as "Red Lithium Grease" sold by the ZEP COMPANY, Atlanta, Georgia, USA. The plug and grease fitting thread size is "1/8-27 NPTF" SAE			

Propeller Torque Maintenance

Note: The propeller nut should be re-torqued according to the following schedule.

Torque the propeller nut to 1220 N-m (900 ft.-lbs). Torque the jam (lock) nut to 860 to 1000 N-m (634 to 738 ft.-lbs). Approach the lower value, then continue until a cotter pin slot in the nut aligns with the hole in the shaft. Install the cotter pin.

1. The propeller nut and lock nut must be checked for torque retention to the above values after initial use or within 10 hours of operation.

2. The propeller nut torque **MUST** be checked in the following operational interval

   A. The propeller nut torque must be checked in accordance with the required torque after an additional 250 hours of operation. If the torque is correct, go to step B. If the torque is incorrect, re-torque the nut and repeat step A.

   B. The propeller nut torque must be checked in accordance with the required torque after an additional 500 hours of operation. If the torque is correct, go to step C. If the torque is incorrect, re-torque the nut and repeat step B.

   C. The propeller nut torque must be checked in accordance with the required torque after an additional 1000 hours of operation. If the torque is correct, go to step D. If the torque is incorrect, re-torque the nut and repeat step C.

   D. The propeller nut torque must be checked in accordance with the required torque after an additional 1500 hours of operation. If the torque is correct, go to step E. If the torque is incorrect, re-torque the nut and repeat step D.

   E. Continue to increase the interval in increments of 1500 hours until the regular “haulout” interval of the vessel is reached.

   F. If at any point in steps A through F, the “haulout” interval of the vessel is reached or surpassed, the torque check interval may be established to be the same as the “haulout” interval. Record the final interval for reference.

Troubleshooting

Troubleshooting Chart

The following chart is intended as a guide for determining the cause of problems that could be encountered and the corrective actions for those difficulties.

The surface drive is one part of a complete power package. Problems in the input power system (engine) or the output power delivery components (transmission and driveline) can cause problems that may be erroneously interpreted as being surface drive related. It is important that the entire power package and control systems be considered when problems are encountered.

The Troubleshooting Chart is shown on the following page.

Table 4. Troubleshooting Chart

Problem	Probable Cause	Remedy
Propeller does not turn	Transmission malfunction. Broken transmission coupling. Broken drive coupling. Broken internal U-joint.	Repair or replace Repair or replace Repair or replace Repair or replace
Trim / steering function failure	Low oil. Pump belt broken. Leak in hydraulic line. Leak in cylinder. Trim control switch failure. Trim control solenoid failure. Hydraulic pump failure. Steering helm malfunction.	Check for leak in the reserve system. Replace Replace Replace Replace Replace Repair or replace. Repair or replace.
Excessive drive noise or vibration	Misaligned inboard driveline. Propeller damage. Low drive oil level. Failed bearing or U-joint. Air in trim cylinders.	Align** Repair or replace. Check for leak. Repair or service the system. Remove drive and repair. Bleed hydraulic system.
Water in drive oil. (The oil looks milky and brown.)	Leak in thrust ball/socket seal. Leak in thrust tube rear oil seal. Loose oil fill and/or drain plug.	Tighten aft threaded retainer ring. Remove and replace packing and o-ring. Tighten or remove and replace the plug.

**See the Driveline alignment in the Installation Chapter

Disassembly

Disassembly Overview

The disassembly instructions that follow are separated into major sub assemblies:

- ❑ Disassembly of the thrust socket from the thrust tube
- ❑ Thrust tube disassembly
- ❑ Propeller shaft disassembly
- ❑ Thrust socket disassembly
- ❑ U-joint / input shaft disassembly

Disassembly of the Thrust Socket from the Thrust Tube

1. Attach special tool T-21567 securely to the propeller shaft and use a hoist to stand the surface drive in a vertical position.

⚠ CAUTION

Do not damage the input shaft when lifting the surface drive. Use enough blocks to keep the input shaft from contacting the floor.

2. Place suitable blocking under the socket and lower the socket onto the blocks. Use the hoist to support the thrust tube and prevent it falling to the side.

3. Remove the 18 M10-1.5 x 25 socket head capscrews, and remove the fin and set it aside.

4. To disassemble the socket from the thrust tube, remove the forward pair of circle clamps on the rubber boot and push the boot up over the thrust tube.

Figure 35. Remove Clamps and Raise Boot Up Onto Thrust Tube

5. Remove the retainer (wear sleeve) cover bolts.

Figure 36. Remove Capscrews from Cover

6. Remove the retainer (wear sleeve) cover, shims and retainer (wear sleeve).

7. Remove thrust tube from socket with caution, taking care that the ball comes out of the socket evenly.

8. The forward thrust ball retainer may come out of the socket along with the thrust ball. Do not drop the forward thrust ball retainer. The forward retainer can be reused if it is not damaged or worn.

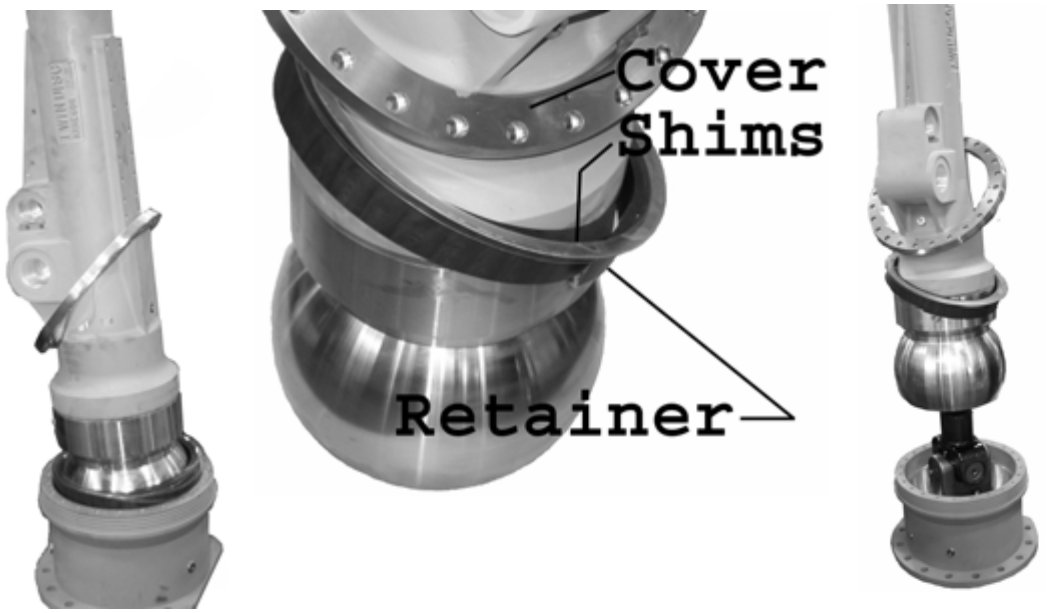


Figure 37. Remove Cover, Shims, Retainer, and Raise Thrust Ball Assembly

9. Store thrust tube securely without anything touching the ball. Protect the spherical surface of the ball from scratches and dents.

10. Cover the socket assembly, the thrust tube and ball to protect from moisture and dirt.

Thrust Tube Disassembly

1. Place the thrust tube vertically in the assembly stand with the output end facing up. See special tool T-21089-5D Stand Setup in Special Tools.

2. Remove the cover (rope guard) screws and the cover and seal assembly. Gently force a thin plastic blade or equivalent between the flange and thrust tube. Remove evenly to avoid jamming the cover assembly within the bore. Avoid chipping or scratching the thrust tube paint.

Figure 38. Remove Cover (Rope Guard, Remove Retaining Ring, Seals, Spacer, and O-rings

3. Remove retaining ring, and remove seals and o-rings from cover and discard. Do not discard the spacer.

4. Rotate the thrust tube in the assembly stand so that the input end is facing up. If a stand is not available, a suitable support should be made.

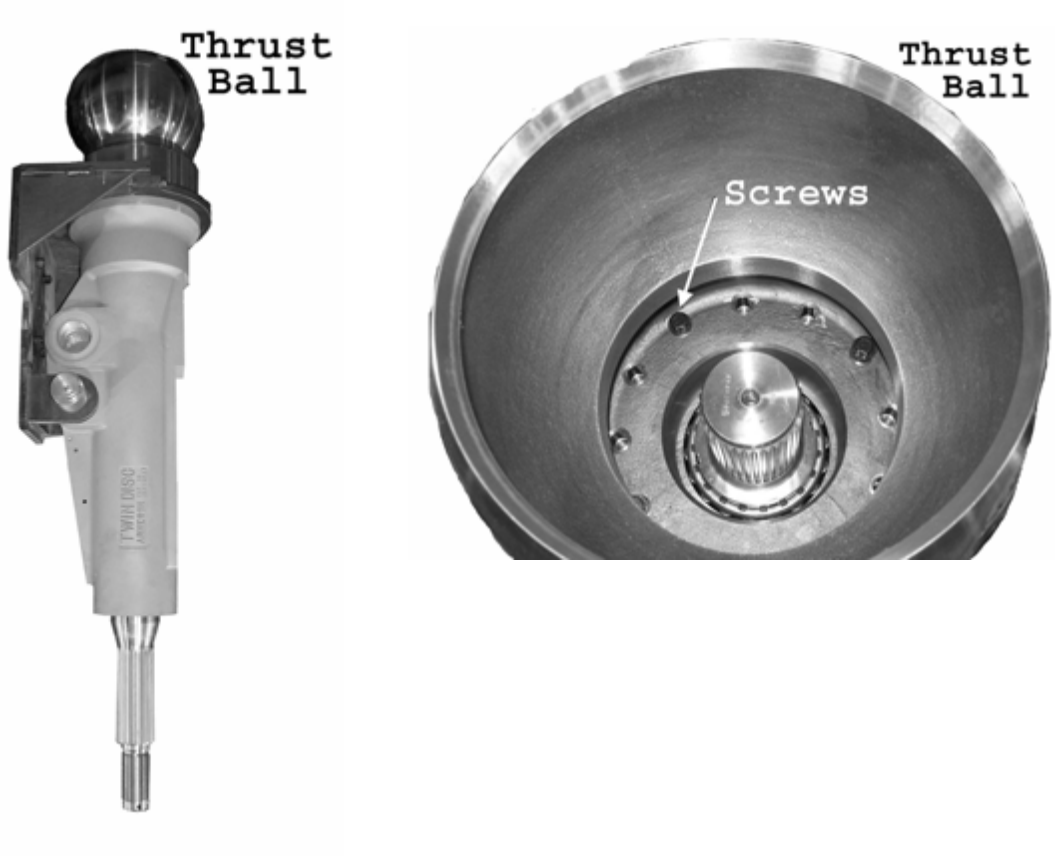


Figure 39. Rotate Thrust Tube Assembly so Ball is Up, Remove 12-point Capscrews

5. Remove the screws holding the thrust ball to the thrust tube. Use a 16mm 12-point socket wrench.

   Note: A lifting device can be fabricated, using a length of channel material that is longer than the inner opening of the ball, that is slightly shorter than the inner diameter of the ball. Drill a hole in the center of the channel material for an eyebolt hole. This device is shown being used in the picture below

6. Slide the thrust ball out of the thrust tube. Remove the o-ring from the bottom of the thrust ball. When sliding the thrust ball out of the thrust tube, watch for the shim pack located between the thrust ball shoulder and thrust bearings. The shims may stick to the ball shoulder, or the thrust bearing.

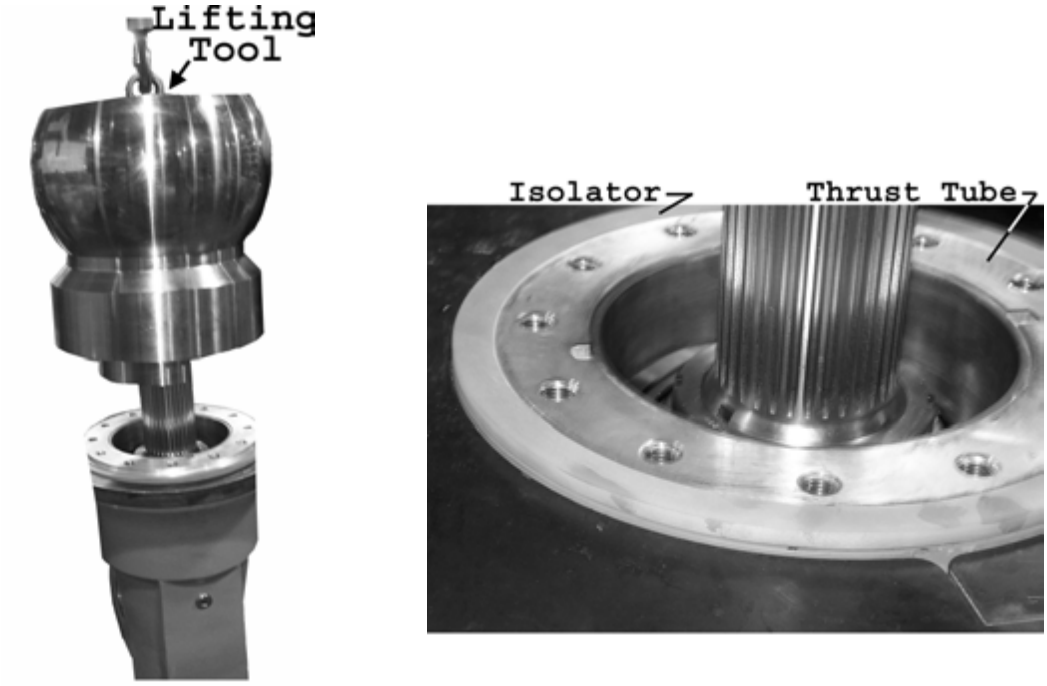


Figure 40. Raise the Ball from the Thrust Tube, Remove O-rings, Shims and Isolator

7. Place the ball aside and inspect for scratches, dents or rough edges. Smooth the ball surface with a fine emery cloth or similar material. Do not create flat spots on the ball's outside surface. Protect the ball surface from scratches and dents.

8. Remove the isolator and o-ring from the face of the thrust tube housing. Check inside of the housing for the remaining shims located against the thrust bearings. If the original bearings will be used in reassembly, save the shims. If the original bearings will **not** be used in the reassembly, a new shim pack will be developed during reassembly.

9. Install a M12 x 1.75 eyebolt into the tapped hole on the forward end of the propeller shaft. Attach a hoist to the threaded eye bolt, and lift the propeller shaft from the thrust tube. It may be necessary to tap the end of the shaft while lifting to remove the upper bearing cup. Use care to avoid damage to the bearings and seal sleeve. Support the shaft on wooden blocks.

⚠ CAUTION

Do not strike the end of the propeller shaft without a wood block or other suitable protection against the shaft. Failure to protect the shaft can cause damage.

Figure 41. Install Eyebolt Into Shaft, Raise Shaft Assembly Out of Thrust Tube

10. Remove the front inner bearing cup from the thrust tube. **Use caution if using heat on the housing. This could damage the painted finish.** Mark the angular location of the bearing sleeve in the thrust tube. If the bearing sleeve is removed from the thrust tube, it must be reinstalled in the same angular location in the thrust tube. Insert a long rod or drift into the rear of the thrust tube. Tap the rod evenly around the cup with a mallet until the cup is free. Discard the bearing cup.

11. Flush the thrust tube using clean solvent to remove any dirt or other materials trapped inside. All components, such as shafts, retainer rings, etc., should also be cleaned prior to reassembly. See Cleaning and Inspection.

Prop Shaft Disassembly

1. On the forward end of the prop shaft, remove the lock nut that holds the inner and outer taper bearings in place. The lock nut is retained by a lock washer with a fold-over tab. The tab must be bent away from the lock nut. Turn the lock nut counterclockwise for removal. Use a hammer and punch or a spanner wrench to loosen the lock nut.

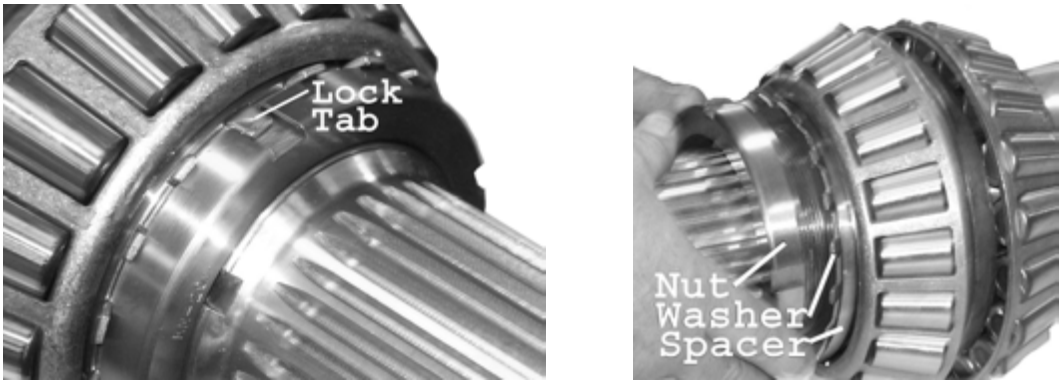


Figure 42. Bend Lock Tab Up, Remove Nut, Washer, and Spacer

2. Remove the lock washer and spacer. Discard the lock washer.

3. The tapered bearings can be removed with heat or by cutting the bearings off the shaft.

⚠ CAUTION

Use extreme caution when cutting bearings away from the shaft. Do not cut or scratch the shaft. Damage to the shaft will cause the loss of press fit on the races, bearings or seal surfaces and will weaken the shaft.

A. **To Remove Bearings with Heat:** To remove the bearings with heat, first break the bearing cages with a chisel and remove it with the tapered rollers. Stand the shaft vertically with the propeller end up and quickly heat the inner races with an acetylene torch until the races drop off.

B. **To Remove Bearings by Cutting:** To cut bearings off, use a cutoff wheel with a carbide or composition wheel. Cut through the bearing cages. Remove the cages and the tapered rollers. Cut a groove in the inner race that is approximately half way through the race. Split the race with a chisel and slide the race off the shaft.

Figure 43. Use Chisel to Cut Bearing Cage to Remove Rollers

4. On the propeller end of the shaft, remove the seal sleeve, bearing, and spacer by using a split bearing puller to pull on the spacer.

5. Clean and inspect the shaft for damage on critical dimension surfaces. See Cleaning and Inspection.

Thrust Socket Disassembly

1. **Preparation:** Before disassembly, the thrust socket, it must be removed from the transom, and it must be separated from the thrust ball assembly.

2. Place the socket on a bench with the large diameter end facing up. Remove the packing shims, o-ring and packing from inside the socket housing.

3. The forward retainer is a slip fit and should slide out of the socket with little effort. Remove the forward retainer.

Figure 44. Remove Packing and O-ring, Remove Retainer

4. Remove the aft tapered bearing sleeve bolts that are located inside the socket.

5. Use a hoist to lift the input shaft assembly, which consists of the U-joint, input shaft, bearings and sleeve, from the socket housing. Place the input shaft assembly aside for disassembly later.

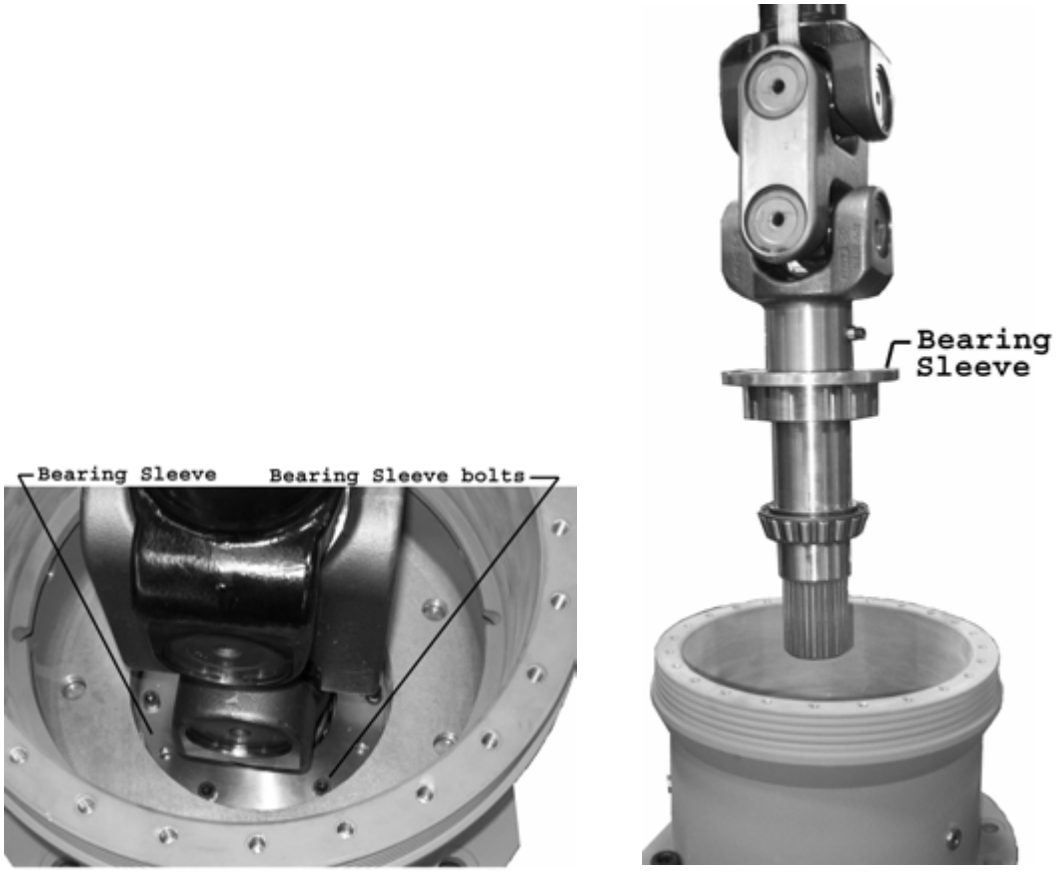


Figure 45. Remove Bearing Sleeve Bolts, Lift Input Shaft Assembly Out of Housing

6. Remove the bearing sleeve shims from the socket housing. Shims may sometimes stick to the bearing sleeve during its removal.

7. Remove the front bearing cup from inside the socket housing. The bearing cup is a slip fit and should slide out of the housing with little effort. If necessary, tap lightly against the bearing lip to assist in removal. Do not damage the bearing because it may be reused if there is no damage or excessive wear.

8. Turn the socket housing over so that the input-end is facing up. Remove the seal retaining ring from inside the small diameter end of the socket.

9. Drive the seals out and discard. Replace all seals and o-rings.

Figure 46. Housing with Seals and Snap Ring Removed Both ends shown

10. **Inspection:** Flush the thrust socket housing and components with clean solvent to remove all chips or debris. Visually inspect all parts for damage or dirt. Inspect all seal or bearing surfaces for wear or damage. The forward retainer should be free from any rough edges or burrs. Smooth any rough areas with 400 grit or finer emery cloth. See Cleaning and Inspection .

Note: The forward and aft edges of the forward retainer are manufactured with as sharp an edge as practical to assist in excluding dirt and debris from the spherical bearing surface. Protect these edges from even the slightest dent or scratch. Accidental damage to these edges must be smoothed by hand-working with a machinist's scraping tool, files, and emery cloth. Restore the spherical surface if it is locally deformed.

U-joint / Input Shaft Disassembly

1. Once the input shaft with the universal-joint is removed from the socket housing, separate the u-joint from the shaft. Stand and support the shaft with the input end down. Support the u-joint with the hoist. Remove the bolts and collars holding the U-joint to the input shaft. Raise the u-joint assembly off the input shaft. Another technique is to clamp the U-joint's H-shaped center coupling in a vise. The U-joint should be positioned so it looks like an H on its side with the bottom leg of the H in a vise.

2. Slide the shaft out of the splines of the yoke taking care that the loose bearing sleeve is restrained to prevent damage.

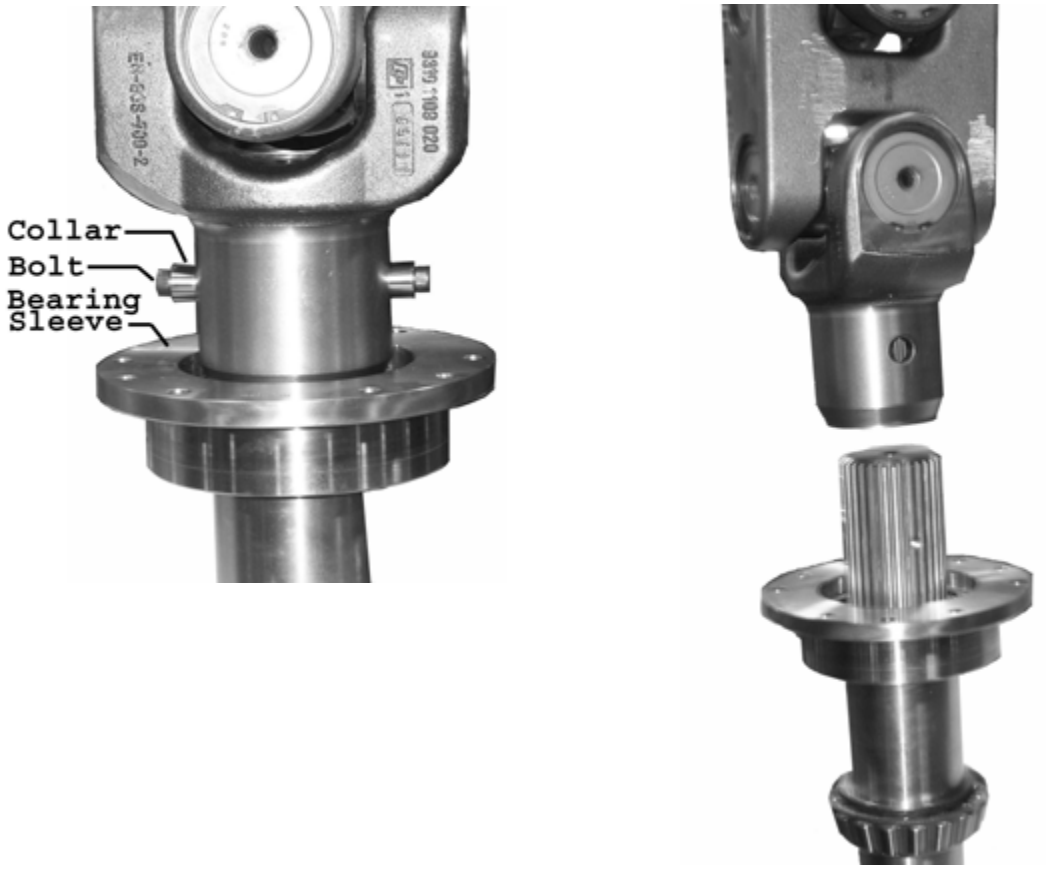


Figure 47. Stand Shaft Assembly and Support, Remove Bolts, Raise U-joint

3. Remove the bearing cup from the bearing sleeve. The bearing cup is a light press fit in the sleeve and should slide out of the sleeve with little effort. If necessary, tap against the bearing lip to assist in removal, or apply even heating to the sleeve outer diameter.

Figure 48. Remove Bearing Cup from the Bearing Sleeve

4. Remove the rear input bearing from the input shaft using a split type bearing puller. If necessary, see Propeller Shaft Disassembly for removal by heat.

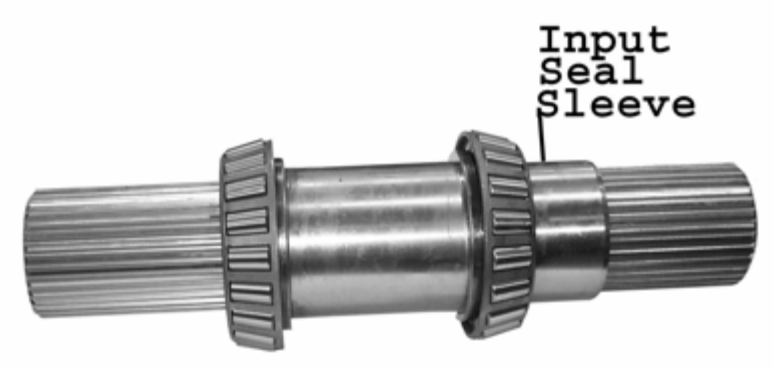


Figure 49. Input Shaft with Bearings and Seal Wear Sleeve

5. Stand the input shaft on the bench, with the forward end down on the bench. Remove the seal wear sleeve. It may be necessary to use an acetylene or butane torch to quickly heat the sleeve.

6. Remove the forward bearing from the input shaft using a split type bearing puller. (The cutting method can be used here if desired.)

7. **Clean and Inspect:** Clean all parts and inspect for damage. Examine the seal sleeve for scratches on the seal surfaces and clean the area with a 400 grit or finer emery cloth. Inspect the yoke splines for burrs and remove if present. See Cleaning and Inspection.

⚠ CAUTION

Use extreme caution when removing rough edges or burrs from critical shaft surfaces. Removing excess material will cause the loss of press on races, bearings or seal surfaces.

If the U-joint requires further disassembly, Twin Disc recommends that the work be performed by qualified personnel familiar with U-joint disassembly and assembly.

For service on universal joints, Twin Disc recommends the following:

- ❑ Driveline specialty shop
- ❑ Authorized Twin Disc / Arneson repair facility
- ❑ Twin Disc, Incorporated factory

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings, packing, retaining (snap) rings, etc., as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must he dried and oiled immediately. Bearings should not be exposed to moisture.

Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.

Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.

Use clean solvent to flush oil pumps, valves, etc.

Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.

De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

Do not remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

⚠ CAUTION

Never dry bearings with compressed air. Do not spin non-lubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

Scrape surfaces to remove old gasket material on previously sealed joints. Wipe off cured sealant with gel-type paint remover containing methylene chloride. Do not get paint or gasket remover on painted surfaces.

Clean surfaces with denatured alcohol or clean solvent to remove oil and grease residue.

Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

Replace cast parts or housings that are cracked.

Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding. This will cause loss of press of bearings or races.

Inspect oil and grease passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.

Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.

Inspect threaded openings for damaged threads. Chase all threads with a thread chaser of the correct size to remove old loctite material.

Inspect studs for damaged threads and looseness. Replace defective studs.

Inspect dowel pins for wear or damage. Replace defective dowels. This applies where a matched set of parts is not involved.

Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Bearings

Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.

Inspect bearings for corrosion, and for indication of wear of balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. Replace the bearing if you find one of these defects, .

Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings and sleeves for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing or sleeve is out-of-round, deeply scored, or excessively worn, replace it. If there is any question, replace.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Assembly

Assembly Overview

See Special Tools for detailed tool drawings. References to special tool numbers are made when required.

See Engineering Drawings for the location and description of the referenced components.

Refer to Description and Specifications, Troubleshooting, and Preventative Maintenance, for all lubrication specifications.

Propeller Shaft Assembly

Note: Heat/Shrink Assembly Methods: When using heat/ shrink methods of assembly, components should be installed by hand. Occasionally, when performing this procedure, a race or bearing may become misaligned in a housing, or on a shaft, and will not slide properly into place. Always have standby tools, such as a drift and plastic mallet, available to tap components into place. Use light taps only when trying to realign a component.

1. Heat the following parts to 250˚F (121˚C):

   - ❑ Two (2) tapered roller bearings
   - ❑ One (1) spherical roller bearing
   - ❑ One (1) seal sleeve with two o rings in place in the inner diameter

2. Support the shaft in a horizontal position on blocks allowing enough radial clearance for installation of the bearings. Apply a thin coat of **"Molykote P37 Ultra Pure High Temperature Paste"** to the shaft on the surfaces where the bearings will seat as an anti-seize compound.

Application Instructions

Apply a thin even coating of paste onto component surfaces. Rub thoroughly into surfaces with a clean lint free cloth, leaving a coating depth less than 0.003 mm (0.0001 in). Excessive coating depth will result in sleeve and bearing distortion and may prevent bearing assembly and reduce bearing life.

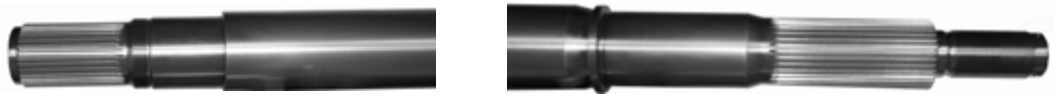


Figure 50. Propeller Shaft (left), and Engine End, Propeller End (right)

3. Install a heated tapered roller bearing on the forward (universal joint) end of the shaft with the smaller diameter end toward the propeller end of the shaft, and seated against the shoulder. Install the second tapered roller bearing with the large diameter end against the large diameter end of the first one. Be sure to maintain pressure on the bearings as they cool until they take hold.

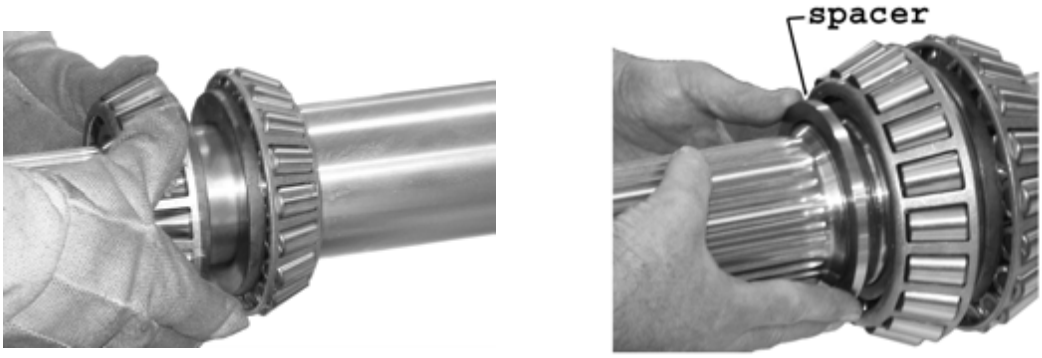


Figure 51. Install Bearings (left), Followed by the Spacer (right)

4. Install the spacer, followed by the washer with the tabs pointing toward the threaded portion of the shaft. Install the nut with the slanted end toward the washer. If a proper spanner is not available, tighten the threaded lock nut by placing a drift in the lock nut notch and tapping the drift with a mallet. Torque the lock nut to at least 100 ft-lbs (136 N-m) to firmly seat the bearings against the shaft shoulder. Secure the lock nut by bending a locking tab on the lock washer into the aligning slot on the lock nut.

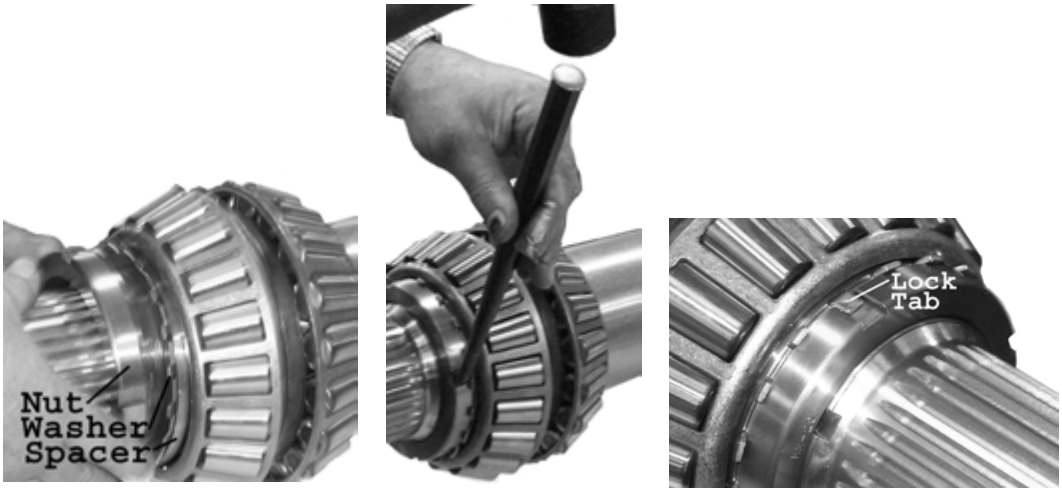


Figure 52. Install Washer and Locking Nut (left), Tighten Nut (center), and Bend Tab Into Slot (right)

5. Install the bearing spacer onto the propeller end of the shaft with the larger opening over the shoulder on the shaft. Install the heated spherical bearing onto the shaft against the spacer.

Figure 53. Place Spacer Over Shaft (left), Place Spacer Over Shoulder (center), and Install Spherical Bearing (right)

6. Confirm that the two o-rings are in the grooves in the inside diameter of the seal sleeve. Install the heated seal sleeve onto the propeller shaft. Use special tool T18050-777 to seat the sleeve against the spherical bearing. As the sleeve cools, re-seat the sleeve making sure it remains tight against the bearing.

Figure 54. O-rings Shown In Sleeve (left), and Place the Sleeve Onto the Shaft (right)

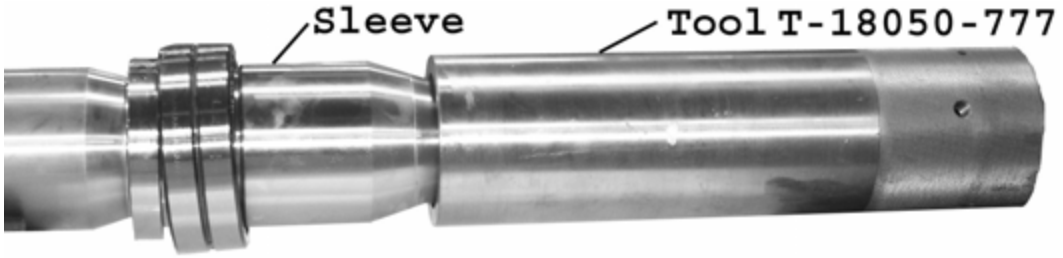


Figure 55. Use Special Tool T-18050-777 to Seat the Sleeve Against the Bearing

⚠ CAUTION

Do not allow dust or debris to settle on bearings or components. Failure to keep components clean will result in damaged parts.

7. Lubricate the bearings, and set this assembly aside. Cover and protect the bearings and splines. Do not allow dust or debris to settle on bearings or components.

Thrust Tube Assembly

1. Stand the thrust tube housing in the vertical position with the large diameter end up, and with at least 534 mm (21 in) of clearance below the bottom of the end of the housing. A roll-over stand over a pit works very well if available. See special tool T-21089-5D in Special Tools.

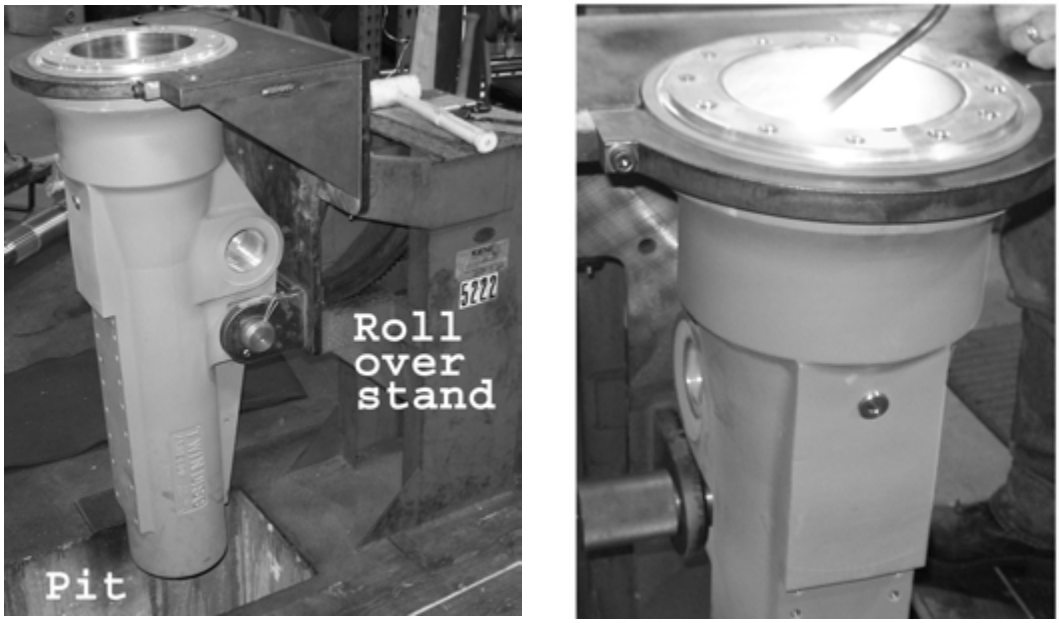


Figure 56. Thrust Tube Housing In Stand (left), and Heat Housing in Bearing Area (right)

2. Freeze the two bearing cups to a temperature of -20˚F (-29˚C):

3. Install the chilled rear bearing cup into the thrust tube. Ensure that the bearing cup seats against the shoulder in the thrust tube.

4. Thread a M12 x 1.75 swivel eyebolt into the tapped hole on the forward end of the propeller shaft. Attach a hoist to the eyebolt. Lubricate the bearings and the races on the propeller shaft with 10 wt or 30 wt oil.

Figure 57. Place Chilled Bearing Cup in Bore (left), and Install Eye Bolt Into Prop Shaft (right)

5. Install the assembled propeller shaft into the thrust tube by inserting the shaft (rear end first) into the forward end of the thrust tube. Take care not to damage the bearings or races while inserting the shaft into the housing. Seat the shaft firmly in the thrust tube.

Figure 58. Lower the Prop Shaft Assembly (left), and Seat the Shaft In the Bearing Race (right)

6. Install the frozen front bearing cup into the thrust tube, and raise the shaft approximately 0.030 inch to ensure that there will be end play in the bearing set. Keep the shaft raised until the rear bearing race stays in place when the shaft is lowered.

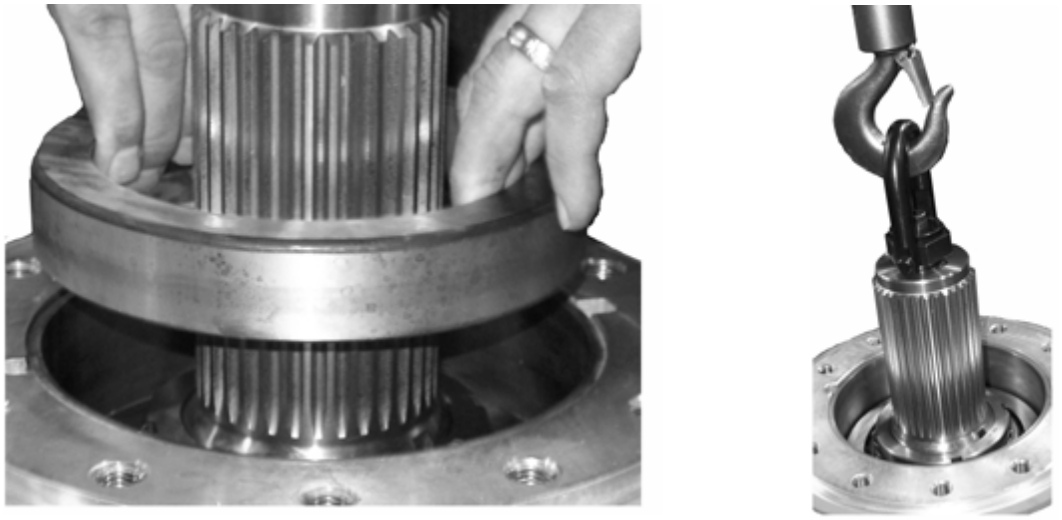


Figure 59. Install the Chilled Rear Bearing Cup (left), and Raise the Shaft to Ensure End Play (right)

7. Install the thrust ball onto the thrust tube. Secure the thrust ball using four M16-2.0 x 50 socket head capscrews, evenly spaced. Torque the capscrews to 170 N-m (125 ft-lbs).

8. Turn the thrust tube assembly over so that the output end is facing up. Install a dial indicator using special tool T-21549-28 onto the prop shaft.

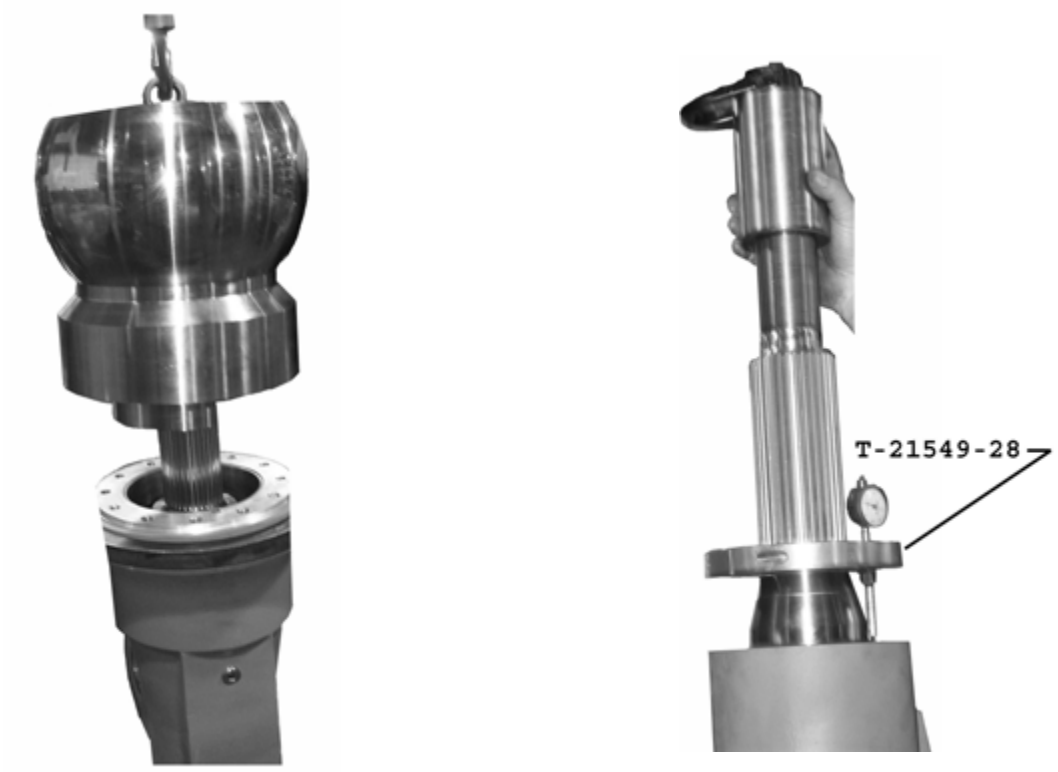


Figure 60. Lower Ball, Secure with Four Capscrews (left), and Turn Over and Install Dial Indicator T-21549-28 (right)

9. Use a hoist and special tool T-21567 to lift up on the prop shaft with a force of approximately 300 lbs. Rotate the shaft several turns and zero the dial indicator. Mark the angular location of the indicator stem on the housing. Lower the prop shaft , rotate several turns, stopping on the mark, and read the indicator. The clearance must be .002 in. to .005 in. (0.51 mm to 0.127 mm). If the indicated reading is out of tolerance, turn the thrust tube over so that the forward end of the tube is facing up. Remove the thrust ball and add the required amount of shims to the top of the front bearing cup to reduce the bearing clearance into tolerance.

10. Repeat Step 9 until the bearing clearance is in tolerance. The correct bearing end play is extremely important to the proper operation of the surface drive.

11. Once the proper bearing end play is verified, turn the thrust tube with the thrust ball up, and remove the thrust ball. Grease the two o-rings with water-resistant lithium grease and install one in the groove located to the outside of the bolt holes on the face of the thrust tube housing and the other in the groove in the thrust ball. Install the isolator onto the thrust tube. The grease must hold the o-ring in place during assembly. Place the isolator on the thrust tube over the o-ring.

12. Clean the threaded holes with denatured alcohol to prepare for Loctite 242 blue or similar liquid thread locker. Lower the thrust ball onto the thrust tube, taking care that the o-rings and isolator remain in the proper location. The fill/vent plug in the thrust ball must be located at the top of the thrust tube. This is opposite the fin mounting surface.

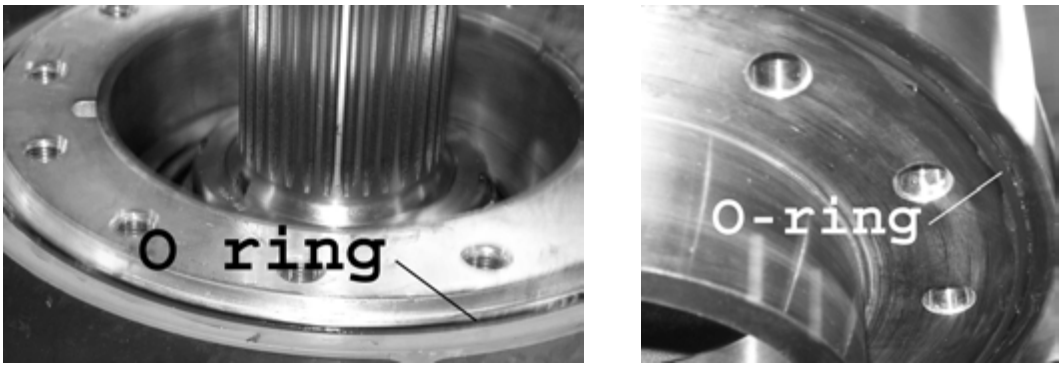


Figure 61. O-ring On Thrust Tube (left), and Use Grease to Hold O-ring in Thrust Ball Groove (right)

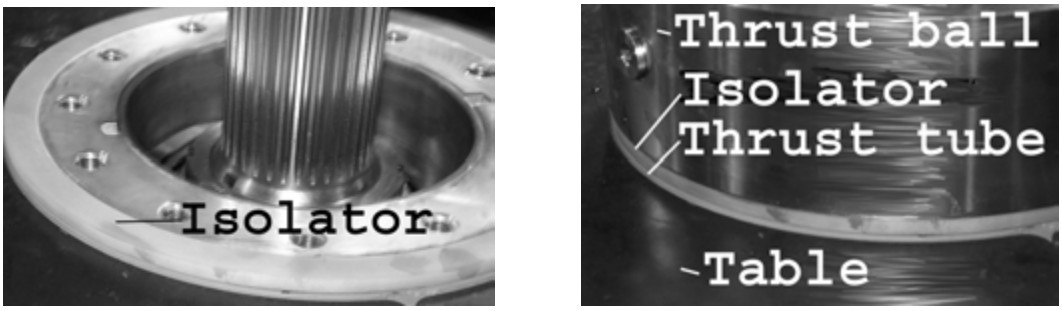


Figure 62. Place Isolator Over Thrust Tube (left), and Lower Thrust Ball Onto Thrust Tube (right)

13. Coat the clean capscrew threads with Loctite 242 blue or similar liquid thread locker and install the twelve M16-2.0 x 50 socket head capscrews. Torque the capscrews to 170 N-m (125 ft-lbs).

Figure 63. Install Capscrews to Secure Ball to Thrust Tube

14. Turn the thrust tube over so that the rear end is facing up.

15. Place the seal cover (rope guard) with the opening facing up. Use special tool T-18050-780 to press a seal into the rear seal cover with the lip opening (rear) down toward the rear of the cover. Install the spacer, followed by another seal with the lip opening (rear) down toward the rear of the cover. Install the third seal with the lip opening facing up, followed by the snap ring. Install two o-rings in the two outer grooves of the cover.

Note: The center groove is a passage for grease.

Figure 64. Seal Orientation - Press First Seal In Followed by the Spacer

Figure 65. Install Second Seal, Third Seal, Snap Ring, O-rings, and Coat with Grease

16. Install the seal cover assembly onto the rear of the thrust tube housing. Note that the notches in the seal cover must align with the roll pins in the thrust tube. Clean the threaded holes with denatured alcohol to prepare for Loctite 242 blue or similar liquid thread locker. Coat the clean capscrew threads with Loctite 242 blue or similar liquid thread locker and install eight M6-1.0 x 16 socket head capscrews. Torque the capscrews to 4.0 N-m (3 ft-lbs).

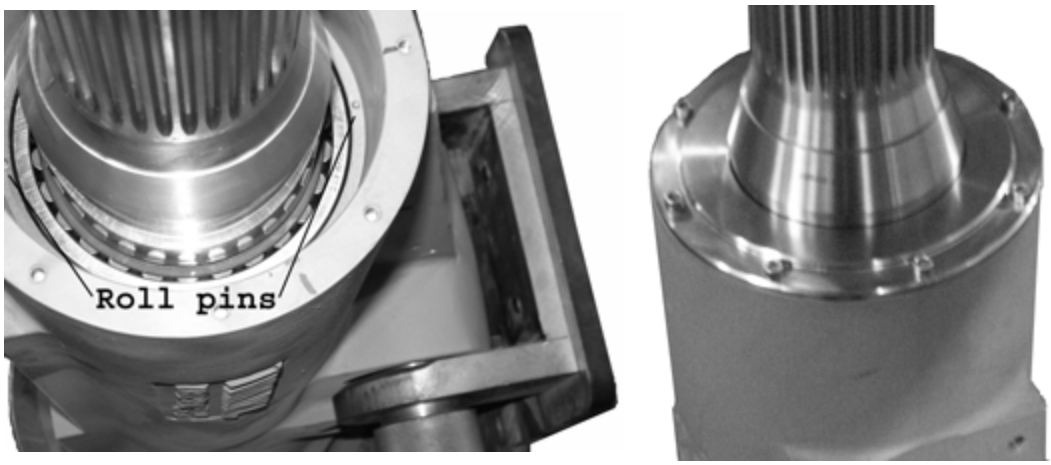


Figure 66. Match Notches in Seal Cover with Roll Pins (left), and Install Seal Carrier (right)

17. Spin the propeller shaft by hand to assure smooth operation. The shaft should spin smoothly. There should be sufficient drag caused by the three lip seals.

Thrust (Input) Shaft and Socket Assembly

1. Heat the two (2) tapered roller bearings and the input shaft (socket end) seal wear sleeve to 250˚ F (121˚ C).

2. Freeze the two (2) bearing cups to -20˚ F (-29˚ C).

3. Assemble the previously heated tapered roller bearing cones onto each end of the input shaft with the smaller diameter of the bearings toward the spline ends of the shaft. Be sure to seat the bearings against the shoulder of the shaft as they cool. Install the input shaft seal wear sleeve on the input shaft against the bearing on the end that has three axial holes . Do not install it on the end with the threaded radial holes in the spline. Clean the threaded holes that are cross drilled in the output end spline with denatured alcohol to prepare for Loctite 242 blue or similar liquid thread locker.

4. Install one of the chilled bearing cup into the bearing sleeve with the thick end of the cup toward the bottom (flange end) of the sleeve.

Figure 67. Install Bearings and Seal Sleeve (left), and Install Cup Into Sleeve (right)

5. Stand the input shaft in the vertical position with the output (universal joint) end up. This can be identified as the spline that has a cross drilled and threaded hole through the shaft. Lubricate the bearing, and place the sleeve with the bearing cup over the output end of the input shaft.

6. Lower the U-joint assembly over the spline, aligning the cross drilled holes in the shaft and u-joint yoke.

7. Coat the two clean M10-1.5 x 40 socket head capscrews threads with Loctite 242 blue or similar liquid thread locker and insert the capscrew through the collar. Install the capscrew and collar through the holes in the u-joint and into the threaded holes in the shaft. Note that the holes in the shaft and the u-joint are not perfectly aligned so that the tapered collar will draw and hold the u-joint yoke against the bearing.

   Note: Care must be taken when assembling the collar and screw into the yoke and shaft to prevent the collar from catching its lower edge on the edge of the hole. Begin by sliding the collar over the screw and into contact with the screw head. The large end of the collar must face the screw head.

   A. Continue to hold the collar against the screw head, thread the screw into the shaft about two turns. The collar should not yet be in the hold. Next, slide the collar into the tapered yoke hole, ensuring that the collar enters the hole without catching its edge on the edge of the hole. It should be possible to tilt the screw slightly to the side to allow the collar to enter the tapered hole.

   B. Once the collar is started into the yoke, advance the screw until it contacts the collar, and then torque the screw to the final torque value.

   C. Tighten the two capscrews evenly until the distance from the top of the collar to the yoke surface measures 2.2 mm (0.087 in). Do not exceed a torque of 42 N-m (30 ft-lbs) on the capscrews.

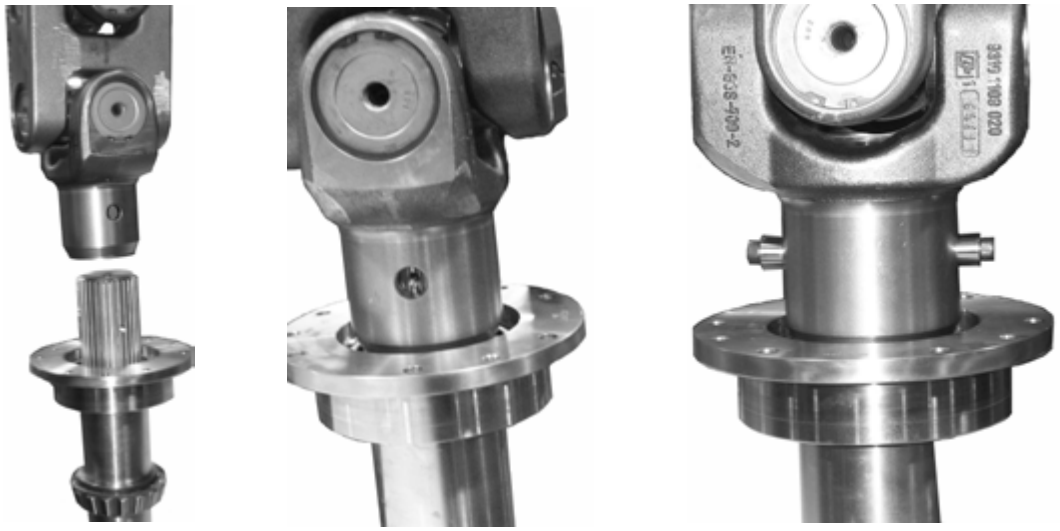


Figure 68. Lower U-joint Onto Spline (left), Align the Hole with the Threads (center), and Install Collars (right)

8. Support the socket housing with the large opening facing up. If necessary, heat the outside of the socket (small diameter end) section with a butane or propane torch to assist in the installation of the forward bearing cup. Do not allow the temperature of the housing to exceed 200˚F (93.3˚C). Install the chilled bearing cup into the housing with the thin end up.

9. Insert two guide screws (M10-1.5) into two of the threaded holes that will be used to align the bearing sleeve and its shims. Place approximately 1.3 mm (.050 in.) thickness of bearing shims into the thrust socket. This ensures that initially there will be end play on the bearing set.

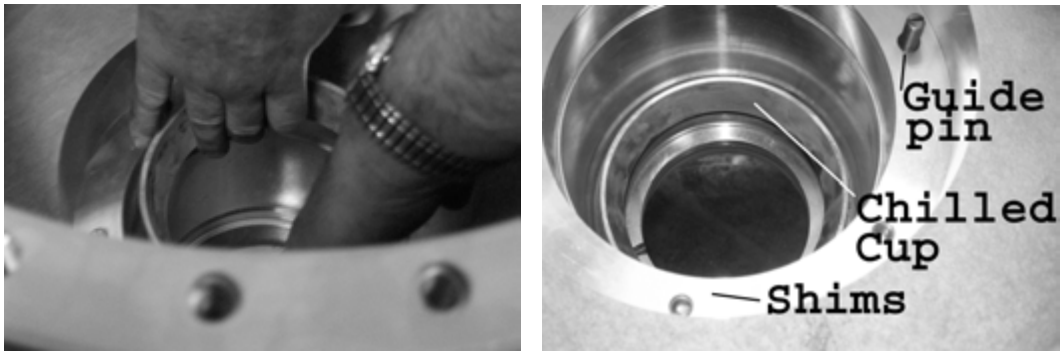


Figure 69. Install Chilled Bearing Cup (left), and Insert Guide Pins and Starting Shim Pack (right)

10. Use a hoist to suspend the input shaft and U-joint assembly above the socket. Lubricate the bearings with oil. Lower the assembly into the thrust socket until seated in the forward tapered roller bearing cup.

Figure 70. Lubricate Bearing and Lower the Input Shaft Assembly Into Housing

11. Install four M10-1.5 x 30 socket head capscrews to retain the bearing sleeve. Torque to 55 N-m (40 ft-lbs).

12. Turn the thrust socket over so that the input end (small diameter end) is facing up, and attach a dial indicator and special tool T-21549-28 to the forward end of the input shaft.

13. Install a swivel eyebolt into the input end of the shaft. Rotate the shaft several turns, and zero the indicator. Mark the angular location of the indicator stem on the socket. Use a hoist to lift on the input end of the shaft, rotate several turns while lifting, stop with the indicator stem on the mark, and note the end play reading on the indicator. The indicated end play should be larger than 0.05 mm (0.002 in). The desired final end play is 0.05 mm to 0.127 mm (.002 in. to .005 in). Turn the assembly over with the large end up.

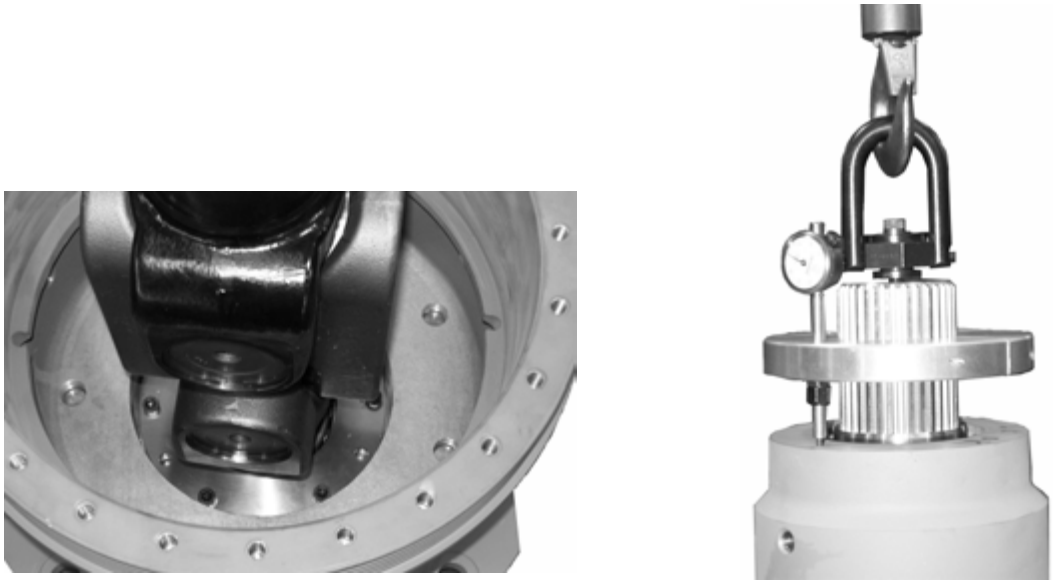


Figure 71. Install Four Capscrews to Retain Sleeve (left), and Turn Over and Measure End Play (right)

14. Remove or add shims between the housing and the bearing sleeve to adjust the bearing clearance, and repeat steps 12 through 14 until the shaft end play is within tolerance. Shims must be removed (not added) to reduce end play.

15. Remove the guide studs, and install the remaining M10-1.5 x 30 socket head capscrews and torque to 55 N-m (40 ft-lbs). Rotate the shaft by hand to assure smooth operation and recheck the final end play.

16. Turn the assembly over with the input shaft up. Lubricate the seal surfaces, and use special tool T-18050-781 to press the seals back-to-back into the seal carrier. The opening of the first seal installed should be down toward the housing, and the opening of the second seal should be outward and away from the housing. Install the retaining (snap) ring.

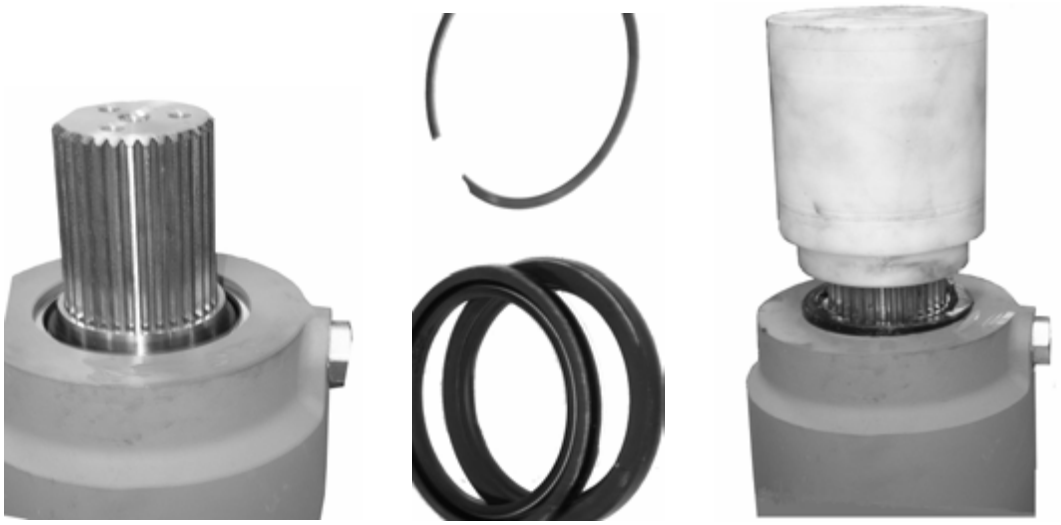


Figure 72. Place Input Up with Seals and Snap Ring (left and center), and Install Seals and Snap Ring (right)

Assembly of Thrust Tube and Ball Into Thrust Socket

Note: If the Thrust Socket was left attached to the transom of the vessel, please see the section following this one for complete instructions and assembly procedures.

Assembly with the Socket Removed from the Transom

1. Support the socket assembly securely with the larger diameter end facing up. Coat the U-joint yoke splines with gear oil to assist in the installation of the yoke onto the propeller shaft.

2. Place the forward retainer into the socket housing. Make sure that the anti-rotation pins are aligned with the notches in the socket housing and that the retainer is seated firmly against the shoulder in the socket. Be sure to carefully inspect the retainer for damage prior to installing it.

   Note: The forward and aft edges of the forward retainer are manufactured with as sharp an edge as practical to assist in excluding dirt and debris from the spherical bearing surface. Protect these edges from even the slightest dent or scratch. Accidental damage to these edges must be smoothed by hand-working with a machinist's scraping tool, files, and emery cloth. Restore the spherical surface if it is locally deformed.

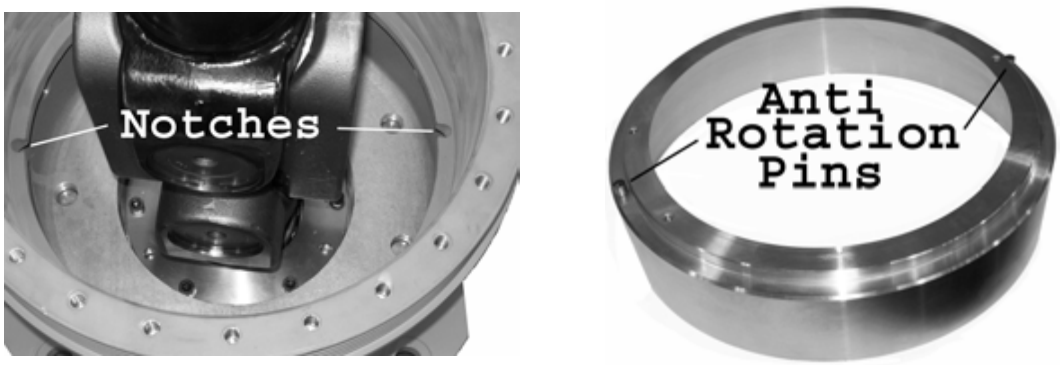


Figure 73. Notches In the Socket (left), and Anti Rotation Pins In the Retainer (right)

3. Install the first packing on top of the retainer, working it smoothly into place. If bulk packing is used, cut two pieces 1258 mm (49.53 in) with the ends cut at a 45 degree angle. The split line should be at either the 10:00 o'clock or the 2:00 o'clock position, using the flat on the socket housing's external mounting flange as the 6:00 o'clock position. Place an o-ring over the packing.

4. Install the second packing on top of the o-ring, working it smoothly into place. This split line should be at either the 2:00 o'clock position or the 10:00 o'clock position that was not used for the first packing above. Shims will be added on top of the packing **after** the rear (output end) retainer is properly shimmed.

Figure 74. Install Packing (left), Followed by O-ring (center) , and Second Packing (right)

5. Place the rear (output end) retainer (wear sleeve) and approximately 5.08 mm (0.200 in) of the 399.50 mm (15.73 in) outer diameter by 366 mm (14.41 in) inner diameter shims over the thrust tube assembly. Place the cover over the thrust tube. Apply a light coat of grease on the entire surface of the thrust ball.

6. Place a swivel eyebolt and special tool T-21567 onto the output end of the propeller shaft. Lift the thrust tube assembly and position above the thrust socket. Make sure the u-joint spline is vertical. Ease the thrust tube into the socket making sure that the propeller shaft spline enters the spline of the u-joint. While lowering, align the flat on the socket with the flat bolting surface of the thrust tube.

7. Install the rear (output end) retainer (wear sleeve) into the socket.

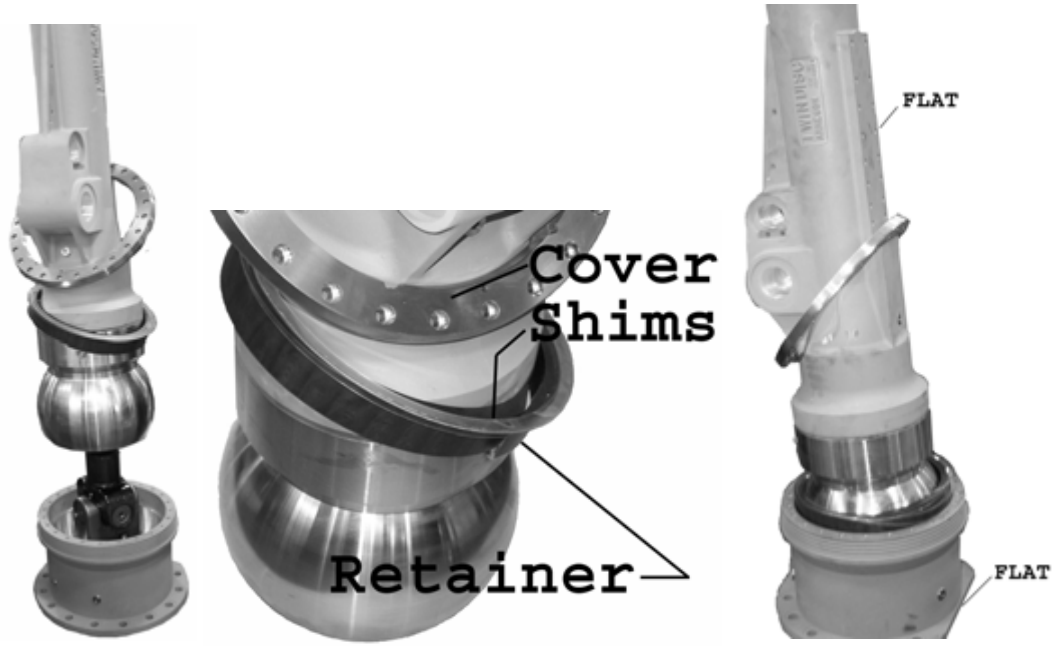


Figure 75. Insert Prop Shaft Into U-joint (left and center), and Align Flat (for fin) with Flat On Housing (right)

8. Place the shims on the top of the rear (output end) retainer (wear sleeve). The rear retainer (wear sleeve) will be deliberately over-shimmed.

9. Install the cover onto the socket assembly. There will be a gap between the socket housing and the cover.

10. Install every third M12-1.75 x 35 socket head capscrew, retaining the cover to the socket..

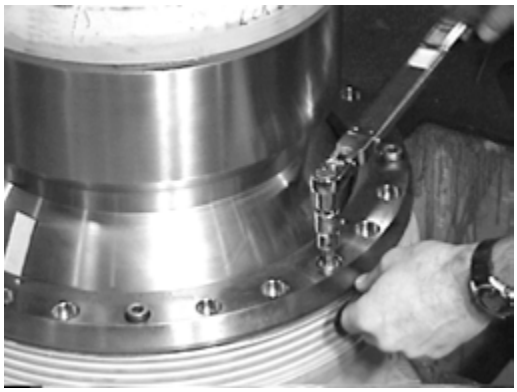


Figure 76. Place Shims On Retainer, Install Cover, and Tighten Screws Evenly

11. Evenly tighten the capscrews while using a feeler gauge to obtain zero gap between the thrust ball and the rear retainer (wear sleeve). Once a zero clearance is achieved, the thrust tube should be tilted left, right, forward and back (a resistance to movement will be felt) to fully seat the ball. The thrust tube assembly should remain attached to the overhead hoist during this procedure as a safety measure.

⚠ WARNING

Do not allow the thrust ball to pivot against the edge of the installed retainer cover. If the thrust tube drops against the socket, damage may occur.

12. Move the thrust tube back to the vertical position and recheck for clearance between the thrust ball and rear retainer (wear sleeve). Remove shims, if necessary, to obtain zero clearance between the thrust ball and the rear retainer (wear sleeve).

Figure 77. Use Feeler Gauge and Obtain Zero Clearance Between Ball and Retainer

13. When zero clearance is obtained, measure the gap between the socket housing and the cover. The distance measured is equal to the thickness of the shims that must be removed from between the rear (output end) retainer and the cover to maintain the desired zero clearance between the ball and rear retainer (wear sleeve).

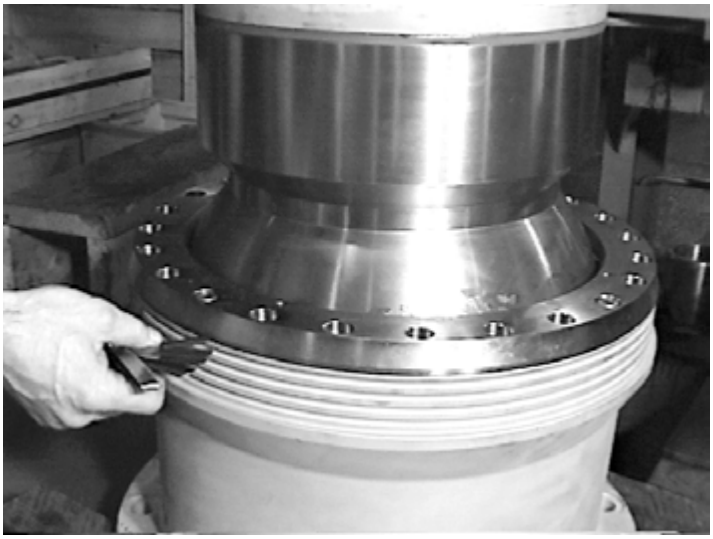


Figure 78. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing

14. Remove the cover and remove the amount of shims equivalent to or the next size larger than the gap measured.

Example

If the gap measured is .115 inches, remove .120 inch in shims. This creates a slightly tight fit between the rear retainer (wear sleeve) and the ball. The rear retainer (wear sleeve) has now been shimmed properly to the ball.

The thrust ball clearance shim pack developed in these preceding steps must be installed into position in the thrust socket while adjusting the previously installed packing and o-ring. No further adjustment of the thrust ball clearance shims will be required.

Note: The thrust ball is sealed to the thrust socket with the combination of two rope packings and an o-ring that were installed previously. To provide a tight seal, the packing and o-ring must be compressed by the rear retainer (wear sleeve) 1.25 mm ± .25 mm (0.050. ± .010 in.). The amount of compression is adjusted with packing shims. These packing shims measure 399.75 mm (15.74 in) outer diameter by 384.75 mm (15.15 in) inner diameter.

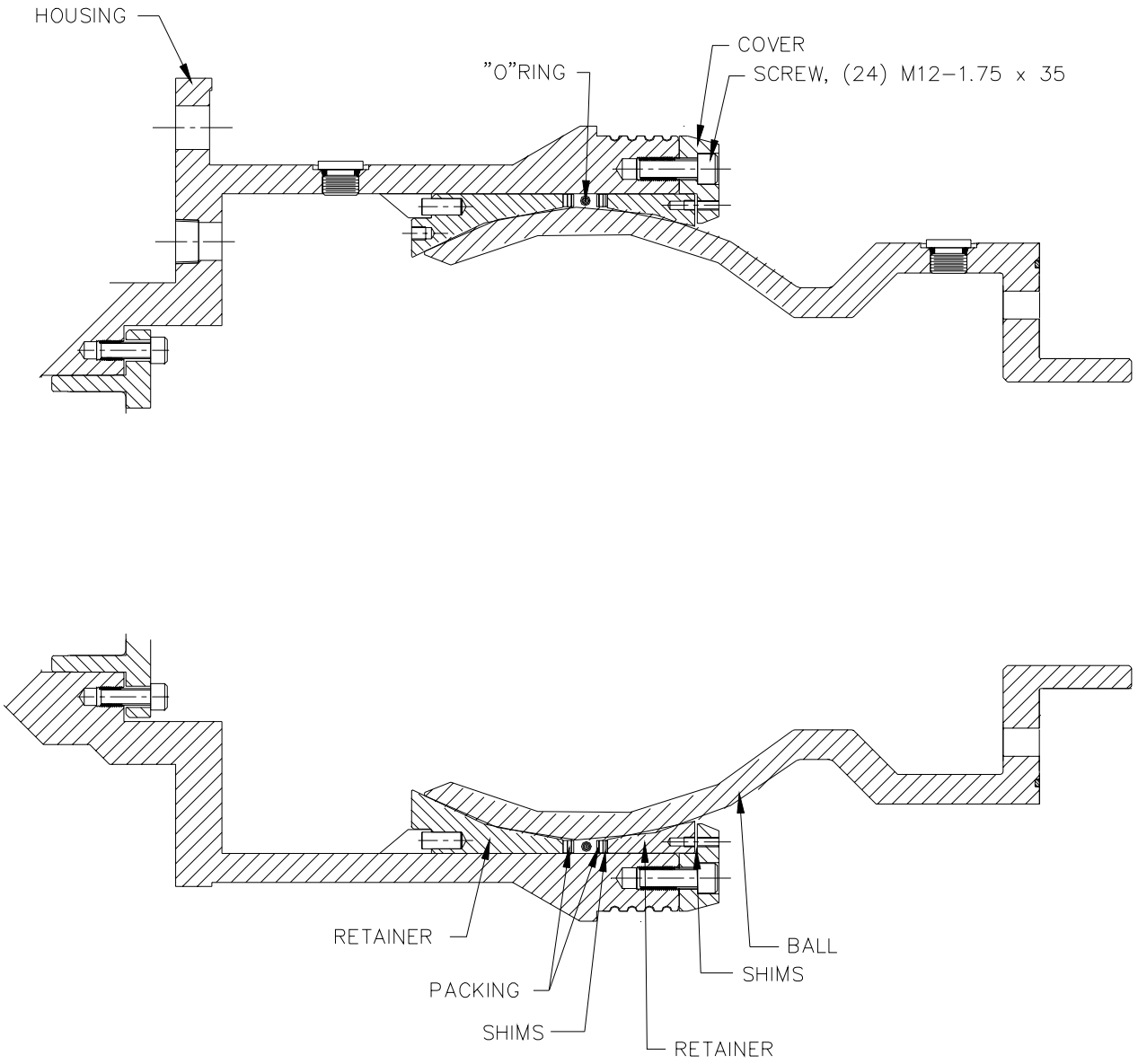


Figure 79. Ball and Socket Parts Identification

15. Raise the cover and the shim pack and hang them on the thrust tube. Remove the rear retainer (wear sleeve) and support it on the thrust tube.

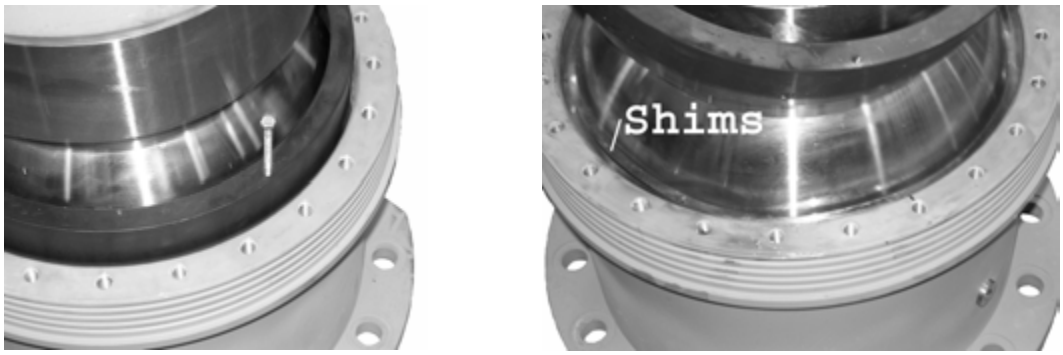


Figure 80. Remove the Retainer or *Wear Sleeve* (left), and Install Packing Shim Pack (right)

16. Install a shim pack of the packing shims measuring approximately 3.8 mm (0.150 in) in thickness. These are placed on top of the packing material. The packing will be deliberately over shimmed.

17. Install the rear retainer (wear sleeve) followed by the shim pack and cover. Install every third M12-1.75 x 35 socket head capscrew, retaining the cover to the socket. Evenly torque the screws to 34 N-m (25 lb-ft).

18. Measure the gap between the thrust socket housing and the cover in several positions around the diameter of the thrust socket. Average these measurements and label this average as **A** (tight retainer bolts). Note that if there is no gap, more shims will need to be added on the packing material.

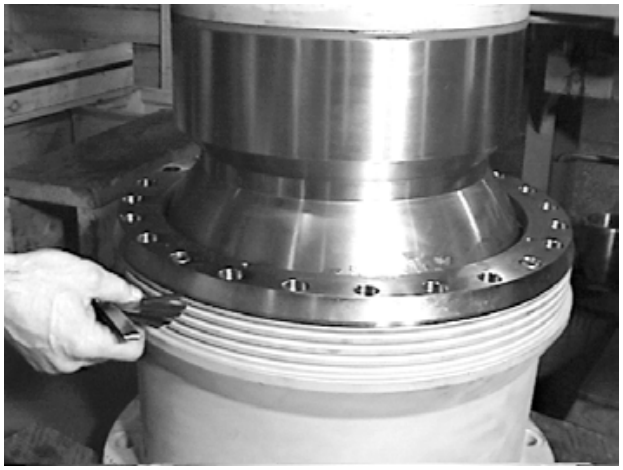


Figure 81. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing - Gap A

19. Loosen the cover retaining screws, and allow the packing and o-ring to relax.

20. Measure the gap between the thrust socket housing and the cover in several positions around the diameter of the thrust socket. Average these measurements and label this average as **B** (loose retainer bolts).

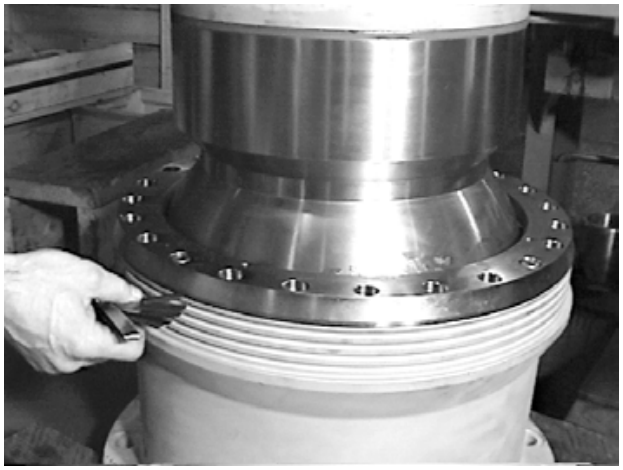


Figure 82. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing - Gap B

21. Subtract **A** (tight retainer bolts) from **B** (loose retainer bolts). Record the difference as **C** (actual compression). **C** represents the actual compression that results from the packing and o-ring being compressed with .150 in (3.81 mm) thickness of packing shims.

22. Subtract the specified amount of compression (1.25 mm ± .25 mm (0.050. ± .010 in.)) from **C** (the actual compression). Record this new calculation as **D** (excess compression).

23. Add **A** (tight retainer bolts) to **D** (excess compression). The sum is equal to the thickness of packing shims that must be removed in order to compress the packing and o-ring to the desired amount of 1.25 mm ± .25 mm (0.050. ± .010 in.).

	Calculation:	Example:
B	Loose retainer bolts	0.110 in (2.80 mm)
-A	Tight Retainer bolts	- 0.030 in (0.75 mm)
'C	Actual Compression	0.080 in (2.03 mm)
C	Actual Compression	0.080 in (2.03 mm)
-( )	Specified Compression	-0.050 in +/- 0.010 in (1.25 mm +/- 0.25 mm)
D	Excessive Compression	0.030 in +/- 0.010 in (0.75 mm +/- 0.25 mm)
A	Tight Retainer Bolts	0.030 in (0.75 mm)
+D	Excess Compression	0.030 in +/- 0.010 in (0.75 mm +/- 0.25 mm)
	Thickness of packing shims to remove	0.060 in +/- 0.010 in (1.50 mm +/- 0.25 mm)

Figure 83. Example of Packing Shim Calculation

24. Remove the cover, rear retainer (wear sleeve) shims, and rear retainer (wear sleeve). Remove the packing shims. Adjust the shim pack as calculated above, and reinstall shims over packing.

25. Install the rear retainer (wear sleeve), shims, and cover. Install 24 M12-1.75 x 35 socket head capscrews and torque to 60 N-m (40 lb-ft.)

Assembly with Socket Attached to Transom

Note: Inspect the packings and the o-ring for damage. Replace, the packing if there is any doubt as the packing and o-ring prevent water ingression into the socket of the surface drive. If replacement is not necessary, proceed to step # 4. If they are being replaced, remove the old packing and o-ring, discard, and clean and lubricate the socket and retainer.

Note: The forward and aft edges of the forward retainer are manufactured with as sharp an edge as practical to assist in excluding dirt and debris from the spherical bearing surface. Protect these edges from even the slightest dent or scratch. Accidental damage to these edges must be smoothed by hand-working with a machinist's scraping tool, files, and emery cloth. Restore the spherical surface if it is locally deformed.

1. Place the forward retainer into the socket housing. Make sure that the anti-rotation pins are aligned with the notches in the socket housing and that the retainer is seated firmly against the shoulder in the socket.

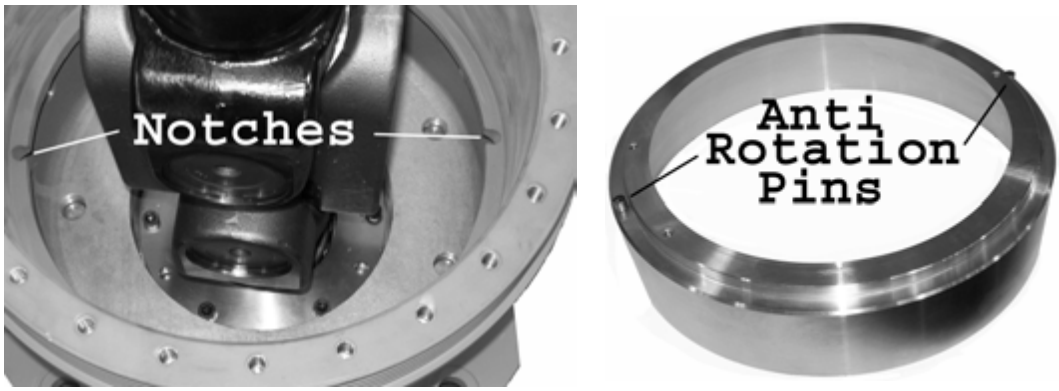


Figure 84. Notches In the Socket (left), and Anti-rotation Pins In the Retainer (right)

2. Install the first packing on top of the retainer, working it smoothly into place. If bulk packing is used, cut two pieces 1258 mm (49.53 in) with the ends cut at a 45 degree angle. The split line should be at either the 10:00 o'clock or the 2:00 o'clock position, using the flat on the socket housing's external mounting flange as the 6:00 o'clock position. Place an o-ring over the packing.

3. Install the second packing on top of the o-ring, working it smoothly into place. This split line should be at either the 2:00 o'clock position or the 10:00 o'clock position that was not used for the first packing above. Shims will be added on top of the packing **after** the rear (output end) retainer is properly shimmed.

Figure 85. Install Packing (left), Followed by O-ring (center), and Second Packing (right)

4. Support the thrust tube assembly in a horizontal position. Place the rear retainer (wear sleeve) and approximately 5.08 mm (0.200 in) of the 399.50 mm (15.73 in) outer diameter by 366 mm (14.41 in) inner diameter shims and the retainer cover (in that order) over the output end of the thrust tube assembly. Shift all of the components to a position just forward of the large two-holed boss on the thrust tube. Apply a light coat of grease to the entire surface of the thrust ball.

5. Coat the U-joint yoke splines with gear oil to assist in the installation of the yoke onto the prop shaft. Coat the retainer with a light coat of grease.

6. Remove four thrust socket-to-transom mounting bolts (two from each side of the thrust socket). Remove the bolts located nearest to the 3 o'clock and 9 o'clock positions.

7. Fabricate a jacking tool, special tool T-21570, as shown in Special Tools. This includes a left and right slide plate, rear support plate and two one inch diameter threaded rods.

8. Bolt the left and right side plate of the special tool to the socket flange and through the transom. The four socket mounting bolts previously removed may have to be replaced with longer bolts for this operation.

9. Suspend the thrust tube horizontally. Keep the output end of the shaft clear for later installation of the jacking tool. Using caution, insert the thrust tube into the socket. Make sure that the ball enters the socket evenly, that the U-joint engages smoothly, and that the packings, o-ring and shims remain in place.

Figure 86. Carefully Guide the Thrust Tube Assembly Into the Socket and U-joint

⚠ WARNING

Do not attempt to pull the thrust tube into the thrust socket using the retainer ring as damage to the ball or retainer ring may result.

10. Install the jacking tool's rear base plate and the threaded rods using two (2) 1 in. nuts to draw the thrust tube into the socket. Apply even pressure to both sides of the rear base plate.

11. Install the rear retainer (wear sleeve) into the socket.

Figure 87. Insert Prop Shaft Into U-joint, Align Flat (for fin) with Flat On Housing

12. Place the shims on the top of the rear retainer (wear sleeve). The rear retainer (wear sleeve) will be deliberately over-shimmed.

13. Install the cover onto the socket assembly. There will be a gap between the socket housing and the cover.

14. Install every third M12-1.75 x 35 socket head capscrew, retaining the cover to the socket.

Figure 88. Place Shims On Retainer, Install Cover, Tighten Screws Evenly

15. Evenly tighten the capscrews while using a feeler gauge to obtain zero gap between the thrust ball and the rear retainer (wear sleeve). Once a zero clearance is achieved, the thrust tube should be tilted left, right, forward, and back (a resistance to movement will be felt) to fully seat the ball. The thrust tube assembly should remain attached to the overhead hoist during this procedure as a safety measure.

⚠ WARNING

Do not allow the thrust ball to pivot against the edge of the installed retainer cover. If the thrust tube drops against the socket, damage may occur.

16. Move the thrust tube back to the horizontal position and recheck for clearance between the thrust ball and rear retainer (wear sleeve). Add or remove shims, as necessary, to obtain zero clearance between the thrust ball and the rear retainer (wear sleeve).

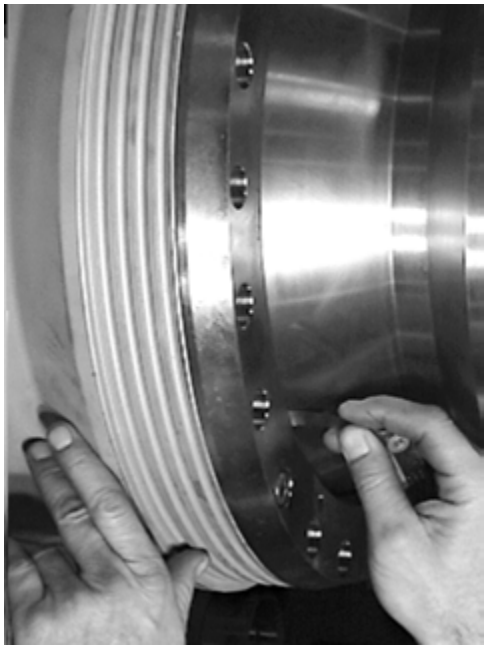


Figure 89. Use Feeler Gauge and Obtain Zero Clearance Between Ball and Retainer

17. When zero clearance is obtained, measure the gap between the socket housing and the cover. The distance measured is equal to the thickness of the shims that must be removed from between the rear retainer and the cover to maintain the desired zero clearance between the ball and rear retainer (wear sleeve).

Figure 90. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing

18. Remove the cover and remove the amount of shims equivalent to or the next size larger than the gap measured.

Example

If the gap measured is .115 inches, remove .120 inch in shims. This creates a slightly tight fit between the rear retainer (wear sleeve) and the ball. The rear retainer (wear sleeve) has now been shimmed properly to the ball.

The thrust ball clearance shim pack developed in these preceding steps must be installed into position in the thrust socket while adjusting the previously installed packing and o-ring. No further adjustment of the thrust ball clearance shims will be required.

Note: The thrust ball is sealed to the thrust socket with the combination of two rope packings and an o-ring that were installed previously. To provide a tight seal, the packing and o-ring must be compressed by the rear retainer (wear sleeve) 1.25 mm ± .25 mm (0.050. ± .010 in.). The amount of compression is adjusted with packing shims. These packing shims measure 399.75 mm (15.74 in) outer diameter by 384.75 mm (15.15 in) inner diameter.

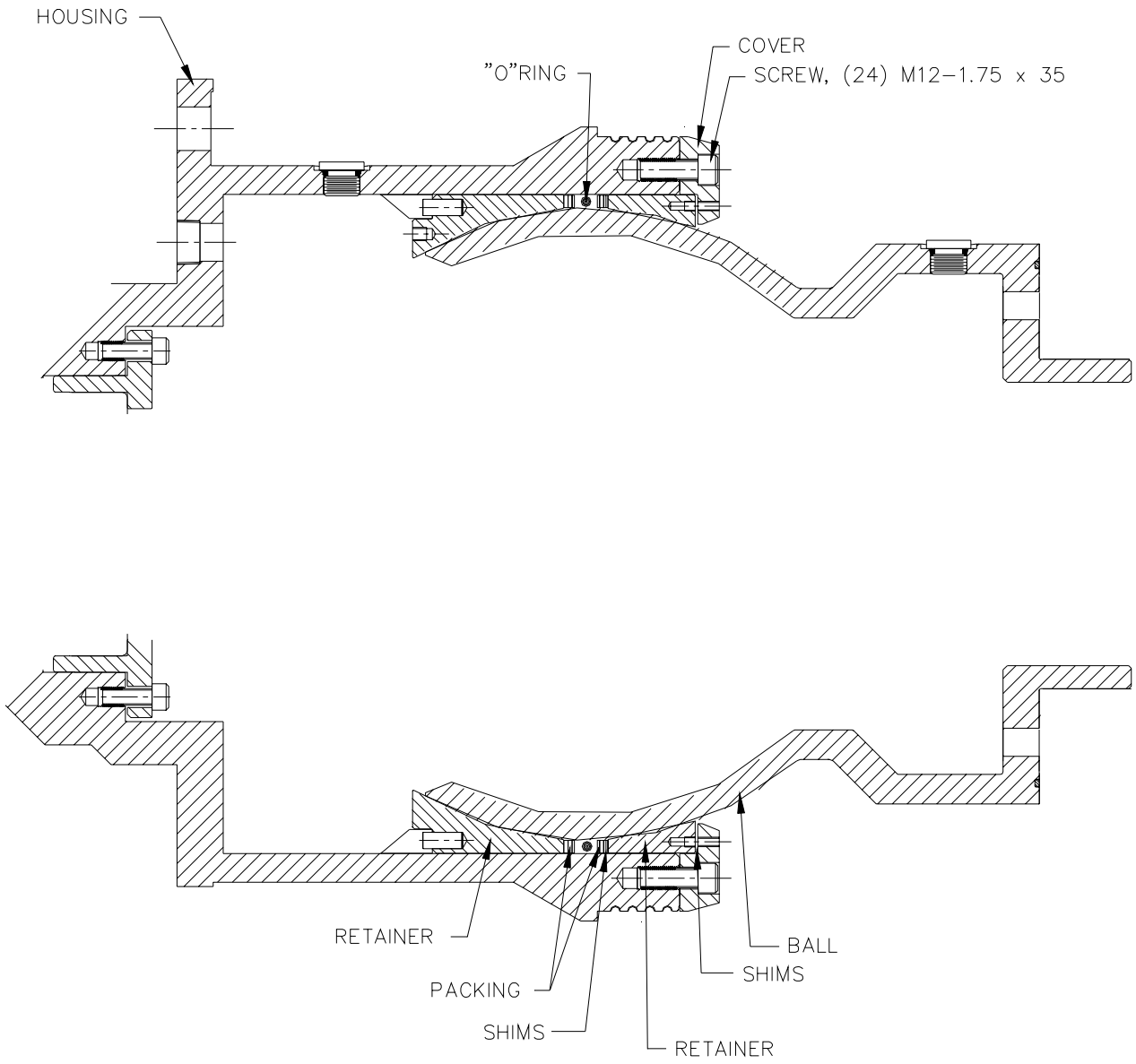
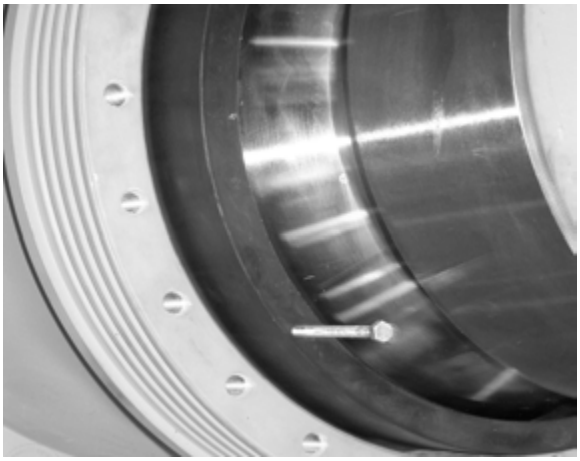


Figure 91. Ball and Socket Parts Identification

19. Raise the cover and the shim pack and hang them on the thrust tube. Remove the rear retainer (wear sleeve) and support it on the thrust tube.



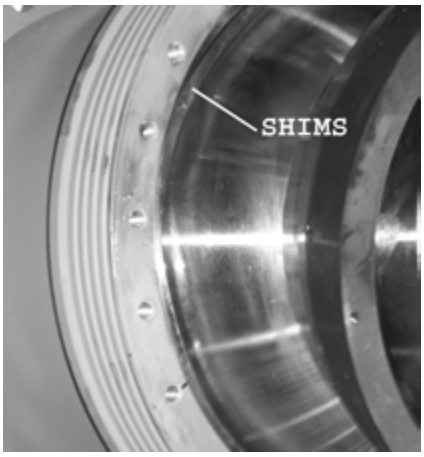


Figure 92. Remove the Retainer or *Wear Sleeve* (left), and Install Packing Shim Pack (right)

20. Install a shim pack of the packing shims measuring approximately 3.8 mm (0.150 in) in thickness. These are placed on top of the packing material. The packing will be deliberately over shimmed.

21. Install the rear retainer (wear sleeve) followed by the shim pack and cover. Install every third M12-1.75 x 35 socket head capscrew, retaining the cover to the socket. Evenly torque the screws to 34 N-m (25 lb-ft).

22. Measure the gap between the thrust socket housing and the cover in several positions around the diameter of the thrust socket. Average these measurements and label this average as **A** (tight retainer bolts). Note that if there is no gap, more shims will need to be added on the packing material.

Figure 93. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing - Gap A

23. Loosen the cover retaining screws, and allow the packing and o-ring to relax.

24. Measure the gap between the thrust socket housing and the cover in several positions around the diameter of the thrust socket. Average these measurements and label this average as **B** (loose retainer bolts).

Figure 94. Use Feeler Gauge to Obtain Average Gap Between Cover and Housing - Gap B

25. Subtract **A** (tight retainer bolts) from **B** (loose retainer bolts). Record the difference as **C** (actual compression). **C** represents the actual compression that results from the packing and o-ring being compressed with .150 in (3.81 mm) thickness of packing shims.

26. Subtract the specified amount of compression (1.25 mm ± .25 mm (0.050. ± .010 in.)) from **C** (the actual compression). Record this new calculation as **D** (excess compression).

27. Add **A** (tight retainer bolts) to **D** (excess compression). The sum is equal to the thickness of packing shims that must be removed in order to compress the packing and o-ring to the desired amount of 1.25 mm ± .25 mm (0.050. ± .010 in.).

	Calculation:	Example:
B	Loose retainer bolts	0.110 in (2.80 mm)
-A	Tight Retainer bolts	- 0.030 in (0.75 mm)
'C	Actual Compression	0.080 in (2.03 mm)
C	Actual Compression	0.080 in (2.03 mm)
-( )	Specified Compression	-0.050 in +/- 0.010 in (1.25 mm +/- 0.25 mm)
D	Excessive Compression	0.030 in +/- 0.010 in (0.75 mm +/- 0.25 mm)
A	Tight Retainer Bolts	0.030 in (0.75 mm)
+D	Excess Compression	0.030 in +/- 0.010 in (0.75 mm +/- 0.25 mm)
	Thickness of packing shims to remove	0.060 in +/- 0.010 in (1.50 mm +/- 0.25 mm)

Figure 95. Example of Packing Shim Calculation

28. Remove the cover, rear retainer (wear sleeve) shims, and rear retainer (wear sleeve). Remove the packing shims. Adjust the shim pack as calculated above, and reinstall shims over packing.

29. Install the rear retainer (wear sleeve), shims, and cover. Install 24 M12-1.75 x 35 socket head capscrews and torque to 60 N-m (40 lb-ft.)

30. Remove the jacking tool and install the four mounting bolts. Torque the mounting bolts to 176 to 203 N-m (130 to 150 ft-lbs).

Removal and Replacement of Thrust Packing and O-Ring

Note: If the packing and o-ring must be replaced due to leakage, remove the ball and thrust tube assembly from the socket, and follow the complete instructions for assembly of the thrust tube to the socket while attached to the/e transom as shown in the previous section.

Boot Installation

Note: The boot is not intended to keep water out. Its purpose is to protect the drive from marine growth and debris. The fin must be removed to install the boot.

1. Clean the interior of the boot with a clean cloth and cleaning solvents.

2. Holding the boot with the large end facing forward, pass the boot over the prop shaft and slide down and over the thrust socket. Make sure that the grooves in the thrust socket housing match up with the ridges on the boot.

3. Secure the boot to the thrust socket with two circle clamps. Make sure that the clamp screws are on the top of the unit. They create a drag if positioned on the bottom or in the water. Apply anti-seize lubricating compound on the clamp threads.

4. Position the output end of the boot over the thrust tube so that the flat portion of the boot is just behind the thrust tube to ball joint. Secure the boot with two circle clamps. Make sure that the screws are on top of the unit.

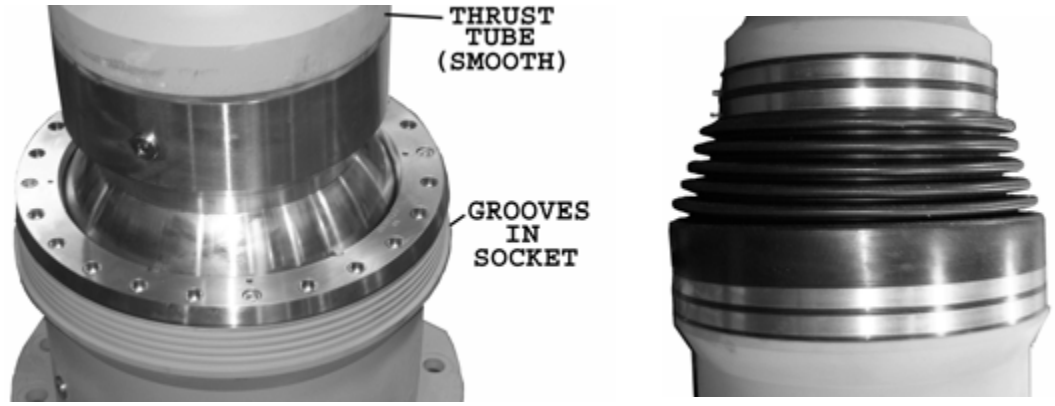


Figure 96. Install Boot Over Output Placing Ribs In Boot In Socket Grooves

Fin Reattachment

1. Remove any rough edges or burrs from the mating surfaces of the thrust tube and fin pad. Repair any paint damage that results. Clean the flat surfaces and threaded holes with alcohol. Spread a thin layer of waterproof (marine-grade) silicone sealer on the thrust tube fin pad, using care to keep silicone out of the threaded holes.

2. Coat the clean capscrew threads with Loctite 242 blue or similar liquid thread locker. Place the fin on the fin pad and install the eighteen M10-1.5 x 35 socket head capscrews. If necessary, tap the fin with a plastic mallet to align the fin on the base. Tighten all screws evenly, squeezing excessive sealer to the outside.

3. Torque the capscrews to 17 N-m (12 ft-lbs) Continue re-torquing until the capscrews no longer turn, as the sealer is squeezed out.

4. Clean the excess sealer from the seam.

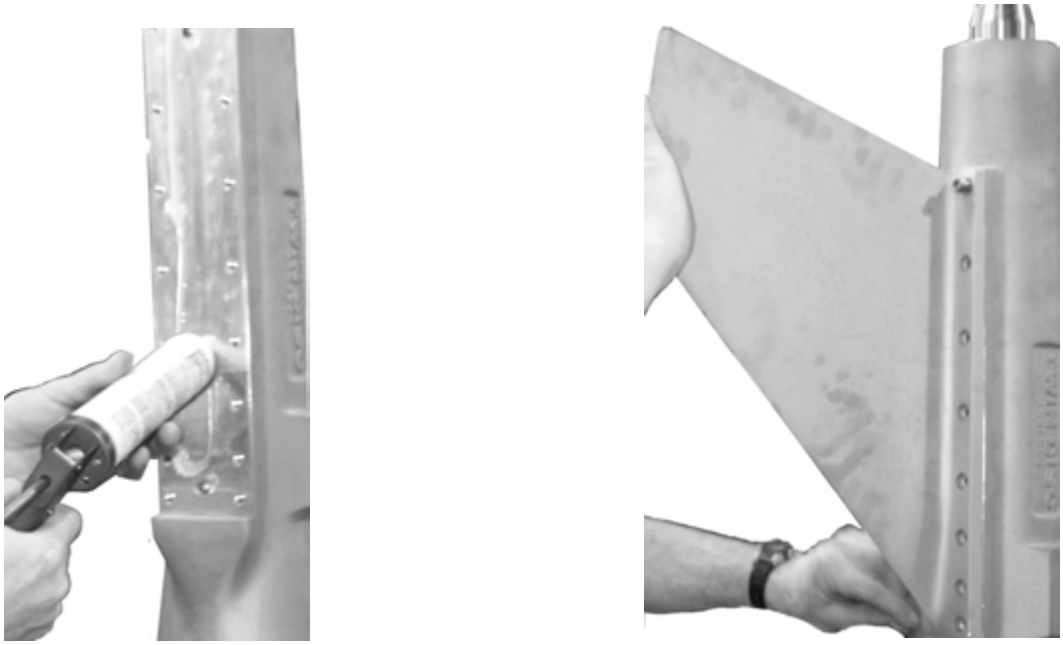


Figure 97. Apply Silicone to Thrust Tube Surface (left), Put Pin In Place, and Install Bolts (right)

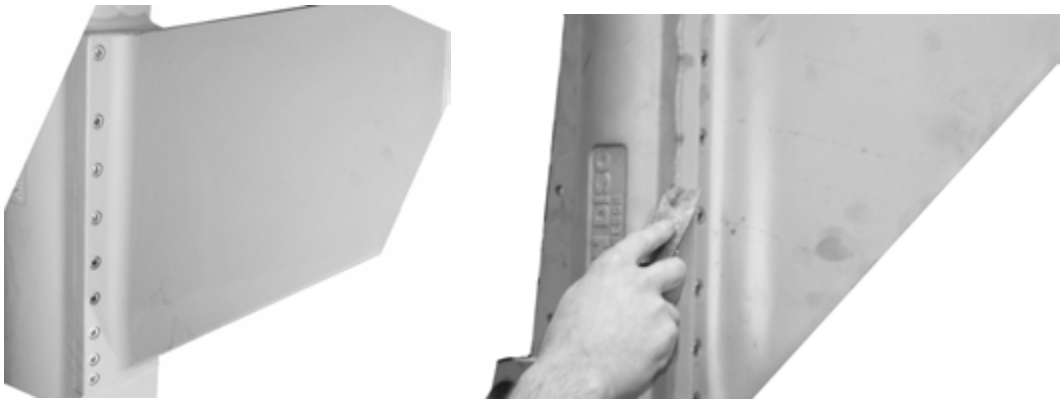


Figure 98. Torque Capscrews (left), Remove Excess Silicone from Tube (right)

Attaching Thrust Unit to Transom

Note: A review of the Installation Section of this manual could be very helpful for properly installing the surface drive.

1. Using suitable lifting device, cradle the unit into place against the transom with the input shaft installed into the hole in transom. See the following illustrations for proper lifting procedures.

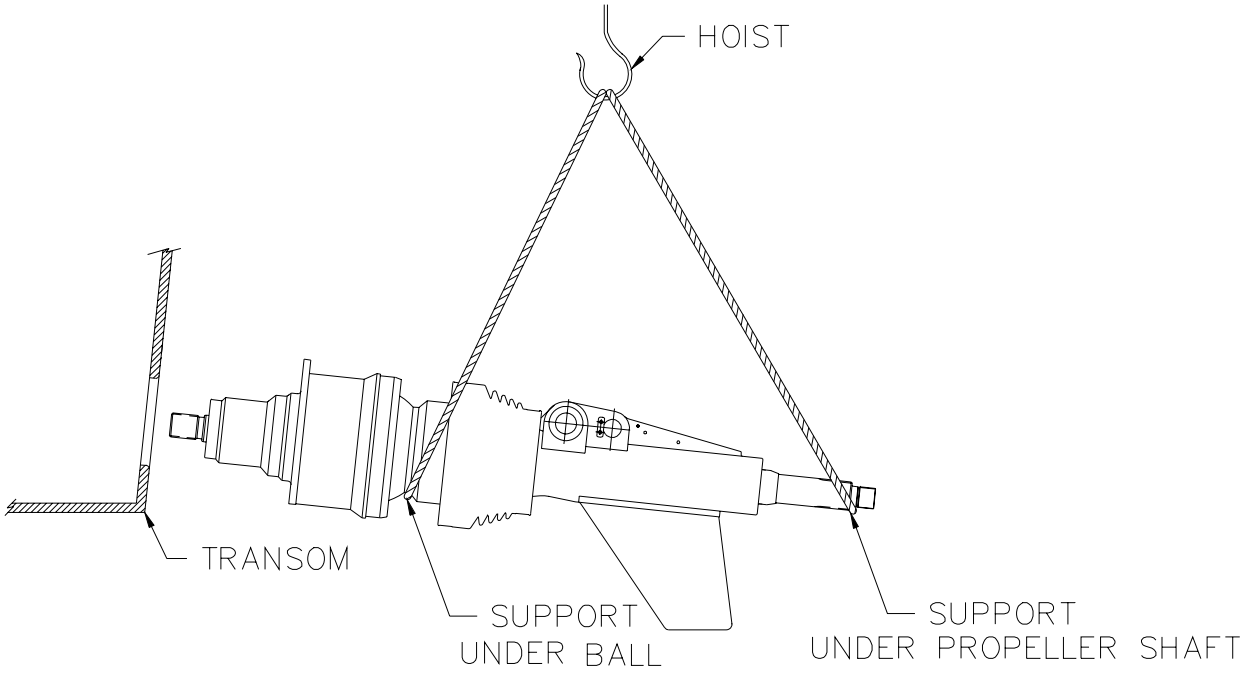


Figure 99. Support Unit for Installation

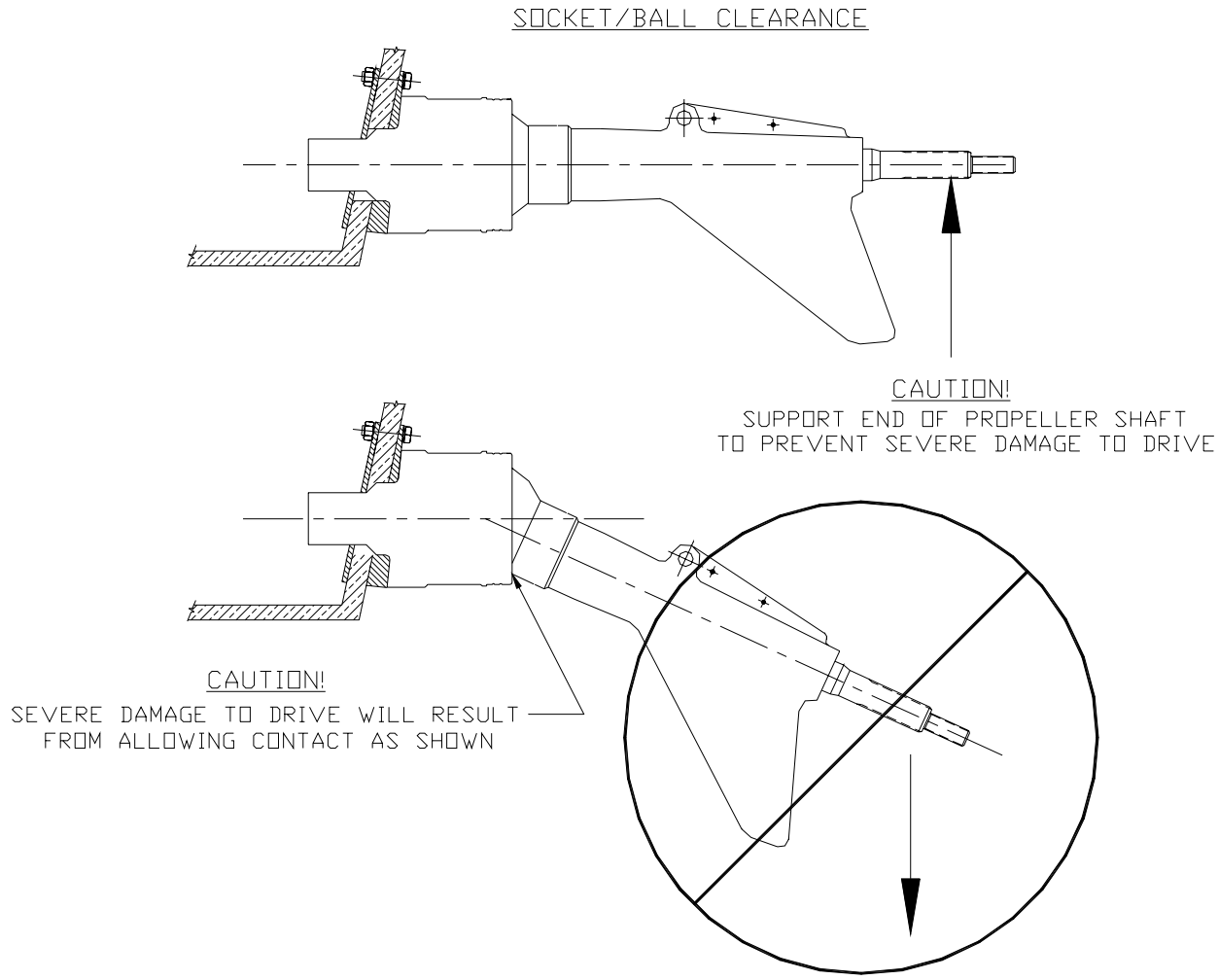


Figure 100. Protect the Ball from Damage

2. Apply marine sealant (3M brand 5200 marine sealant or equivalent is recommended) to the transom area where the surface drive is to be installed.

3. Using a suitable lifting device, lift the surface drive up against the transom, and if necessary, place a Delrin plastic isolation pad between the socket and the transom.

4. Align the mounting bolt holes.

5. Coat each bolt with marine transom sealant (3M brand 5200 marine sealant or equivalent is recommended) to prevent leakage.

6. Install the mounting bolts with Delrin plastic bushings through the transom.

7. Place a Delrin plastic isolation pad inside the vessel between the backing plate and transom.

8. Secure the backing plate with the capscrews, washers, and nuts.

9. Install the nuts and washers inside the transom and torque to 319 N-m (235 ft-lbs). Follow the torque sequence shown on the next page.

Note: Delrin isolation pads and bushings are only needed on metal vessels and vessels with graphite composite hulls.

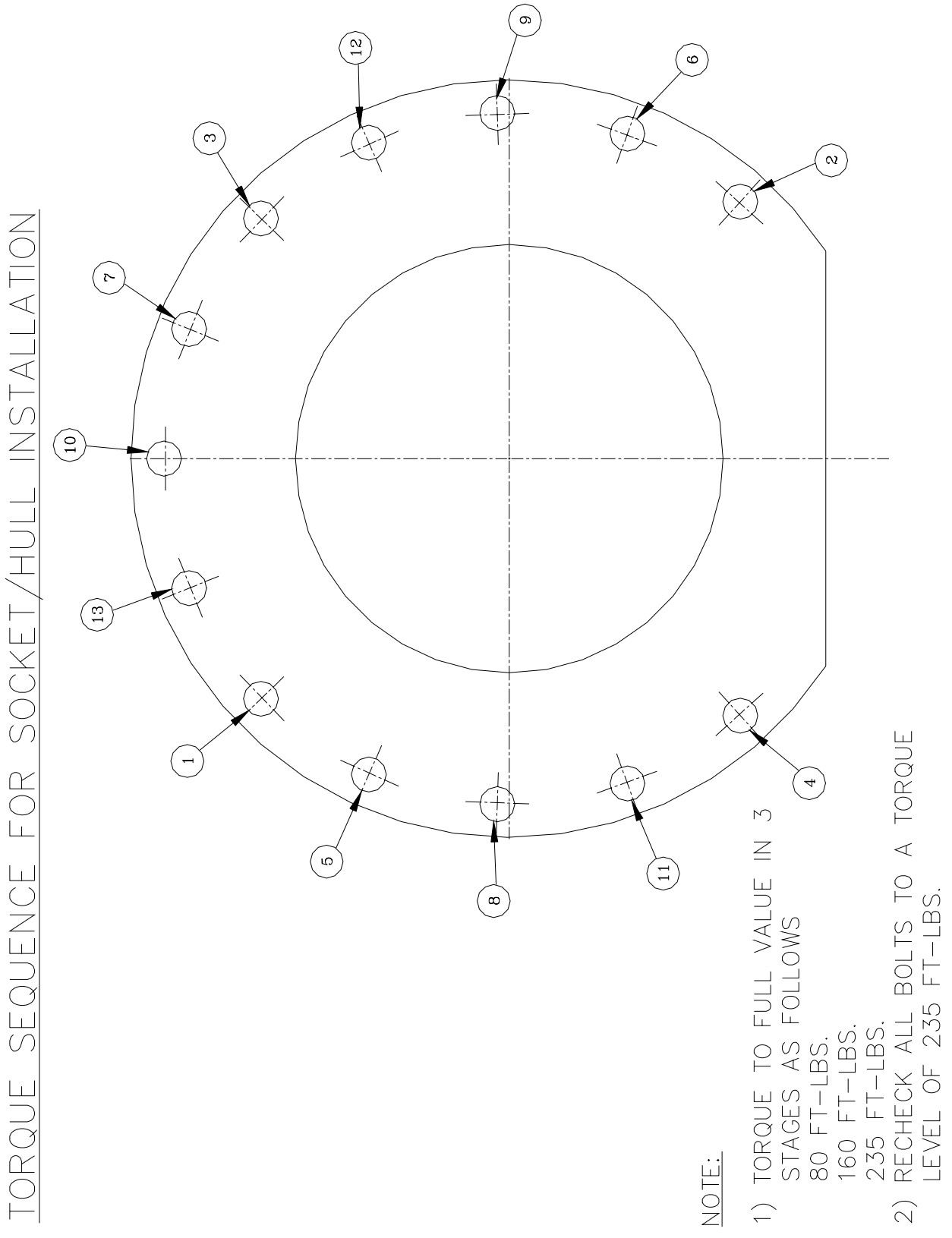


Figure 101. Torque Sequence for Socket Installation on Hull

Propeller Installation - Routine Maintenance

1. Apply a thin coat of anti-seize lubricating compound to the propeller shaft as shown in Figure 102.

⚠ CAUTION

Do not apply anti-seize compound to the propeller or propeller shaft tapers. Tapers must be clean and dry for assembly.

2. Install the propeller, thrust washer, propeller nut, lock nut, on the shaft as shown in Figure 102. Torque the propeller nut to 1220 N-m (900 ft.-lbs). Torque the jam (lock) nut to 860 to 1000 N-m (634 to 738 ft.-lbs). Approach the lower value, then continue until a cotter pin slot in the nut aligns with the hole in the shaft. Install the cotter pin.

   Note: The propeller nut should be re-torqued following the following schedule.

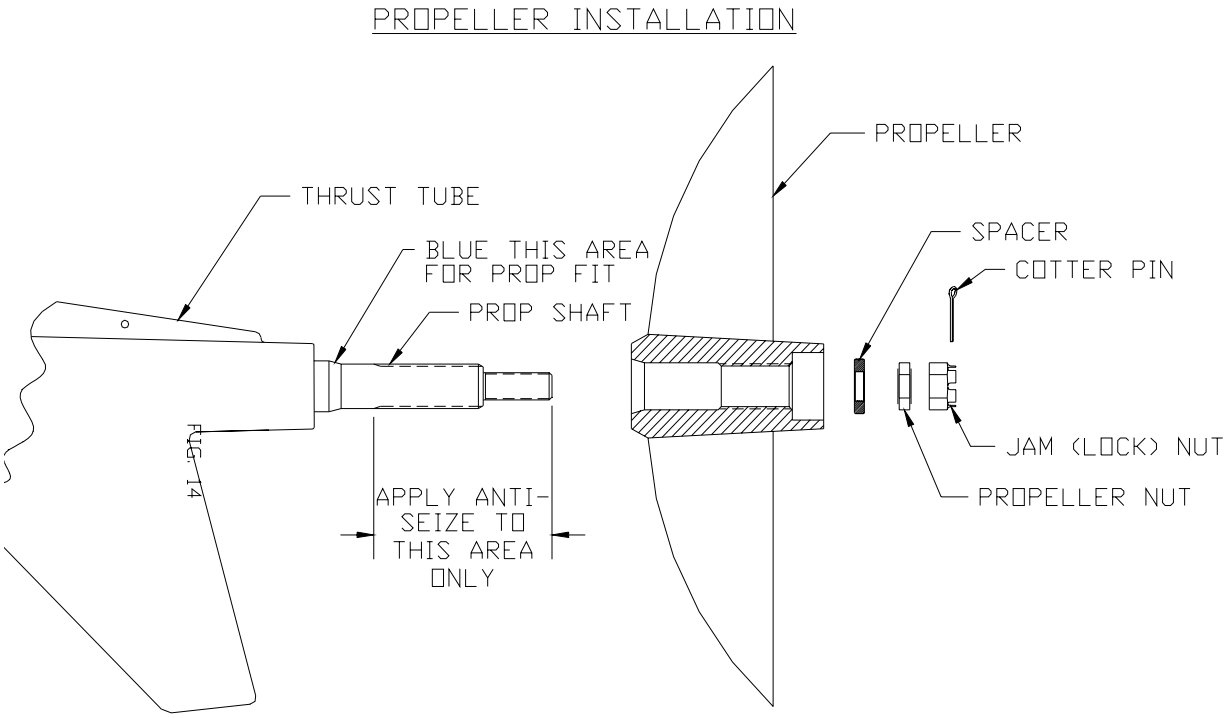


Figure 102. Propeller Installation

3. The propeller nut and lock nut must be checked for torque retention to the above values after initial use or within 10 hours of operation.

4. The propeller nut torque **MUST** be checked in the following operational interval

   A. The propeller nut torque must be checked in accordance with step 2 after an additional 250 hours of operation. If the torque is correct, go to step B. If the torque is incorrect, re-torque the nut and repeat step A.

   B. The propeller nut torque must be checked in accordance with step 2 after an additional 500 hours of operation. If the torque is correct, go to step C. If the torque is incorrect, re-torque the nut and repeat step B.

   C. The propeller nut torque must be checked in accordance with step 2 after an additional 1000 hours of operation. If the torque is correct, go to step D. If the torque is incorrect, re-torque the nut and repeat step C.

   D. The propeller nut torque must be checked in accordance with step 2 after an additional 1500 hours of operation. If the torque is correct, go to step E. If the torque is incorrect, re-torque the nut and repeat step D.

   E. Continue to increase the interval in increments of 1500 hours until the regular “haulout” interval of the vessel is reached.

   F. If at any point in steps A through F, the “haulout” interval of the vessel is reached or surpassed, the torque check interval may be established to be the same as the “haulout” interval. Record the final interval for reference.

Propeller Installation - New Applications

First time installation of new propellers will require a check to verify proper mating of the tapered shoulder on the propeller with the tapered shoulder on the shaft. Mismatched tapers may result in a damaged or broken propeller shaft and a lost propeller. Follow the procedure below to check the propeller to shaft fit:

1. Clean the taper on the forward end of the propeller hub and the tapered shoulder of the shaft with alcohol or other cleaner and wipe dry.

2. Apply a layout dye to the shaft taper as follows. Use a machinist's layout dye such as Dykem "Steel Layout Blue" Dykem part number DX100 marketed by ITW Dymon Company, 805 E. Old 56 Highway, Olathe, KS 66061 USA.

3. Apply the layout fluid to the shaft taper as thinly and evenly as possible over the entire tapered surface. The more evenly the dye is applied, the more accurate will be the reading. Allow the dye to dry completely before proceeding.

4. Slide the propeller onto the shaft until the male and female tapers touch. Install the propeller nut and torque the nut to 200 N-m (150 ft-lbs). Verify that the propeller is securely seated on the shaft taper.

5. Remove the propeller nut, and slide the propeller away from the shaft, being careful not to disturb the layout dye on the shaft and on the propeller hub internal (female) taper.

6. Evaluate the contact pattern on both tapers. See Figure 103 for guidance on acceptable contact patterns. The surfaces should match approximately 80% of the total tapered area.

   Note: It is important that the contact should be biased toward the larger diameter end of both tapers. If contact is predominant at the small end, the shaft may be over-stressed locally and may fail. Contact Twin Disc if the taper contact pattern is not in accordance with Figure 103.

8. Once the contact is confirmed to be acceptable, clean the dye from the tapers with the above solvent and re-install the propeller as outlined in the previous section.

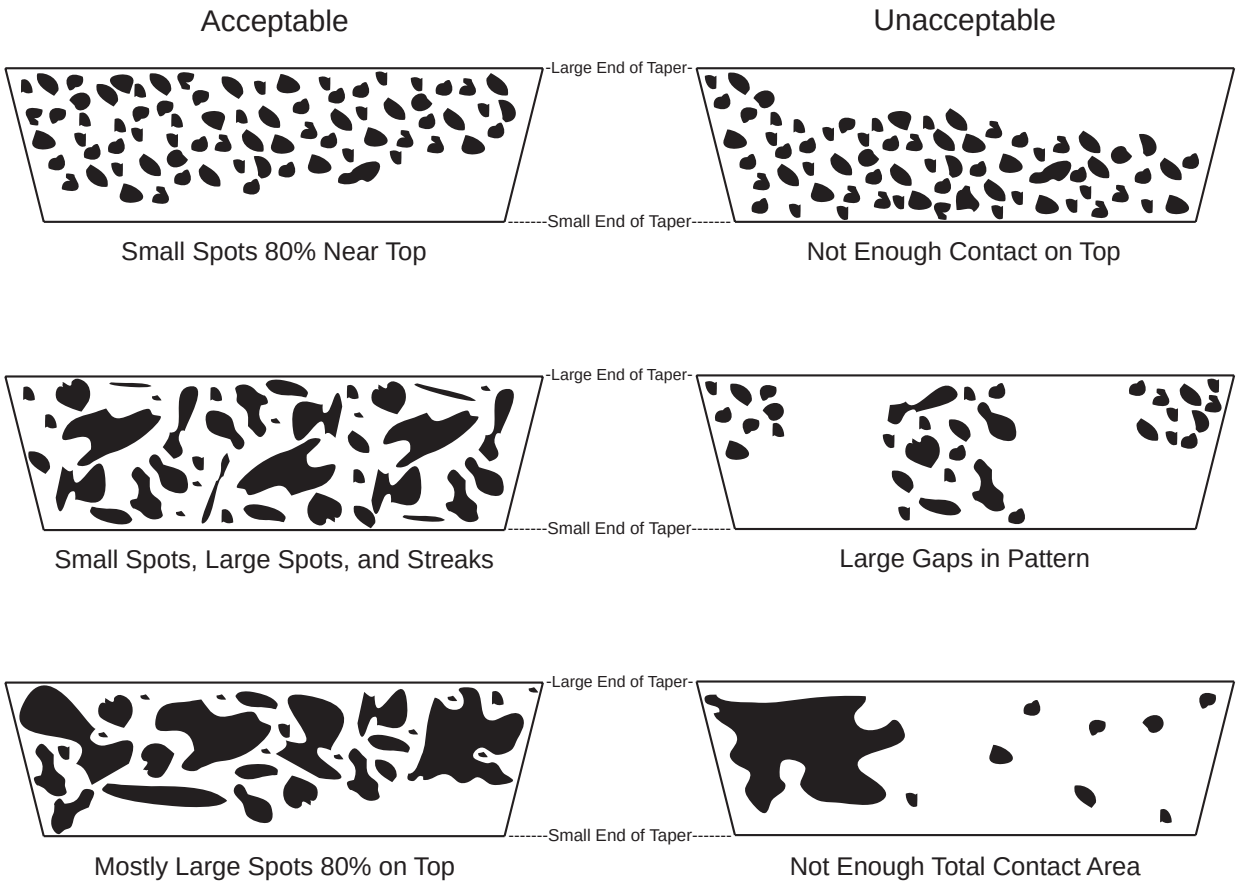


Figure 103. Dye Contact Pattern Samples

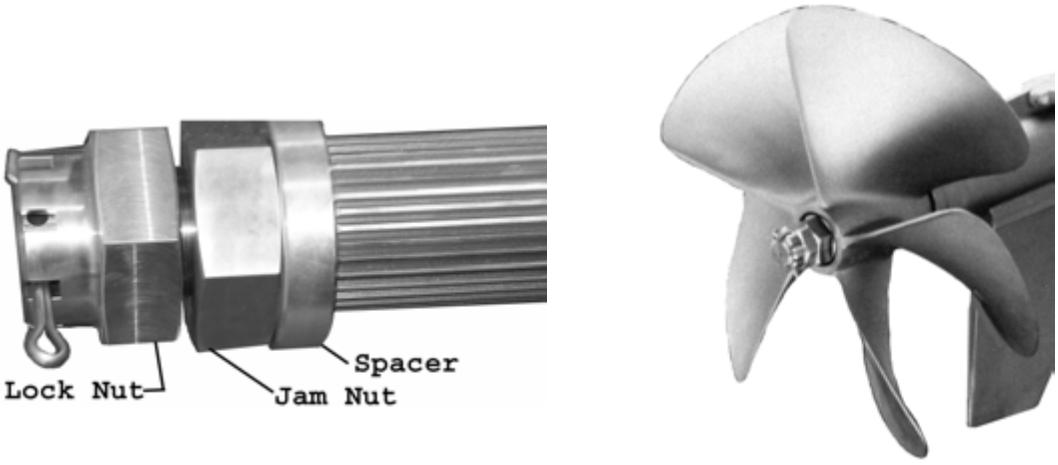


Figure 104. Propeller Retaining Parts, Propeller Installed

Special Tools

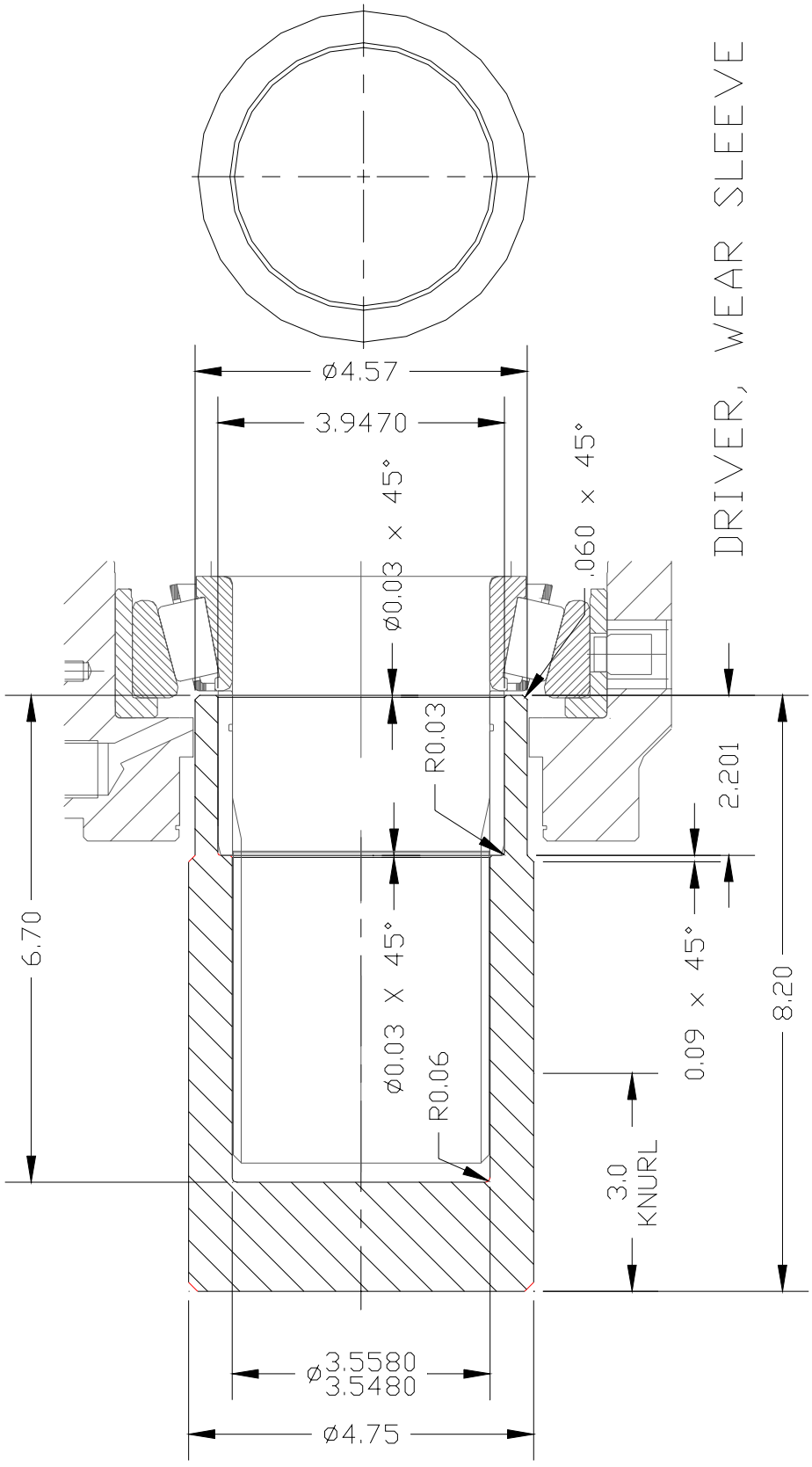
List of Special Tools

The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continue on the following page.

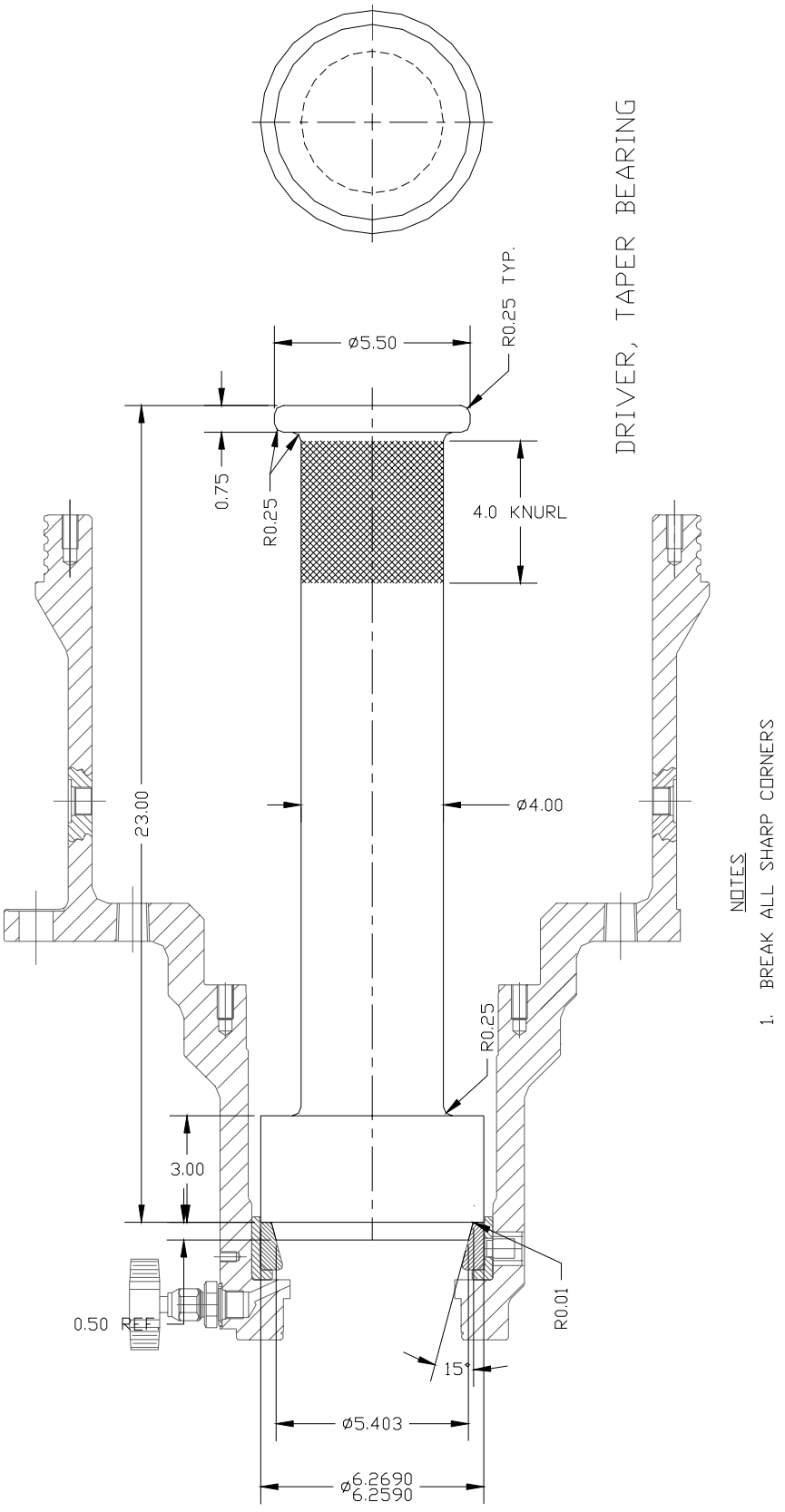
- ❑ T-18050-774 Input (Socket) Shaft Wear Sleeve Driver
- ❑ T-18050-775 Input (Socket) Shaft Bearing Cup Driver
- ❑ T-18050-776 Thrust Bearing Cup Driver
- ❑ T-18050-777 Propeller Shaft Seal Sleeve Driver
- ❑ T-18050-780 Propeller Shaft Seal Driver Assembly, Detail 1
- ❑ T-18050-780 Propeller Shaft Seal Driver Assembly, Detail 2
- ❑ T-18050-781 Input (Socket) Shaft Seal Driver
- ❑ T-21089-5A Assembly Stand Adapter, (1 of 2)
- ❑ T-21089-5A Assembly Stand Adapter, (2 of 2)
- ❑ T-21089-5B Assembly Stand Adapter, (1 of 2)
- ❑ T-21089-5B Assembly Stand Adapter, (2 of 2)
- ❑ T-21089-5C Assembly Stand Adapter, (1 of 2)
- ❑ T-21089-5C Assembly Stand Adapter, (2 of 2)
- ❑ T-21089-5D Stand Setup ASD 15A1S, (1 of 2)
- ❑ T-21089-5D Stand Setup ASD 15A1S, (2 of 2)
- ❑ T-21549-28 Shaft Indicator Holder
- ❑ T-21567 Lifting Fixture

- ❑ T-21570 Jacking Tool (1 of 2)
- ❑ T-21570 Jacking Tool (2 of 2)

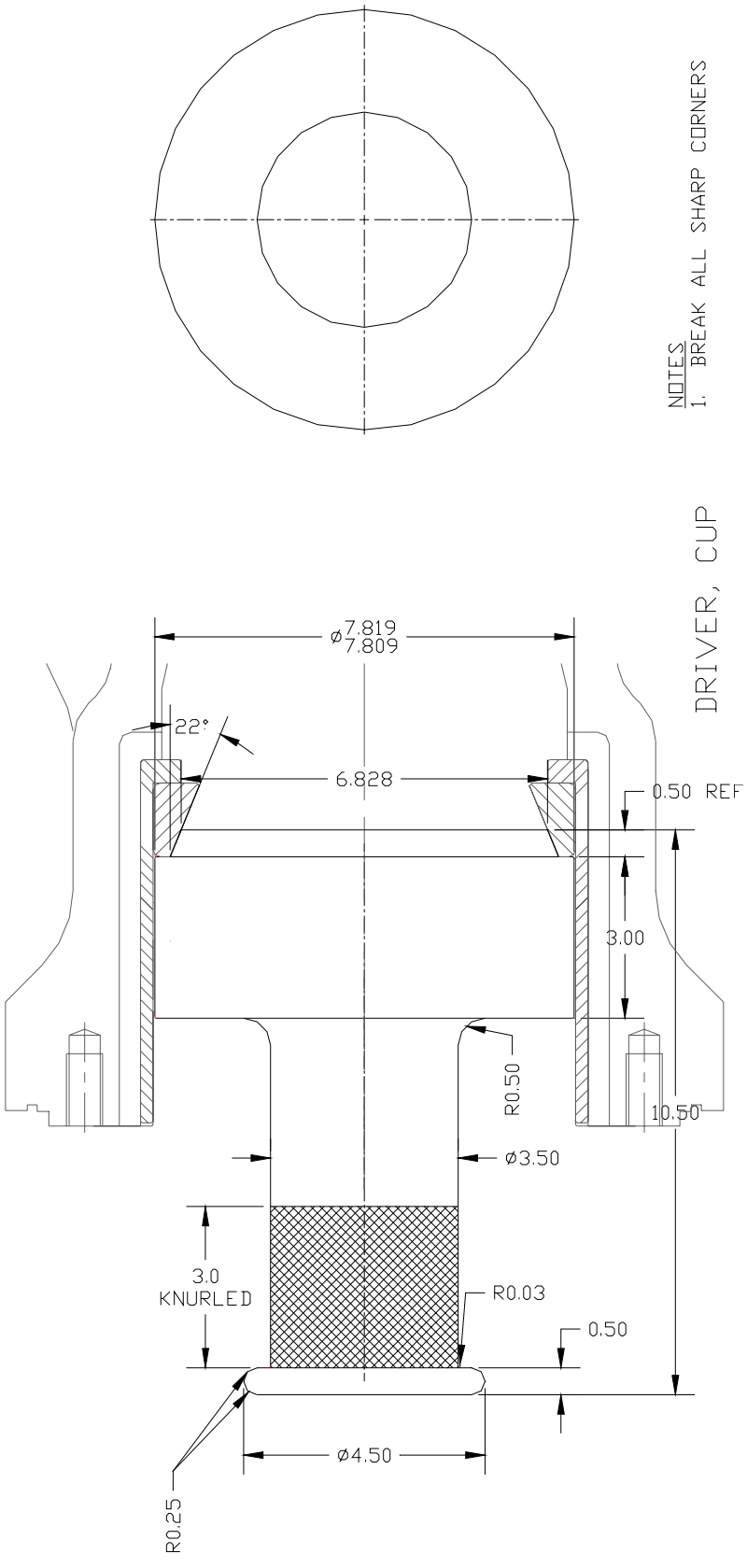
Input (Socket) Shaft Wear Sleeve Driver T-18050-774



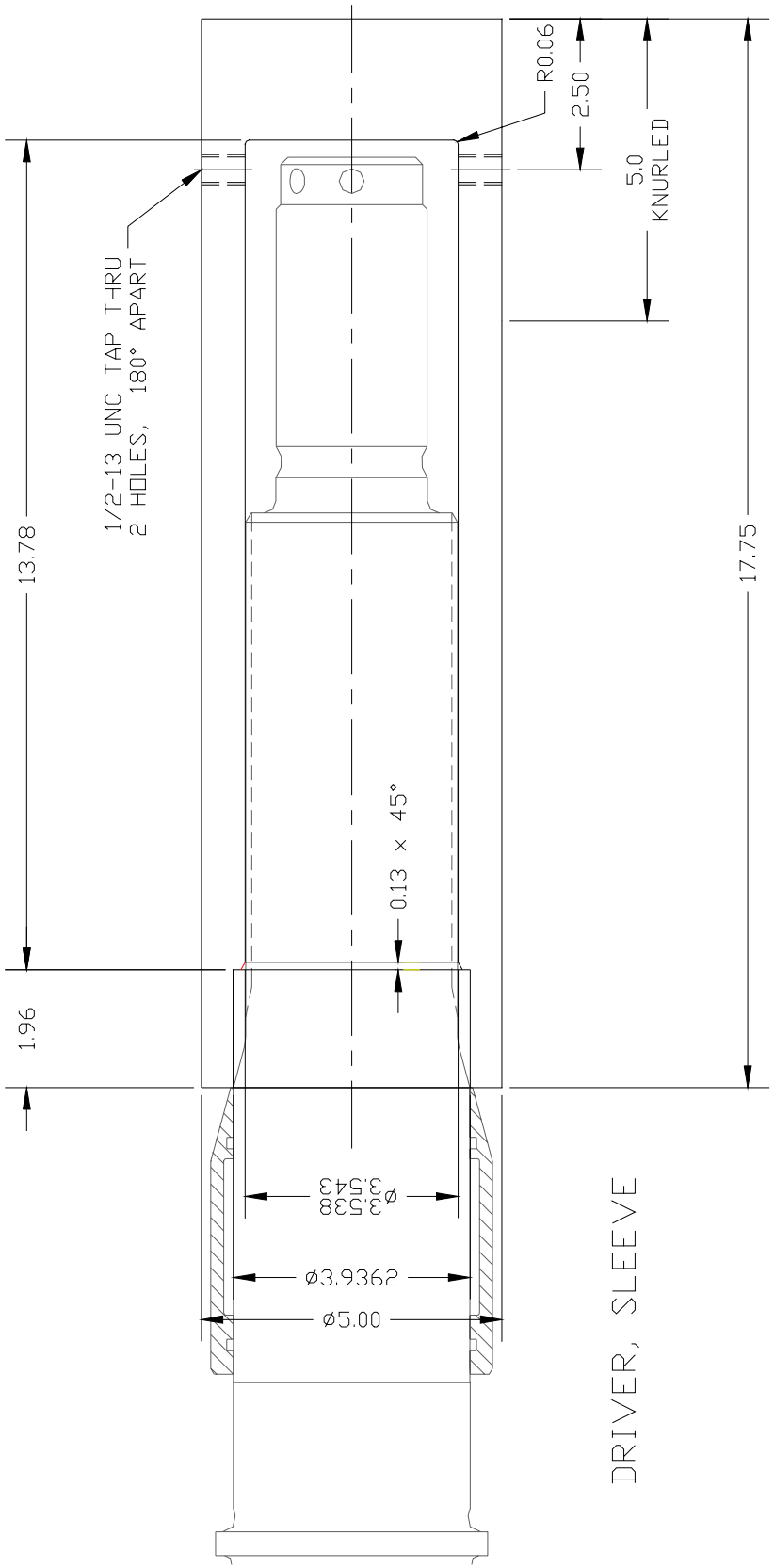
Input (Socket) Shaft Bearing Cup Driver T-18050-775



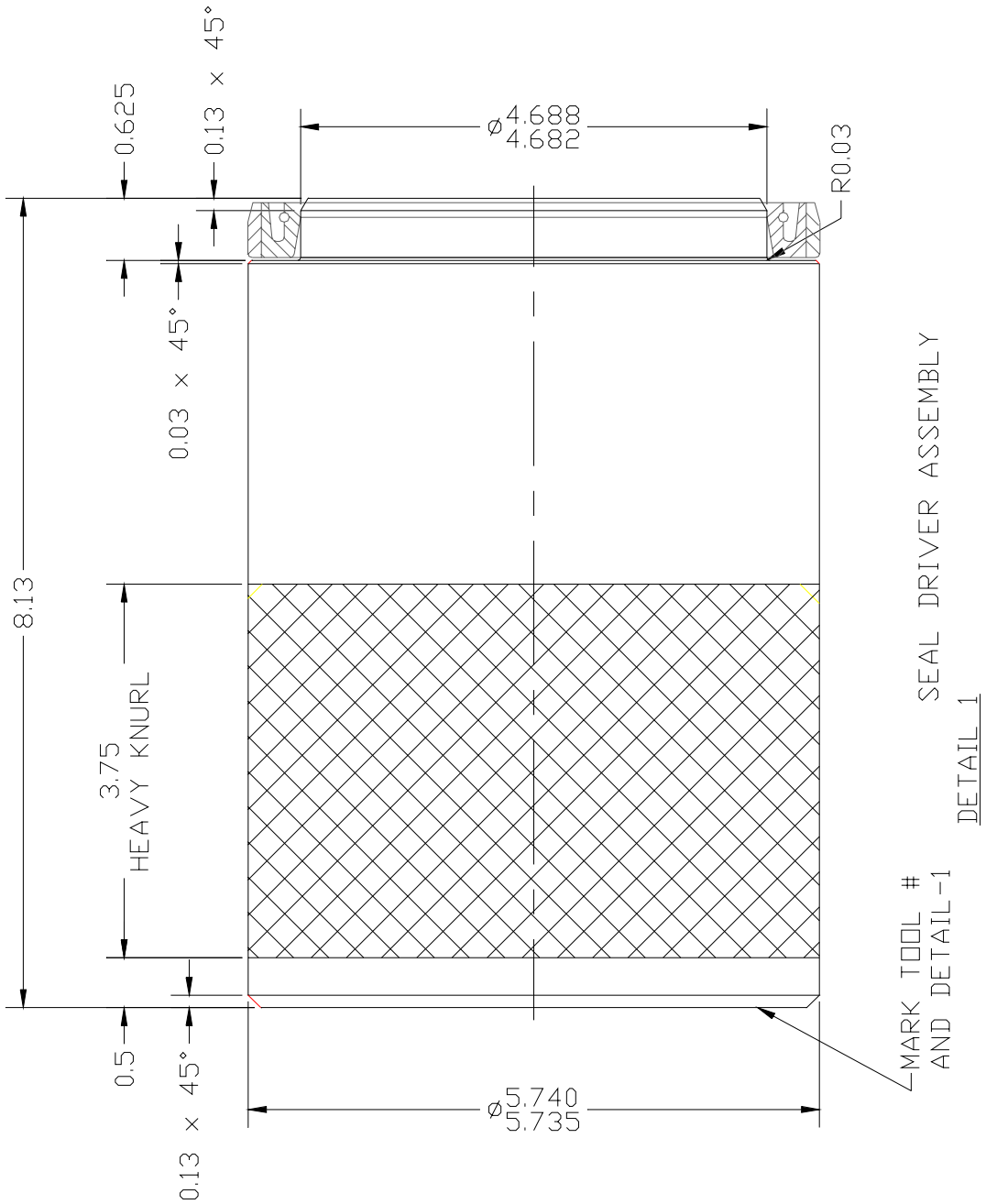
Thrust Bearing Cup Driver T-18050-776



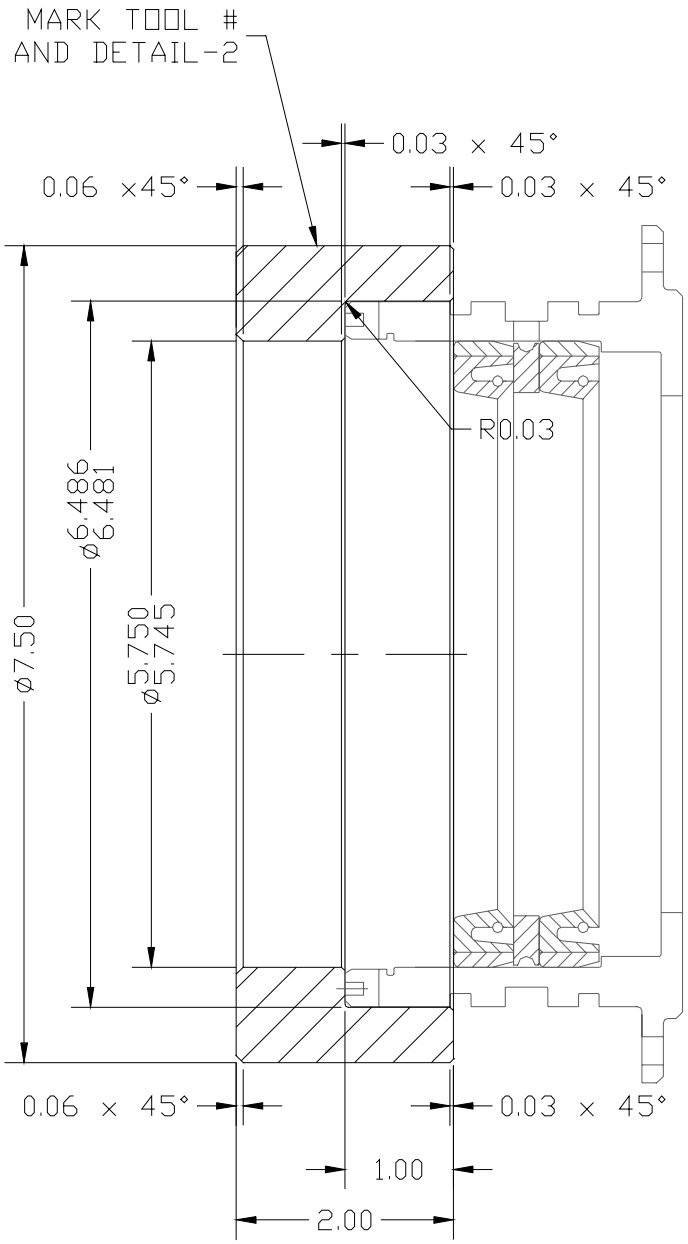
Propeller Shaft Seal Sleeve Driver T-18050-777



Propeller Shaft Seal Driver Assembly T-18050-780 Detail 1

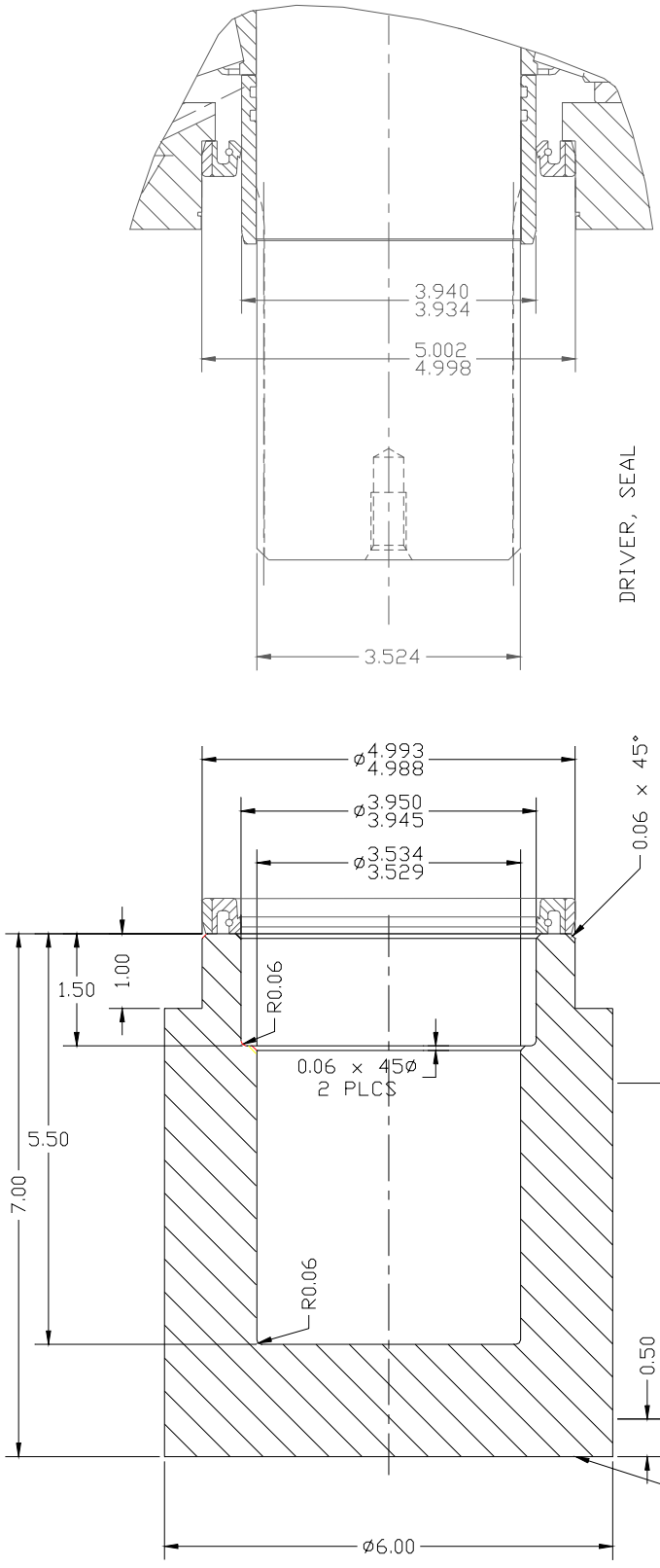


Propeller Shaft Seal Driver Assembly T-18050-780 Detail 2

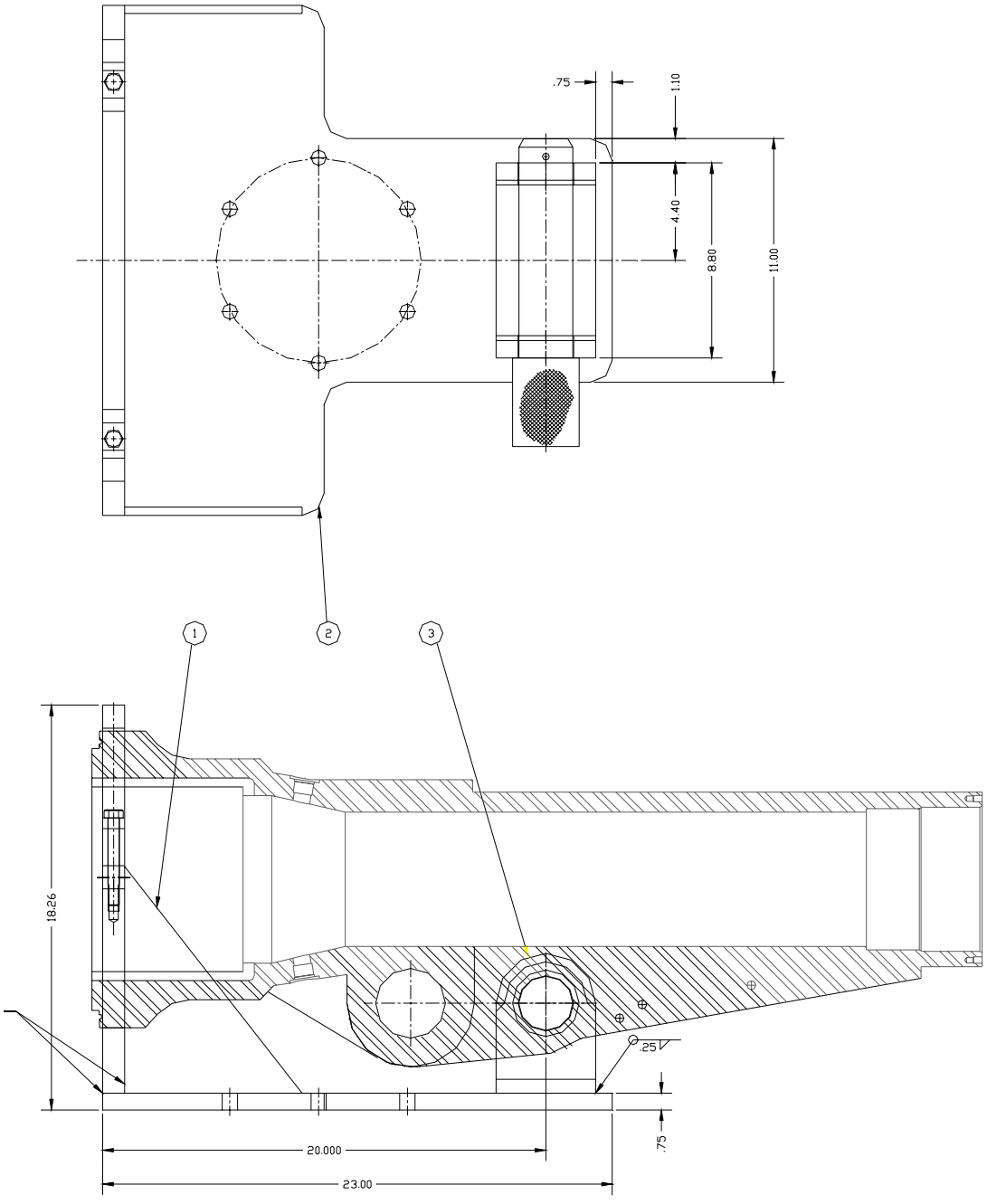


DETAIL 2

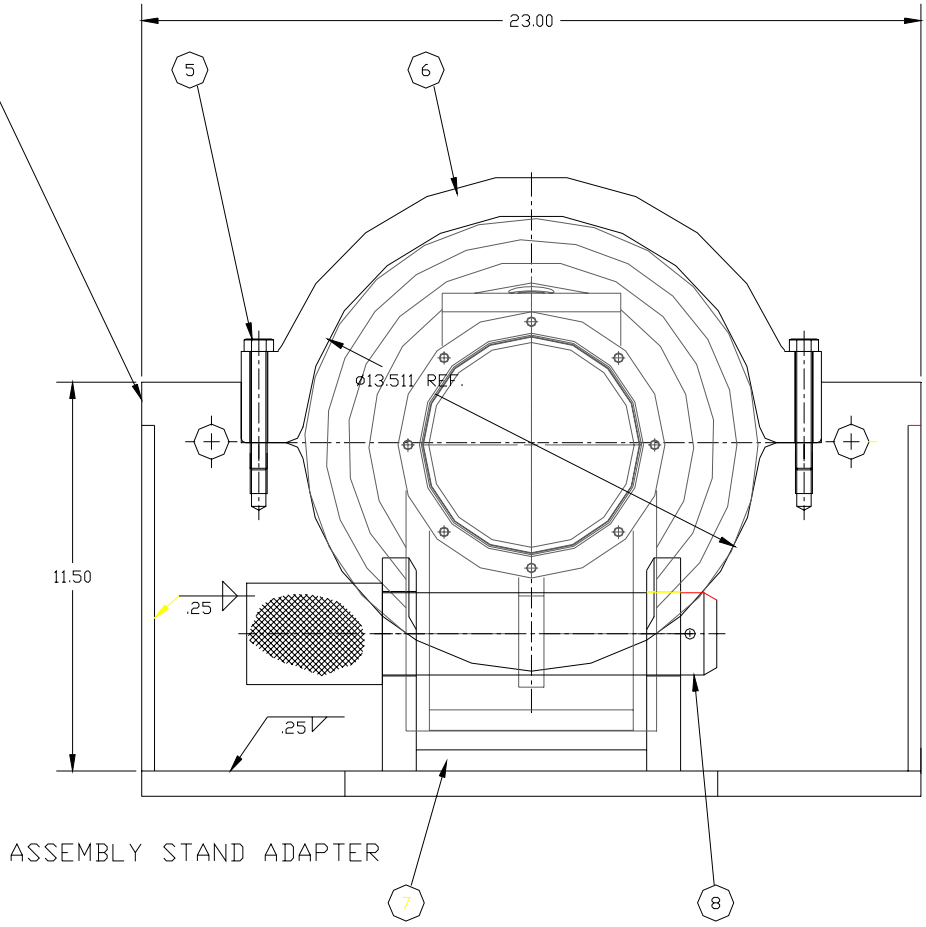
Input (Socket) Shaft Seal Driver T-18050-781



Assembly Stand Adapter T-21089-5A (1 of 2)

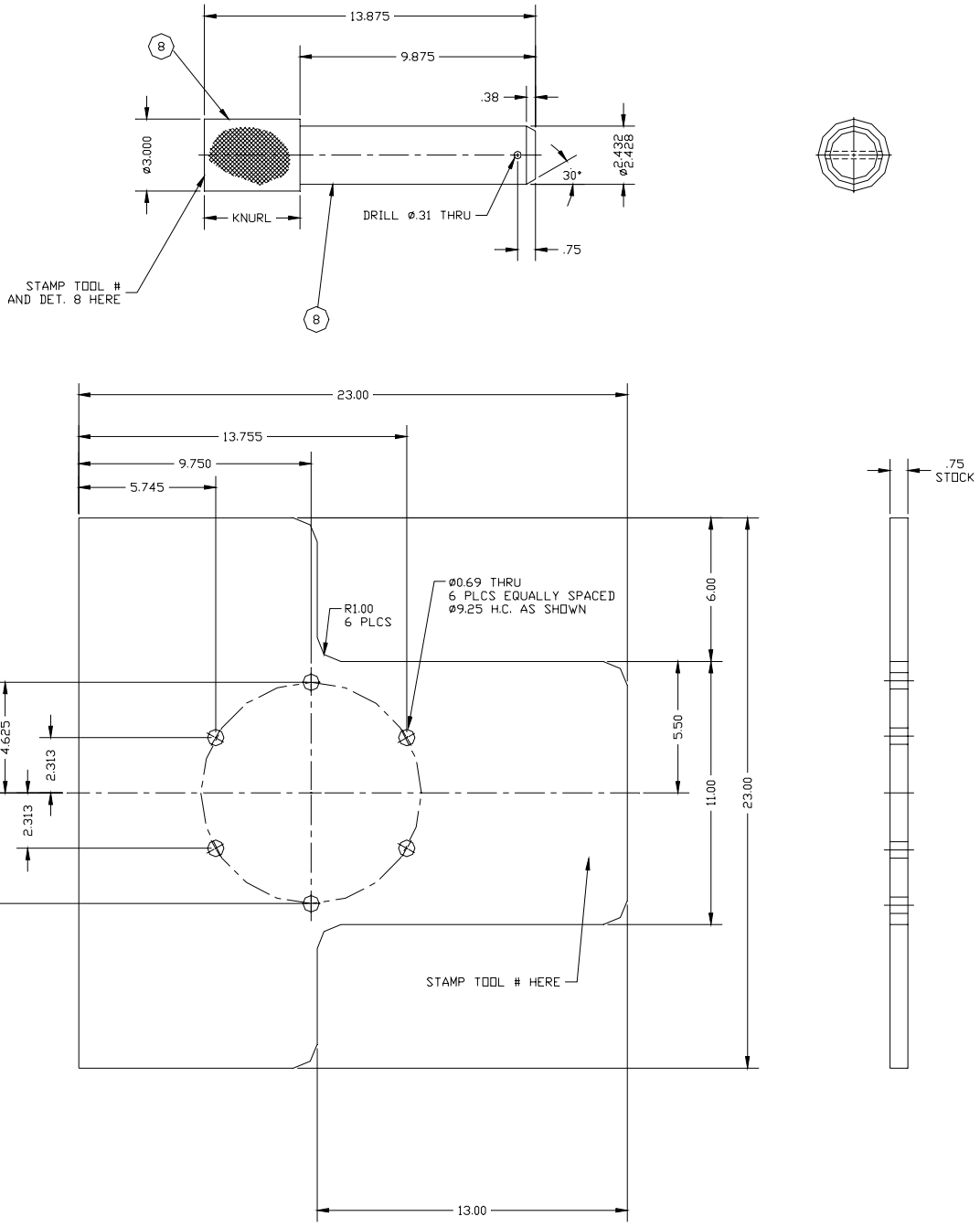


Assembly Stand Adapter T-21089-5A (2 of 2)



DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
8	1	CRS	PIN RETAINING	ø3.00 x 14.0 SEE SHEET #2
7	1	CRS	BASE, BRACKET	6.80 x 4.50 x .63 SEE SHEET #3
6	1	CRS	PLATE, UPPER SUPPORT	8.00 x 17.13 x 1.00 SEE SHEET #3
5	2	PUR	SCREW, HEX. HD.	1/2-13 UNC x 3.50
4	1	CRS	PLATE, BOTTOM SUPPORT	23.0 x 11.5 x 1.00 SEE SHEET #2
3	2	CRS	BRACKET	6.31 x 4.50 x 1.00 SEE SHEET #3
2	1	CRS	PLATE, BASE	23.0 x 23.0 x 0.75 SEE SHEET #2
1	2	CRS	GUSSET	8.00 x 10.0 x .375 SEE SHEET #3

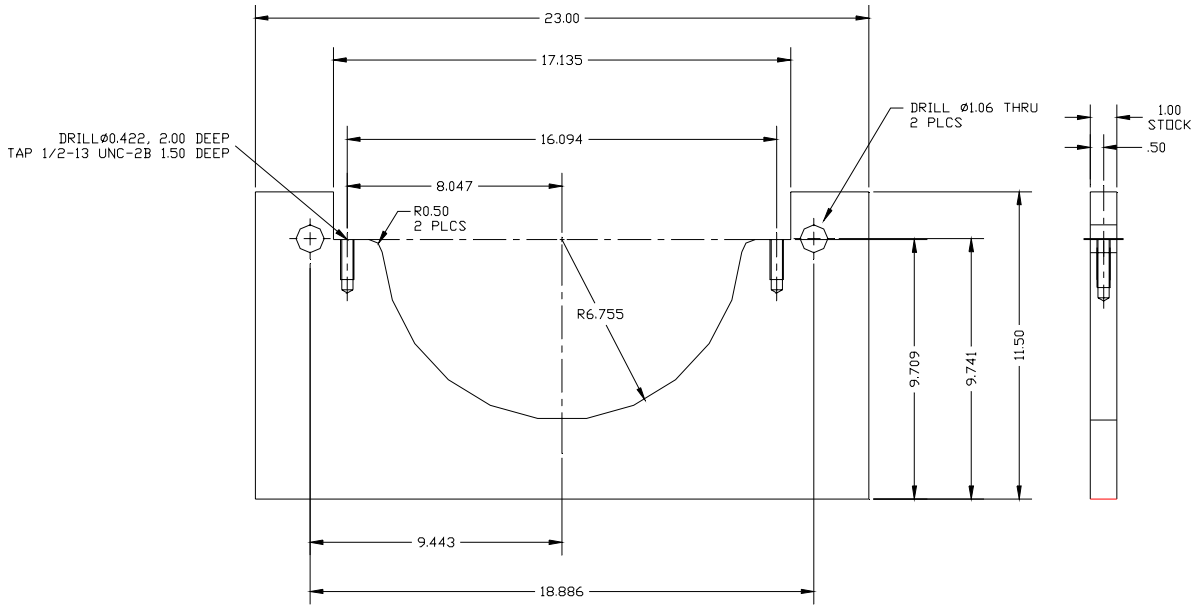
Assembly Stand Adapter T-21089-5B (1 of 2)



DETAIL 2
1. ROUND ALL SHARP EDGES.

Assembly Stand Adapter T-21089-5B (2 of 2)

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
8	1	CRS	RETAINER, PIN	ø3.00 X 14.0
4	1	CRS	PLATE, BOTTOM SUPPORT	23.0 x 11.5 x 1.00
2	1	CRS	PLATE, BASE	23.0 x 23.0 x 0.75

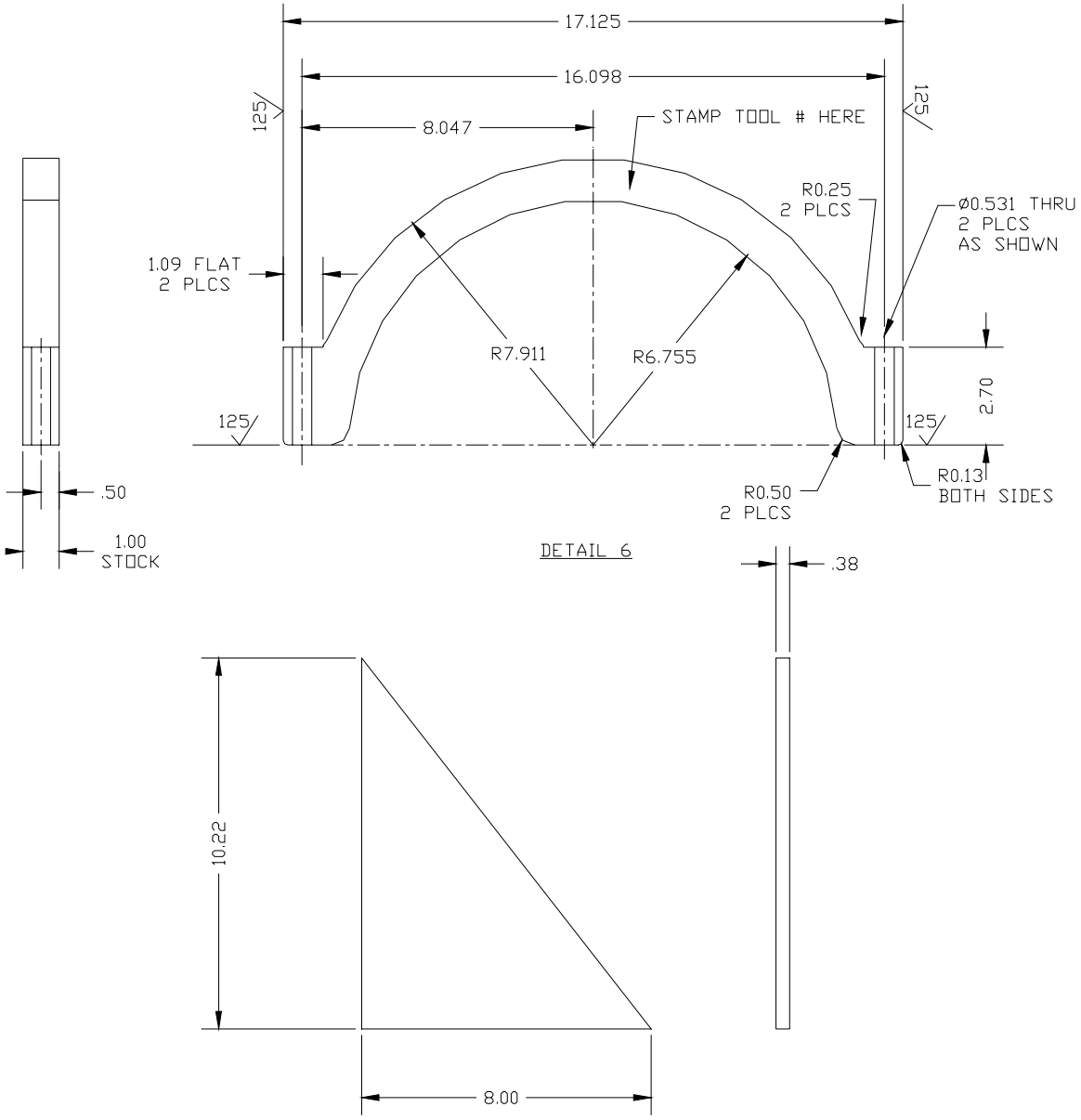


ASSEMBLY STAND ADAPTER

DETAIL 4

1. ROUND ALL SHARP EDGES.

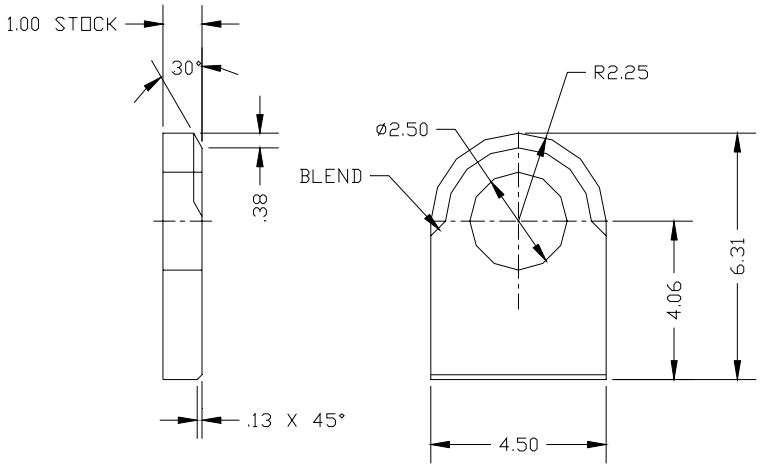
Assembly Stand Adapter T-21089-5C (1 of 2)



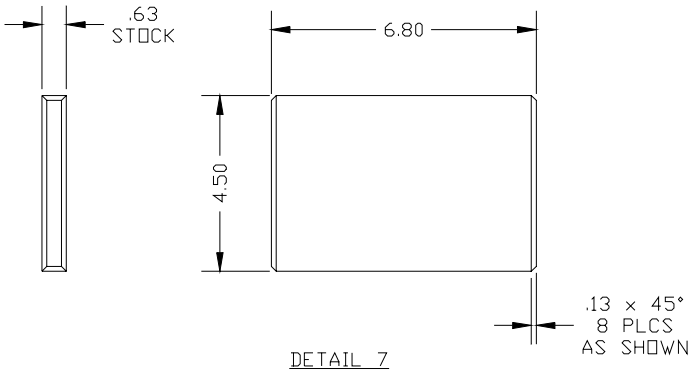
DETAIL 1

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
7	1	CRS	BASE, BRACKET	6.80 x 4.50 x .63
6	1	CRS	PLATE, UPPER SUPPORT	8.00 x 17.13 x 1.00
3	2	CRS	BRACKET	6.31 x 4.50 x 1.00
1	2	CRS	GUSSET	8.00 x 10.0 x .375

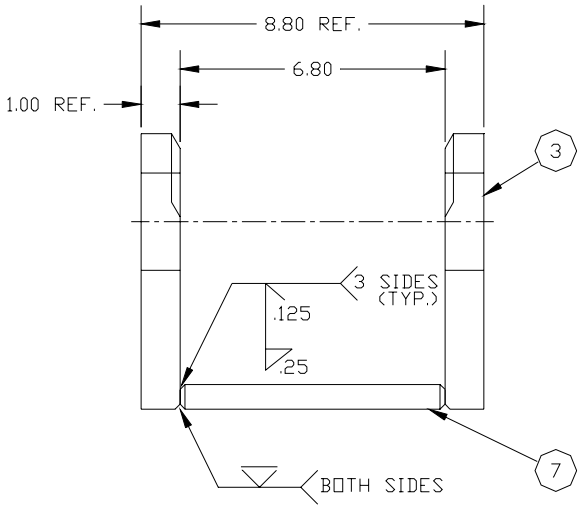
Assembly Stand Adapter T-21089-5C (2 of 2)



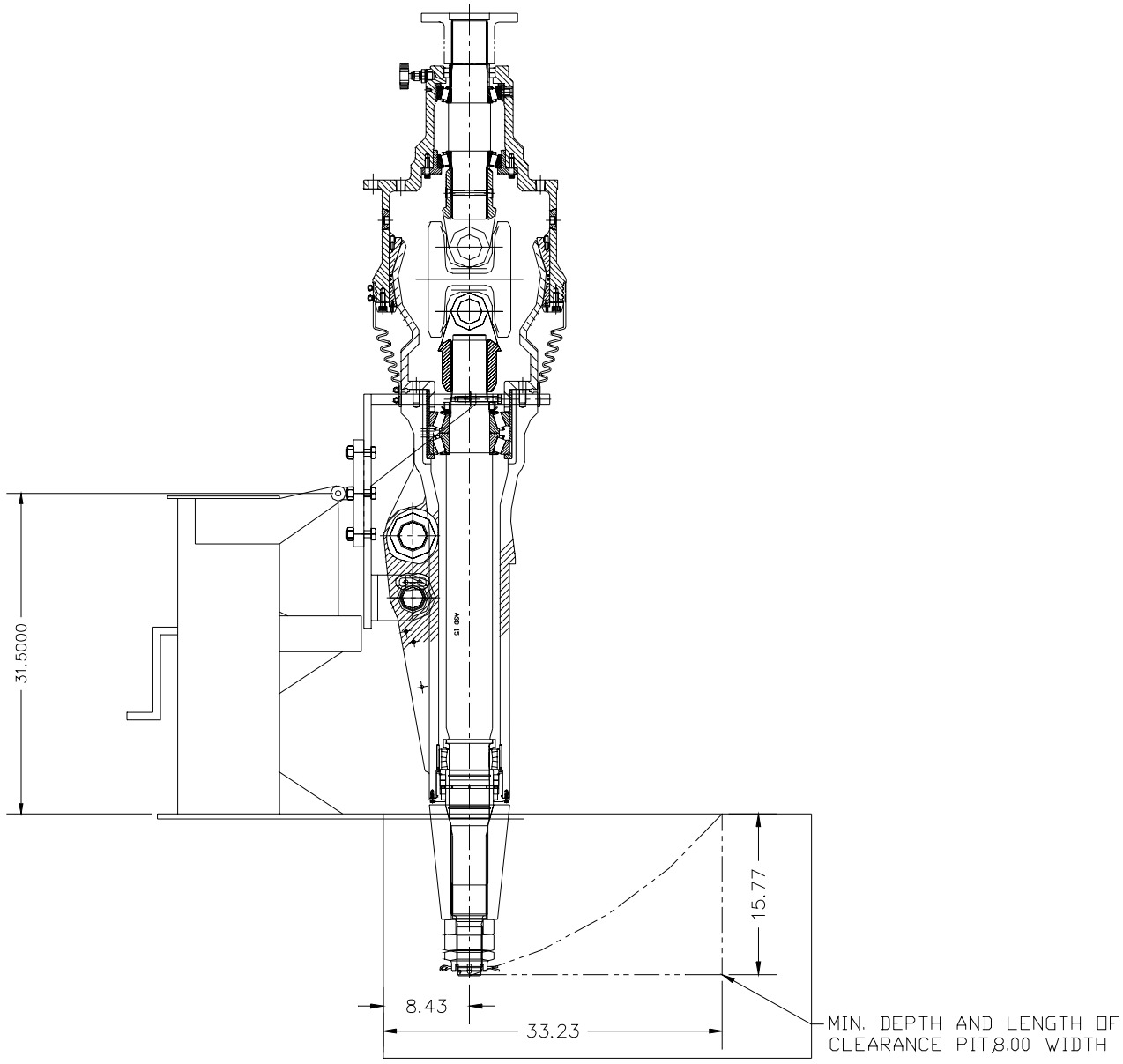
DETAIL 3



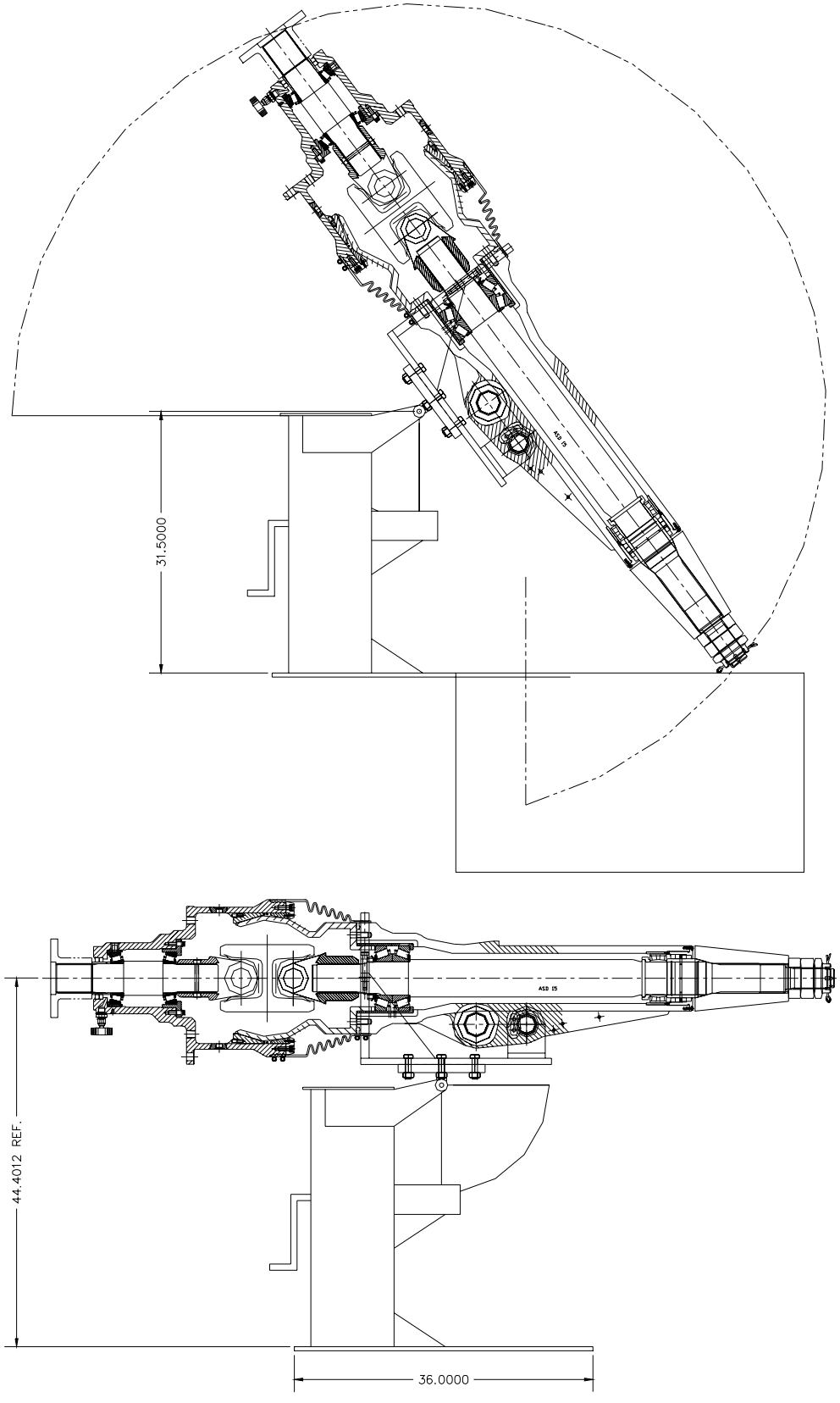
DETAIL 7



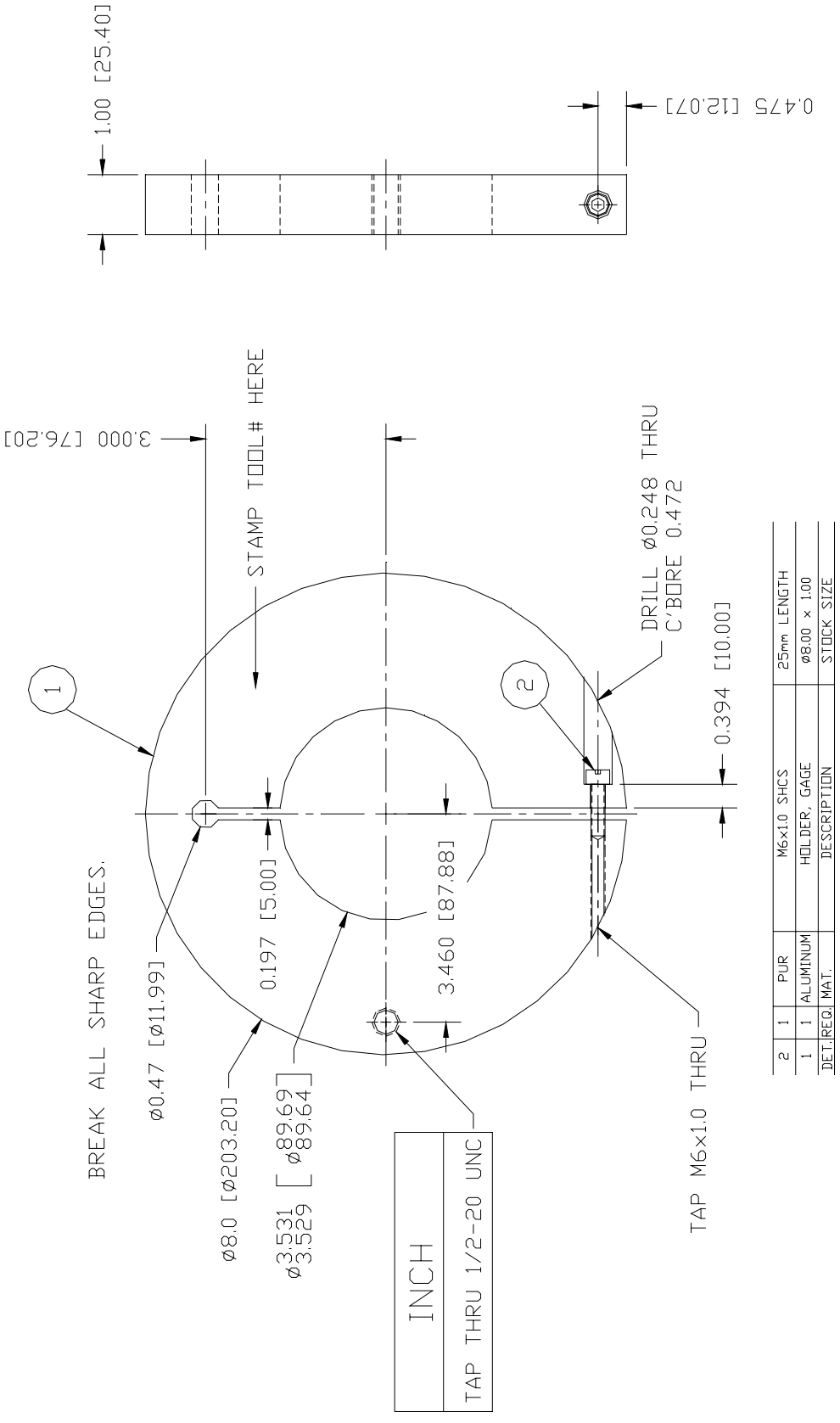
Stand Setup ASD 15A1S T-21089-5D (1 of 2)



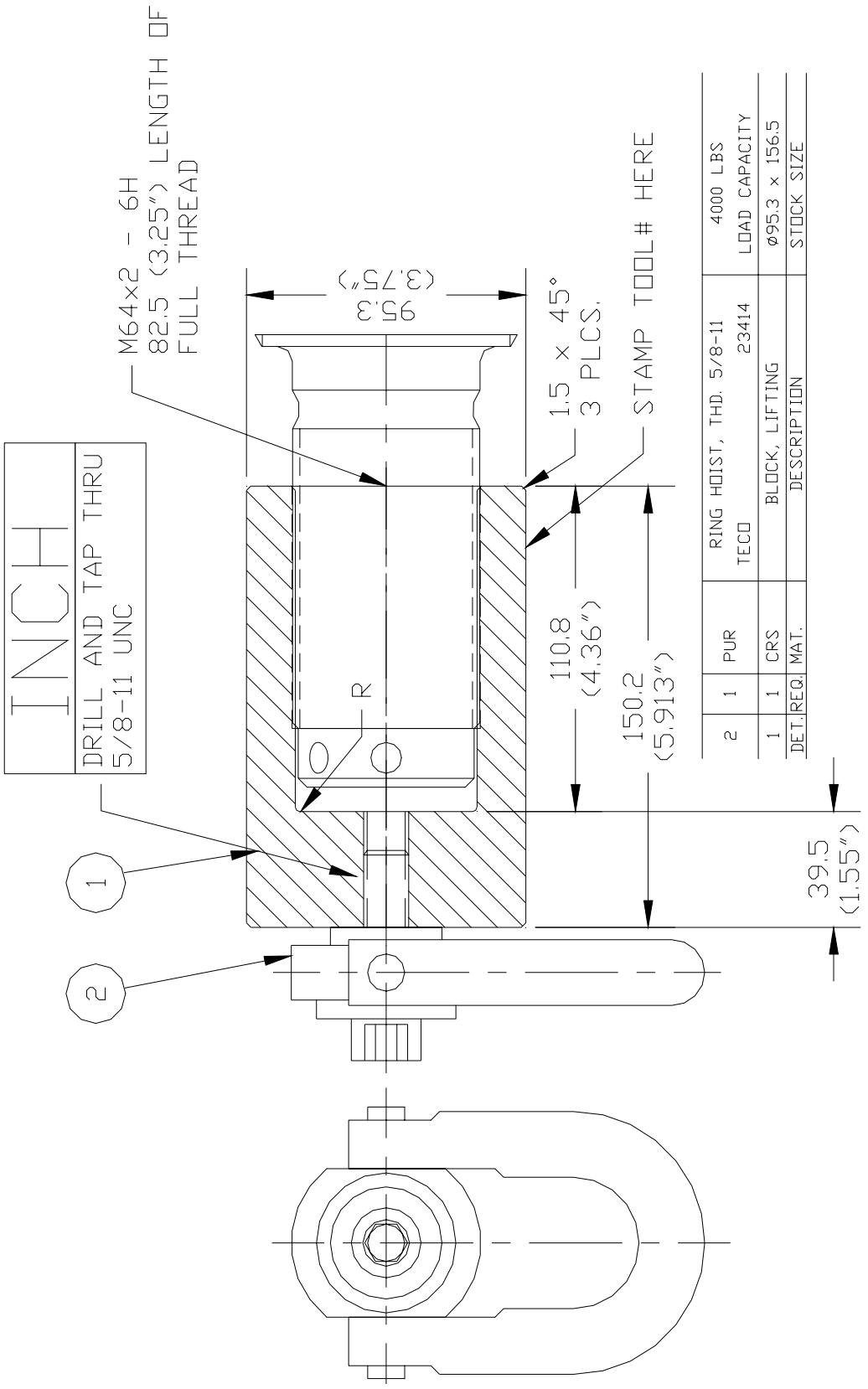
Stand Setup ASD 15A1S T-21089-5D (2of 2)



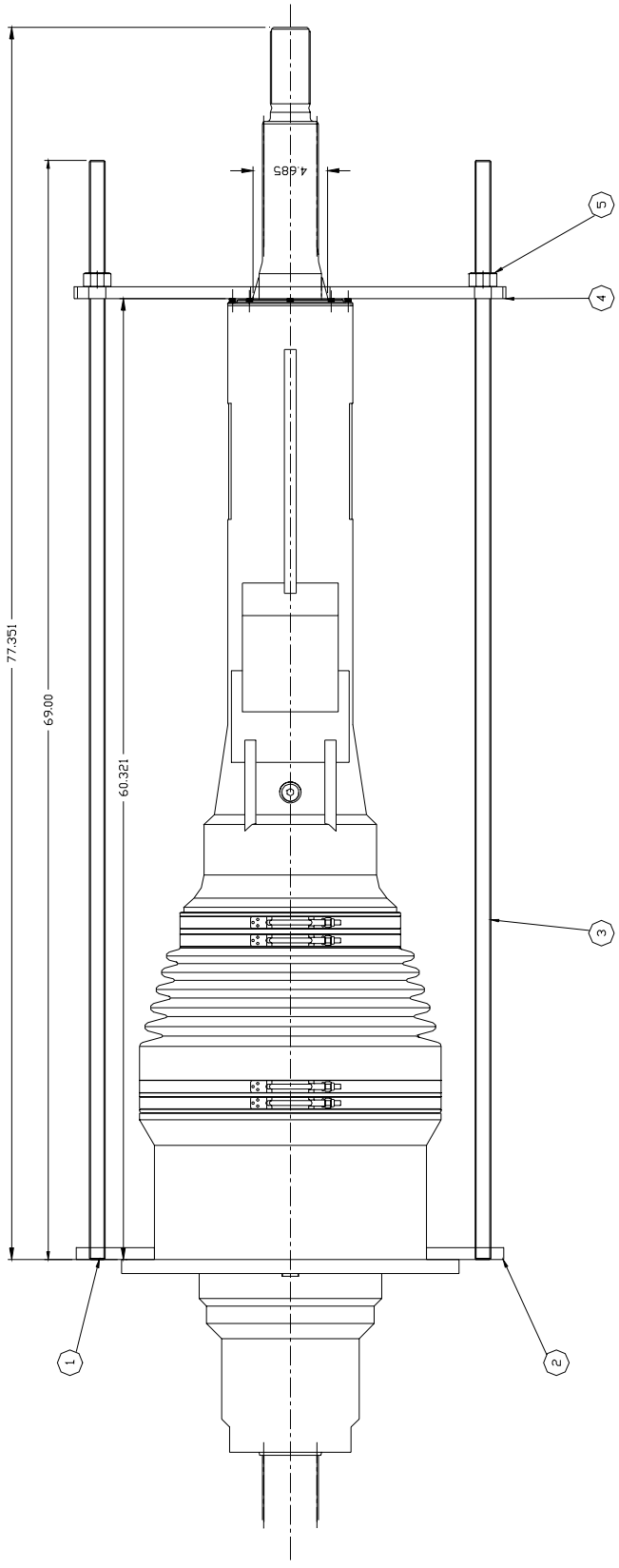
Shaft Indicator Holder T-21549-28



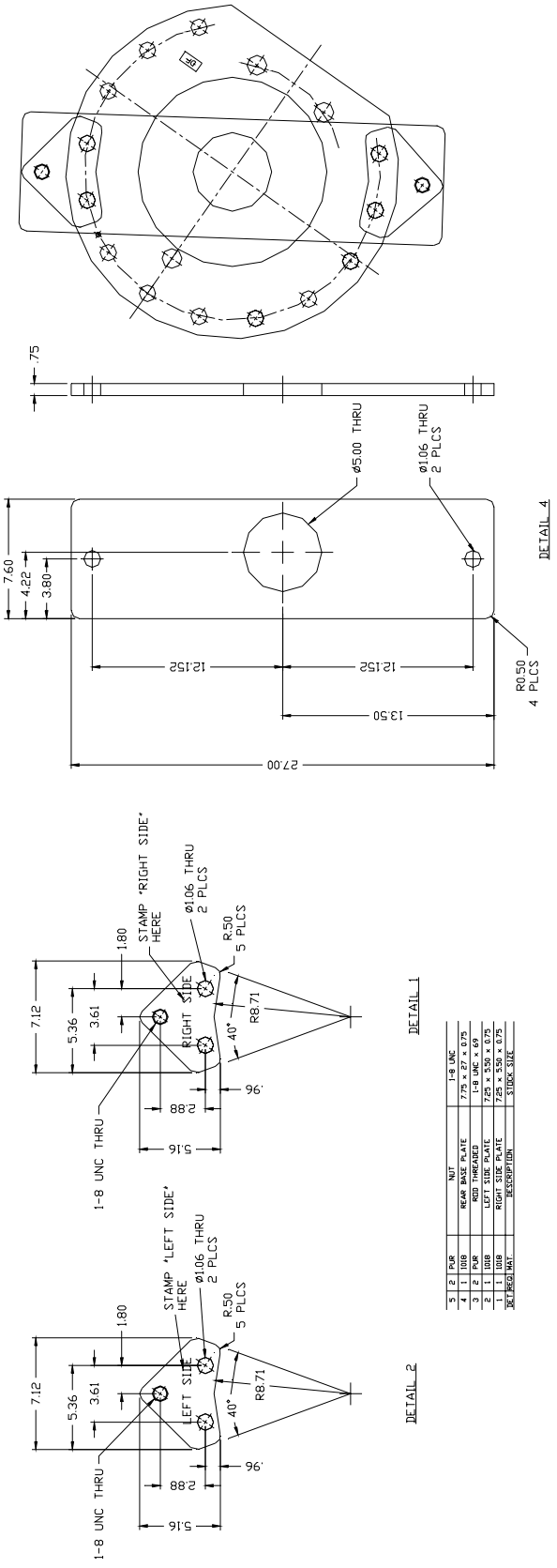
Lifting Fixture T-21567



Jacking Tool T-21570 (1 of 2)



Jacking Tool T-21570 (2 of 2)



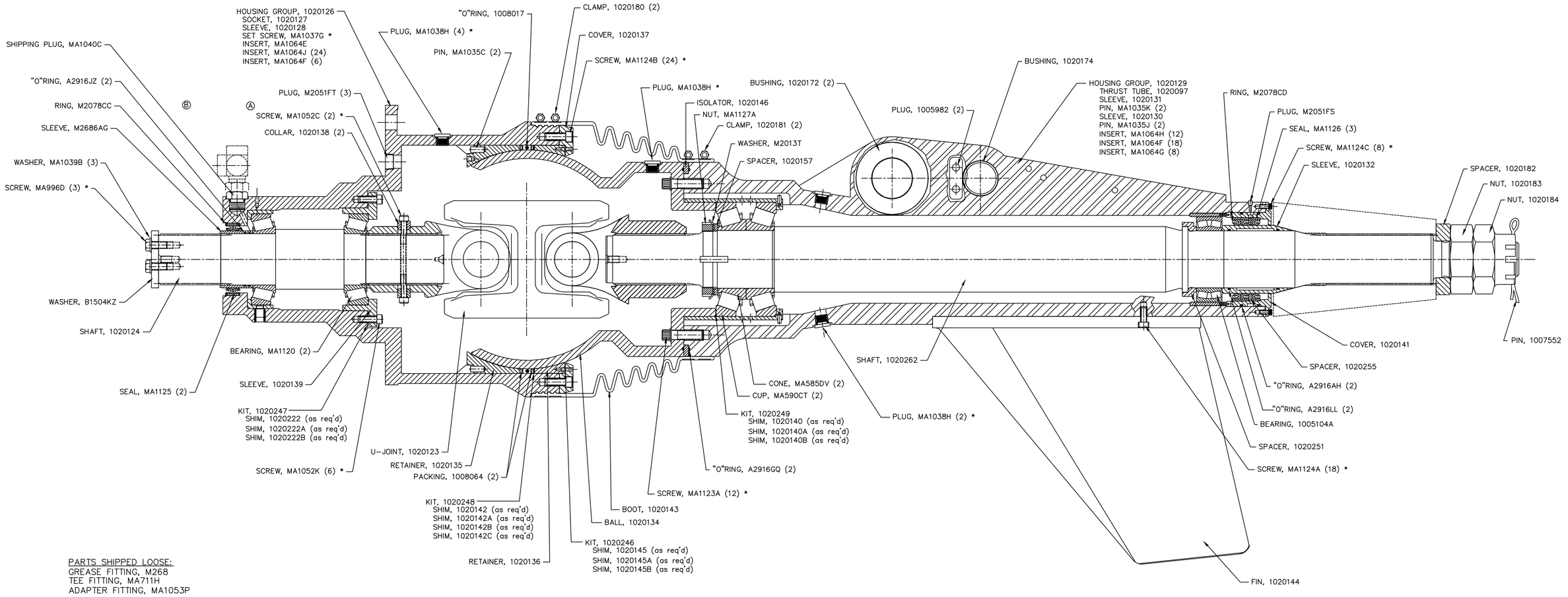
Notes

Engineering Drawings

List of Engineering Drawings

The following pages include the engineering drawings that are specific to this model. The engineering drawings included are listed below.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.



PARTS SHIPPED LOOSE:
GREASE FITTING, M268
TEE FITTING, MA711H
ADAPTER FITTING, MA1053P

FEATURES:
- STAINLESS STEEL SHAFTING
- TRIPLE PROPELLER SHAFT SEALS
- ALUMINUM HOUSING

REF. B.O.M. #: 1020120

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1018683

REV	SHEET	ZONE	CH. NO.	DATE
B	1,2&3	A3	ECN10345	8-14-01
A	1	E5	ECN10280	6-29-01

MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg / kg/m^3
FIRST USE
ASSY.
MODEL ASD 15
NAME DRIVE ASS'Y.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5-30-01
SCALE .375=1.00
DRN. D. MEYERS
CHK. FN
APPD. FN

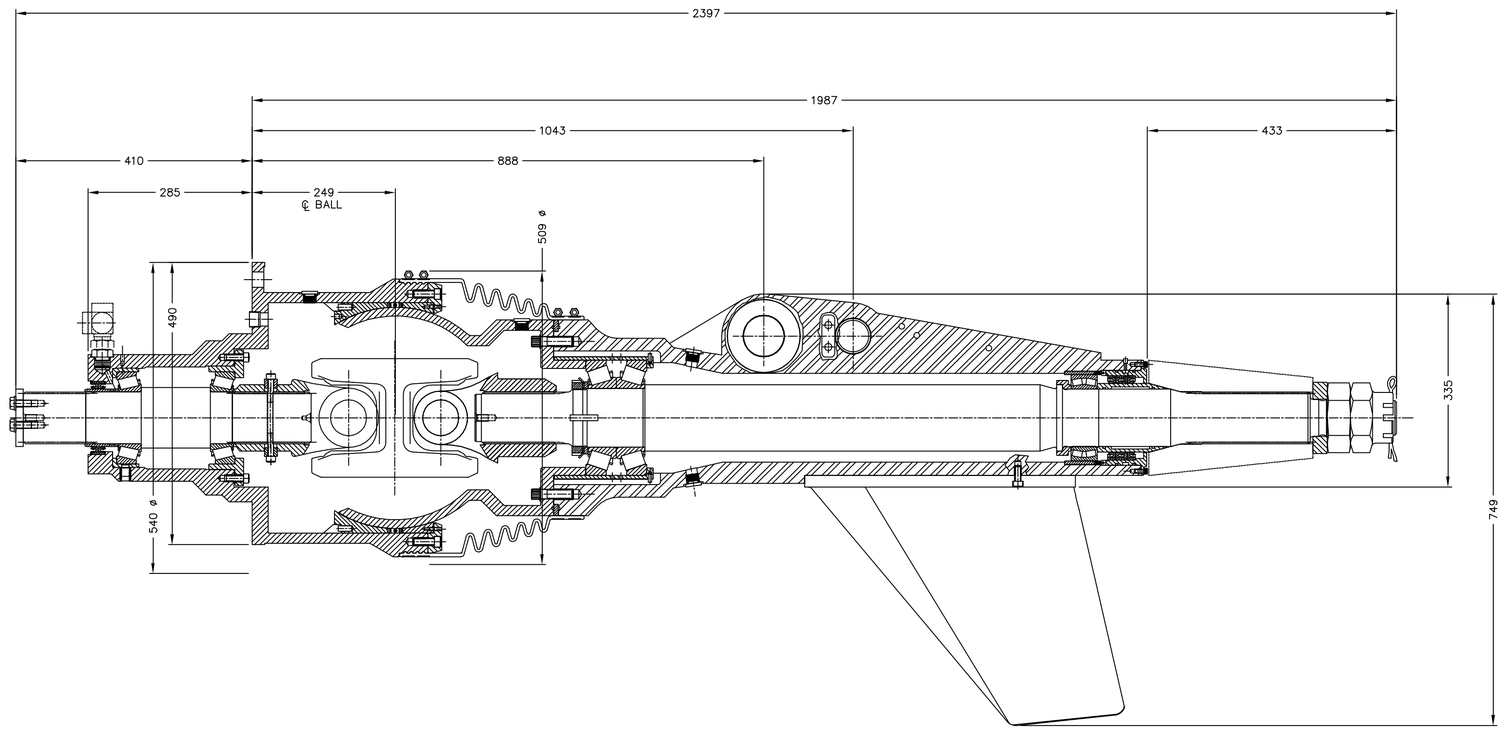
TWIN DISC INCORPORATED RACINE, WI 53403 – USA

1020119

SHEET 1 OF 4 REV B

P/N	DESCRIPTION	DRY TORQUE VALUE	
MA1124C	SCREW (COVER)	4.0 N–m	(3.0 FT–LB)
MA1124A	SCREW (FIN)	17 N–m	(12 FT–LB)
MA1123A	SCREW (BALL)	170 N–m	(125 FT–LB)
MA1124B	SCREW (RETAINER COVER)	60 N–m	(40 FT–LB)
1020183	NUT (PROP)	1140–1285 N–m	(800–900 FT–LB)
1020184	NUT, JAM (LOCK) (PROP)	SEE NOTE 9	SEE NOTE 9
MA1052K	SCREW (U–JOINT FIXATION)	SEE NOTE 10	SEE NOTE 10
MA1052K	SCREW (BEARING SLEEVE)	55 N–m	(40 FT–LB)
MA996D	SCREW (COMPANION FLANGE)	100 N–m	(75 FT–LB)

TAPER PIPE FITTINGS SHALL BE SCREWED HAND TIGHT AND WRENCHED AN ADDITIONAL 1.5–2.0 TURNS. USE PIPE SEALANT SPARINGLY.



NOTES:

1) PACKING, QTY 2, 1250mm (49.17IN) LENGTH EACH IS REQUIRED.

2) STACK SHIMS SO THAT 0.05 TO 0.13mm (.002 TO .005 IN) BEARING END PLAY IS ACHIEVED.

3a) APPLY LUBRICANT ON AND BETWEEN SEALS. LUBRICANT SHALL BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS ZEP BRAND RED LITHIUM GREASE.

3b) THE PROPELLER SHAFT SEALS ARE PROVIDED WITH A LUBRICATION PORT. TO LUBRICATE THE SEALS, REMOVE THE PIPE PLUG AND INSERT THE GREASE FITTING THAT IS PROVIDED WITH THE DRIVE. USE ZEP BRAND RED LITHIUM GREASE OR EQUAL AS ABOVE. PUMP GREASE UNTIL CLEAN GREASE EMERGES UNDER THE EDGE OF THE COVER (ROPE GUARD).

4) APPLY MARINE GRADE SILICONE (NON HARDENING) ON THE FIN PAD SURFACE PRIOR TO INSTALLATION.

5a) COAT THE * MARKED THREADS WITH THREAD LOCKING COMPOUND (242, 742 BLUE SEMI–PERMANENT).
USE ALL APPLICABLE SOLVENTS, PRIMERS, AND ACTIVATORS.

5b) COAT ALL TAPER PIPE THREADS WITH A NON–HARDENING PIPE THREAD SEALANT.
USE SPARINGLY.

6) SHIM PROCEDURE

AFT RETAINER

a) PLACE FORWARD RETAINER (1020135) INTO SOCKET HOUSING. ENSURE THE RETAINER IS SEATED FIRMLY AGAINST THE SHOULDER IN THE SOCKET.

b) THIS PROCEDURE IS TO SHIM THE AFT RETAINER (1020136) TO THE THRUST BALL (1020134). PLACE THE THRUST BALL INTO THE FORWARD RETAINER. INSTALL ENOUGH SHIMS (OVER–SHIM THE RETAINER COVER (1020137)) AS TO CREATE A GAP BETWEEN THE COVER AND THE SOCKET HOUSING.

c) THE WEIGHT OF THE RETAINER COVER WILL CAUSE THE AFT RETAINER TO SEAT AS A LINE FIT TO THE BALL. BECAUSE THE COVER WAS OVER–SHIMMED, A GAP WILL EXIST BETWEEN THE COVER AND THE SOCKET HOUSING. MEASURE THIS GAP. TAKE SEVERAL READINGS AROUND THE UNIT AND AVERAGE THE VALUES.

d) REMOVE THE AMOUNT OF SHIMS EQUIVALENT TO OR THE NEXT SIZE LARGER THAN THE GAP MEASURED. FOR EXAMPLE, IF THE GAP MEASURED IS 2.92mm (.115 IN) INCHES, REMOVE 3.05mm (.120 IN). THIS WILL CREATE A LINE FIT TO SLIGHTLY LOOSE BETWEEN THE AFT RETAINER AND THE BALL. THE AFT RETAINER HAS NOW BEEN SHIMMED PROPERLY TO THE BALL.

SEAL AND PACKING

a) REMOVE THE THRUST BALL FROM THE SOCKET. INSTALL THE PACKING, O–RING AND THEN PACKING OVER THE FORWARD RETAINER. NEXT, SHIMS ARE REQUIRED BETWEEN THE AFT RETAINER AND PACKING. THE GOAL IS TO OBTAIN THE PROPER SQUEEZE ON THE O–RING. THE PACKING IS NOT A RESILIENT MATERIAL, THEREFORE, ONCE COMPRESSED WILL MAINTAIN ITS SHAPE. PROPER SQUEEZE ON THE O–RING IS 10–15% OF THE CROSS SECTION WHICH IS 1.0 TO 1.5mm (.04 TO .06 IN).

b) INITIALLY OVER–SHIM THE PACKING MATERIAL BY INSERTING 3.8mm (.150 IN) OF SHIMS. INSTALL THE AFT RETAINER, RETAINER COVER, AND BOLTS. TORQUE EVENLY TO 36 N–m (25 FT–LB.) BECAUSE THE PACKING WAS OVER–SHIMMED, A GAP WILL EXIST BETWEEN THE RETAINER COVER AND THE SOCKET HOUSING. MEASURE THIS GAP. TAKE SEVERAL READINGS AROUND THE UNIT AND AVERAGE THE VALUES.

c) LOOSEN THE BOLTS ON THE RETAINER COVER TO ALLOW THE O–RING TO RELAX AGAIN, MEASURE THIS GAP. TAKE SEVERAL READINGS AROUND THE UNIT AND AVERAGE THE VALUES. THE DIFFERENCE BETWEEN THESE TWO READINGS IS THE SQUEEZE ON THE O–RING.

EXAMPLE

A) 3.8mm (.150 IN) SHIMS ON THE PACKING, RETAINER BOLTS TORQUED TO 25 FT–LBS. ——— GAP=0.75mm (.030 IN) AVG.
B) LOOSEN RETAINER BOLTS. ——— GAP=2.75mm (.110IN) AVG.
C) SQUEEZE ON O–RING. ——— SQUEEZE=2mm (.08 IN)

THE O–RING SQUEEZE SHOULD BE BETWEEN 1.0 TO 1.5mm (.040–.060. IN) THIS EXAMPLE, 0.75 mm (0.030 IN) OF SHIM MATERIAL SHOULD BE REMOVED.

7) LUBRICANT RECOMMENDATIONS;
SAE 30 WITH EMULSIFYING PROPERTIES
MIN. VISCOSITY 100 CST @ 100F
FILL DRIVE UNTIL EXTERNAL RESERVOIR
IS ONE THIRD FULL.

8) TORQUE JAM NUT TO 860–1000 N–m (600–700 FT.–LB.). APPROACH LOWER TORQUE VALUE, THEN CONTINUE UNTIL COTTER PIN SLOT IN NUT ALIGNS WITH HOLE IN SHAFT.

9) FROM TOP OF PLUG TO O.D. OF YOKE TO BE NOT LESS THAN 2.2mm. TORQUE NOT TO EXCEED 42 N–m (30 FT–LBS).

10) HANDLE CAREFULLY TO AVOID DAMAGING PAINT. TOUCH–UP CHIPPED PAINT WITH A TWO PART MARINE EPOXY PRIMER SUCH AS PETTIT #6455 METAL PRIMER FOLLOWED BY #4700 AND #4701 HIGH BUILD EPOXY PRIMER OR EQUAL. THE MINIMUM THICKNESS FOR CURED PRIMER IS 0.15mm (.006 IN).

11) AFTER DRIVE IS INSTALLED, REMOVE SHIPPING PLUG MA1040C AND REPLACE WITH LUBE OIL SYSTEM ADAPTER FITTINGS MA1053P AND MA711H.

12) SEE TWIN DISC SERVICE MANUAL FOR ALL OTHER PROCEDURES AND SPECIFICATIONS. Ⓑ

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO 1018683

REF. B.O.M. #: 1020120

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg | Wk² N·m²

FIRST USE
ASSY.
MODEL ASD 15
NAME DRIVE ASS'Y.

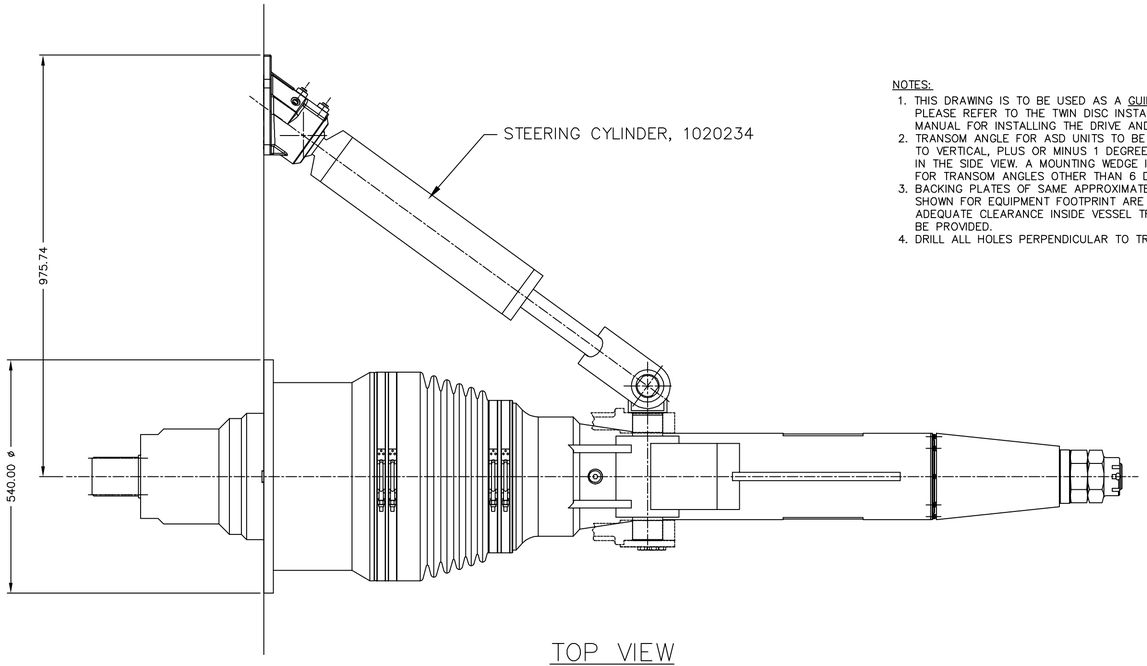
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5–30–01
SCALE .25=1.00
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

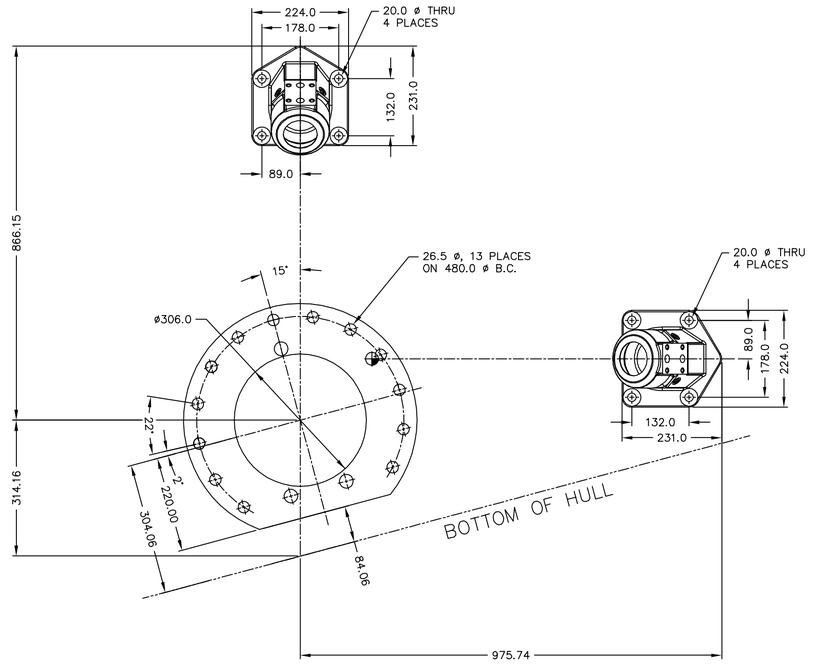
1020119

SHEET 2 OF 4 REV B

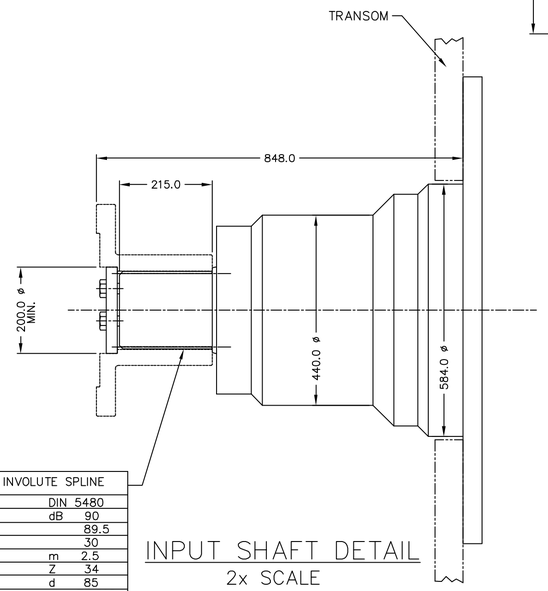


TOP VIEW

NOTES:
1. THIS DRAWING IS TO BE USED AS A GUIDE ONLY. PLEASE REFER TO THE TWIN DISC INSTALLATION MANUAL FOR INSTALLING THE DRIVE AND CYLINDERS.
2. TRANSOM ANGLE FOR ASD UNITS TO BE 6 DEGREES TO VERTICAL, PLUS OR MINUS 1 DEGREE, AS SHOWN IN THE SIDE VIEW. A MOUNTING WEDGE IS REQUIRED FOR TRANSOM ANGLES OTHER THAN 6 DEGREES.
3. BACKING PLATES OF SAME APPROXIMATE DIMENSIONS AS SHOWN FOR EQUIPMENT FOOTPRINT ARE SUPPLIED. ADEQUATE CLEARANCE INSIDE VESSEL TRANSOM SHOULD BE PROVIDED.
4. DRILL ALL HOLES PERPENDICULAR TO TRANSOM.

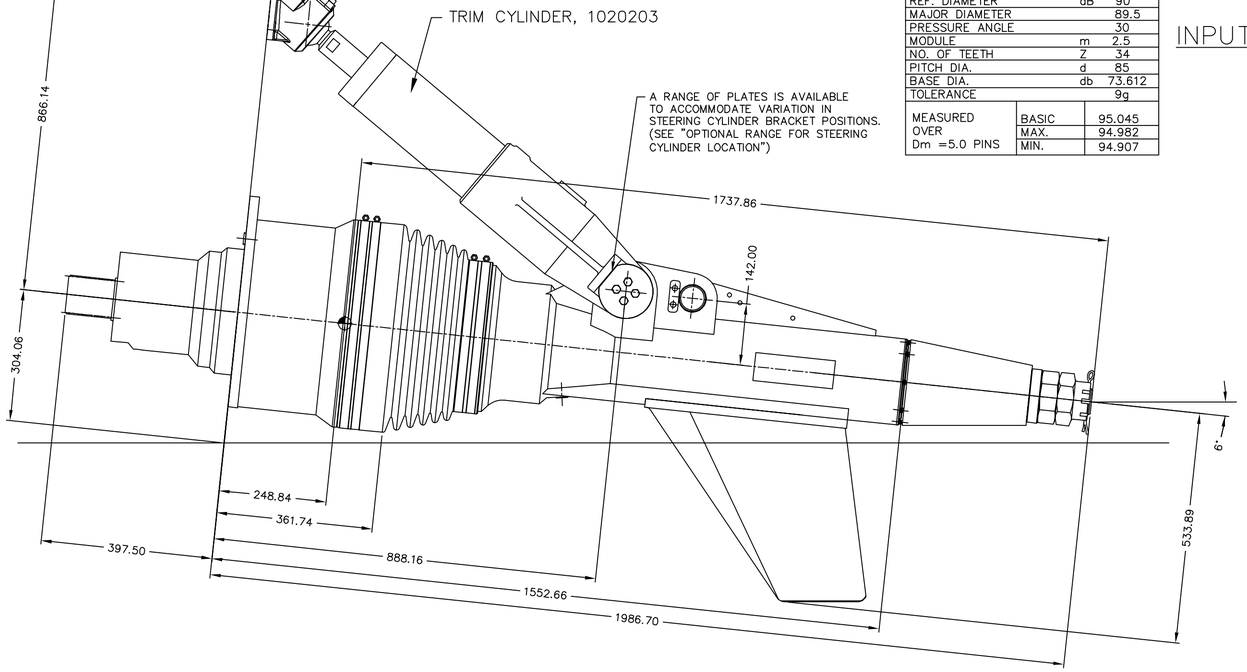


END VIEW

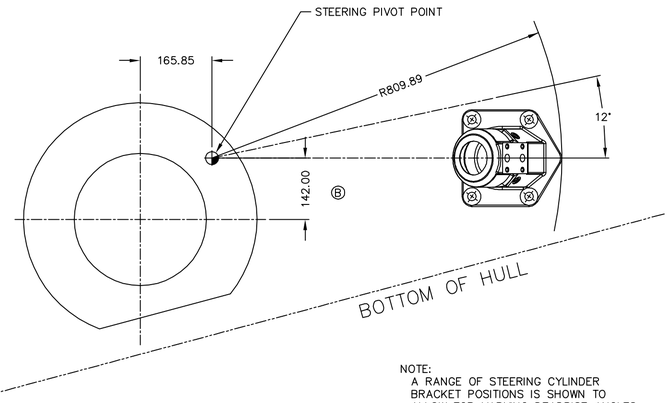


INPUT SHAFT DETAIL
2x SCALE

METRIC EXTERNAL INVOLUTE SPLINE		
SPLINE TYPE		DIN 5480
REF. DIAMETER	dB	90
MAJOR DIAMETER		89.5
PRESSURE ANGLE		30
MODULE	m	2.5
NO. OF TEETH	Z	34
PITCH DIA.	d	85
BASE DIA.	db	73.612
TOLERANCE		9g
MEASURED OVER Dm =5.0 PINS	BASIC	95.045
	MAX.	94.982
	MIN.	94.907



SIDE VIEW



NOTE:
A RANGE OF STEERING CYLINDER BRACKET POSITIONS IS SHOWN TO ALLOW FOR VARYING DEADRISE ANGLES.

OPTIONAL RANGE FOR STEERING CYLINDER LOCATION

REF. B.O.M.'s:
DRIVE ——— 1020120
STEERING CYLINDER GROUP – 1020325
TRIM CYLINDER GROUP ——— 1020324

SHEET 1 PARTS DRAWING
SHEET 2 ASSEMBLY NOTES
SHEET 3 INSTALLATION INTERFACE
SHEET 4 INBOARD STEERING CYLINDER ARRANGEMENT

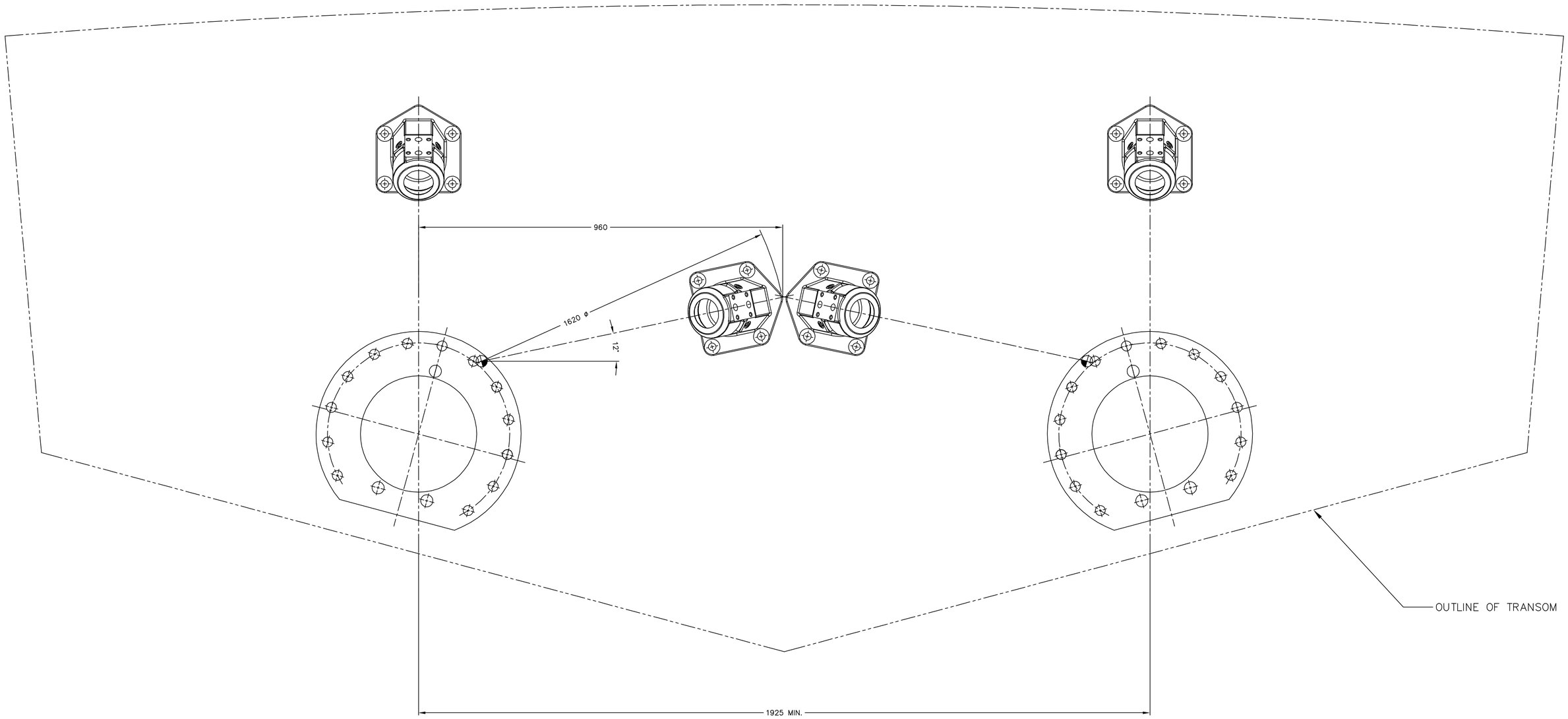
METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg / lb
FIRST USE ASSY. ASD 15
MODEL
NAME DRIVE ASS'Y.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.38
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 5-30-01
SCALE 3/16
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

1020119

SHEET 3 OF 4 REV B



REF. B.O.M.'s:
DRIVE ——— 1020120
STEERING CYLINDER GROUP – 1020325
TRIM CYLINDER GROUP ——— 1020324

SHEET 1 PARTS DRAWING
SHEET 2 ASSEMBLY NOTES
SHEET 3 INSTALLATION INTERFACE
SHEET 4 INBOARD STEERING CYLINDER ARRANGEMENT

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT kg
m^2
$N \cdot m^2$
FIRST USE
ASSY.
MODEL ASD 15
NAME DRIVE ASS'Y.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5-30-01
SCALE 0.25=1.00
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

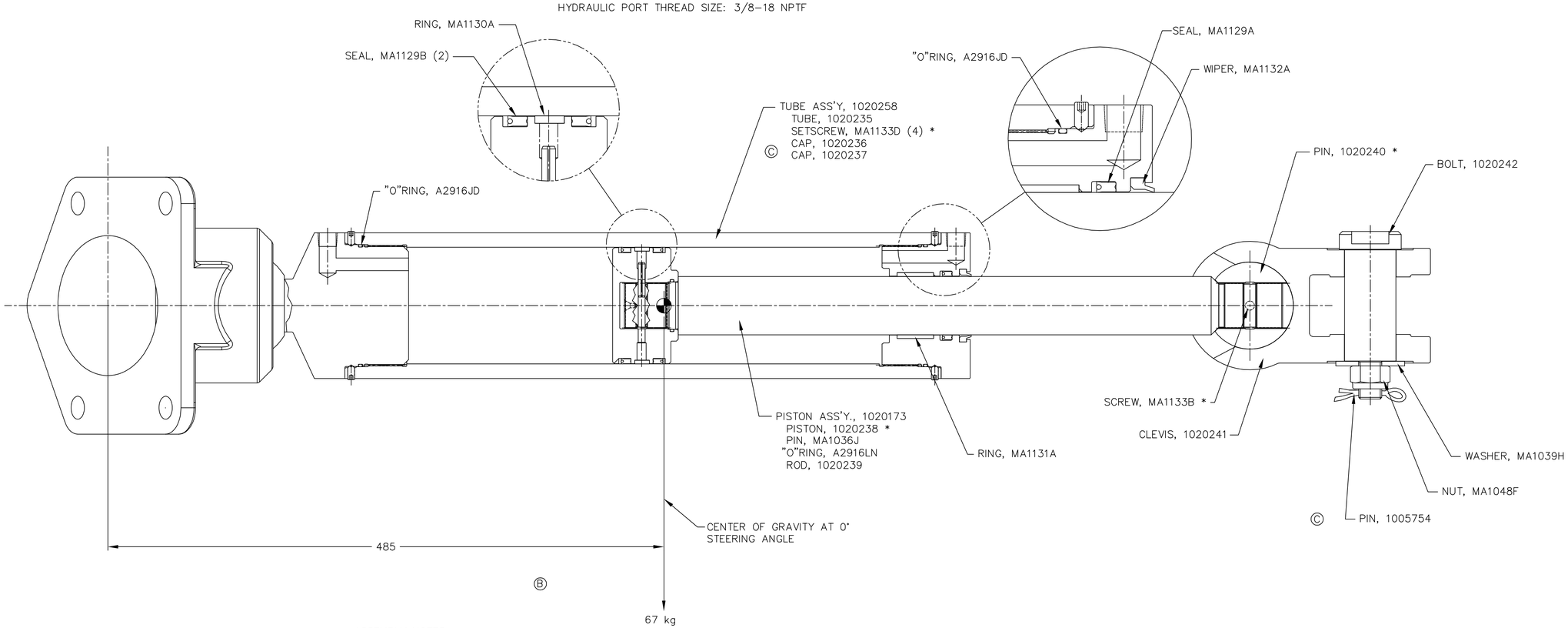
1020119

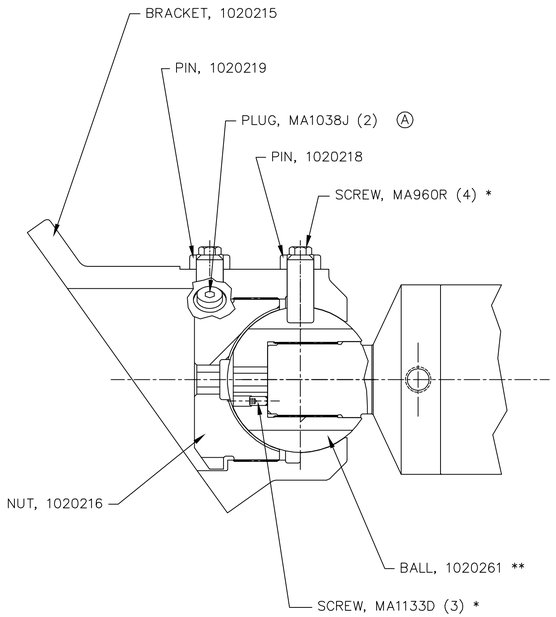
SHEET 4 OF 4 REV B

CYLINDER SPECIFICATIONS

BORE	101.6 (4.00 IN.)	ROD DIA.	50.77 (2.00 IN.)
STROKE	361.9 (14.25 IN.)	OPER. MEDIA	STD. HYD. OIL
		OPER. PRESS.	1500 P.S.I. MAX.
			2000 P.S.I. SYSTEM RELIEF VALVE

HYDRAULIC PORT THREAD SIZE: 3/8–18 NPTF





ASSEMBLY NOTES:

1) APPLY A THIN COAT OF LUBRICANT BETWEEN MATING SURFACES OF BALL/BRACKET/NUT, PIVOT PIN/CLEVIS, AND CLEVIS PIN/CLEVIS. LUBRICANT TYPE MUST BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS "RED LITHIUM GREASE" MARKETED BY THE ZEP CORP., ATLANTA, GA, USA. UNLESS OTHERWISE STATED, DO NOT LUBRICATE COMPONENT THREADS. INSTALL THREADED PARTS WITH LOCTITE AS SPECIFIED IN THESE NOTES. CLEAN THREADS PRIOR TO APPLYING LOCTITE.

2) INSTALL LIGHTLY OILED SEAL, WEAR RING, AND SCRAPER IN ROD CAP. LIGHTLY OIL ROD AND INSERT ROD THROUGH END CAP. INSERT PREVIOUSLY LUBRICATED PIVOT PIN INTO CLEVIS AND THREAD IT ONTO ROD. TORQUE AS SPECIFIED. DIMPLE THE ROD THROUGH THE M8 PIVOT PIN HOLE (THE SMALLER OF THE TWO) USING 6.5MMø DRILL. DIMPLE MUST BE FULL 6.5MMø. INSTALL SET SCREW MA1133B, TORQUE AS SPECIFIED.

3) INSTALL CAP O–RINGS, PISTON SEALS, AND WEAR RING. LIGHTLY OIL PISTON SEALS, WEAR RING, AND TUBE BORE. ASSEMBLE CAPS 1020236 AND 1020237 (DO NOT LUBRICATE THREADS) TO TUBE UNTIL HAND TIGHT. ALIGN SET SCREW HOLES IN TUBE WITH PREVIOUSLY DRILLED DIMPLES IN CAPS. CLEAN SET SCREW THREADS, APPLY SET SCREWS MA1133D AND TORQUE AS SPECIFIED.

4) LIGHTLY LUBRICATE SPHERICAL SURFACES OF BALL AND BRACKET USING ABOVE GREASE. KEEP GREASE AWAY FROM THREADS. PLACE BRACKET OVER THREADED END OF CAP. ENSURE BALL AND CAP THREADS ARE CLEAN , THEN THREAD BALL ONTO CAP USING LOCKTITE AS SPECIFIED. TORQUE TO SPECIFIED VALUE. INSERT SET SCREWS MA1133D INTO BALL, TORQUE AS SPECIFIED.

5) ALIGN SLOT IN BALL WITH HOLE IN BRACKET. INSTALL PIN 1020218 AND TORQUE SCREWS MA960R TO SPECIFIED VALUE. LUBRICATE NUT THREADS (1020216) AND SCREW NUT INTO BRACKET UNTIL HAND TIGHT. TORQUE TO SPECIFIED VALUE. BACK THE NUT UNTIL PIN 1020219 CAN BE FULLY INSERTED. TORQUE SCREWS MA960R TO SPECIFIED VALUE.

6) TORQUE VALUES

	P/N	DESCRIPTION	TORQUE VALUES
©	1020261	BALL	215–285 N–m (150–200 FT–LB)
	MA960R	SCREW	15 N–m (10 FT–LB)
	1020237	CAP	SEE NOTE 3)
	1020236	CAP	SEE NOTE 3)
	MA1133D	SET SCREW	7 N–m (5 FT–LB)
	1020238	PISTON	SEE NOTES
	1020240	PIN	110–140 N–m (75–100 FT–LB)
	MA1133B	SET SCREW	15 N–m (10 FT–LB)
	MA1048F	NUT	57 N–m (40 FT–LB)
	1020216	NUT	70 N–m (50 FT–LB) MAX.

7) COAT THE * MARKED THREADS WITH LOCKTITE THREAD LOCKER 242. (T42 BLUE SEMI–PERMANENT).

8) COAT THE ** MARKED THREADS WITH LOCKTITE THREAD LOCKER (T70 RED PERMANENT).

9) USE PIPE SEALANT ON HYDRAULIC FITTING THREADS.

REF. BOM. 1020233

REV	SHEET	ZONE	CH. NO.	DATE
C	1	D5	ECN10633	3–11–02
B	1	D3	ECN10280	6–29–01
A	1	E3	ECN10254	6–19–01

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 67 kg (147 lbs.) WR² N-m²

FIRST USE
ASSY.
MODEL ASD 15

NAME CYLINDER ASS'Y, STEERING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.5
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5–16–01
SCALE 0.5=1.0
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

1020234

SHEET 1 OF 2 REV C

SHEET 1
CYLINDER
ARRANGEMENT

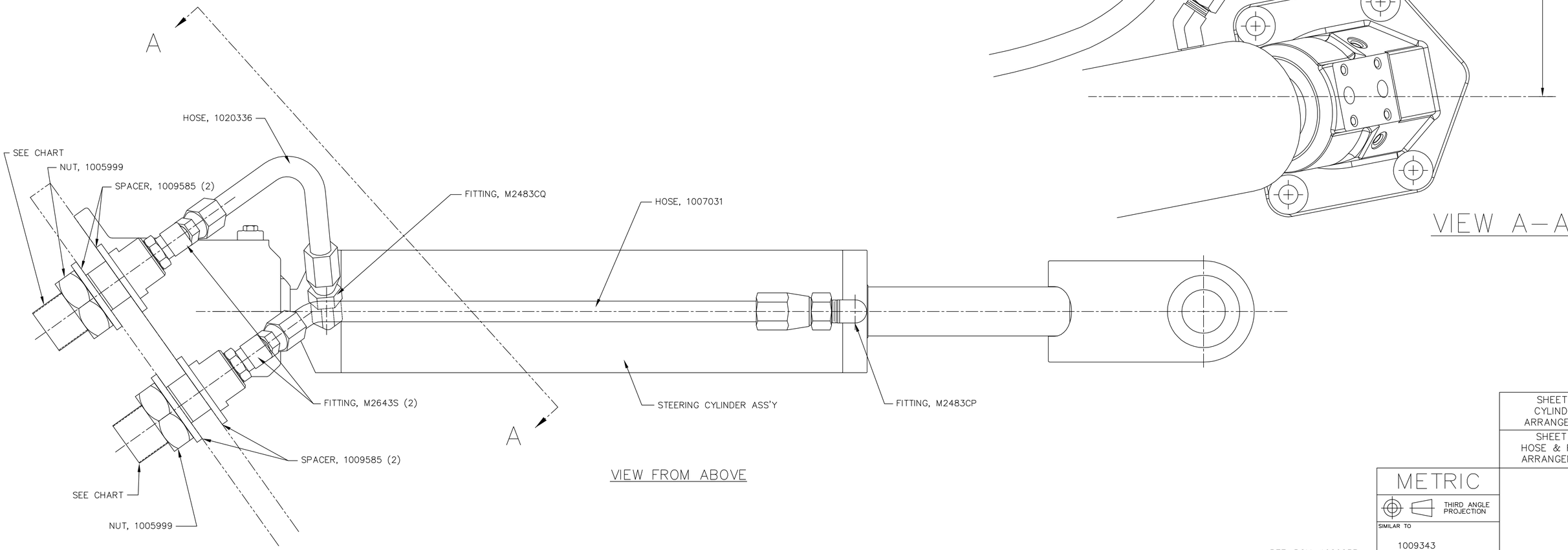
SHEET 2
HOSE & FITTING
ARRANGEMENT

METRIC

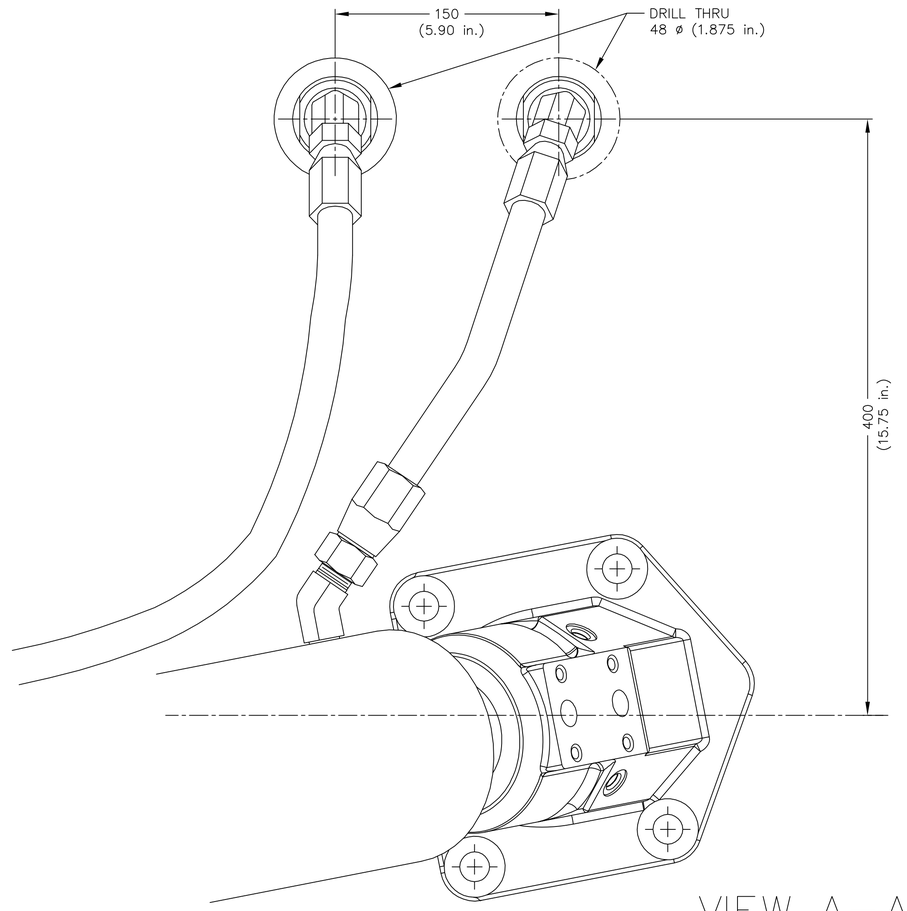
THIRD ANGLE PROJECTION

SIMILAR TO
1009343

TRANSOM THICKNESS mm	(in.)	FITTING	CYLINDER GROUP BOM
13	(.5)	1007020	1020325
25	(1.0)	1007020	1020325
38	(1.5)	1007020	1020325
50	(2.0)	1007020A	1020325A
64	(2.5)	1007020A	1020325A
75	(3.0)	1007020A	1020325A
90	(3.5)	1007020B	1020325B
102	(4.0)	1007020B	1020325B
115	(4.5)	1007020B	1020325B
127	(5.0)	1007020C	1020325C
140	(5.5)	1007020C	1020325C
152	(6.0)	1007020C	1020325C
165	(6.5)		
203	(8.0)		



VIEW FROM ABOVE



VIEW A–A

SHEET 1 CYLINDER ARRANGEMENT

SHEET 2 HOSE & FITTING ARRANGEMENT

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO 1009343

REF. BOM. 1020233

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 61.75 kg (136 lbs.) WR² N-m²

FIRST USE ASSY. MODEL ASD 15

NAME CYLINDER ASS'Y, STEERING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5–16–01

SCALE 0.5=1.0

DRN. D. MEYERS

CHK. FN

APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

1020234

SHEET 2 OF 2 REV C

ASSEMBLY NOTES:

1) THESE NOTES APPLY TO PISTON SUBASSEMBLY 1020257, TUBE SUBASSEMBLY 1020256, AND THE REMAINING PARTS. SUBASSEMBLIES ARE ASSEMBLED IN ACCORDANCE WITH THEIR RESPECTIVE DRAWINGS.

2) APPLY A THIN COAT OF LUBRICANT BETWEEN MATING SURFACES OF BALL/BRACKET/NUT. LUBRICANT TYPE MUST BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS "RED LITHIUM GREASE" MARKETED BY THE ZEP CORP., ATLANTA, GA, USA. UNLESS OTHERWISE STATED, DO NOT LUBRICATE COMPONENT THREADS. INSTALL THREADED PARTS WITH LOCTITE AS SPECIFIED IN THESE NOTES. CLEAN THREADS PRIOR TO APPLYING LOCTITE.

3) INSTALL LIGHTLY OILED SEAL, WEAR RING, AND SCRAPER IN ROD CAP. LIGHTLY OIL ROD AND INSERT ROD THROUGH END CAP. KEEP GREASE AWAY FROM THREADS. PLACE BRACKET OVER THREADED Ⓒ END OF ROD. ENSURE BALL AND ROD THREADS ARE CLEAN, THEN THREAD BALL ONTO ROD. TORQUE TO SPECIFIED VALUE. INSERT SET SCREWS MA1133D INTO BALL, TORQUE AS SPECIFIED.

4) ALIGN SLOT IN BALL WITH HOLE IN BRACKET. INSTALL PIN 1020218 AND TORQUE SCREWS MA960R TO SPECIFIED VALUE. LUBRICATE NUT (1020216) AND BRACKET THREADS AND SCREW NUT INTO BRACKET UNTIL HAND TIGHT. TORQUE TO SPECIFIED VALUE. BACK THE NUT (IF NECESSARY) UNTIL PIN 1020219 CAN BE FULLY INSERTED. TORQUE SCREWS MA960R TO SPECIFIED VALUE.

5) ASSEMBLE THE PLUG, SLEEVE, ROD 1020211, AND CAP 1020209 TOGETHER AS A UNIT. TORQUE AS SPECIFIED. INSTALL 4 LIGHTLY OILED O-RINGS. INSERT THE ASSEMBLY FULLY INTO THE TUBE. LIGHTLY OIL INTERNAL YOKE THREADS AND O-RING. THREAD TUBE WITH STOP ASSEMBLY INTO YOKE HAND TIGHT. ALIGN SET SCREW HOLES IN YOKE WITH DIMPLES IN TUBE. INSTALL SET SCREWS MA1133C, TORQUE AS SPECIFIED.

6) THE PISTON SHOULD ALREADY BE INSTALLED ON THE ROD. INSTALL CAP O-RING, PISTON SEALS, AND WEAR RINGS. LIGHTLY OIL O-RING, PISTON SEALS, WEAR RING, AND TUBE BORE. ASSEMBLE CAP WITH PISTON INTO TUBE UNTIL HAND TIGHT. ALIGN SET SCREW HOLES IN TUBE WITH PREVIOUSLY DRILLED DIMPLES IN CAP. APPLY SET SCREWS MA1133D AND TORQUE AS SPECIFIED.

7) TORQUE VALUES

		P/N	DESCRIPTION	TORQUE VALUES
Ⓑ	**	1020217	BALL	215-285 N-m (150-200 FT-LB)
Ⓑ	*	MA960R	SCREW	15 N-m (10 FT-LB)
		1020204	YOKE	SEE NOTE 4)
		1020206	CAP	SEE NOTE 5)
	*	MA1133D	SET SCREW	7 N-m (5 FT-LB)
Ⓒ	*	1020208	PISTON	140 N-m (100 FT-LB) SEE NOTE 1)
		1020216	NUT	70 N-m (50 FT-LB) MAX.
	*	MA1133C	SET SCREW	15 N-m (10 FT-LB)
	**	1020211	ROD	15 N-m (10 FT-LB)
		MA996AK	CAP SCREW	25 N-m (18 FT-LB)

8) COAT THE * MARKED THREADS WITH LOCKTITE THREAD LOCKER 242. (T42 BLUE SEMI-PERMANENT).

9) COAT THE ** MARKED THREADS WITH LOCKTITE THREAD LOCKER (T70 RED PERMANENT).

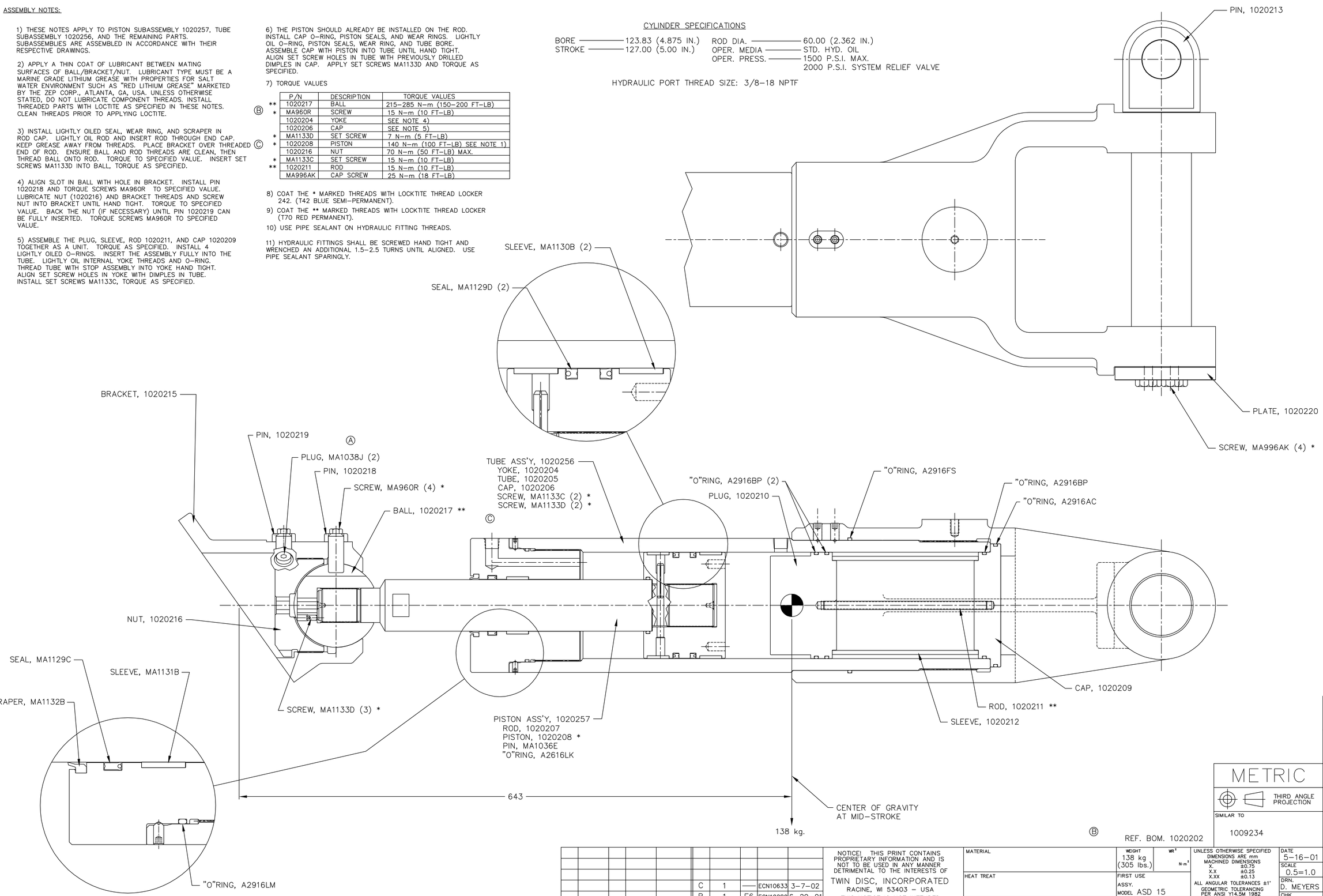
10) USE PIPE SEALANT ON HYDRAULIC FITTING THREADS.

11) HYDRAULIC FITTINGS SHALL BE SCREWED HAND TIGHT AND WRENCHED AN ADDITIONAL 1.5-2.5 TURNS UNTIL ALIGNED. USE PIPE SEALANT SPARINGLY.

CYLINDER SPECIFICATIONS

BORE ——— 123.83 (4.875 IN.)
STROKE ——— 127.00 (5.00 IN.)
ROD DIA. ——— 60.00 (2.362 IN.)
OPER. MEDIA ——— STD. HYD. OIL
OPER. PRESS. ——— 1500 P.S.I. MAX.
2000 P.S.I. SYSTEM RELIEF VALVE

HYDRAULIC PORT THREAD SIZE: 3/8-18 NPTF



SHEET 1 CYLINDER ARRANGEMENT

SHEET 2 HOSE & FITTING ARRANGEMENT

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO 1009234

REV	SHEET	ZONE	CH. NO.	DATE
C	1	——	ECN10633	3-7-02
B	1	E6	ECN10280	6-29-01
A	1	E4	ECN10254	6-19-01

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 138 kg (305 lbs.)

m^2 / $N\text{-}m^2$

FIRST USE

ASSY. MODEL ASD 15

NAME CYLINDER ASS'Y, TRIM

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

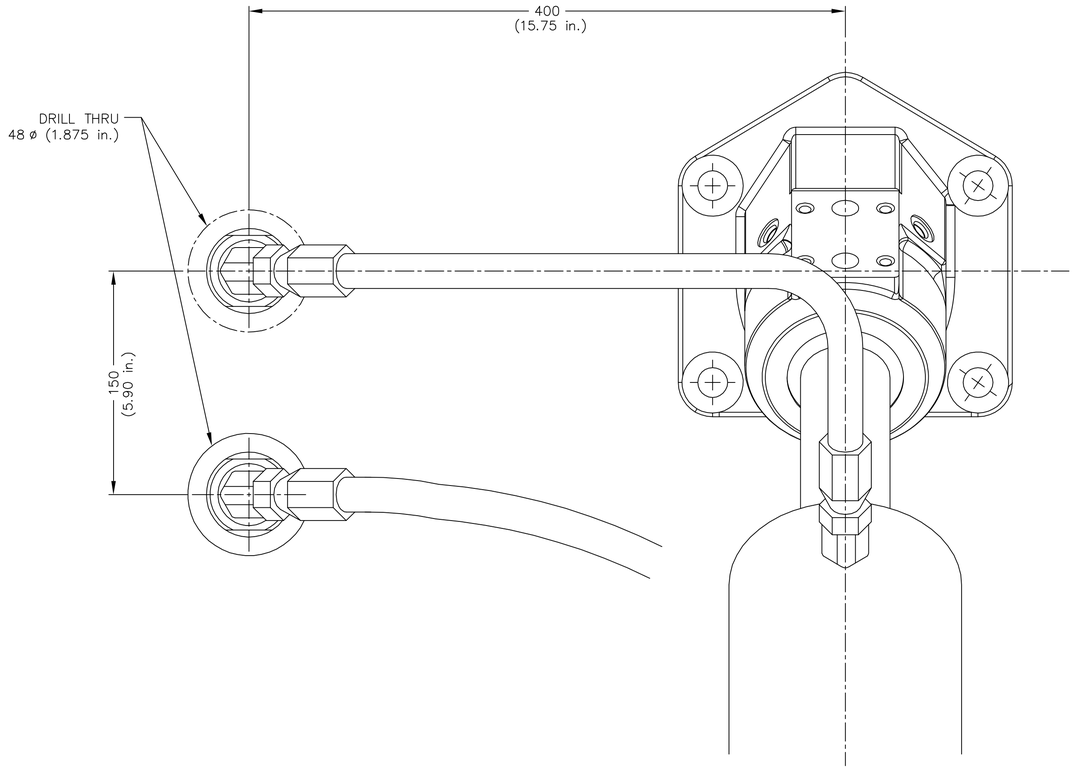
DATE 5-16-01
SCALE 0.5=1.0
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

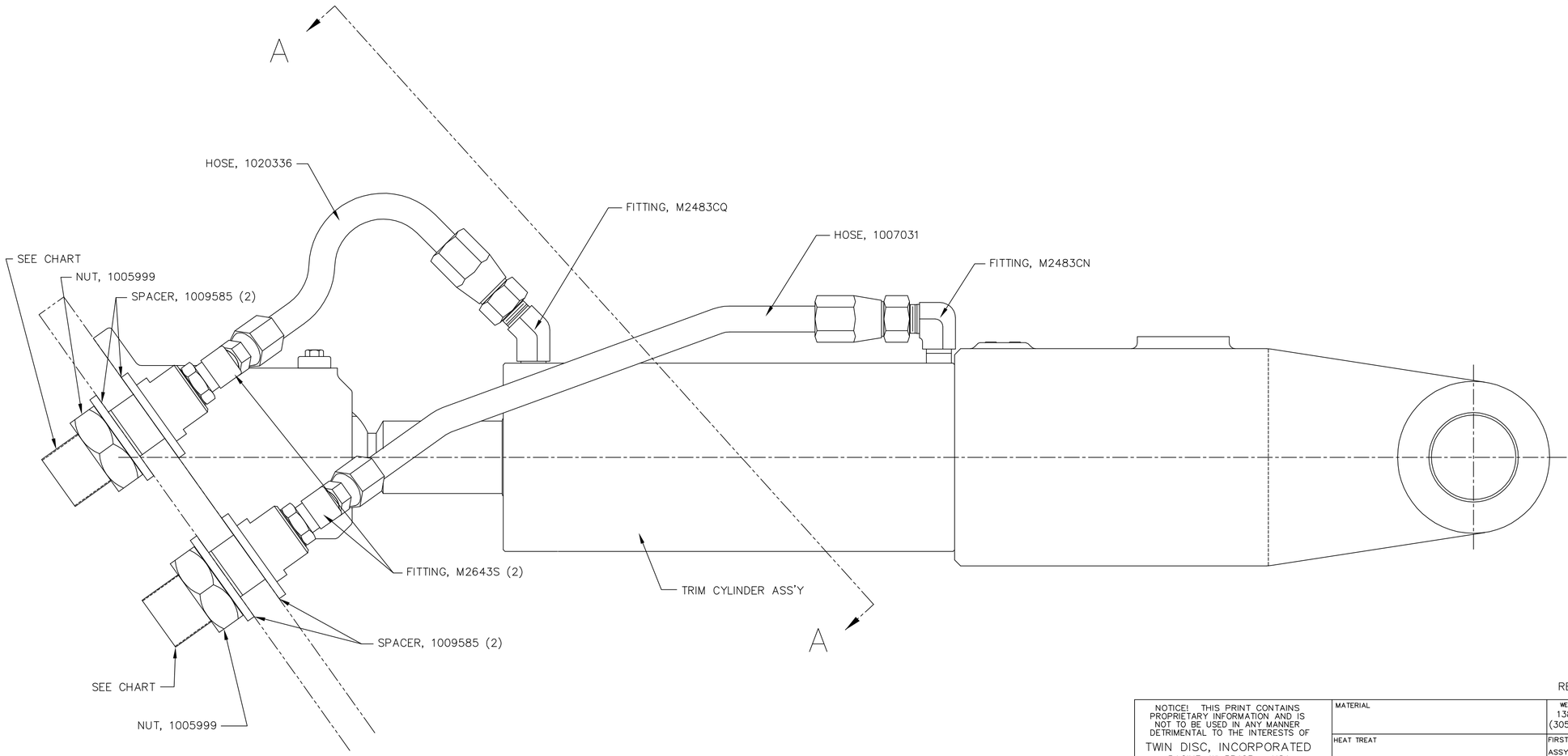
1020203

SHEET 1 OF 2 REV C

TRANSOM THICKNESS mm	(in.)	FITTING	CYLINDER GROUP BOM
13	(.5)	1007020	1020324
25	(1.0)	1007020	1020324
38	(1.5)	1007020	1020324
50	(2.0)	1007020A	1020324A
64	(2.5)	1007020A	1020324A
75	(3.0)	1007020A	1020324A
90	(3.5)	1007020B	1020324B
102	(4.0)	1007020B	1020324B
115	(4.5)	1007020B	1020324B
127	(5.0)	1007020C	1020324C
140	(5.5)	1007020C	1020324C
152	(6.0)	1007020C	1020324C
165	(6.5)		
203	(8.0)		



VIEW A–A



REF. BOM. 1020202

SHEET 1 CYLINDER ARRANGEMENT

SHEET 2 HOSE & FITTING ARRANGEMENT

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO 1009234

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 138 kg (305 LBS.) WR² N-m²

FIRST USE ASSY. MODEL ASD 15

NAME CYLINDER ASS'Y, TRIM

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 5–16–01
SCALE 0.5=1.0
DRN. D. MEYERS
CHK. FN
APPD. FN

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

1020203

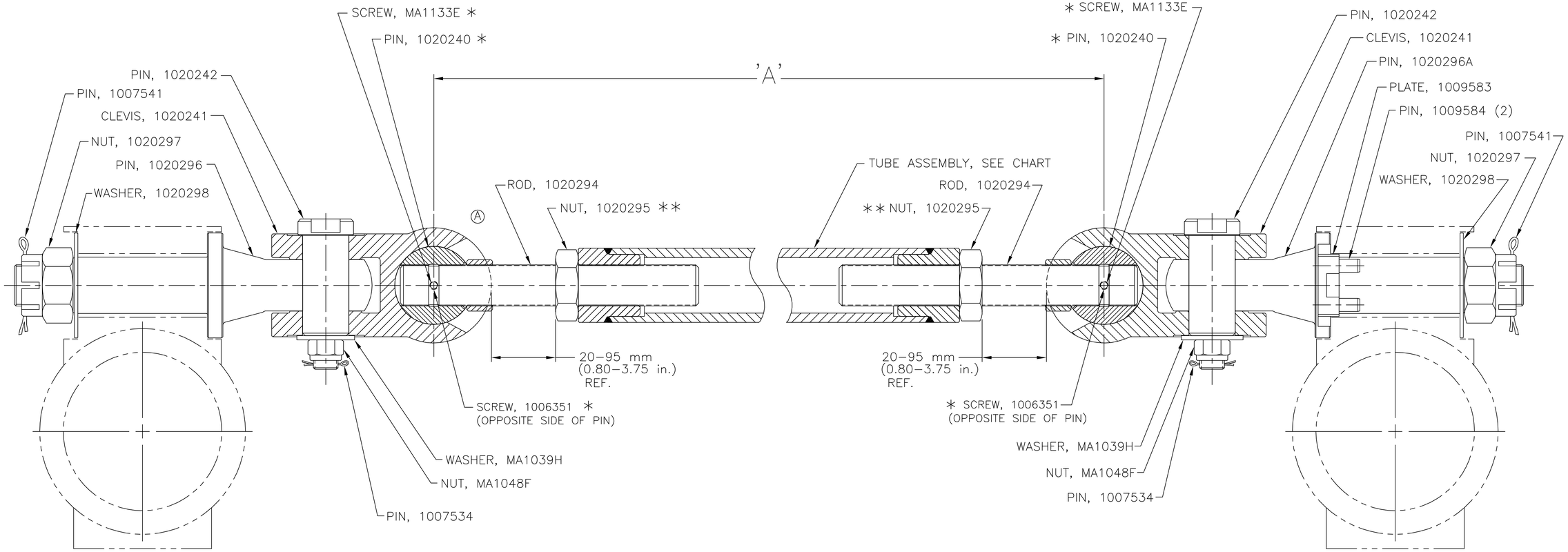
SHEET 2 OF 2 REV C

1) APPLY A THIN COAT OF LUBRICANT BETWEEN MATING SURFACES OF PINS AND CLEVIS. LUBRICANT TYPE MUST BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS RED LITHIUM GREASE. SOLD BY ZEP MANUFACTURING CO. Ⓑ ATLANTA, GA. USA
UNLESS OTHERWISE STATED, DO NOT LUBRICATE COMPONENT THREADS.
2) LUBRICATE THREADS ON PINS 1020296, 1020296A AND 1020242.
3) CENTER TUBE ASSEMBLY TO EQUALIZE LENGTH OF EXPOSED THREADED ROD 1020294.
4) APPLY LOCTITE THREAD LOCKING COMPUND #242 BLUE (OR EQUAL) TO PARTS MARKED WITH ∗.
5) APPLY LOCTITE WICKING COMPOUND #290 GREEN (OR EQUAL) TO PARTS MARKED WITH ∗∗.
6) INSTALL 1006351 FLUSH WITH END OF PIVOT PIN 1020240.

TORQUE VALUES	
PART	TORQUE: Nm (lbf–ft)
NUT, 1020297	285 Nm (200 LB–FT)
NUT, MA1048F	57 Nm (40 LB–FT)
SCREW, MA1133E	15 Nm (10 LB–FT)
NUT, 1020295	285 Nm (200 LB–FT)

TIE BAR ASSEMBLY	TIE BAR ASSEMBLY (BOM)	DRIVE CENTER DISTANCE mm (in)	DIMENSION 'A' mm (in)	TUBE ASSEMBLY
1020290	1020290	1750–1900 (68.90–74.80)	1184–1334 (46.61–52.52)	1020291
1020290A	1020290A	1900–2050 (74.80–80.71)	1334–1484 (52.52–58.43)	1020291A
1020290B	1020290B	1600–1750 (63.00–68.90)	1034–1184 (40.71–46.61)	1020291B
1020290C	1020290C	2050–2200 (80.71–86.60)	1484–1634 (58.43–64.30)	1020291C

Ⓒ



REV	ZONE	CH. NO.	DATE
C	E3	ECN10841	5–16–02
B	E3	ECN10828	5–10–02
A	C3 E3	ECN10345	8–23–01

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT 60 kg. (132 lbs.)

WR^2 $N \cdot m^2$

FIRST USE

ASSY.

MODEL ASD–15

NAME TIE BAR ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1007424

DATE 5–9–01
SCALE 1/2
DRN. J.R.
CHK. FN
APPD. FN

TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

1020290 SERIES

SHEET 1 OF 1 REV C

Notes

#1020619 07/02

TWIN DISC, INCORPORATED RACINE, WISCONSIN 53403, U.S.A. 262-638-4000/262-638-4482 (FAX) WWW.TWINDISC.COM