TWIN DISC
INCORPORATED

Service Manual

Arneson Surface Drive™

Model:
ASD12B1LU

Document Number: 1022808

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.

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August, 2007

Arneson Surface Drive™ Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY-
COMMERCIAL MARINE TRANSMISSION, SURFACE DRIVE, and ELECTRONIC CONTROL SYSTEMS

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 shipment by Twin Disc, Incorporated to 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.**
The original customer does not 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.

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 on all Commercial Marine Products except on Electronic Control Systems. . 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.

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.

FLAT RATE HOUR ALLOWANCE
COMMERCIAL MARINE *SURFACE DRIVE*

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

Description of Flat Rate Labor	ASD6	ASD8	ASD 10	ASD 11	ASD1 2	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

FLAT RATE HOUR ALLOWANCE
COMMERCIAL MARINE *ELECTRONIC CONTROL SYSTEMS*

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

*** Travel and related expenses are not included as a part of Twin Disc Electronic Control Warranty.**

Description of Flat Rate Labor (hours allowed for function to the right =>)	EC200	EC250	EC300	External Sensor
Removal and Reinstallation and Test	3	3	3	1
Electronic Control Repair * * there are no serviceable internal components	0	0	0	0

Table of Contents

Introduction

General Information

This publication provides service information for the Twin Disc model ASD 12B1LU 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, Incorporated 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, Incorporated, Racine, Wisconsin, U.S.A.

Description and Specifications

General

The ASD 12B1LU Arneson Surface Drives are in line steerable propulsion systems that support and drive 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.

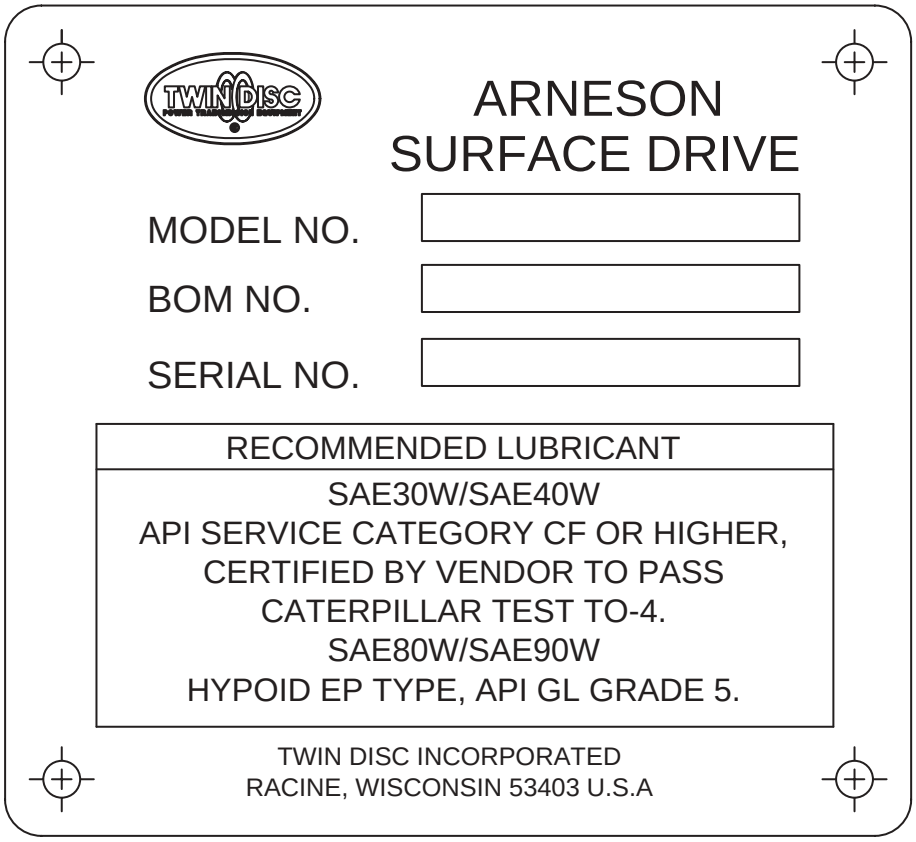


Figure 1. Nameplate for Arneson Surface Drive

Construction Features

Arrangement

Arneson Surface Drives are 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

Arneson Surface Drives are comprised of three housings: the thrust tube, the thrust ball, and the thrust socket. All three are made of nickel - aluminum - bronze alloy material.

Bearings

The input (engine driven) shaft is supported and located by a cylindrical roller bearing on the input end and a ball bearing on the output end. The propeller shaft is supported by two tapered roller bearings on the input end, and by a cylindrical 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 cup.

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.

Weight

The approximate dry weight of the ASD12B1LU is 356 kg (785 lbs). This includes the drive, trim and steering cylinders, trim pump, reservoir, mounting hardware, and hoses.

Drive Lubrication Features

Drive Oil Capacity

The approximate capacity of the drive and reservoir is 19 - 21 liters (5 - 5.5 gallons).

Lubrication Specifications

The lubricating oil is specified as:

- ☐ SAE 30W/40W - API Service Category CF or higher, certified by vendor to pass Caterpillar test TO-4.
- ☐ SAE 80W/90W - Hypoid EP Type, API GL Grade 5.

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.

Torque Values for Fasteners

Table 1. Torque Specifications for Fasteners used in ASD 12B1LU

DESCRIPTION	DRY TORQUE VALUE	
	N·m	Lb-Ft
Screw (Aft Cover)*	2260 N·mm	20 lb-in.
Screw (Fin)*	35 N·m	25 lb-ft
Screw (Ball)*	140 N·m	100 lb-ft
Nut, Lock (Input Flange)	240 N·m	175 lb-ft
Nut, Lock (Tapered Bearings on Prop Shaft)	140 N·m (min.)	100 lb-ft (min.)
Screw (Ball Retainer Clip)	7350 N·mm	65 lb-in.
Nut, Jam (Prop)	610 - 680 N·m	450 - 500 lb-ft
Nut, Lock (Prop)	480 - 540 N·m**	350 - 400 lb-ft**
Screw (U-Joint)*	65 N·m	45 lb-ft
* Apply Loctite® 242 or similar semi-permanent threadlocker.		
** Approach lower torque value, then continue until the cotter pin slot in nut aligns with hole in shaft. Do not exceed the maximum torque value.		

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 12B1LU is designed for a maximum intermittent torque loading of 4800 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 Arneson Surface Drive 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 21cm (8 in.) each side of the propeller tips, and at least 1.83 m (6 ft) forward of the transom.

The optimum mounting angle for Arneson Surface Drive is six degrees to the vessel’s baseline. Correct mounting of the unit may require a supplementary wedge. When ordering the Arneson Surface Drive, 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 6.40 mm (1/4 in.). Transom outboard surface must be flat to within 1.60 mm (1/16 in.). Transom inboard surface must be flat to within 3.18 mm (1/8 in.) 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 marine transom sealant. 3M Brand 5200 marine sealant or equivalent is recommended. Follow manufacturer'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
613 Third Street
Suite 10
Annapolis, MD 21403, USA
www.abycinc.org

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 2, 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 3, as this can cause damage to the ball and socket bearings. The supporting mechanism must be capable of carrying the unit's weight, approximately 600 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 1019886E should be applied to the wedge and not directly to the transom.

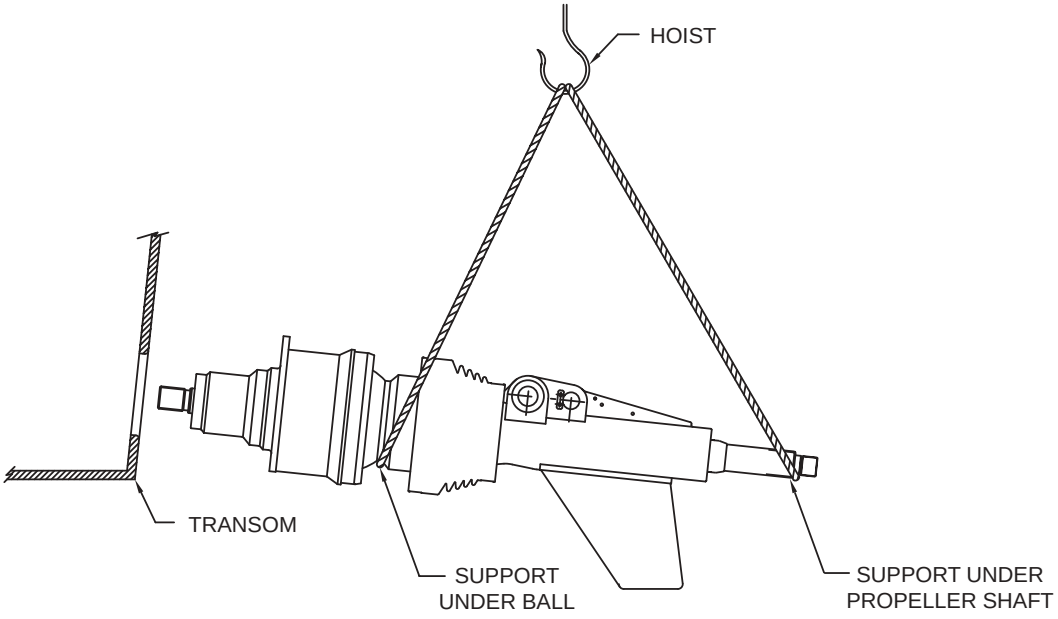


Figure 2. Support Unit for Installation

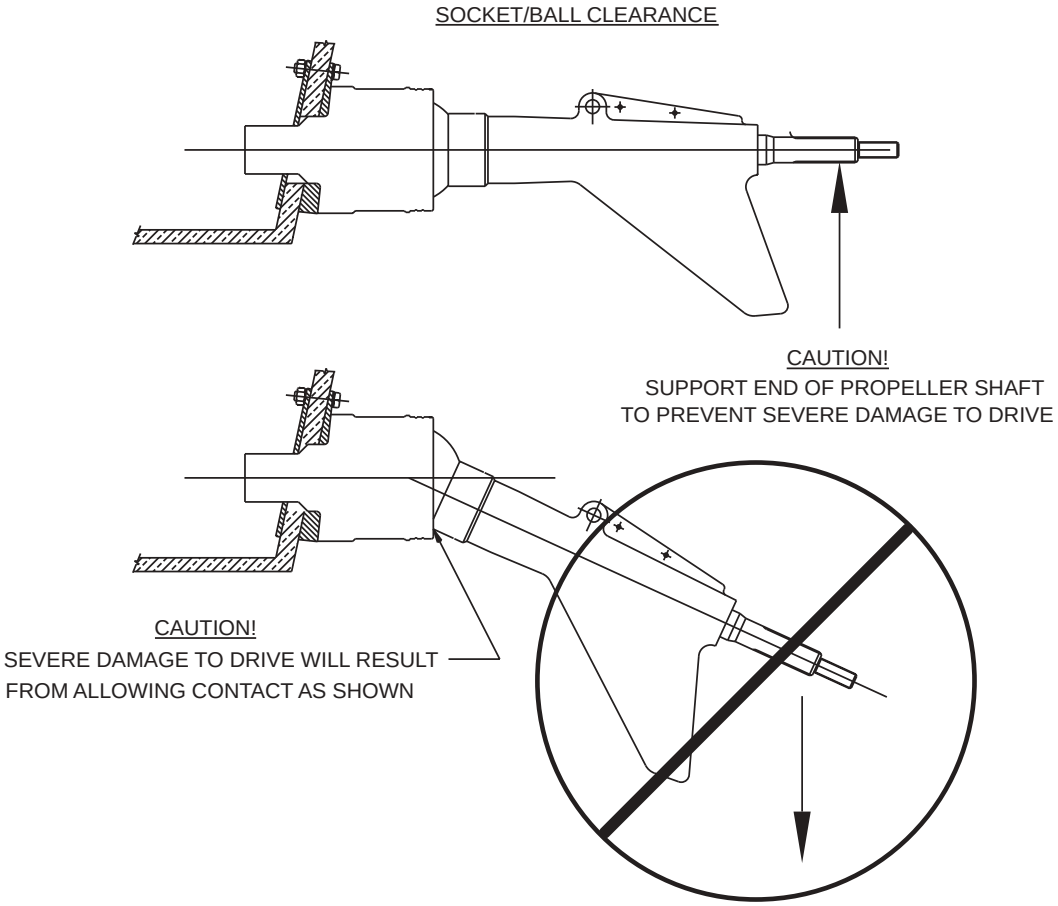


Figure 3. Protect Ball from Damage

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 4.

2. Template 1019886E duplicates the cross section of the thrust socket and wedge (if applicable) and is used to locate the drive centerline for 1 in. 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 1019886E should be applied to the wedge and not directly to the transom.

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

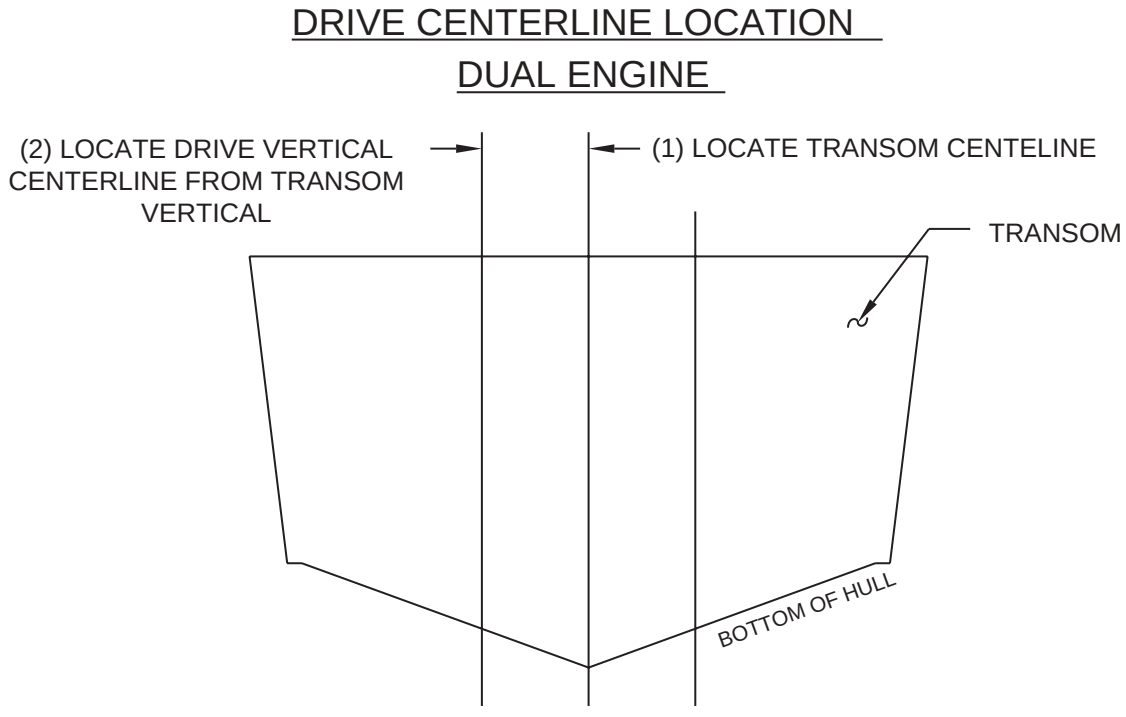


Figure 4. Drive Centerline Location

3. Use Template 1019886E to locate and mark drive centerline(s) as shown in Figure 5.

4. A For single drive installations, position centerline of Template 1019886E on transom centerline. Locate “Point C” on transom using template 1017597, page 1. Mark centers for mount holes (7), and lubrication holes (2).

4. B For twin drive installations, locate and match “Point C” on transom using template 1019886E. Rotate template until cutaway area on the thrust socket flange is parallel to the hull deadrise as shown in Figure 5. Locate and mark centers for mount bolts (7) and lubrication holes (2).

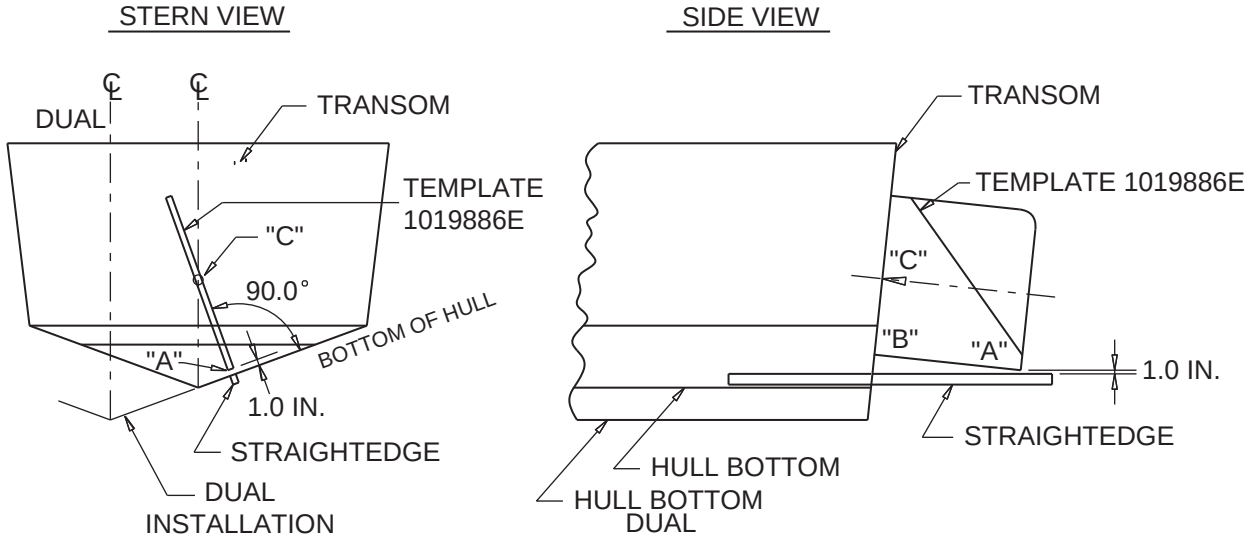


Figure 5. Mark Hull using Template 1019886E

5. 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 1019886E can be used to orient the drill as shown in Figure 6.

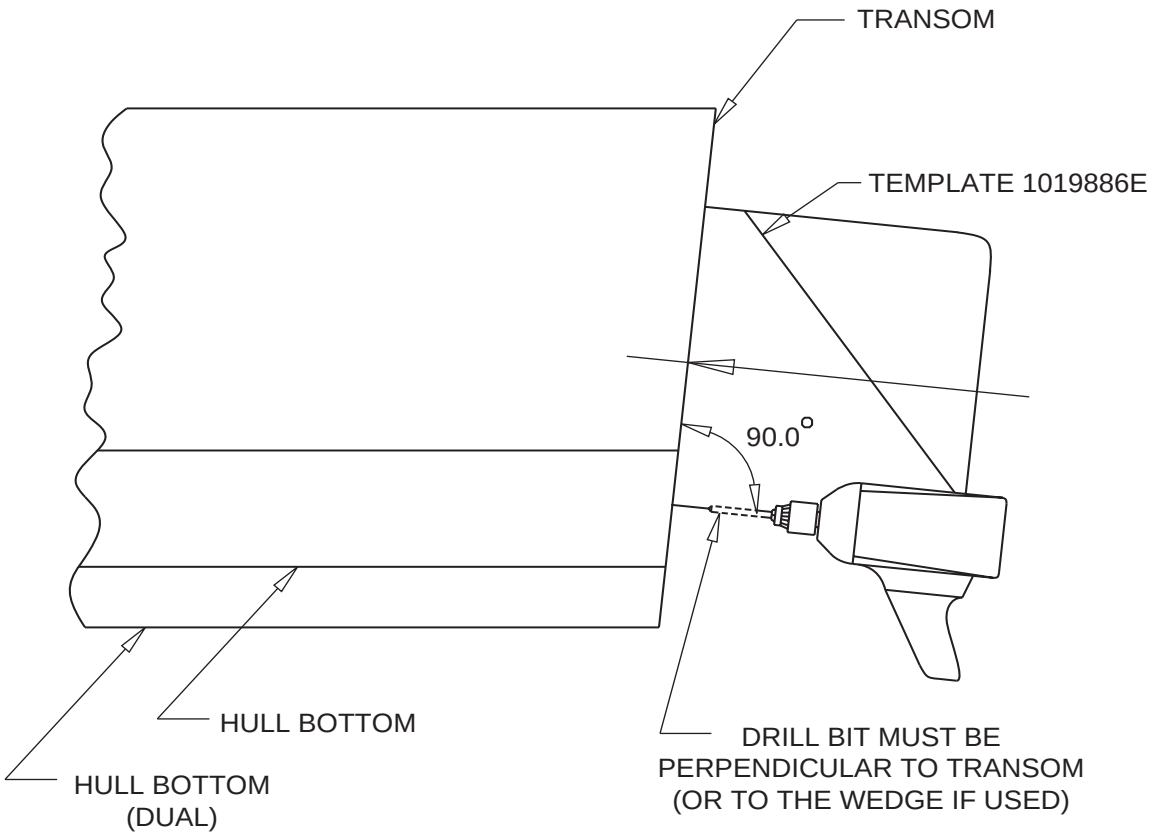


Figure 6. Drill Holes

6. Follow the pilot hole with a 198 mm (7.8 in) hole saw at the same angle used in Step C.

7. Hold the thrust unit in place and verify 1 in. clearance* from the edge of the thrust socket to the plane of the vessel's bottom. See Figure 7. Verify that the drive flange hole pattern matches the hole pattern marked on the transom from template 1017597, page 1.

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

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

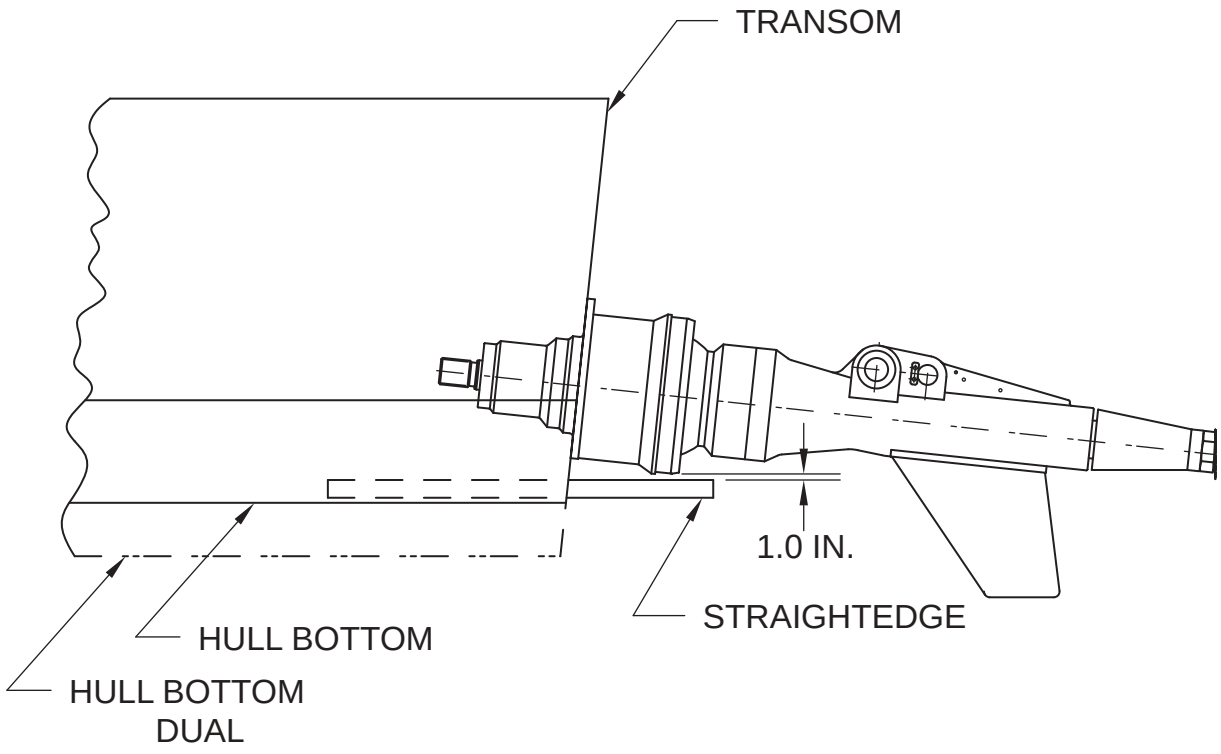


Figure 7. Measure for Clearance

8. Remove the drive unit and drill (7) 28.5 mm (1.12 in.) diameter holes and (2) 28.5 mm (1.12 in.) lubrication holes using template 1017597, page 1. Holes should be drilled perpendicular to the transom.

9. Mount the basic drive unit (trim and steering cylinders not installed) using the backing plate and 1 in. diameter stainless steel bolts, nylock nuts and washers as shown in Figure 8. Uniformly torque the nuts to 175 - 200 N-m (130 - 150 ft-lbs) using the tightening sequence on Figure 9. Apply a generous layer of marine transom sealant under the bracket and in the fastener holes to prevent water leakage. Do not turn the bolts when tightening them. Hold the bolts in place and only turn the nuts. If this procedure is not followed, leaks can develop in the holes.

   Note: The backing plate must be oriented with the spot-faced holes outward and with the stamped top upward*.

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

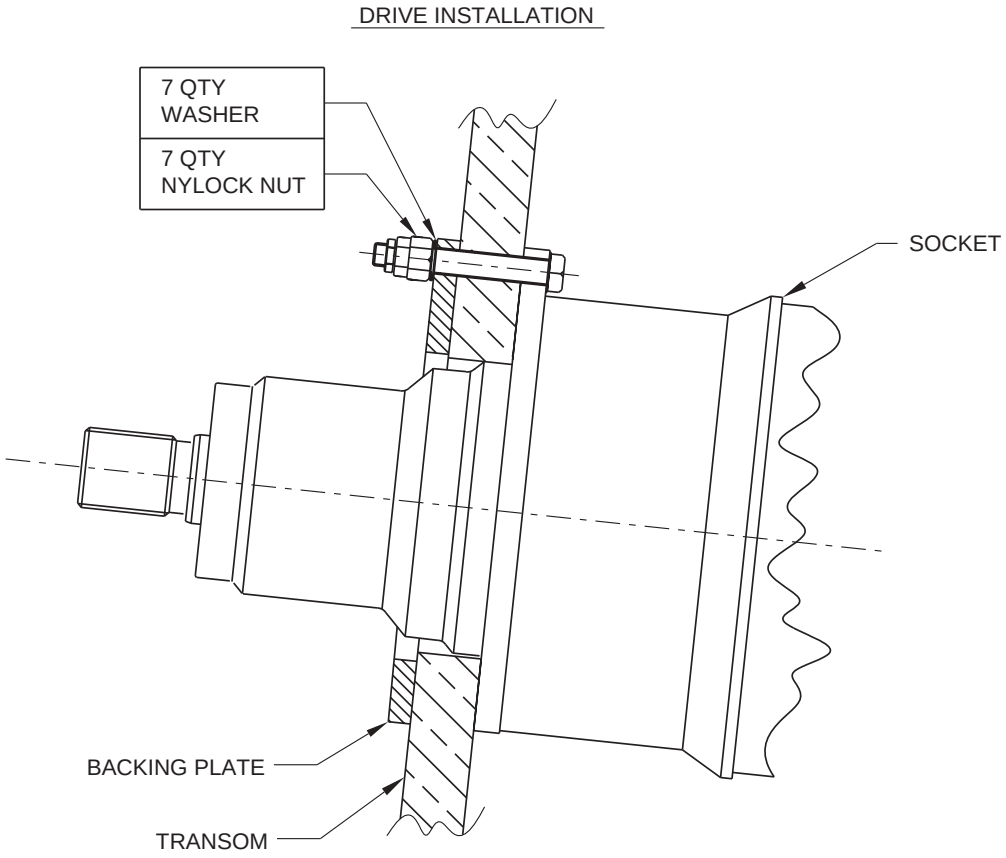


Figure 8. Drive Installation

10. Install the input flange (companion flange) onto the input shaft. See Figure 10. Torque the flange retainer bolts to 100 N-m (75 ft-lbs.).

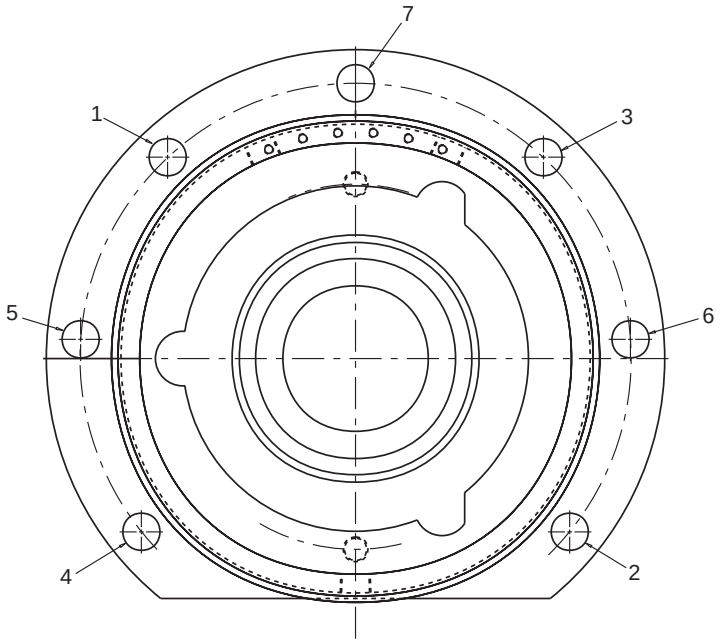


Figure 9. Torque Sequence for Socket to Hull

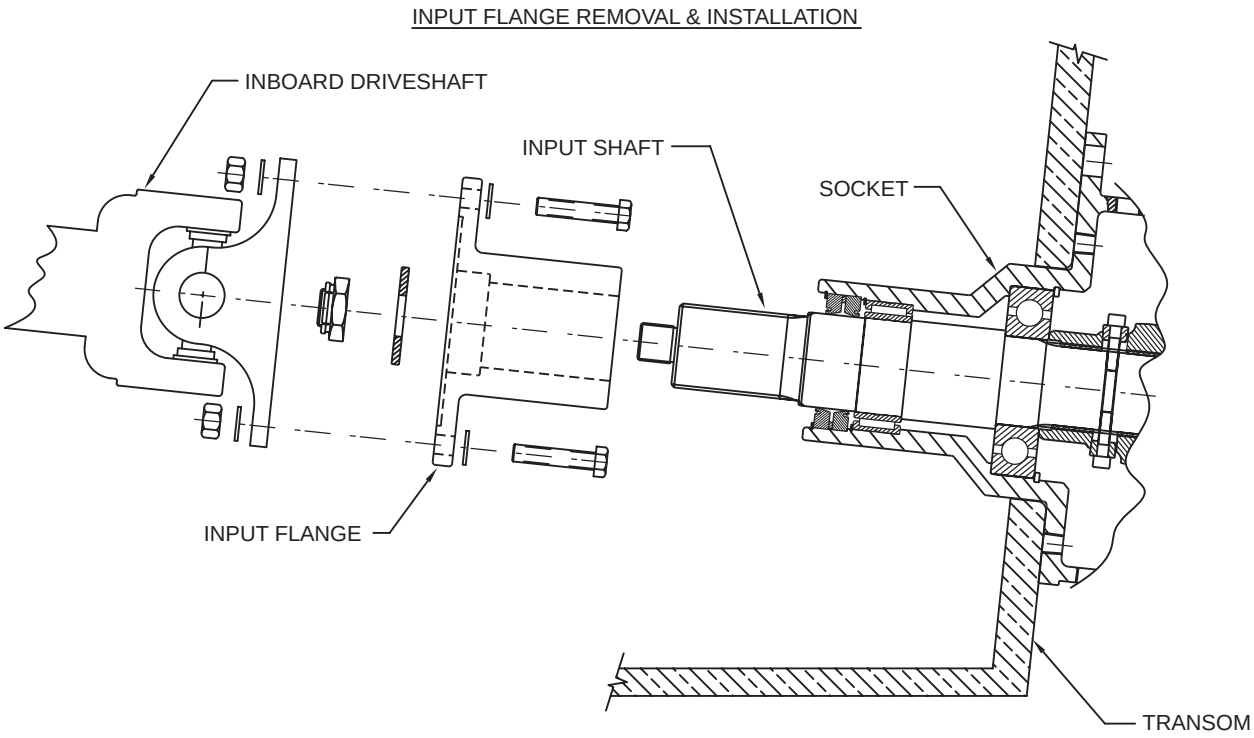


Figure 10. Input Flange Removal and Installation

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 Figure 11 for assembly instructions for the cylinder yoke.

1. Connect the trim cylinder to the thrust tube using the supplied mounting hardware. See Figure 11.

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.

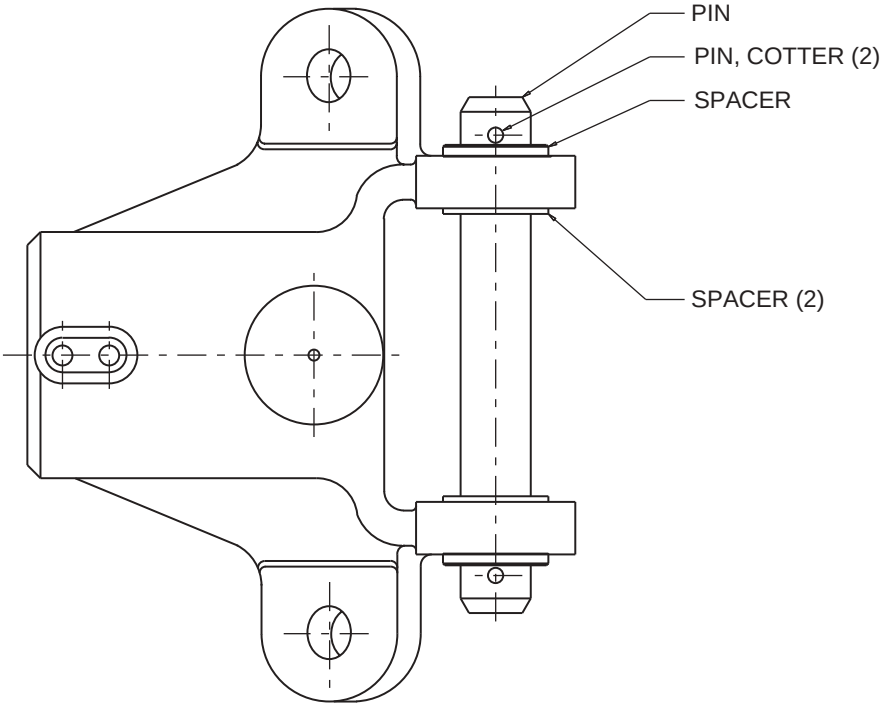


Figure 11. Trim Cylinder Mount

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 12 and 13. 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*.

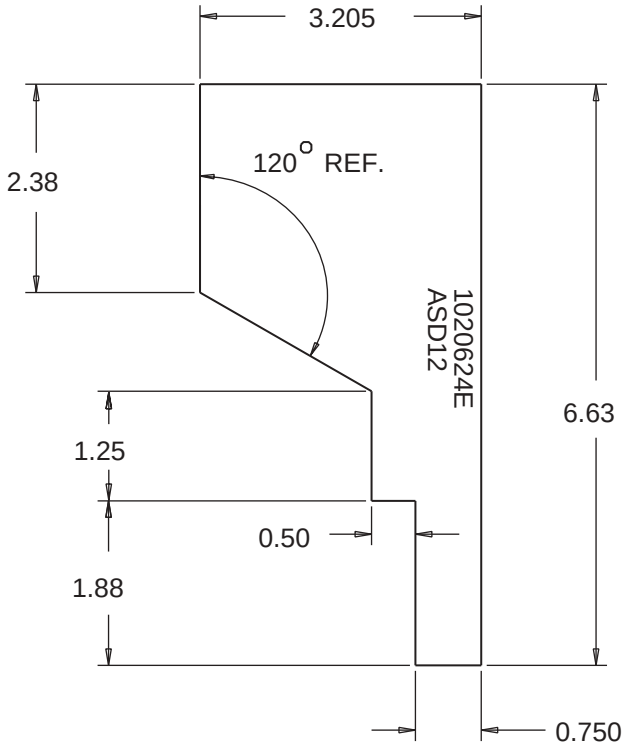


Figure 12. Drive Centering Template 1020624E

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 drive centerline.

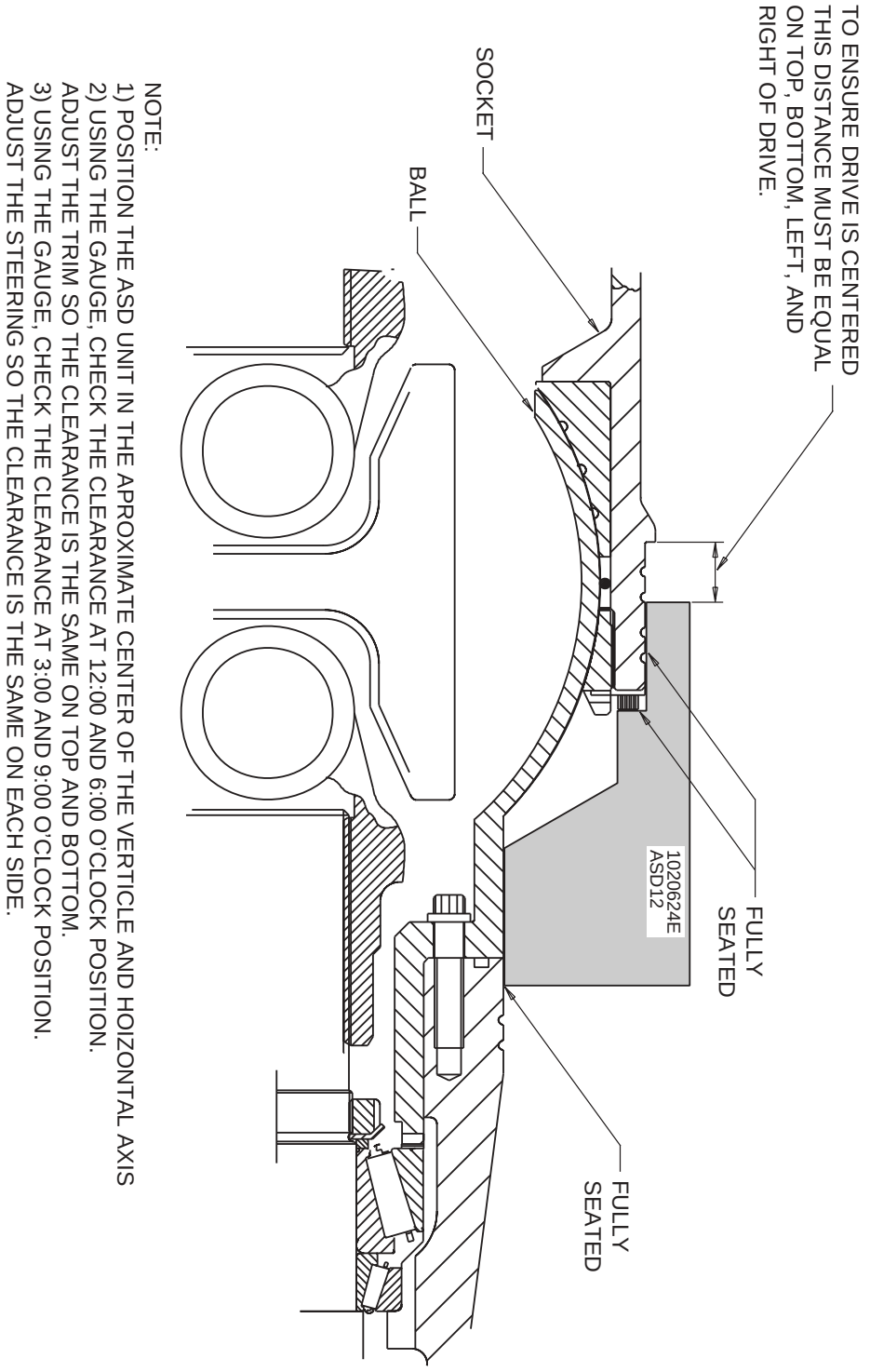


Figure 13. Center the Thrust Ball in the Socket

5. Transfer the trim bracket hole pattern and drill four 20 mm (0.78 in.) and two 15.5 mm (0.61 in.) diameter holes as shown in Figure 14 and drawings 1017597-1 and -2. Mount the trim cylinder bracket with its backing plate and stainless steel 3/4 in. diameter bolts, nuts, and washers. Torque nuts to 122 N-m (90 ft.-lbs). Apply a generous layer of marine transom sealant under the bracket and in the fastener holes in the transom to prevent water leakage. Do not turn the bolts when tightening them. Hold the bolts in place and only turn the nuts. If this procedure is not followed, leaks can develop in the holes.

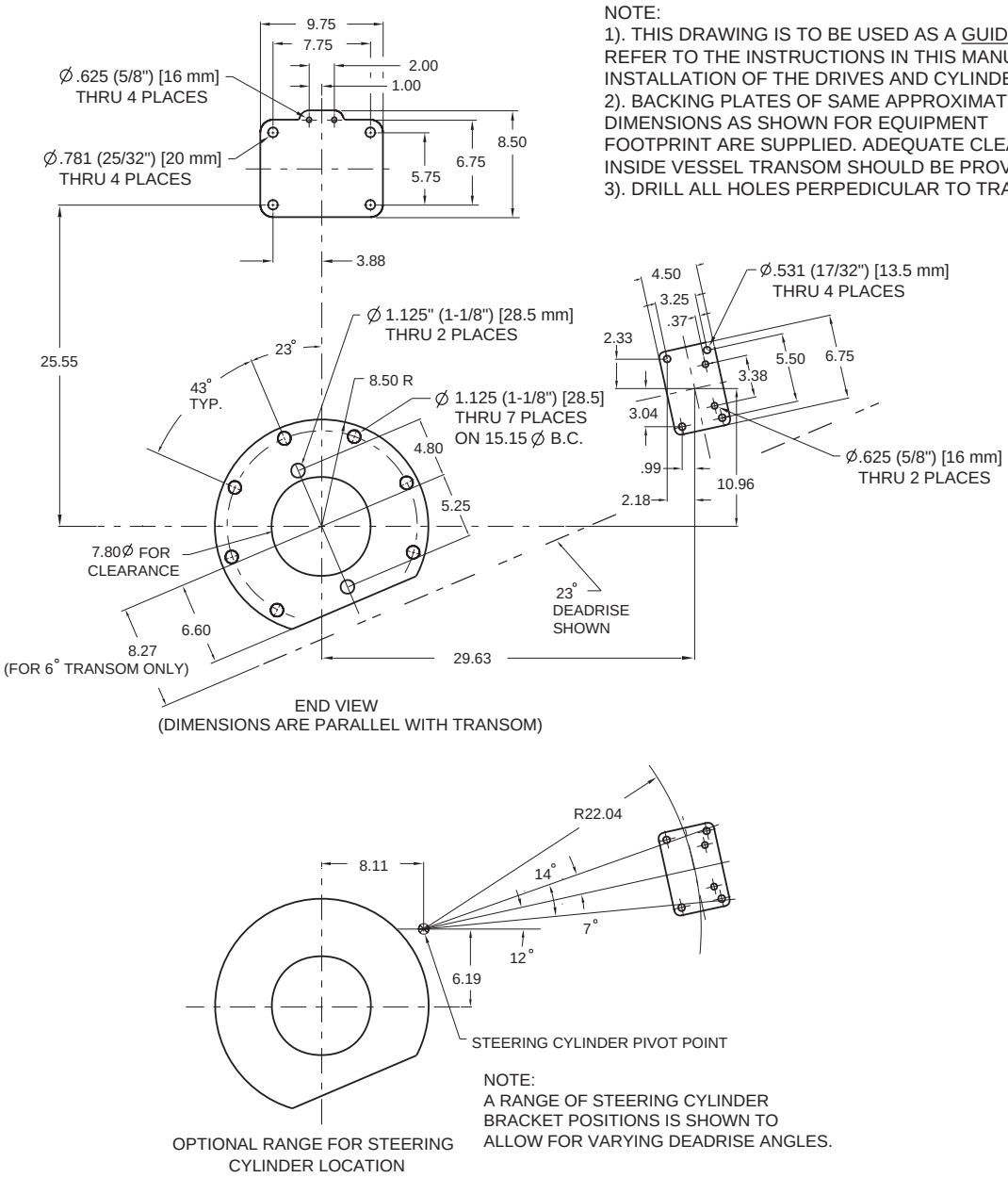


Figure 14. Transom Layout Dual Drive

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 both be inboard or both be outboard of the drives.

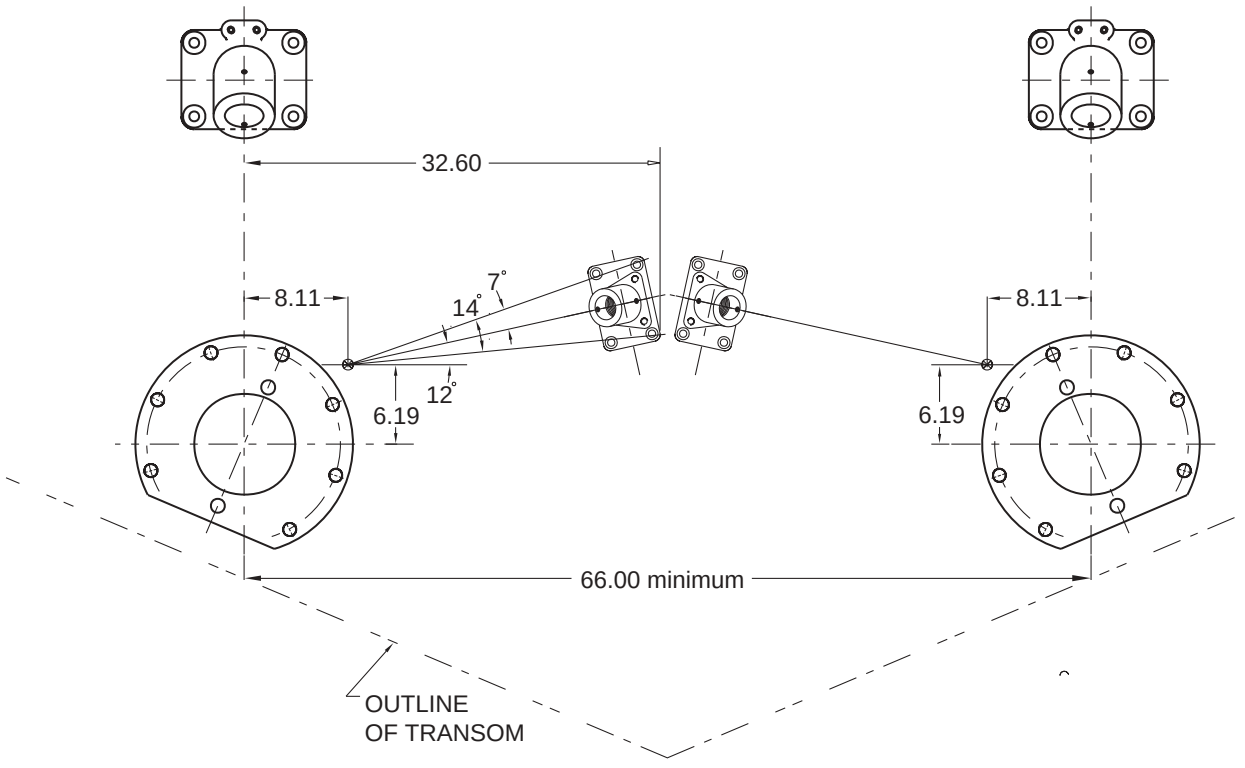


Figure 15. Transom with Optional Inboard Steering

2. Position the drive in the neutral trim position and parallel to the vessel centerline. See Figure 13. Attach the steering cylinder clevis to the trim yoke pin with the hardware supplied. See Figure 16. 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 14. 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 in. 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 6 mm (1/4 in.) clearance between the thrust ball and socket. Place the steering cylinder bracket against the transom and mark the location. Mark the bracket outline on the transom.

5. Pivot the drive horizontally in the other direction, extend the cylinder completely, and repeat the procedure. 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 steering bracket hole pattern and drill four 13.5 mm (0.53 in.) and

two 16 mm (0.63 in.) diameter holes as shown in Figure 14 and drawings 1014597-1 and -2. Mount the steering cylinder bracket with its backing plate and stainless steel 1/2 in. diameter bolts, nuts, and washers. Torque nuts to 61 N-m (45 ft.-lbs). Apply a generous layer of marine transom sealant under the bracket and in the fastener holes in the transom to prevent water leakage. Do not turn the bolts when tightening them. Hold the bolts in place and only turn the nuts. If this procedure is not followed, leaks can develop in the holes.

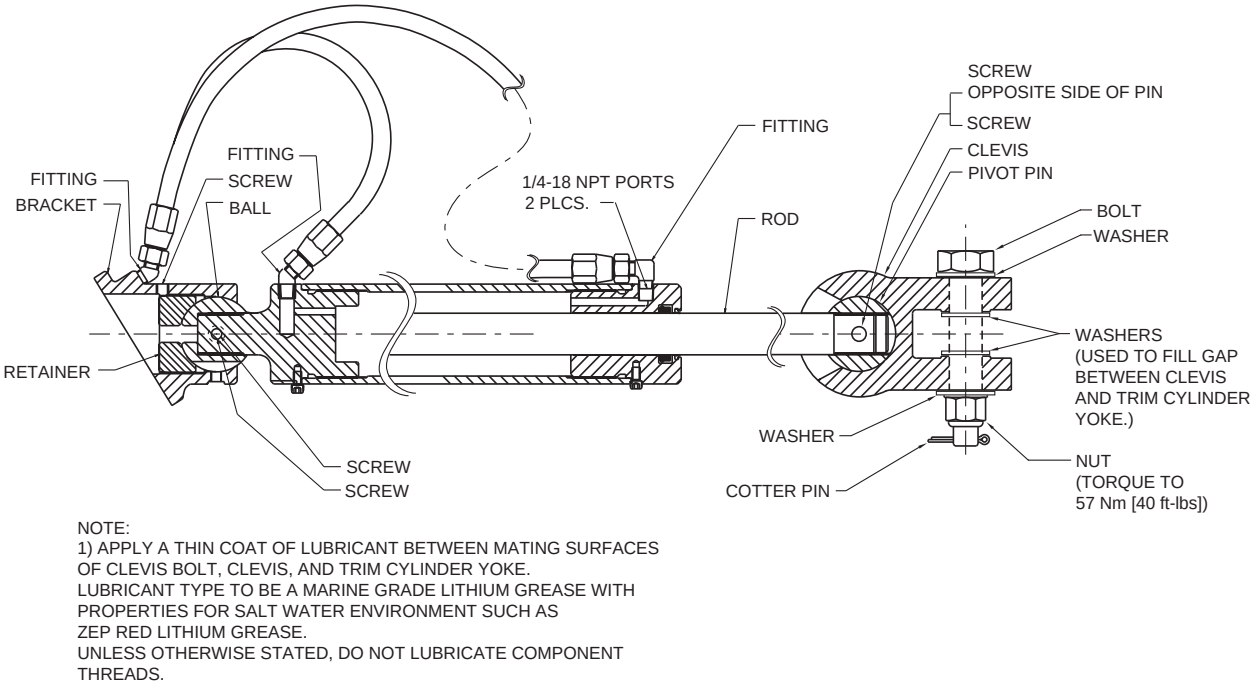


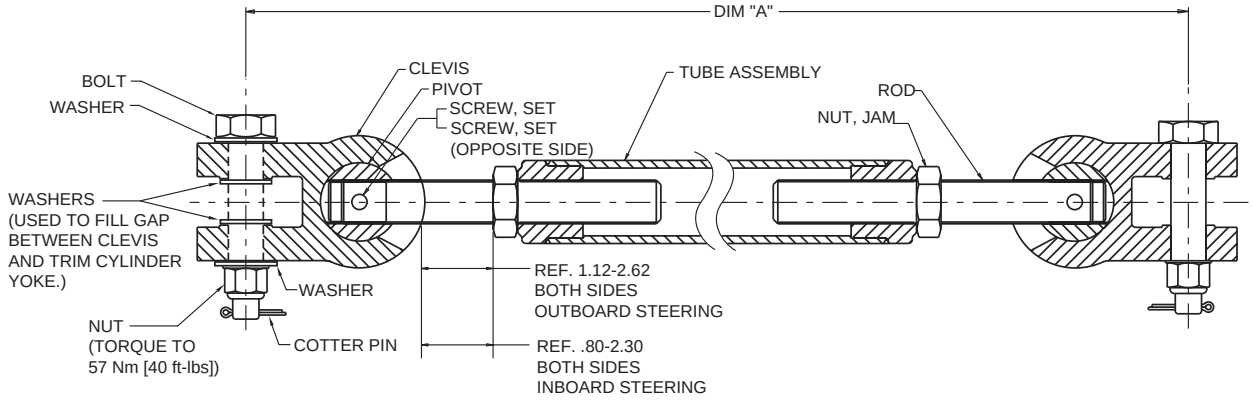
Figure 16. Steering Cylinder

7. A tie bar is required for twin drive installations on mono hull vessels. When ordering the tie bar, specify drive centerline-to-centerline

hardware provided. Comply with all requirements and torque values shown in Figure 17. Adjust the length of the tie bar as required to make the drive thrust housings parallel. Torque tie bar jam nuts.

8. Once the trim cylinders, steering cylinders, and tie bar are installed, cycle the units in all directions to check all the clearances at the thrust ball, cylinder transom mounting brackets, steering cylinder clevis, and tie bar clevis to assure no contact is made between the pivoting and stationary components. Critical positions to check are when the drives are steered fully to port and fully to starboard with the drives trimmed both fully up and fully down (four total check positions).

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



NOTES:
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 ZEP RED LITHIUM GREASE.
2) LUBRICATE THREADS WITH AN ANTI-SEIZE THAT DOES NOT CONTAIN GRAPHITE OR MOLYBDENUM DISULFIDE, SUCH AS LOCTITE® WHITE HI-TEMP ANTI-SEIZE.
3) CENTER TUBE ASSEMBLY TO EQUALIZE LENGTH OF EXPOSED THREADED ROD.

Figure 17. 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. Most drivelines should not be run in a straight line, where the transmission output shaft and surface drive input shaft are perfectly in line. 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 20.

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). See Figures 18 and 19.

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 1.59 mm (.0625 in.). 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.

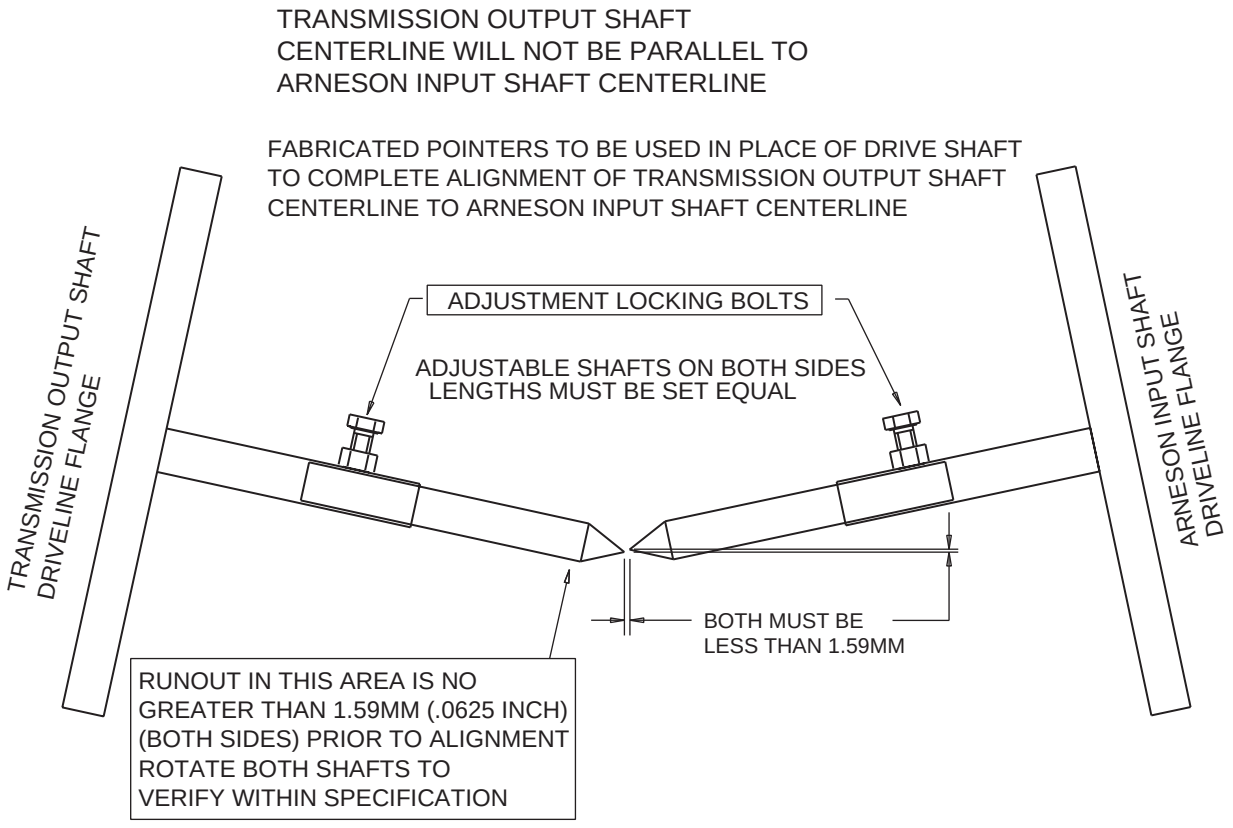


Figure 18. Remote or Island Mounted Alignment Tool, Shafts not Parallel

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.

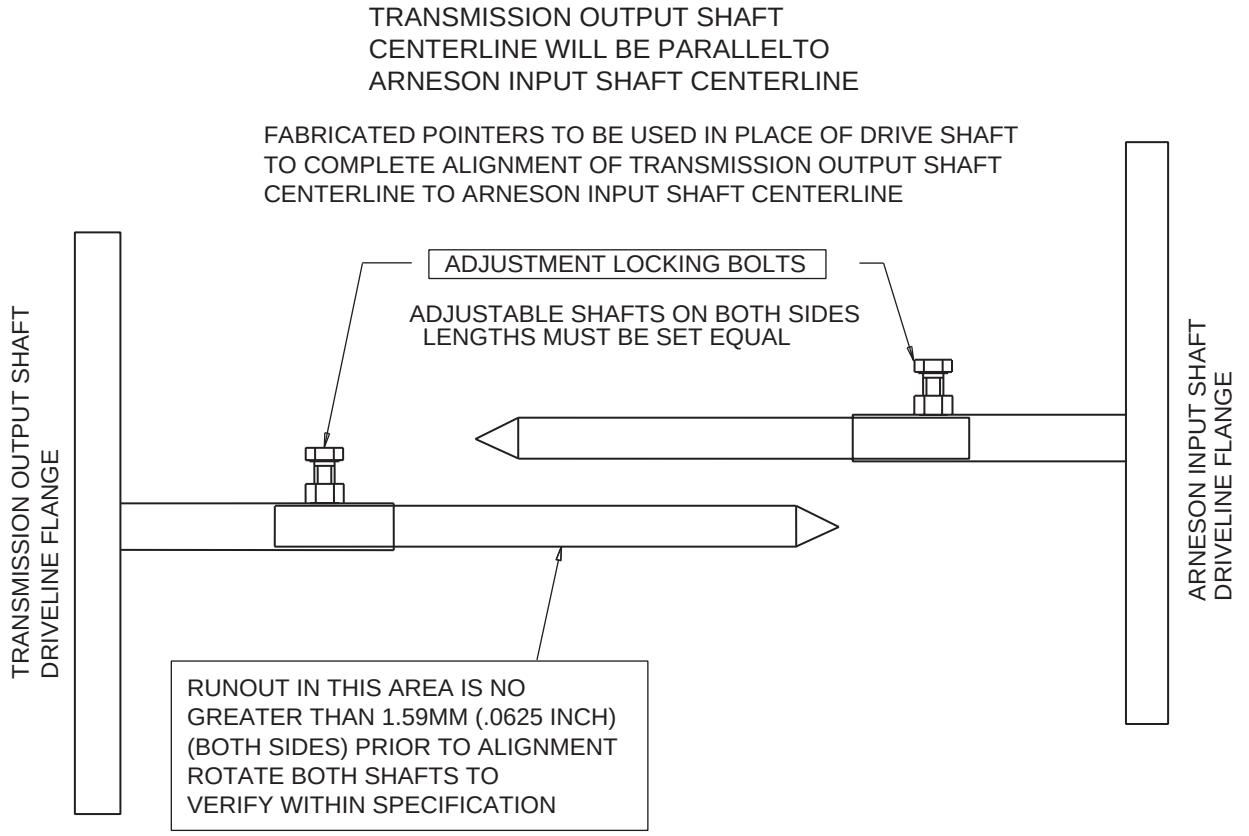


Figure 19. Remote or Island Mounted Alignment Tool, Shafts Parallel

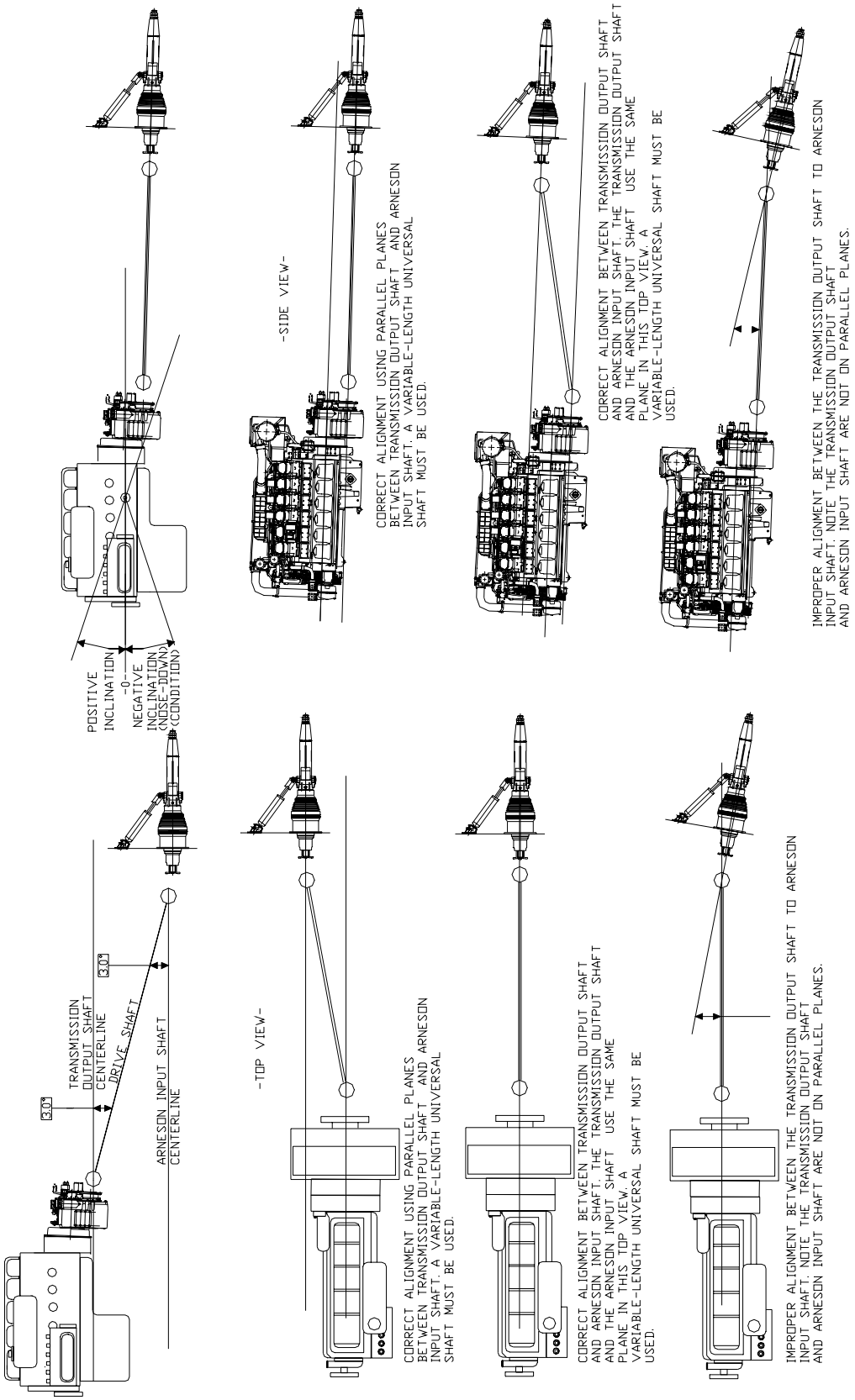


Figure 20. Examples of Proper and Improper Alignment

Lubrication

Arneson Surface Drives are supplied with an internal lubrication system that can be serviced inside the vessel. A non-pressurized type of lubrication system is standard equipment on an Arneson Surface Drive, and is described below.

Internal Lube Kit

The Internal Lube Kit supplied by Twin Disc, Incorporated for ASD 12 drives is shown in Figure 21. It includes an oil reservoir, hose, clamps, hose fittings and plugs. The customer provides the necessary support brackets for the reservoir. All components are to be internally clean to prevent oil contamination.

Reservoir Mounting

1. Mount reservoir 254 mm (10 in.) or higher above surface drive centerline as shown in Figure 21. Support reservoir on bottom or under flange and secure to the vessel's structure. Connect 1/2 in. hose as shown in Figure 21.

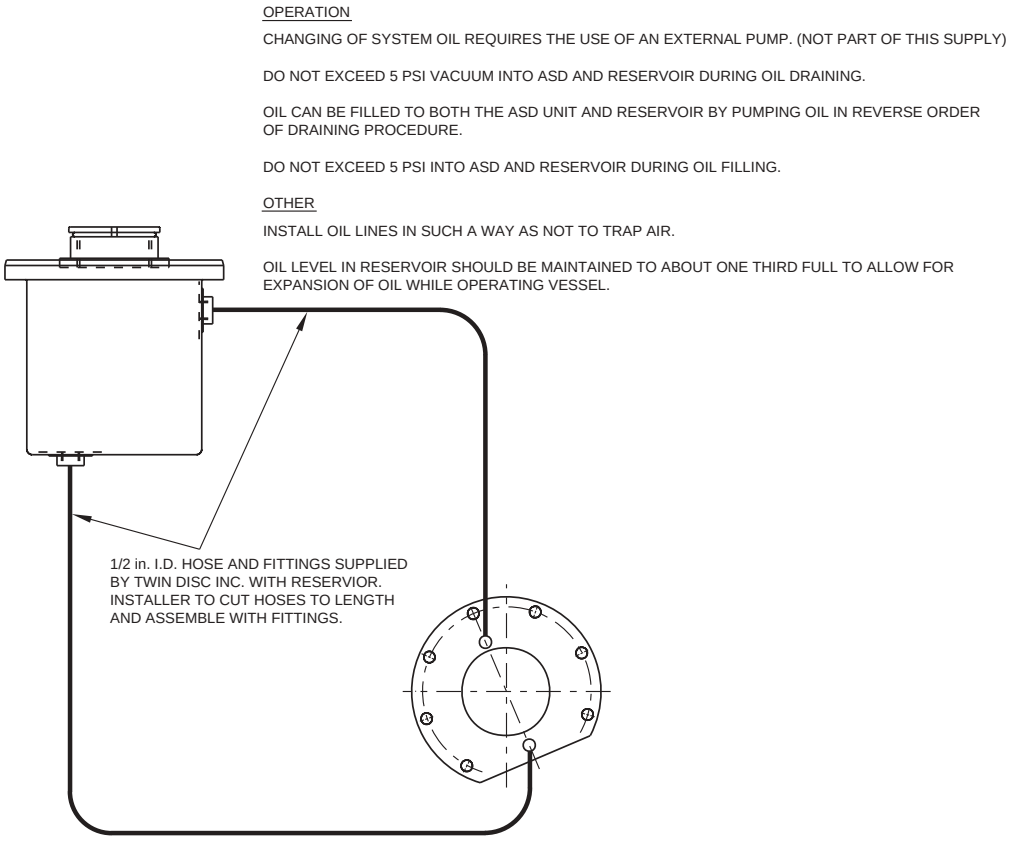


Figure 21. Lubrication System

To Fill the Unit

See the Drive Lubrication Features section for a listing of proper oils to be used for filling the drive and reservoir.

1. Trim the drive all the way down by extending the trim cylinder.

2. If the vessel is out of the water;

   A. Remove the plug on the top of the socket and the plug at the forward end on top of the thrust tube.

   B. Fill the drive as much as possible through the open thrust tube plug hole. Plug that hole.

   C. Continue filling as much as possible through the open socket plug hole. Plug that hole.

   D. Finish filling the drive through the top of the reservoir until the reservoir is one-third full.

   E. Replace all fill plugs and check fittings.

   F. Check this level after 24 hours and after the first vessel operation. If necessary, add more oil to the reservoir until it is again one-third full.

3. If the vessel is in the water;

   A. Fill through the top of the reservoir until the oil sustains a one-third full level in the reservoir.

   Note: Filling the drive will take longer when the vessel is in the water because the oil takes time to flow through bearings, etc. in the drive.

   B. Replace all fill plugs and check fittings.

   C. Check this level after 24 hours and after the first vessel operation. If necessary, add more oil to the reservoir until it is again one-third full.

4. During operation, the lube oil level will rise in the oil reservoir due to heat and 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 cools and is not running or idling.

To Drain the Unit

1. Trim the drive all the way up by retracting the trim cylinder.

2. If the vessel is out of the water, remove the drain plug at the bottom of the socket. Replace the drain plug after the oil has drained out.

3. If the vessel is in the water, drain the reservoir. Connect the hose at the bottom of the reservoir to a pump and pump the oil out of the unit. Reconnect the hose to the reservoir after pumping.

Propeller Installation - Routine Maintenance

1. Apply a thin coat of anti-seize lubricating compound to the propeller shaft as shown in Figure 22. The anti-seize should not contain graphite or molbdenum disulfide, such as Loctite® White HI-Temp anti-seize.

2. Install the propeller, thrust washer, propeller nut, lock nut, on the shaft as shown in Figure 22. Torque the propeller nut to 640 - 710 N-m (450 - 500 ft.-lbs). Torque the jam (lock) nut to 500 - 570 N-m (350 - 400 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 must be re-torqued per the following schedule.

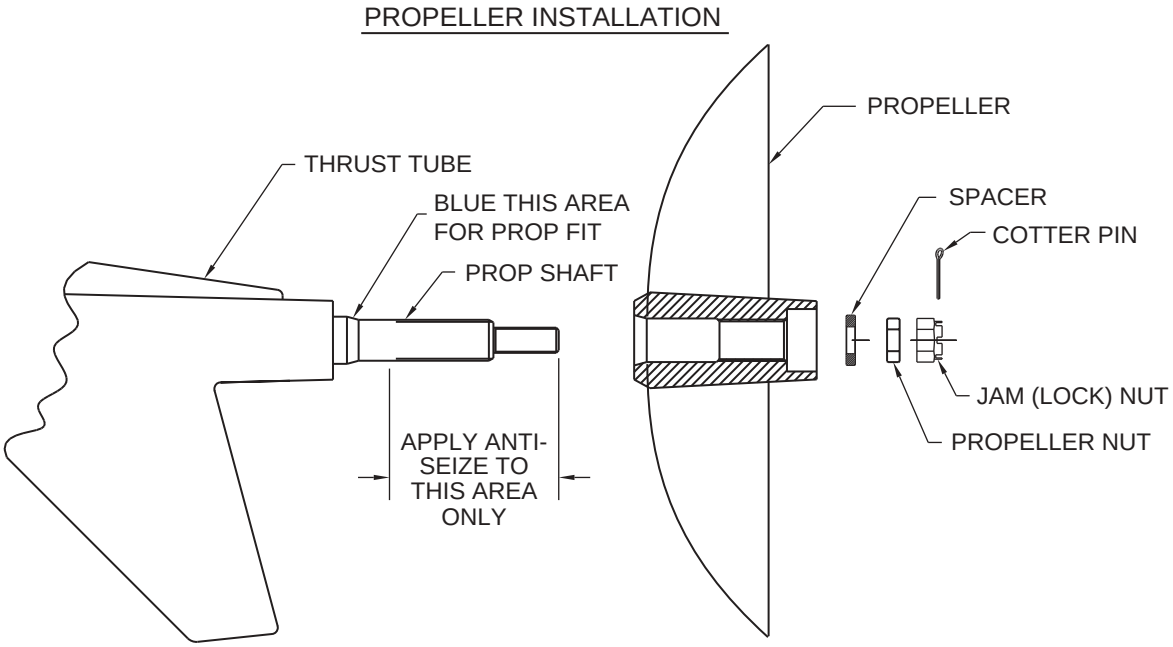


Figure 22. Propeller Installation

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.

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 23 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 overstressed locally and may fail. Contact Twin Disc if the taper contact pattern is not in accordance with Figure 23.

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

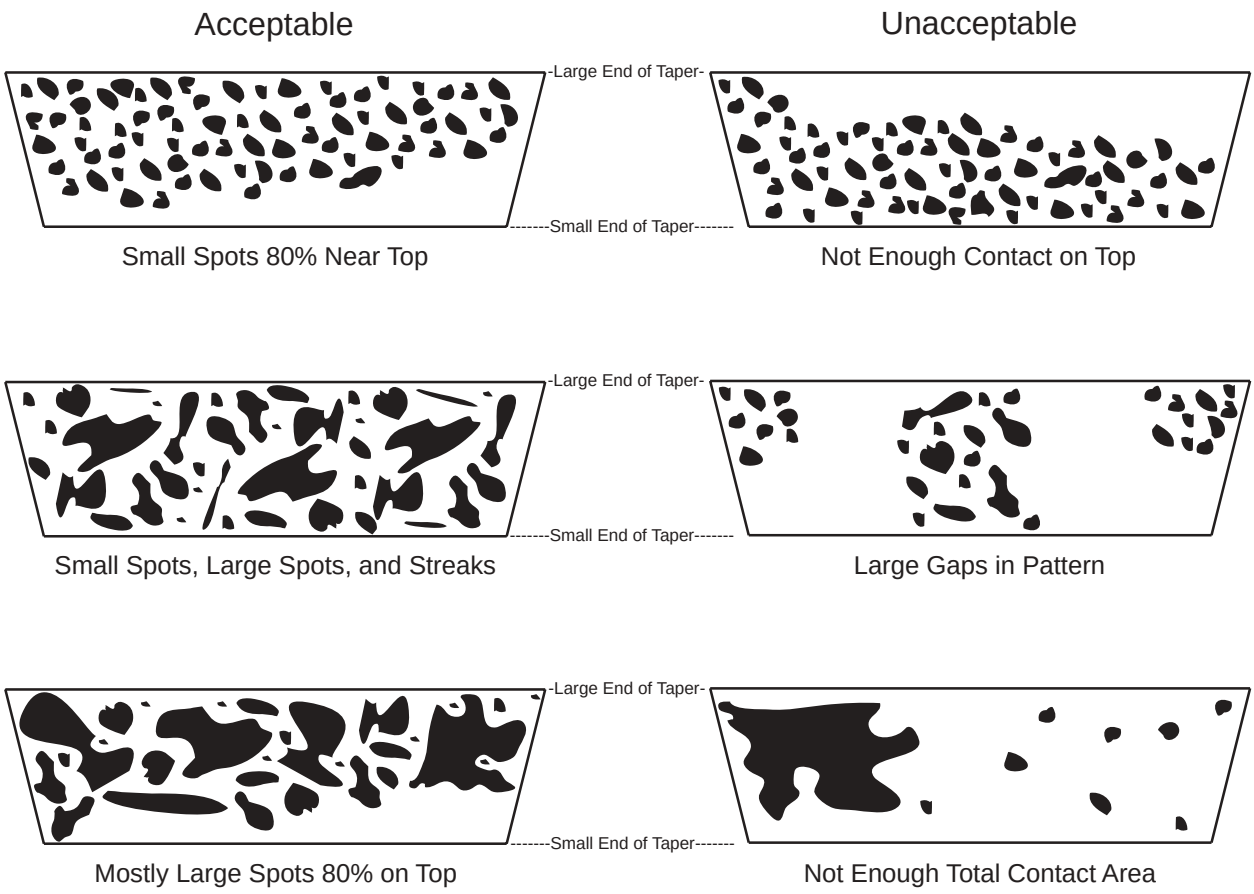


Figure 23. Dye Contact Pattern Samples

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 Anode Kit for cathodic protection. Reference instructions are available from Twin Disc, Incorporated for system installation and details.

Anti-fouling Protection

It is recommended that a suitable antifouling paint be applied to minimize marine growth. Care must be taken to keep anti-fouling away from pivoting joints, cylinder rods, output shaft, anodes, bonding wires and anywhere else the anti-fouling could interfere with the proper operation of the drive.

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 once a month thereafter. Possible corrosion problems can be detected and solved by checking the anodes often. Replace 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.

Operation

General

The following information is intended for use by the vessel operator. It will help the operator understand the operation of Arneson Surface Drives, and applies to the surface drives 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.

Arneson Surface Drives provide 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 1/3 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 hydraulic systems on Arneson Surface Drives, lubrication and steering/trim, that need proper maintenance. 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. The hydraulic steering and trim is a self contained system. It is used to operate the trim cylinder and the steering cylinders of the surface drive.

Proper maintenance of the cathodic protection system (anodes, bonding system, etc.) is very important in preventing deterioration of the Arneson Surface Drives.

Lubrication

Lubrication oil should be checked daily. The reservoir should be approximately 1/3 full when cold with the drive stopped, to allow for expansion from heat and agitation during operation.

A milky appearance is usually 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.

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.

See the Maintenance Checklist table in this section for the recommended oil change intervals.

Steering and Trim Hydraulic Oil System

Oil Level

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

Oil and Filter Change Interval

The oil filter (if equipped) in the Steering System should be changed whenever the engine filters are changed, and when the oil is 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 month. Replace 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 2. 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: Check that it is tight			**X**	**X**

Propeller Torque Maintenance

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

Torque the propeller nut to 640 - 710 Nm (450 - 500 ft.-lbs). Torque the jam (lock) nut to 500 - 570 Nm (350 - 400 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 3. Troubleshooting Chart

Problem	Probable Cause	Remedy
Propeller does not turn	Transmission malfunction.	Repair or replace.
	Broken transmission coupling.	Repair or replace.
	Broken drive coupling.	Repair or replace.
	Broken internal U-joint.	Repair or replace.
Trim / steering function failure	Low hydraulic oil.	Check for leak. Repair or service the system.
	Pump belt broken	Replace.
	Leak in hydraulic line.	Replace.
	Leak in cylinder.	Repair.
	Trim control switch failure.	Replace.
	Trim control solenoid failure.	Replace.
	Hydraulic pump failure.	Repair or replace.
	Steering helm malfunction.	Repair or replace.
Excessive drive noise or vibration	Misaligned inboard driveline.	Align.**
	Propeller damaged.	Repair or replace.
	Low drive oil level.	Check for leak. Repair or service the system.
	Failed bearing or U-joint.	Remove drive and repair.
	Air in trim cylinders.	Bleed hydraulic system.
Water in drive oil (The oil looks milky and brown.)	Leak in thrust ball/socket seal.	Tighten aft threaded retainer ring. Remove and replace packing and o-ring.
	Leak in thrust tube aft oil seal.	Remove and replace aft oil seals and o-rings. Repair or replace shaft sleeve if damaged.
	Loose oil fill and/or drain plug.	Tighten or remove and replace the plug.
Anodes are significantly corroded after a short period of time in the water.	Electrical fault on vessel.	Repair elecrical fault, check bonding system, and replace anodes.
	Stray current from marina or another vesel.	Install galvanic isolator and/or check that it is working. If problem continues, investigate installing a polarization transformer.
	Not enough anodes.	Install additional anodes.
	Too much uncoated, more noble metals.	Coat the more noble metals, i.e. - stainless steels, brasses, bronzes, etc.
Anodes are not corroding or corroding extremely slowly.	No problem.	No remedy needed.
	Anodes not connected to bonding system.	Ensure that the anodes have less than 1.0 Ohm resistance with all metals they are protecting.
	Poor quality anodes.	Use anodes made per the proper MIL specification.
	Anodes are covered with paint, tape, etc.	Remove any coatings on the anodes surfaces.
**See the Driveline alignment in the Installation Chapter.		

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 Arneson Surface Drive.

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

Special Tools:

- Wrench (Special Tool #1009229, provided with new surface drives)

⚠WARNING

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

1. 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.

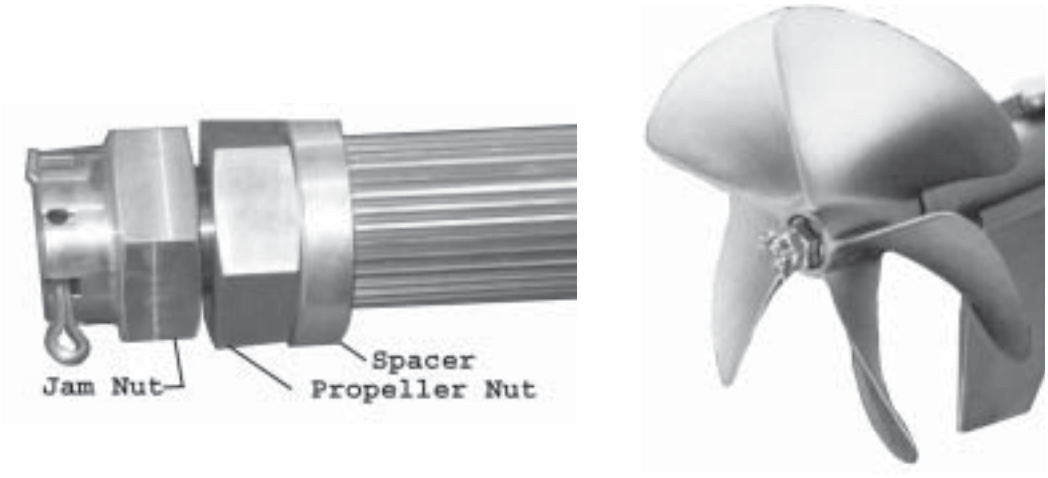


Figure 24. Propeller Retaining Parts (left), and Propeller Installed (right)

⚠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.

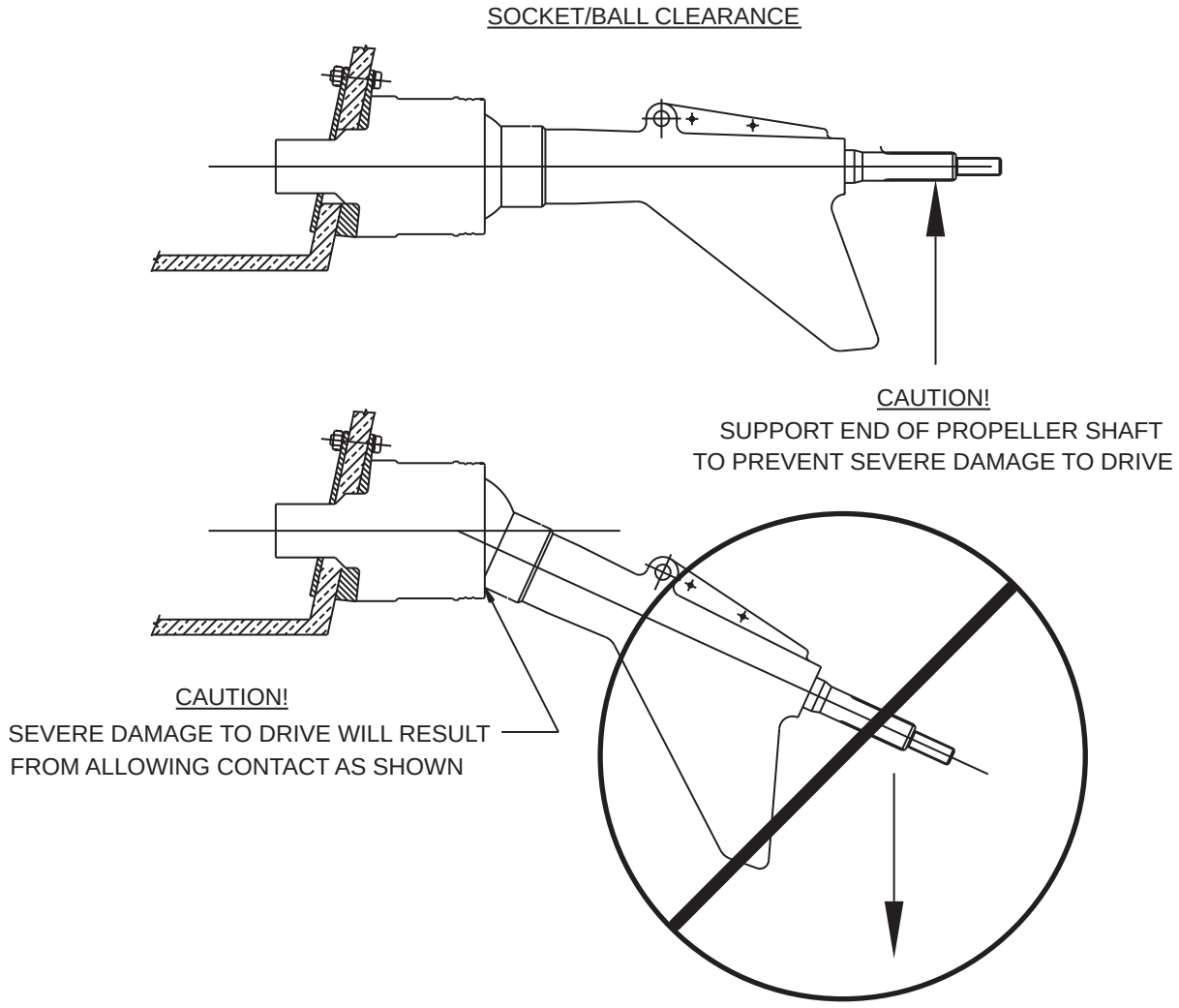


Figure 25. Protect Ball from Damage

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

3. Remove trim yoke pin(s) from trim yoke(s), disconnecting steering cylinder and/or tie bar from thrust tube.

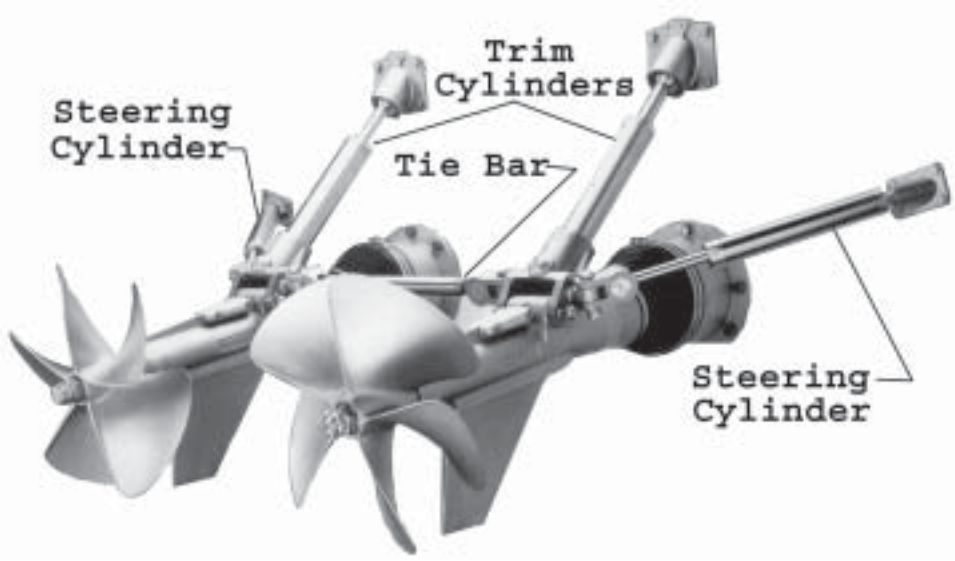


Figure 26. Rear View of Dual Installation Showing Cylinders and Tie Bar

4. Loosen band clamps on boot and push back over thrust tube.

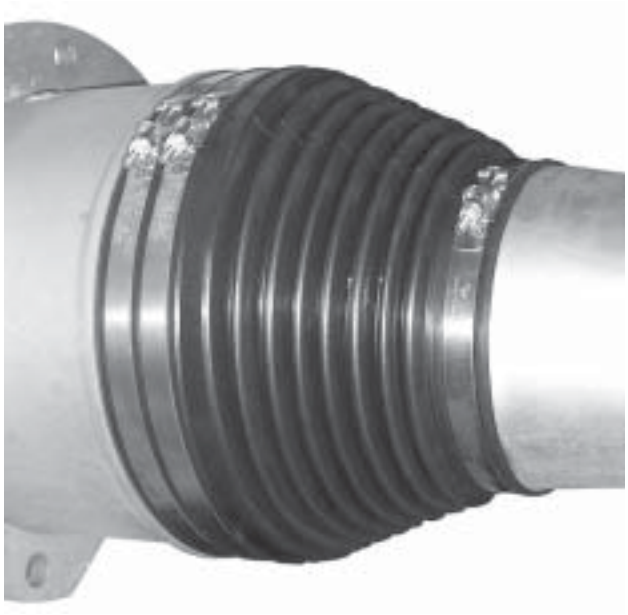


Figure 27. Band Clamps and Boot

5. Unscrew and remove safety clip around aft retainer.

Figure 28. Removing the Safety Clip Around the Aft Retainer

6. Using wrench (Special Tool #1009229) unscrew aft retainer counterclockwise.

   Note: If retainer is seized, or moves with great difficulty, gently and evenly heat the outside of the socket near the aft retainer with a butane or propane torch.

⚠CAUTION

Do not overheat housings. Excessive heat may damage or distort casting. Socket housing should not be heated above 121°C (250°F).

Figure 29. Unscrewing threaded Aft Retainer

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

⚠CAUTION

Do not let ball contact the threaded edges of the socket. Severe damage to the ball and socket could result.

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

Removal of Complete Arneson Surface Drive Unit From Transom

⚠WARNING

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

1. 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.

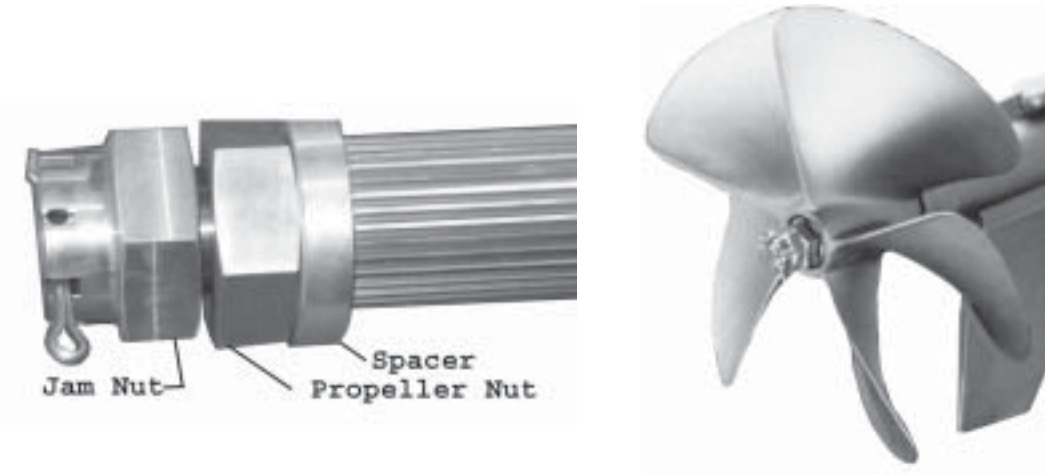


Figure 30. Propeller Retaining Parts (left), and Propeller Installed (right)

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

3. Remove trim yoke pin(s) from trim yoke(s), disconnecting steering cylinder and/or tie bar from thrust tube.

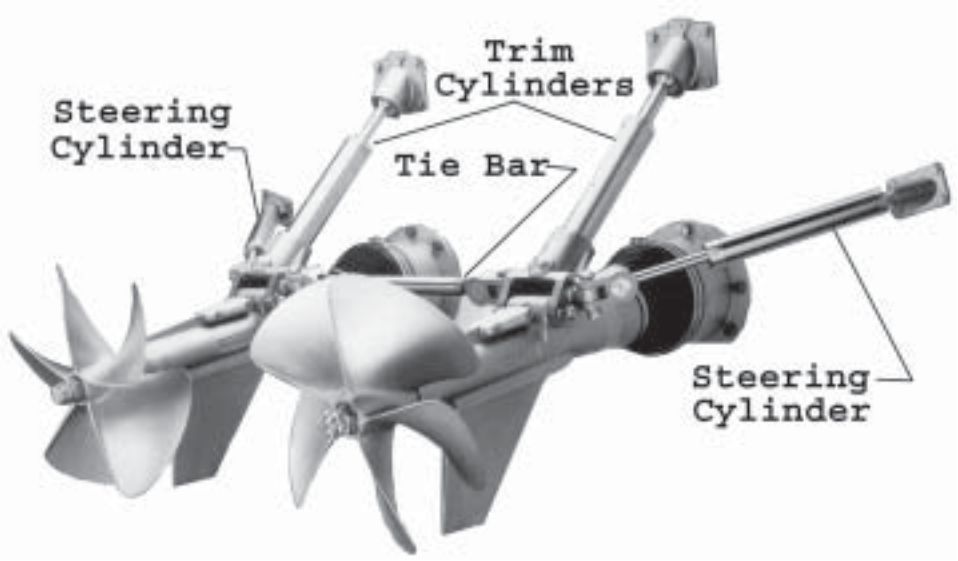


Figure 31. Rear View of Dual Installation Showing Cylinders and Tie Bar

⚠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.

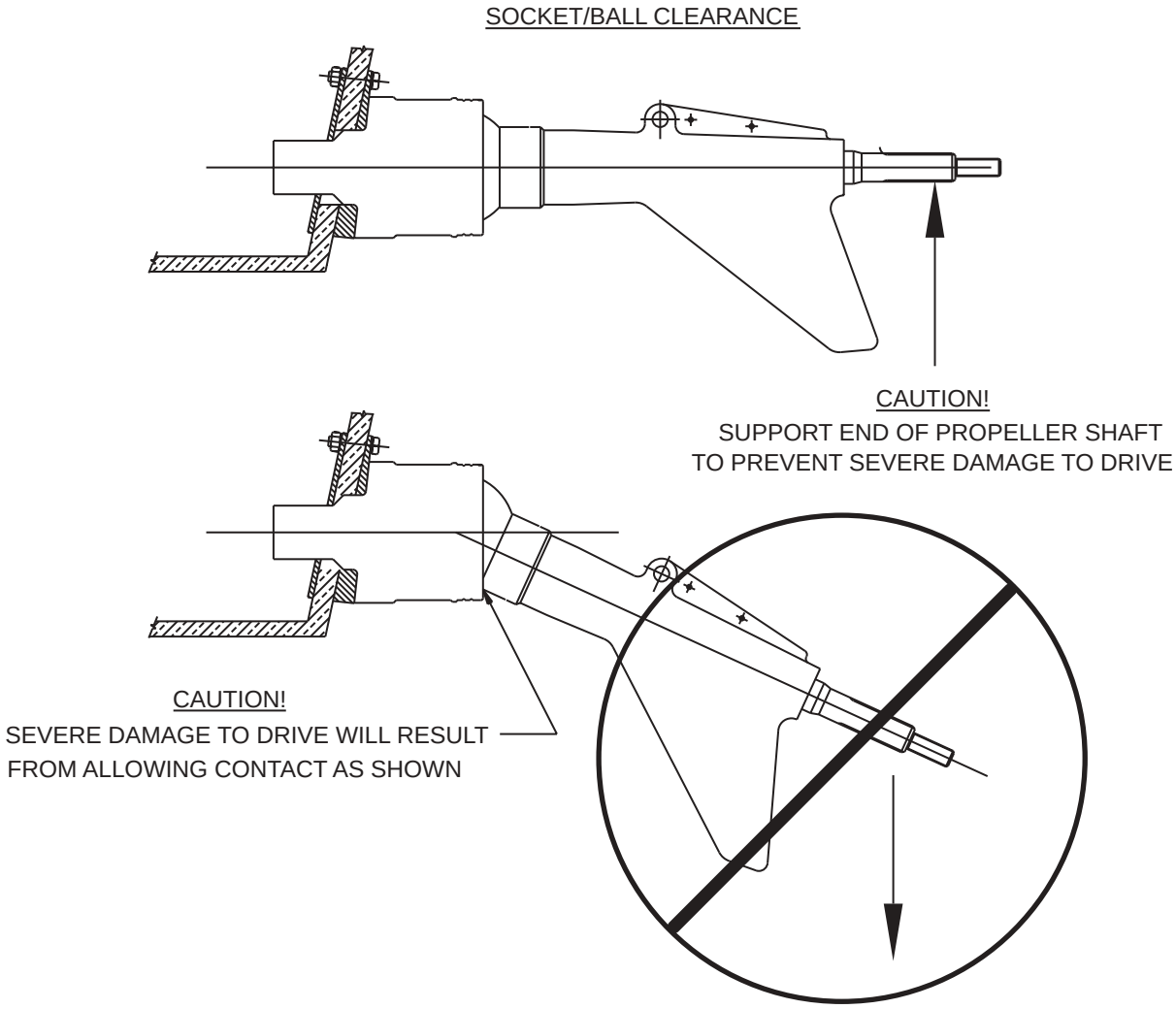


Figure 32. Protect Ball from Damage

4. Disconnect driveline companion flange at input shaft and remove center flex lock nut and thrust washer on drive input shaft.

   Note: Additional removal of driveline components may be required to allow access to companion flange center flex nut.

5. Support Arneson Surface Drive unit properly to prevent Arneson Surface Drive from falling when the mounting bolts are removed.

⚠CAUTION

Do not cradle the Arneson Surface Drive unit on the propeller shaft or input shaft. Damage to the unit could result.

6. Remove socket mounting bolts, nuts, and washers. Cut or scrape as much sealant as possible from the edges of the socket. Avoid scratching or other damage to the transom. Use a blunt tool when prying the socket flange from the transom. Apply force slowly and evenly at several points on the flange. Drive should now slide away from transom. Take care not to damage input shaft spines or threads upon removal of unit from transom.

7. Place Arneson Surface Drive unit on suitable blocks or stands.

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

Note: It is highly recommended to replace all bearings, seals, and o-rings that are accessible when servicing the drive.

Disassembly of Thrust Socket from Thrust Tube (If complete ASD unit was removed from the transom.)

Special Tools:

- Wrench (Special Tool #1009229, provided with new surface drives)

1. Disassemble socket from thrust tube by first loosening band clamps on boot and push boot back over thrust tube.

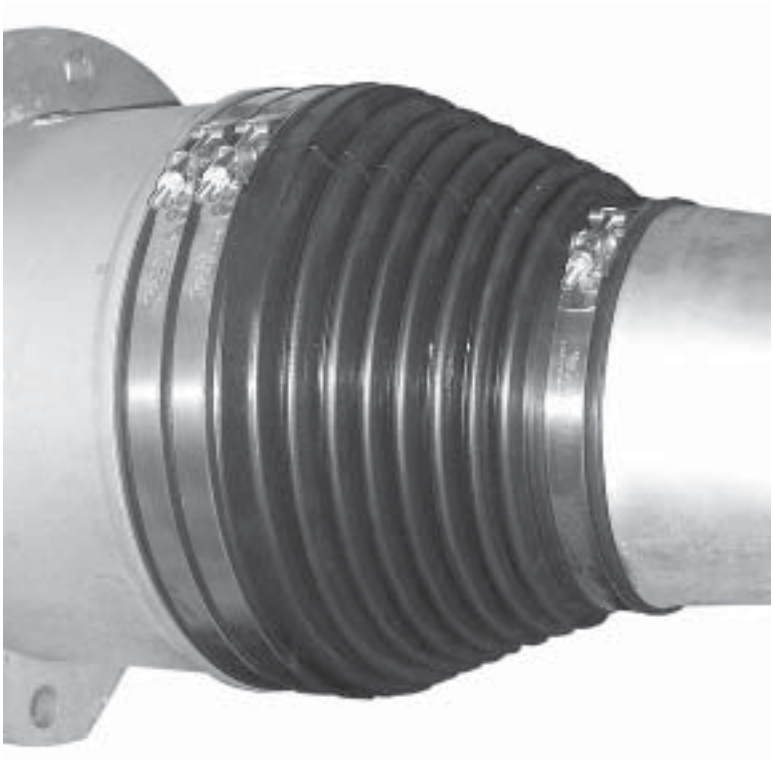


Figure 33. Boot Secured With Three Circle Clamps

2. Using a micrometer, depth gauge or other accurate method, measure exact distance that face of aft retainer projects from face of thrust socket. This will allow for accurate reinstallation when thrust tube is reinstalled. Record this measurement for use when reassembling the drive.

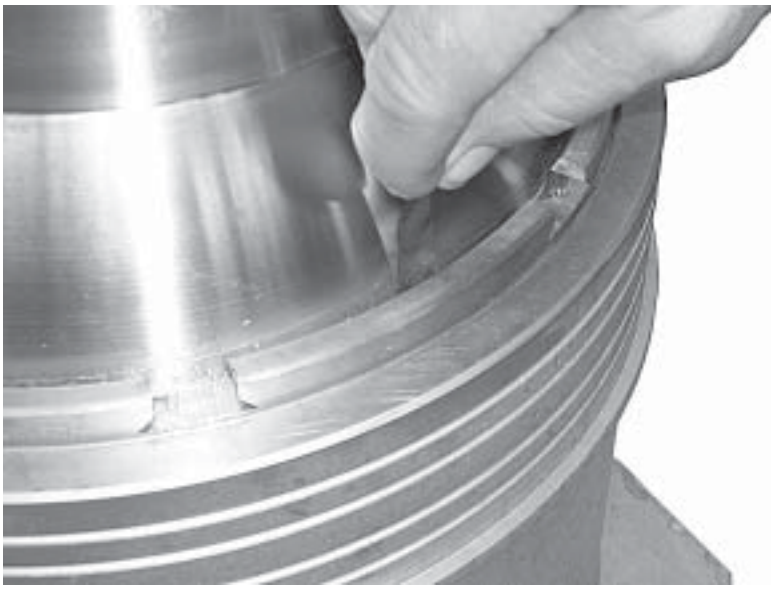


Figure 34. Measuring the Gap Between Thrust Ball and Aft Retainer

Note: Place a container under thrust socket to catch normal oil spillage as the unit comes apart.

3. Unscrew and remove safety clip around aft retainer.

Figure 35. Aft Retainer Ring Lock Clip in the Notch Locking Tab

4. Using wrench (Special Tool #1009229) unscrew aft retainer counterclockwise. If retainer is seized, or moves with great difficulty, gently and evenly heat the outside of the socket near the aft retainer with a butane or propane torch.

⚠CAUTION

Do not overheat housings. Excessive heat may damage or distort casting. Socket housing should not be heated above 121°C (250°F).

Figure 36. Removing the Aft Retainer using Special Wrench

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

⚠CAUTION

Do not let ball contact the threaded edges of the socket. Severe damage to the ball and socket could result.

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

Disassembly of the Thrust Tube

Special Tools:

- Assembly Stand Fixture T-21085 (Not required, but very helpful. If a stand is not available, a suitable support should be made.)
- Eyebolt with 1/2-20 UNF screw

Note: It is highly recommended to replace all bearings, seals, and o-rings that are accessible when servicing the drive.

1. Once thrust tube assembly has been removed from socket section, begin disassembly by placing the thrust tube vertically in the assembly stand (special tool T-21085) with input end facing up.

Figure 37. Rotate Thrust Tube Assembly so Ball is Up, Remove 12-point Capscrews

2. Remove the screws holding the thrust ball to the thrust tube. Use a 1/2" 12-point socket wrench.

3. Lift thrust ball out of thrust tube.

Note: When lifting thrust ball out of thrust tube, watch for the shim pack located between thrust ball shoulder and thrust bearings. Upon ball removal, shims may stick to ball shoulder.

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

5. Remove O-ring from face of thrust tube housing and check inside for remaining shims located against the thrust bearings. If original bearings will be used in reassembly, save these shims. If original bearings will **not** be used in reassembly, the shim pack will change.

6. Remove propeller shaft from housing by first threading a 1/2"-20 UNF eyebolt into tapped hole on forward end of propeller shaft. Attach hoist to eyebolt. Heat thrust tube housing at the forward bearing area with a butane or propane torch.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not allow housing temperature to exceed 121°C (250°F).

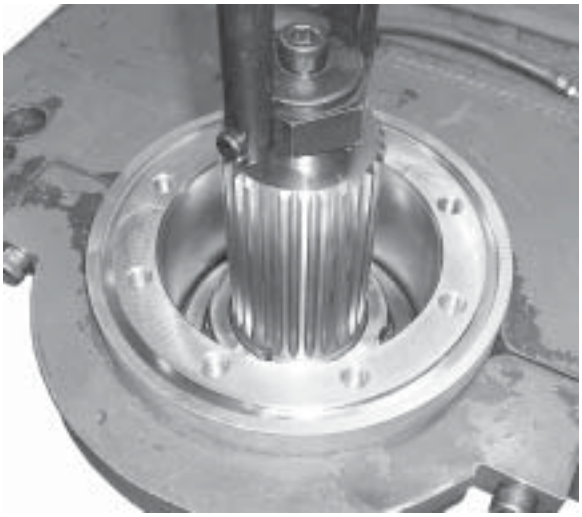


Figure 38. Remove propeller shaft

7. As housing is heated, apply just enough lifting force to suspend drive. Apply heat slowly until bearing cup frees itself. Place the propeller shaft assembly aside.

8. Rotate thrust tube in assembly stand so aft end is facing up. Remove six retaining screws located on the face of the rear seal block assembly. Remove the seal housing.

Figure 39. Seal Carrier

9. Remove the seals and bearing retaining ring.

⚠CAUTION

Do not scratch or damage shaft when removing components. If damaged yet repairable, use a fine emery cloth to smooth the surface.

10. Rotate the thrust tube so that the forward end is facing up.

11. Remove aft bearing by heating housing around bearing with a butane or propane torch. The bearing may fall out.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not allow housing temperature to exceed 121°C (250°F).

12. If the bearing does not fall out with just heat, insert a long drift or rod into the forward end of tube through to rear. Tap rod evenly around bearing circumference with mallet or hammer until bearing is free. Discard this bearing.

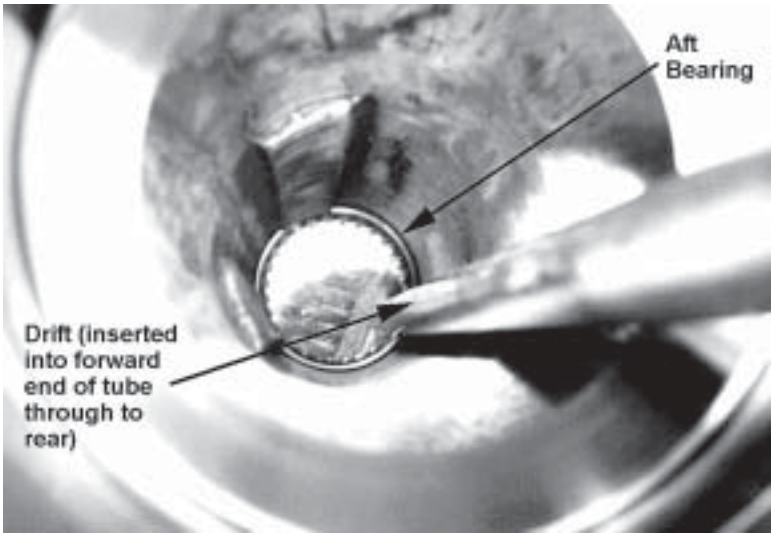


Figure 40. Inserting drift into thrust tube to remove aft bearing

13. Rotate thrust tube so the aft end is facing up. Remove bearing cup from forward end of thrust tube by heating housing around cup with a butane or propane torch and inserting a long drift or rod from rear of tube. Tap rod evenly around cup with a mallet until cup is free. Discard cup.

14. At this point, thrust tube should be flushed out using clean solvent to remove dirt or other materials trapped inside. All components such as shafts, retainer rings, etc. should also be cleaned at this point, prior to reassembly as described in Cleaning and Inspection.

Disassembly of the Propeller Shaft

1. On the forward end of the propeller shaft, remove threaded lock nut that holds tapered bearing in place by tapping lightly with hammer and drift tool. Lock nut is retained by lock washer with fold-over tab. Tab must be bent away from lock nut to spin freely off shaft. Threaded lock nut spins counterclockwise for removal. Remove lock washer and spacer. Discard lock washer.

Figure 41. Bending Fold-Over Tab to Remove Lock Nut

2. Remove tapered bearings by using heat or by cutting the bearings off the shaft.

   2a. To remove bearings with heat, first break the bearing cage with a chisel on both sides of the rollers. Stand shaft vertically with the propeller end up and quickly heat inner races with an acetylene torch until the races drop off.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not overheat races when removing from shaft. Races should not be heated above 121°C (250°F). Excessive heat will damage or distort the shaft.

   2b. **To cut bearings off,** use a cutoff wheel with a carbide or composition wheel. Cut through roller cage. Separate the cage and rollers from the inner race. Cut groove in inner race until half through the race. Split race with chisel and slide off shaft.

⚠CAUTION

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

Figure 42. Breaking Bearing Cage With a Chisel

3. On the propeller end of the shaft, remove seal sleeve, spacer and rear roller bearing race by applying rapid heat with an acetylene torch. Slide components off the shaft. Discard the rear roller bearing race and the seal sleeve.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not allow housing temperature to exceed 121°C (250°F).

4. Clean and inspect shaft for damage on critical dimension surfaces as directed in Cleaning and Inspection.

Disassembly of the Thrust Socket

Special Tools:

- Two eyebolts with 1-inch threaded shank
- Socket Bench (This should be an assembly bench capable of supporting a minimum of 454 Kg (1000 lbs.) The bench should have a hole in the center approximately 216 mm (8 1/2 in.) in diameter and two 29 mm (1-1/8 in.) bolt holes 180° apart outside of the center hole. The bolt holes should have a 432 mm (17 in.) bolt hole center. When working at the bench, secure thrust socket to bench with two 1 in. bolts.

1. Before disassembly of thrust socket can be accomplished, remove the thrust tube/ball assembly from thrust socket using instructions in the Disassembly of Thrust Socket from Thrust Tube section.

2. Remove socket shaft, U-joint, bearing, and inner race by first placing thrust socket on socket bench with smaller diameter end through hole in bench.

3. Remove shims, O-ring, and packing. Remove forward retainer. Note cutouts in socket lip in three places to use as lifting points on retainer. Forward retainer is a slip fit and should slide out of socket with little effort.

Figure 43. Removing Shims, O-ring, Packing, and Forward Retainer

4. Remove retaining ring from groove next to the ball bearing.

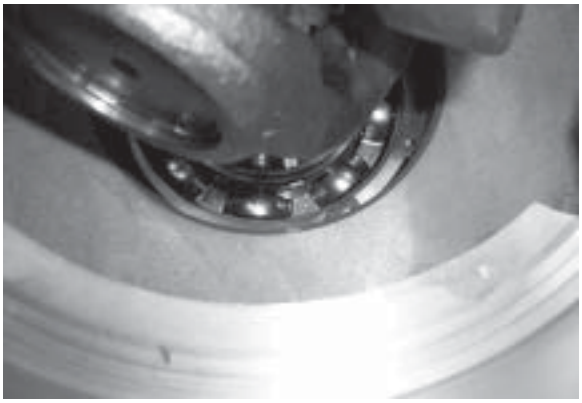


Figure 44. Removing Retaining Ring

5. Remove the screws holding socket assembly to the bench. Support the assembly about 15 cm (6 in.) above the bench top with wooden blocks. It should be high enough to allow space for a butane or propane torch. Lift U-joint with hoist with just enough lifting force to suspend socket. Heat housing around large ball bearing until U-joint assembly lifts out. Be careful not to damage shaft and U-joint because these items may be reused.

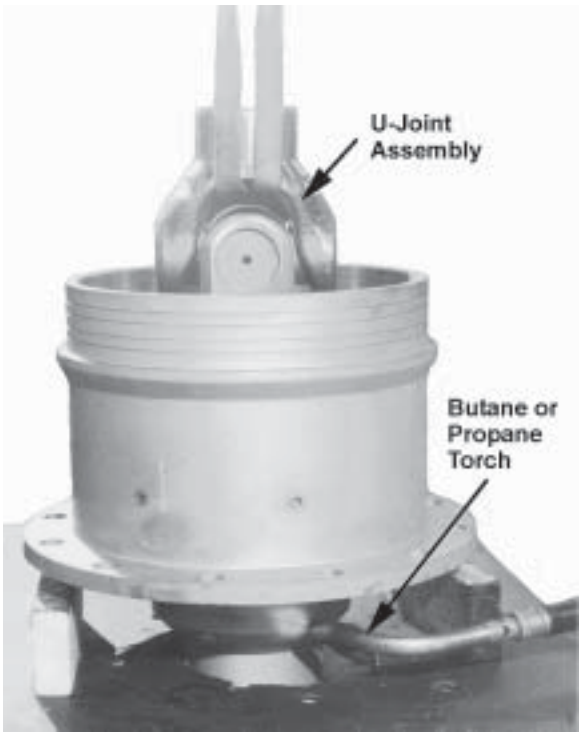


Figure 45. Heating Housing to Remove U-Joint Assembly

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not overheat housings. Excessive heat will damage or distort the casting. Socket housing should not be heated above 121°C (250°F).

6. Rest thrust socket on its side and remove seal retaining ring from small diameter end of socket. Remove oil seals and bearing retaining ring. Do not damage retaining rings as these items may be reused. Seals should be replaced with new parts.

7. Remove roller bearing outer race from smaller diameter end of the housing by first threading two 1 in. lifting eye bolts on opposite sides of the housing in the mounting bolt holes. Lift socket and heat housing at the bearing area until the bearing race drops out. If necessary, tap lightly against bearing race with a drift to assist in removal.

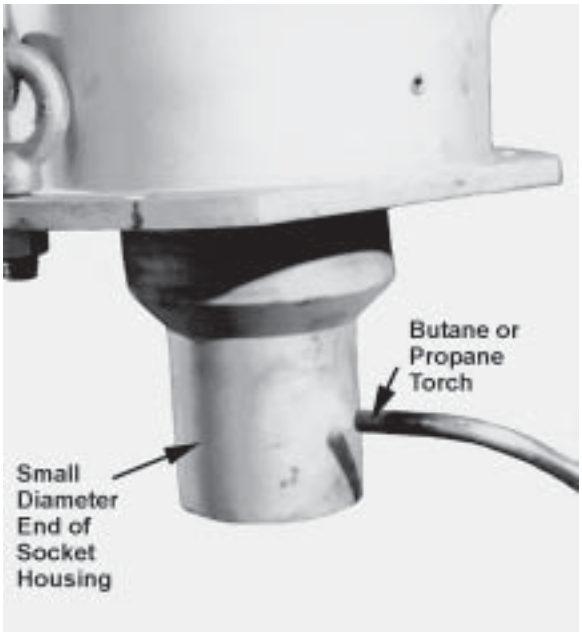


Figure 46. Heating Housing to Remove Roller Bearing from Small Diameter End

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not overheat housings. Excessive heat will damage or distort the casting. Socket housing should not be heated above 121°C (250°F).

8. Flush thrust socket housing and components with clean solvent to remove all debris. Visually inspect all parts for damage or dirt. Inspect all seal and bearing contact surfaces for wear or damage. 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 section of this manual.

Disassembly of the U-Joint / Input Shaft

1. Once the input shaft with the universal-joint is removed from the socket housing, separate the u-joint from the shaft. 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. Remove the bolts and collars holding the U-joint to the input shaft. Slide the shaft out of the splines of the yoke.

Figure 47. Bolts and Collars holding the U-joint to the Input Shaft

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

Figure 48. Seal Sleeve

4. Remove roller bearing by using heat or by cutting the bearings off the shaft.

   4a. To remove bearing with heat, first break the bearing cage with a chisel on both sides of the rollers. Stand shaft vertically with the propeller end up and quickly heat inner races with an acetylene torch until the races drop off.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠CAUTION

Do not overheat race when removing from shaft. Race should not be heated above 121°C (250°F). Excessive heat will damage or distort the shaft.

   4b. **To cut bearings off,** use a cutoff wheel with a carbide or composition wheel. Cut through roller cage. Separate the cage and rollers from the inner race. Cut groove in inner race until half through the race. Split race with chisel and slide off shaft.

⚠CAUTION

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

5. **Clean and Inspect:** Clean all parts and inspect for damage. If the seal sleeve is to be re-used, examine it for scratches on the seal mating 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.

NOTES

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.

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 400 grit or finer emery cloth or a 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 400 grit or finer emery 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 thread locking compound.

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 400 grit or finer emery 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 400 grit or finer emery cloth. If the bushing or sleeve is out-of-round, deeply scored, or excessively worn, replace it. If there is any question, replace.

Spacers

Inspect spacers for distortion, scores, burrs and wear. Rework or replace any defective spacers.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with 400 grit or finer emery cloth or a soft stone. Replace the part if other defects are found.

Flexible Hoses

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

Anodes

Replace anodes before they are 50% of their original size.

Inspect anodes (both drive and transom mounted) to see if they are still secured tightly. If loose, tighten or replace the anodes.

Inspect for marine growth, coatings, tape, etc. covering anodes. Replace if they cover more than 10% of the anode surface area.

Assembly

Assembly Overview

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

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

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

⚠WARNING

Handle the heated and frozen components with care. The heated parts are extremely HOT. The frozen parts are extremely COLD.

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.

Note: It is highly recommended to replace all bearings, seals, and o-rings that are accessible when servicing the drive.

Propeller Shaft Assembly

Special Tools:

- Wear Sleeve Driver T-18050-805

Heat the following parts to 121°C (250°F):

- Two (2) Tapered Bearings Cones
- Bearing Race
- Seal Sleeve

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

1. Support the shaft in a horizontal position on blocks allowing enough radial clearance for installation of the bearings. Apply a thin coat of anti-seize that does not contain graphite or molbdenum disulfide (such as Loctite® White HI-Temp Anti-Seize) to the shaft on the surfaces where the bearings will seat.

   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 which will reduce bearing life.

2. Lubricate propeller shaft and tapered bearings with oil prior to assembly. Slip heated tapered bearings on forward end of propeller shaft (short spline end) one at a time. The bearings should be positioned back to back (with small diameter ends facing out).

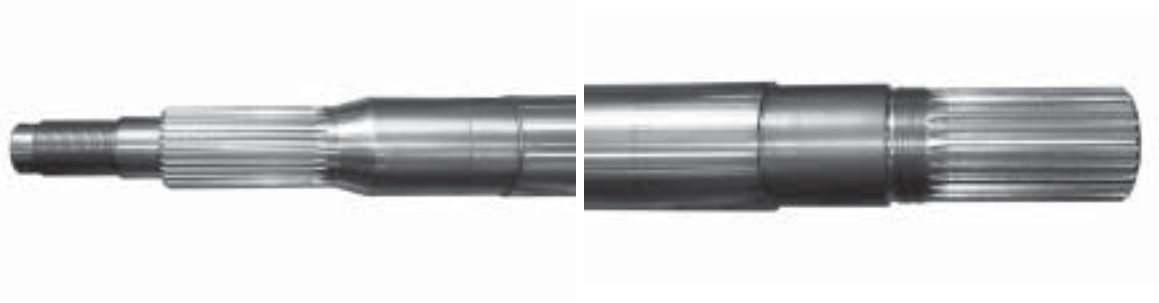


Figure 49. Propeller Shaft - Propeller End (left), Forward End (right)

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

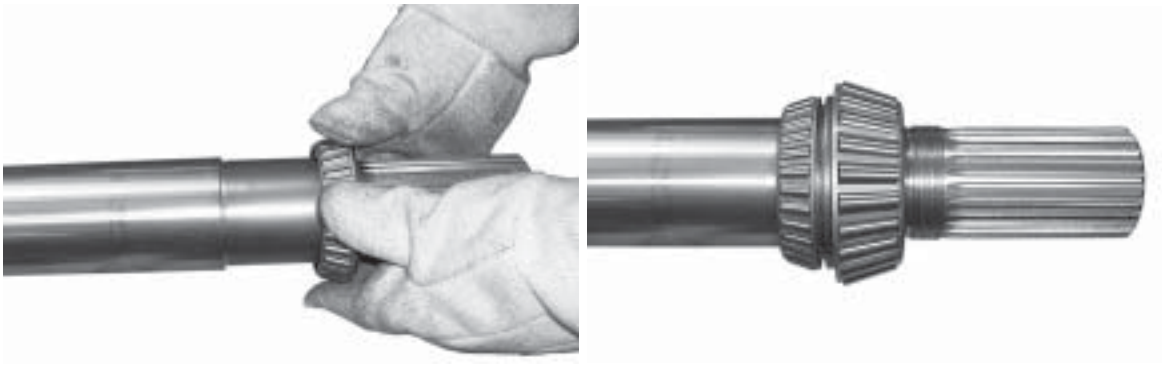


Figure 50. Install Tapered Roller Bearings

3. Slide spacer on forward end of shaft, positioning it against the bearing.

Figure 51. Spacer positioning

4. Slide lock washer and threaded lock nut onto the shaft. Tighten threaded lock nut with a hook spanner wrench. Torque lock nut to 136 N-m (100 ft-lbs). Ensure the bearings are firmly seated against shaft shoulder.

Figure 52. Thread Lock Nut

5. Secure lock nut by bending a locking tab into a slot on the nut.

Figure 53. Securing Lock Nut by Bending Locking Tab

6. Slide the heated bearing race followed by the seal sleeve onto the aft end of the shaft (long spline end) using special tool - T-18050-805.

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

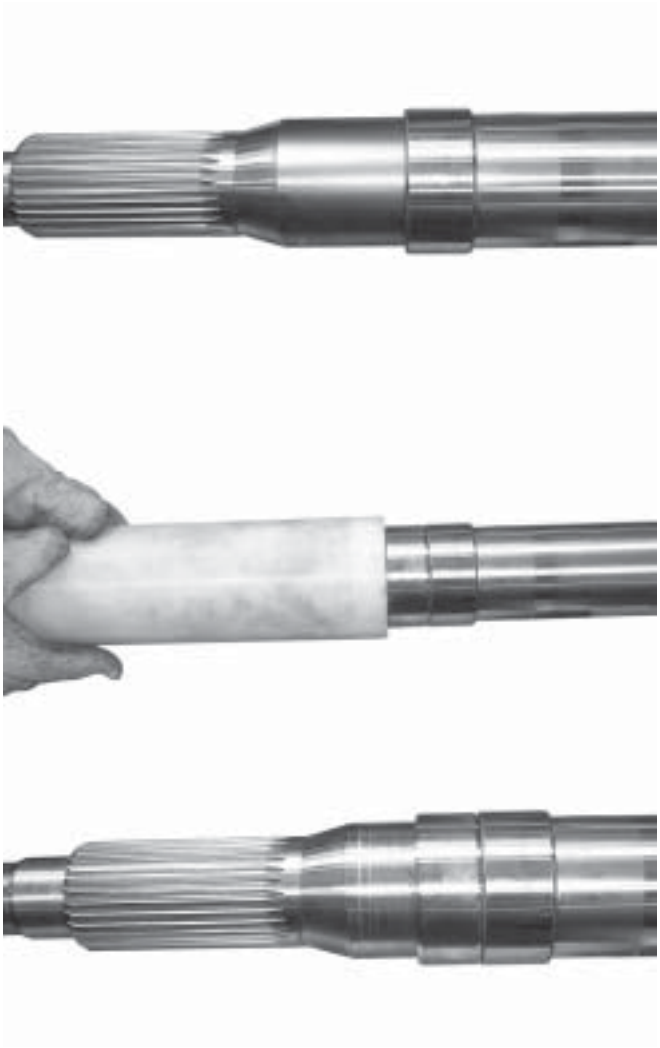


Figure 54. Sliding the Heated Bearing Race on the Shaft

7. Set this assembly aside. Place plastic bags over bearings and similarly protect rear race and splines. Do not allow dust or debris to settle on bearings or components.

Thrust Tube Assembly

Special Tools:

- Assembly Stand T-21085
- 1/2”-20 UNF Eyebolt
- Thrust Tube & Socket Roller Bearing Driver T-18050-579
- Inner Bearing Cup Driver T-18050-640
- Seal Driver T-18050-804
- Wear Sleeve Driver T-18050-805
- Shaft Endplay Indicator Holder T-21549-11
- Lifting Fixture T-21172-2
- Six Measurement Shims 0.254 mm (.010 in.)

Freeze the following parts to a temperature of -29°C (-20°F):

- Roller Bearing
- Two (2) Bearing Cups

⚠WARNING

Handle the components with care. The frozen parts are extremely COLD.

1. Heat the thrust tube bearing housing to 121°C (250°F).

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

2. Place thrust tube vertically in assembly stand with propeller end (end with smaller housing diameter) facing up. Heat thrust tube bearing housing area. Slide frozen roller bearing into aft bore of thrust tube. Seat bearing against shoulder with special tool T-18050-579, if necessary.

Figure 55. Installing Aft Thrust Tube Bearing

3. Install bearing spiral-lock retainer ring into aft end of thrust tube.

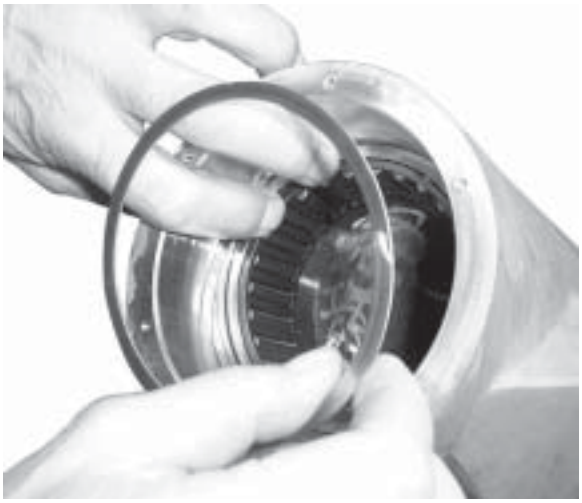


Figure 56. Installing Rear Bearing Spiral-Lock Retainer Ring

4. Rotate the thrust tube in the assembly stand so the forward end of the tube (end with larger diameter) is facing up. Heat thrust tube bearing housing area. Slide the first frozen bearing cup into the forward end of the tube. Open end of the cup should face up. Seat cup firmly against shoulder with special tool T-18050-640.

⚠WARNING

Handle the components with care. The frozen parts are extremely COLD.

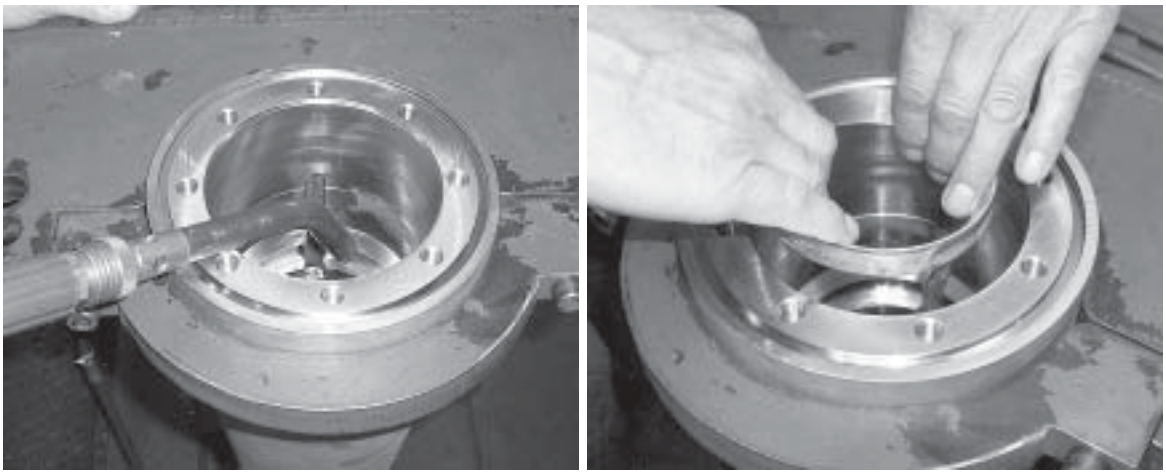


Figure 57. Installing First Bearing Cup

5. Lubricate bearings and race with oil to prepare for installation into thrust tube. Thread 1/2”-20 UNF eyebolt into tapped hole on the forward end of propeller shaft. Attach hoist to eye bolt.

Figure 58. Install Eye Bolt

6. Lower assembled propeller shaft (aft end first) into forward end of thrust tube. Take care not to damage propeller bearing while inserting shaft into housing. Seat shaft firmly into the thrust tube.

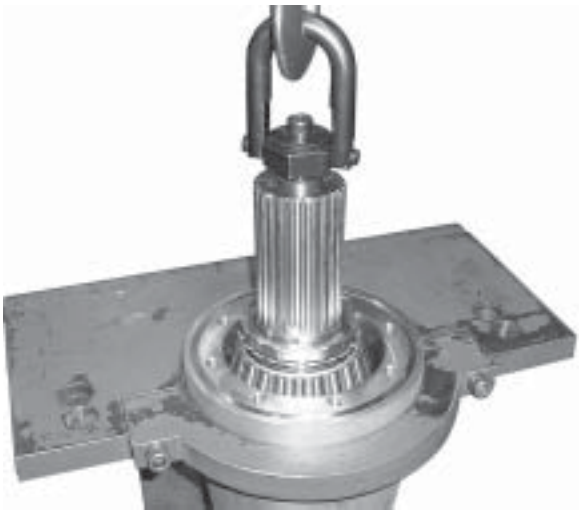


Figure 59. Installing Propeller Shaft Assembly into Thrust Tube

7. Visually check that the propeller bearing has not been damaged.

   Note: If using a new shaft, thrust bearing, thrust tube or thrust ball, you must re-shim the thrust bearing endplay.

8. Install second frozen thrust bearing cup into the forward end of the thrust tube. Open end of the cup faces down. If re-shimming is necessary, immediately raise the shaft 0.76 mm (0.030 in.) to ensure there will be end play in the bearing set. Keep the shaft raised until the front bearing cup stays in place when the shaft is lowered.

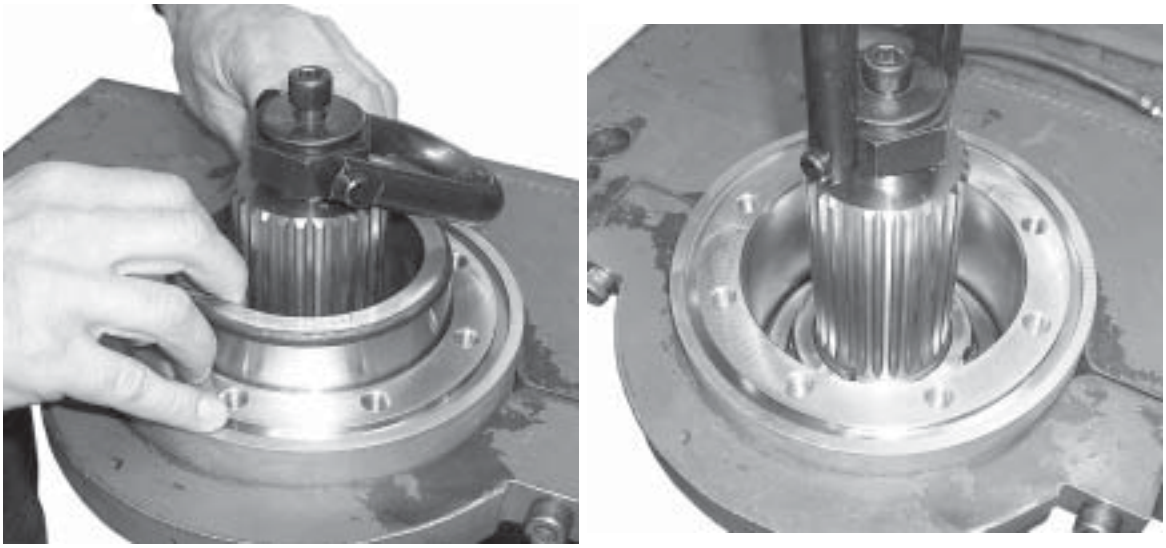


Figure 60. Install the Chilled Front Bearing Cup (left), and Raise the Shaft to Ensure End Play (right)

Thrust Bearing Shimming Procedure

Note: If re-shimming is not necessary, install the used shim pack on top of the thrust bearing cup and go to step 7, skipping the Thrust Bearing Shimming Procedure.

Note: Shimming to the correct bearing endplay is extremely important to the proper operation of the Arneson Surface Drive.

1. Install the thrust ball onto the thrust tube. Align slots in thrust ball with case slots in thrust tube. Secure the thrust ball using four of the eight 1/2-13 x 2 in. 12-point socket head capscrews, evenly spaced. Torque the capscrews to 135 N-m (100 ft-lbs).

2. Turn the thrust tube assembly over so that the output end is facing up. Install a dial indicator using special tool T-21549-11 onto the prop shaft.

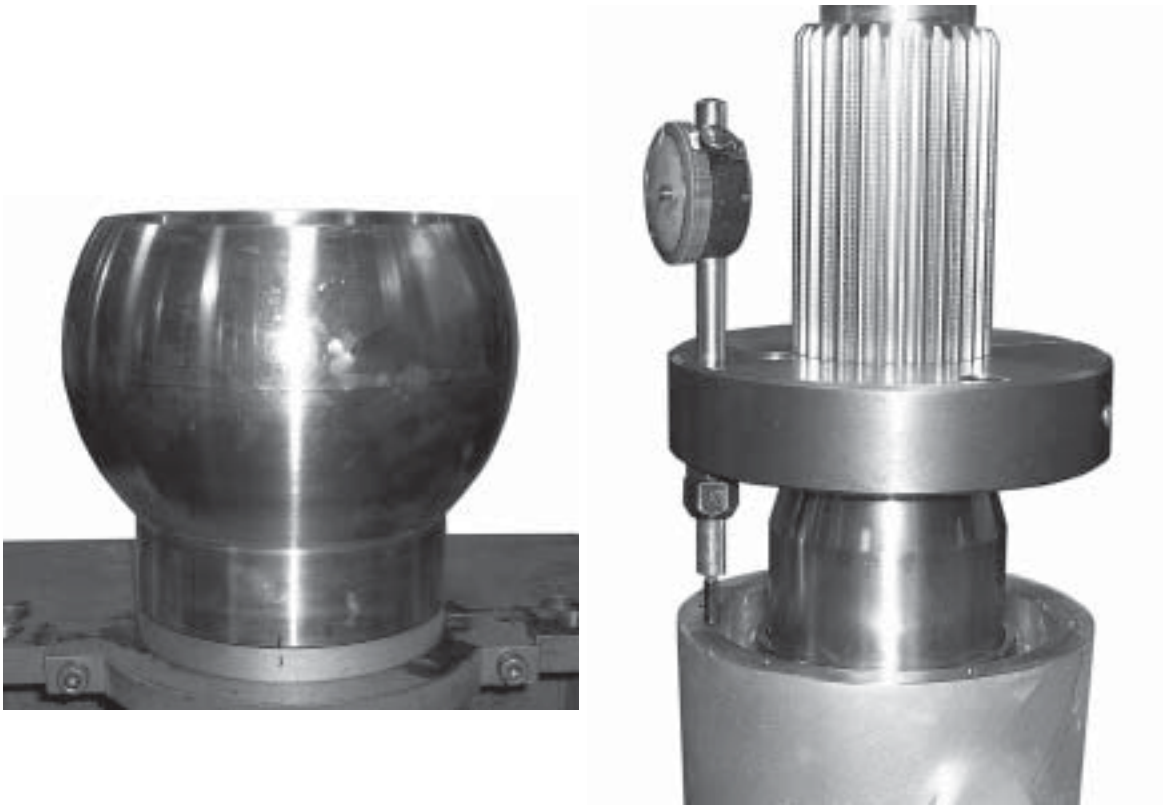


Figure 61. Lower Ball, Secure with Four Capscrews (left), and Turn Over and Install Dial Indicator T-21549-11 (right)

3. Use a hoist and special tool T-21172-2 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 0.05 - 0.13 mm (0.002 - 0.005 in.). If the indicated reading is out of tolerance, turn the thrust tube over so that the forward end of the tube is facing up. Mark the thrust ball to ensure placement of the thrust ball in the same location after placing necessary shims. 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.

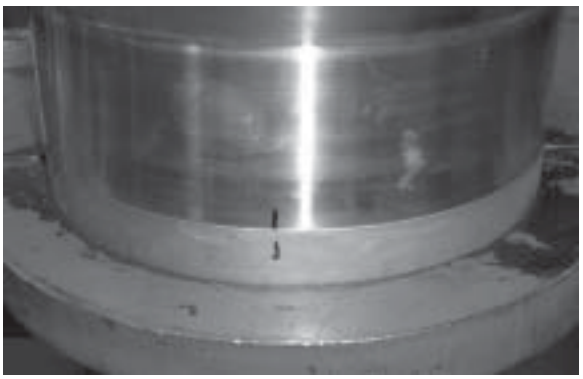


Figure 62. Thrust Ball Location Mark

4. Repeat step 3 until the bearing clearance is in tolerance.

   Note: The correct bearing end play is extremely important to the proper operation of the surface drive.

5. Remove the thrust ball.

6. Grease O-ring with water-resistant lithium grease and install in groove located to the outside of the bolt holes on the forward face of the thrust tube housing. Clean bolt holes and bolts with denatured alcohol to prepare for thread locking compound.

7. Lower thrust ball into thrust tube. If re-shimming was done, align the marks on the thrust ball and thrust tube from the shimming procedure. If re-shimming was not done, align slots in thrust ball pilot with cast slots in thrust tube. Coat the bolt threads with Loctite® 242 or similar semi-permanent threadlocker and install the eight 12-point bolts. Torque bolts to 136 N-m (100 ft-lbs).

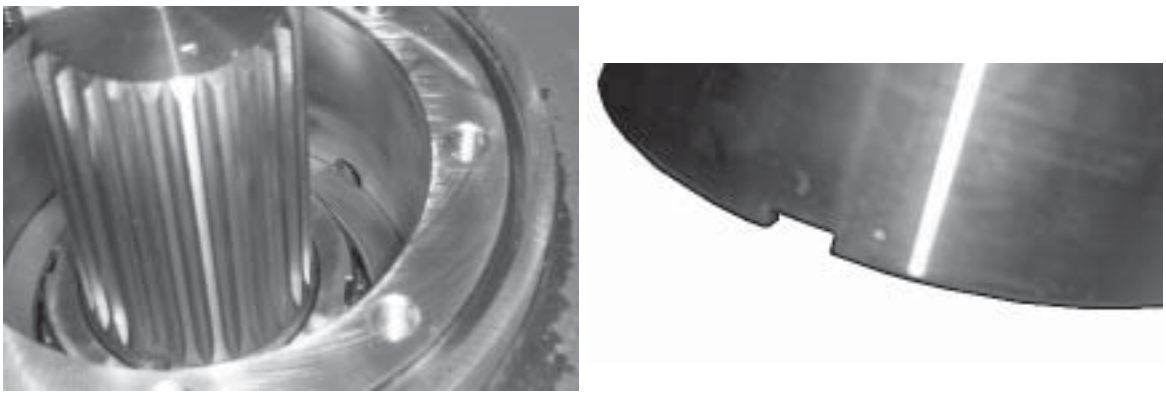


Figure 63. Case Slot (left), Thrust Ball Slot (right)

Aft Seal Installation

Aft Lip Seal

Note: There are two different aft sealing arrangements on the ASD12B1LU.

Before February 1st, 2007, ASD12B1LU drives were shipped with two aft seals, one to seal oil in and one to seal oil out. There was a spacer placed in-between the seals and the aft cover had a pilot that protruded into the thrust tube. The shaft sleeve did not protrude past the aft cover. See the Double-Seal Drives instructions for installation procedures.

After February 1st, 2007, ASD12B1LU drives were shipped with three aft seals, one to seal oil in and two to seal oil out. The spacer was not used in-between the seals and the aft cover changed to a flat plate. The shaft sleeve was made longer and protrudes under the aft cover. The seals did not change during this conversion. See the Triple-Seal Drive instructions for installation procedures.

An ASD12B1LU retrofit kit is available to convert double-seal drives to triple-seal. See Aft Seal Conversion Diagram in Engineering Drawings. Contact the factory for details.

Double-Seal Drives (before February 1, 2007)

1. Rotate the thrust tube in the assembly stand with the propeller end (end with smaller housing diameter) facing up.

2. Liberally coat inside and outside of the seals including the spacer with water resistant lithium grease.

3. Install lip seal and spacer. Seals are installed back to back, with a spacer between them, using special tool - seal driver T-18050-804. Cover the shaft splines to protect the seals as they are pushed into the housing with the driver. Garter spring on first seal faces the thrust ball.

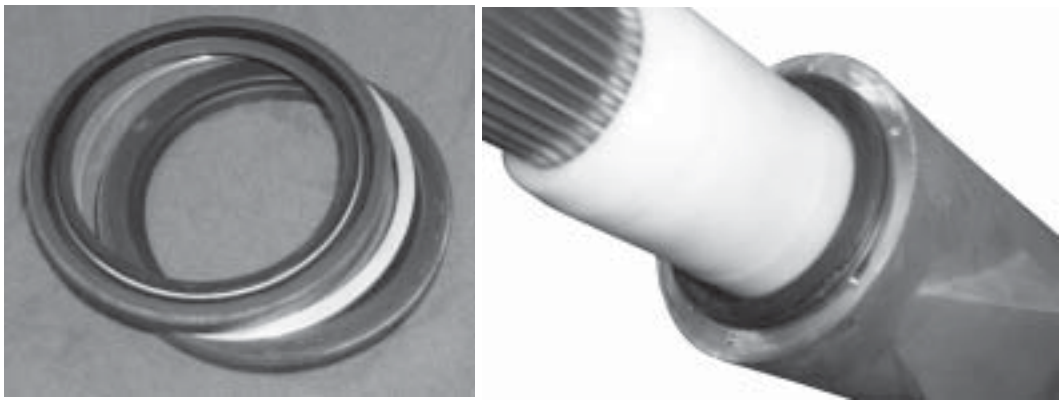


Figure 64. Seal Pack (left), Installing Inner Seal (right)

⚠WARNING

The garter spring of the forward seal (the first to be installed into the block) must face forward. The garter spring of the aft seal must face aft.

4. Install spacer.

Figure 65. Installing Spacer

5. Install second lip seal using special tool - T-18050-804. Garter spring on the second seal faces aft.

Figure 66. Installing Outer Seal (left), Using Seal Driver (right)

6. Install the seal cover onto the rear of the thrust tube housing. Clean the threaded holes with denatured alcohol. Coat the clean capscrew threads with Loctite® 242 or similar semi-permanent threadlocker and install six 8-32 x 3/8” socket head capscrews. Torque the capscrews to 2.26 N-m (20 in.-lbs).

Figure 67. Install Seal Carrier

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

Triple-Seal Drives (after February 1, 2007)

1. Rotate the thrust tube in the assembly stand with the propeller end (end with smaller housing diameter) facing up.

2. Liberally coat inside and outside of the seals with water resistant lithium grease.

3. Install inner lip seal using special tool - seal driver T-18050-804. Cover the shaft splines to protect the seals as they are pushed into the housing with the driver. Garter spring on first seal faces the thrust ball.

Figure 68. Installing Inner Seal

⚠WARNING

The garter spring of the forward seal (the first to be installed into the block) must face forward. The garter spring of the two aft seals must face aft.

4. Install second and third lip seals, one at a time, using special tool T-18050-804. Garter spring on second and third seals face aft.

Figure 69. Installing Outer Seals (left), Using Seal Driver (right)

5. Install the seal cover onto the rear of the thrust tube housing. Clean the threaded holes with denatured alcohol. Coat the clean capscrew threads with Loctite® 242 or similar semi-permanent threadlocker and install six 8-32 x 3/8" socket head capscrews. Torque the capscrews to 2.26 N-m (20 in.-lbs).

Figure 70. Install Seal Carrier

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

Input Shaft and Socket Assembly

Freeze the following parts to a temperature of -29°C (-20°F):

- Roller Bearing

⚠WARNING

Handle the components with care. The frozen parts are extremely COLD.

1. Heat the roller bearing and the input shaft (socket end) seal wear sleeve to 250° F (121° C).

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

2. Assemble the previously heated bearing sleeve to the input end of the input shaft.

Figure 71. Input Shaft Seal Sleeve

3. Assemble the previously heated ball bearing onto the output (universal joint) end of the input shaft. Be sure to hold the bearing against the shoulder of the shaft as it cools.

4. Clean the threaded holes that are cross drilled in the output end spline with denatured alcohol to prepare for Loctite® 242 or similar semi-permanent threadlocker.

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.

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 3/8 - 24 UNF x 1-1/2” socket head capscrew threads with Loctite® 242 or similar semi-permanent threadlocker 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 and 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. Do not exceed a torque of 65 N-m (45 ft-lbs) on the capscrews.

Figure 72. Lower U-joint Onto Spline (left), Install Collars (right)

Thrust Socket

1. Place thrust socket on assembly bench with the smaller diameter end facing up. Lubricate bore and outside of forward socket bearing with lubricating oil. If necessary, heat the outside of the small diameter end of the socket with a butane or propane torch to assist in the installation of the roller bearing. Do not allow temperature of housing to exceed 121°C (250°F).

⚠CAUTION

Do not overheat races when removing from shaft. Races should not be heated above 121°C (250°F). Excessive heat will damage or distort the shaft.

Figure 73. Thrust Socket Housing

2. Install frozen forward socket roller bearing into small diameter end of the socket. Slide bearing down to shoulder in housing. Seat bearing against shoulder with special tool T-18050-579, if necessary.

⚠WARNING

Handle the components with care. The frozen parts are extremely COLD.

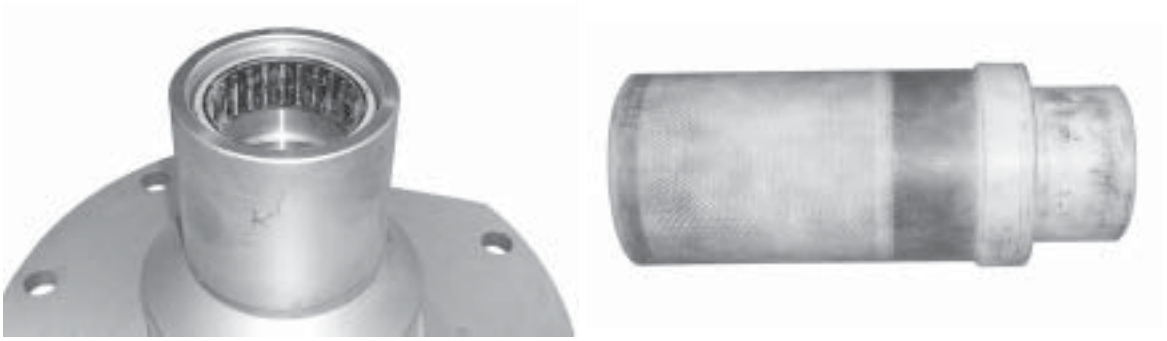


Figure 74. Installing Frozen Forward Socket Bearing into Socket

3. Install bearing retaining ring. Assure ring is seated into groove.

Figure 75. Installing Retaining Ring

4. Place thrust socket in socket bench with small diameter end protruding through hole in bench.

Input Shaft and U-Joint

1. Before installing input shaft and U-joint into socket, place spiral-lock retainer ring above bearing on input shaft.

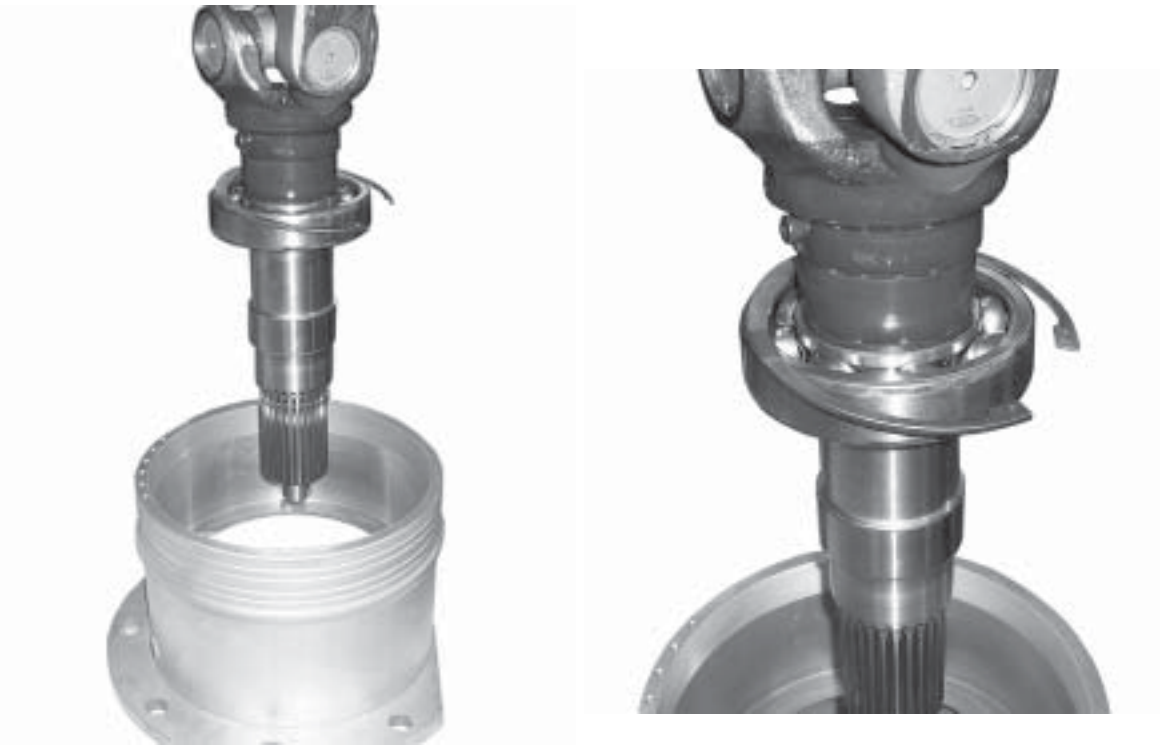


Figure 76. Installing Input Shaft and U-Joint into Socket

2. Heat the socket housing with a butane or propane torch to assist in the installation of U-joint assembly. Do not allow housing temperature to exceed 121°C (250°F).

⚠WARNING

Handle the components with care. The heated parts are extremely HOT.

⚠WARNING

Assure shaft and bearing are kept straight as they are installed into housing. Do not bind.

Figure 77. Installing Input Shaft and U-Joint into Socket

3. Lift the input shaft and U-joint assembly above socket. Lower the assembly into the thrust socket until ball bearing is above the bearing bore. Align bearing to bore, and once housing is heated, bearing should fall into place. Keep the bearing straight in housing bore. When shaft is inserted into socket, assure that roller bearing engages smoothly.

4. After socket shaft assembly is installed, install retainer ring, (which was placed above the bearing before installation), into the retainer ring groove. Use a suitable retaining ring pliers, to help compress the bearing retaining ring while installing it. The retaining ring pliers may have to be modified by bending its prongs. This will allow its handle avoid the u-joint during installation. Lubricate bearing with oil.

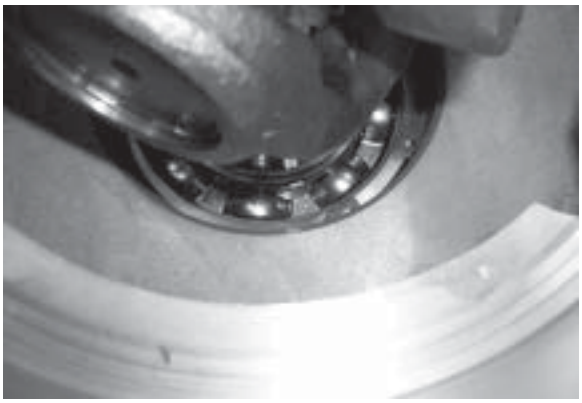


Figure 78. Installing Retaining Ring

5. Prepare the forward retainer for installation into the socket housing. Inspect spherical surface of this ring for any scratches or burrs on its surface. Remove rough areas by lightly sanding with emery cloth or 400 or finer grit sandpaper. Thoroughly clean with alcohol. Slide forward thrust retainer ring into socket housing.

6. Install packing and O-ring into thrust socket. (See following instructions: Removal and Replacement of Thrust Socket Packing and O-Ring)

Removal and Replacement of Thrust Socket Packing & O-Ring

1. Remove old packing and O-ring from socket, discard.

2. Place layer of new packing around inside of socket at packing groove, taking care not to twist out of square shape. Butt 45° angle cuts together. The ideal position of packing joints is at the 10 o'clock and 2 o'clock position in relation to top of the drive unit. Work excess packing around until it lies flat against socket wall. If necessary, trim packing to achieve proper fit.

3. Place O-ring against first layer of packing. Smooth flat against socket wall.

4. Place second layer of new packing around inside of socket, as in step 3, and press down to keep O-ring in place. Make sure second butted packing joint is rotated at least 90° in relation to the first.

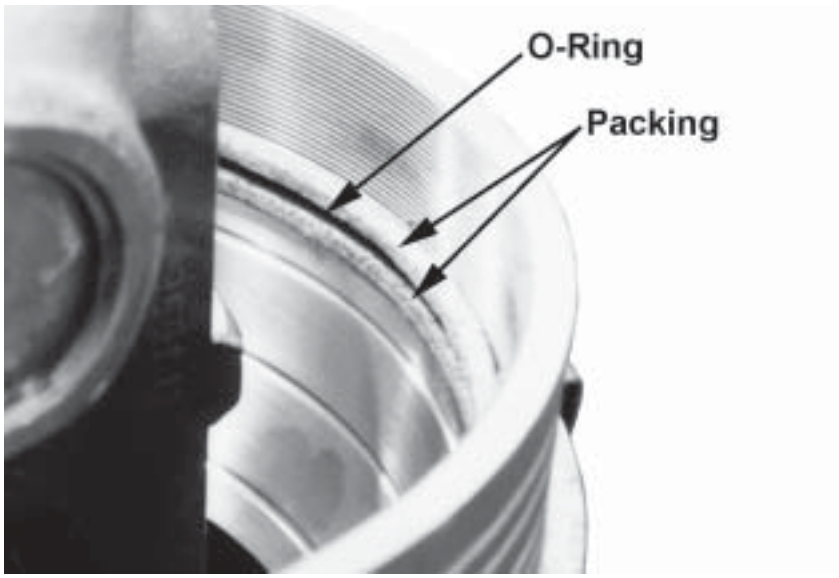


Figure 79. Replacement of Thrust Socket Packing and O-Ring

5. Coat retaining ring, packing, and O-ring with water resistant lithium grease. Lubricate universal joint with lubricating oil.

6. The socket is now ready for installation of thrust tube.

Installation of Thrust Tube Into Thrust Socket

Special Tools:

- Assembly Stand T-21085 (if socket has been removed from transom)
- Press Apparatus T-21549-12
- Wrench 1009229 (provided with original package)
- Seal Driver T-18050-804

To assure correct sealing of thrust ball, O-ring, and packing when changing thrust tube assembly, the aft (threaded) retainer must exert the correct pressure on the packing. A 3 mm (1/8 in.) press on the packing material ensures adequate pressure.

When correctly installed, there should be less than a 0.05 mm (0.002 in.) clearance between thrust ball and the aft retainer. Check this dimension with a standard feeler gauge tool. When placing aft retainer into thrust socket assembly, a shim pack may be required.

⚠WARNING

Support thrust tube with block-and-tackle, forklift or other system capable of carrying its weight. This will assist in a smooth insertion and avoid damage to unit.

⚠CAUTION

Do not let ball contact the threaded edges of the socket. Severe damage to the ball and socket could result.

1. Coat entire spherical surface of thrust ball with water resistant lithium grease.

If the socket is attached to the transom:

2a. Place approximately 4 mm (0.15 in.) shims in socket on top of packing. Coat U-joint yoke splines with lubricating oil to assist in installation of yoke onto propeller shaft.

Insert thrust tube into socket with caution, taking care that the ball enters socket evenly and firmly, U-joint is engaging smoothly and that the packing and O-ring material remain in place.

Note: U-joint can be positioned by running a rope or wire through upper fill hole of thrust socket. Thread a loop between the front U-joint yoke and the “+” shaped piece. Next, loop that end around the outer diameter of the U-joint’s front spline. This can then be pulled tight to hold U-joint yoke in place to assist in thrust tube insertion. Once splines are engaged, remove rope or wire by pulling it out through the hole.

Figure 80. Support U-Joint During Installation of Thrust Tube into Thrust Socket

3a. Inspect aft retainer for any nicks, scratches or burrs. Smooth with 400 grit or finer emery cloth, and clean thoroughly with alcohol or cleaning solvent. Coat threads of aft retainer with anti-seize that does not contain graphite or molbdenum disulfide such as Loctite® White HI-Temp Anti-Seize. Slip ring over thrust tube, and position around thrust ball.

4a. Remove two of the drive unit's mounting bolts. Bolts to remove will be directly across from each other (180° apart) at approximately the 3 o'clock and 9 o'clock positions.

Install the threaded rods of press apparatus, special tool T-21549-12, into each hole and attach nuts to the inside of transom to secure rods.

Place the plate of the press apparatus over the propeller shaft to rest against the aft end of the thrust tube. The threaded rods should pass through the 1 inch holes on either side of the center hole of the plate. Secure the plate with nuts. Go to Step 5.

If the socket has been removed from the transom:

2b. Position the socket in socket bench with larger diameter end facing up. Coat U-joint yoke splines with lubricating oil to assist in installation of yoke onto propeller shaft. Place approximately 4mm (0.15 in.) shims in socket on top of packing.

Lift thrust tube and position above thrust socket. Slowly lower thrust tube into socket.

3b. Inspect aft retainer for any nicks, scratches or burrs. Smooth with 400 grit or finer emery cloth, and clean thoroughly with alcohol or cleaning solvent. Coat threads of aft retainer with anti-seize that does not contain graphite or molbdenum disulfide such as Loctite® White HI-Temp Anti-Seize. Slip ring over thrust tube, and position around thrust ball.

4b. Place the unit horizontally in the assembly stand. Position the socket so the flat end of its mounting flange is facing the same direction as the fin mount on the thrust tube.

Install the threaded rods of press apparatus, special tool T-21549-12, through the mounting plate bolt holes in the 3 o'clock and 9 o'clock positions. Attach nuts on the forward end of the threaded rods.

Pass the threaded rods through the 1-inch bolt holes in the press apparatus plate. Attach nuts to the aft end of the threaded rod. Go to Step 5.

5. Once rods are in place, draw together the thrust tube and socket by tightening nuts on the rods. Perform this step by evenly applying pressure to both sides of press fixture. Stop tightening when nuts become extremely difficult to turn. Note the distance from the front end of the socket flange to the aft end of the propeller shaft should be very close to 1590 mm (62.5 in.).

⚠CAUTION

Do not attempt to pull thrust tube into thrust socket using retainer ring. This can scratch the thrust ball and cause retainer ring to warp or break. It can also cause a rough ball surface that will severely affect the sealing integrity of the packing and o-ring arrangement.

Figure 81. Tightening the Aft Retainer using Special Wrench

6. Inspect shims and ensure that they are flat against the packing and will not get caught in the retainer threads.

7. Thread aft retainer into socket until contact is made and resistance is felt on packing.

8. Measure and record the distance from the aft end of the retainer to the aft end of the socket in three places. The average of these values is distance “A”. Distance “B” is equal to “A” minus 3 mm (1/8 in.).

9. Tighten the aft retainer until the distance from the aft end of the retainer to the aft end of the socket is “B”.

   If the gap between the thrust ball and retainer becomes zero before “B” is reached, DO NOT tighten the retainer any more. Doing so may damage the thrust ball and/or retaining ring. Remove the retainer and add the smallest plastic shim available to the shim pack. Before installing the new shim, measure it’s thickness in three places. Add the average value to “B”. Tighten the retainer again until the distance between the aft end of the retainer and the aft end of the socket is the new “B”.

   Note: Shims may be cut in one place to aid in assembly. Make sure to place cut shims underneath an uncut shim so that the retainer does not contact them.

   Repeat this step as necessary.

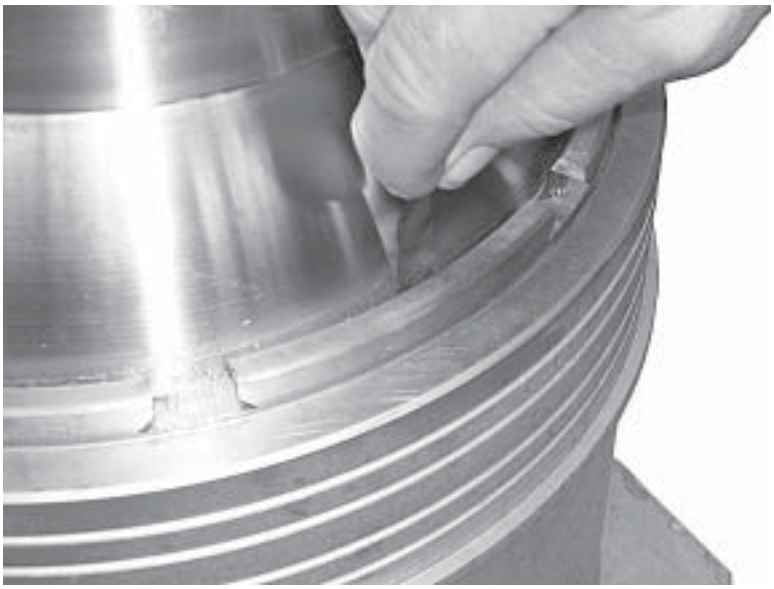


Figure 82. Measuring the Gap Between Thrust Ball and Aft Retainer

10. Measure the gap between the aft retainer and the thrust ball. It should be no more than 0.05 mm (0.002 in.). If the gap is greater than that, remove the retainer and 0.25 mm (0.010 in.) of shims for every 0.08 mm (0.003 in.) of extra gap.

    For example:
    If the measured gap is 0.20 mm (0.008 in.), remove the retainer and 0.50 mm (0.020 in.) of shims.

Table 4. Shim Calculation Example

Gap		Required Gap		Extra Gap		Thickness of shims to remove.
0.20 mm	-	0.05 mm	=	0.15 mm		
0.008 in.	-	0.002 in.	=	0.006 in.		
Extra Gap						
0.15 mm	x	0.25 mm	÷	0.08 mm	=	0.47 mm*
0.006 in.	x	0.010 in.	÷	0.003 in.	=	0.020 in.
* Round to 0.50 mm						

Replace the retainer and subtract the shim thickness removed from “B”. Retighten the retainer until the distance between the aft end of the retainer and the aft end of the socket is the new “B”. If the retainer contacts the ball before “B” is reached, stop tightening the ring and go back to step 9.

Repeat this step as necessary until there is 3 mm (1/8 in.) compression on the packing and less than 0.05 mm (0.002 in.) of gap between the retainer and thrust ball. The aft retainer should be very tight at this point.

Note: There is no torque setting specified for the final installation of the aft retaining ring.

11. When both the desired aft retainer projection and 0.05 mm (0.002 in.) or less gap between thrust ball and aft retainer have been reached, disconnect the press apparatus. Check that the U-joint has clearance in all directions by gently angling the thrust tube to the extreme right, left, up and down positions.

⚠CAUTION

Do not allow the thrust ball to contact against the thrust socket.

12. Rotate prop shaft at every extreme position to check for smooth operation and absence of binding. If there is any binding or roughness when spinning the shaft, contact your local distributor or the factory for instructions.

13. If socket is attached to transom, reinstall the two mounting bolts removed earlier. Torque mounting bolts to 175-200 N-m (130-150 ft-lbs). See Mounting Hardware in Installation Section.

14. Install front oil seals back to back but seperated by the spacer. Install seals using special tool - seal driver T-18050-804. Cover the socket shaft with the input seal protector to protect the seals as they are pushed into the housing with the driver. Garter spring on first seal faces the U-joint. Garter spring on second seal should face forward. Fill the seals and the groove between the two seals with lithium-based grease to assure proper lubrication.

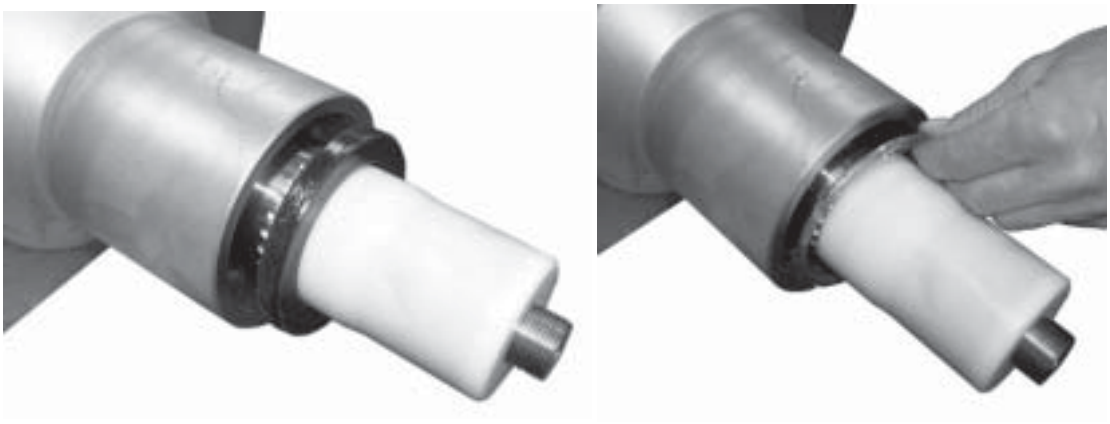


Figure 83. Installing Front Oil Seals and Spacer

15. Install spiral retaining ring.

Figure 84. Installing Spiral Lock Retaining Ring

16. Place clip in the notch of the aft retainer that is positioned in front of the six bolt holes on the aft face of socket housing. Clean tapped holes with alcohol and dry with compressed air. Secure with two bolts that have been coated with Loctite® 242 or similar semi-permanent threadlocker. Torque retainer clip bolts 7.3 N-m (65 in-lbs).

Figure 85. Aft Retainer Ring Lock Clip in the Notch Locking Tab

Boot Installation

Note: The boot is not intended to keep water out—its purpose is to protect the drive from marine growth and debris.

1. Clean the interior of the boot with a clean rag and cleaning solvent.

2. Holding the boot with the large end facing forward, pass the boot over the propeller shaft and slide down to the thrust socket. Assure that the grooves in the thrust tube and socket housings match up with the ridges on the inner diameter of the boot.

3. Secure boot to thrust tube with small circle clamp and to the socket with two large circle clamps. Assure that the clamp screws are on the top of the unit. Apply anti-seize that does not contain graphite or molbdenum disulfide such as Loctite® White HI-Temp Anti-Seize, on clamp threads.

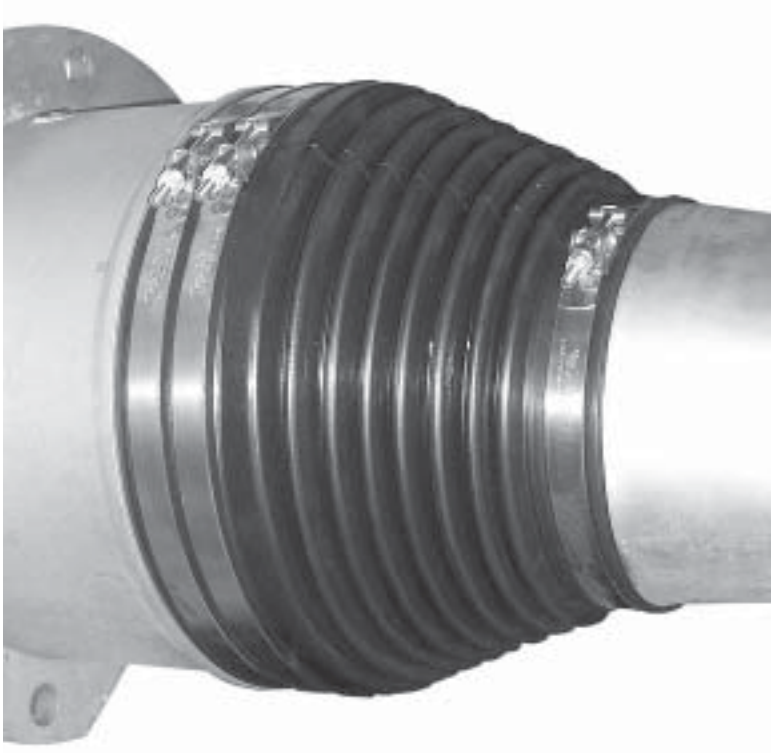


Figure 86. Boot Secured With Three Circle Clamps

Fin Reattachment

1. If working on more than one unit at a time, make sure that the number on the fin is the same as the number on the fin pad. The number can be found on the port side of the thrust tube under the Twin Disc logo. On the fin the number is located on the upper port side.

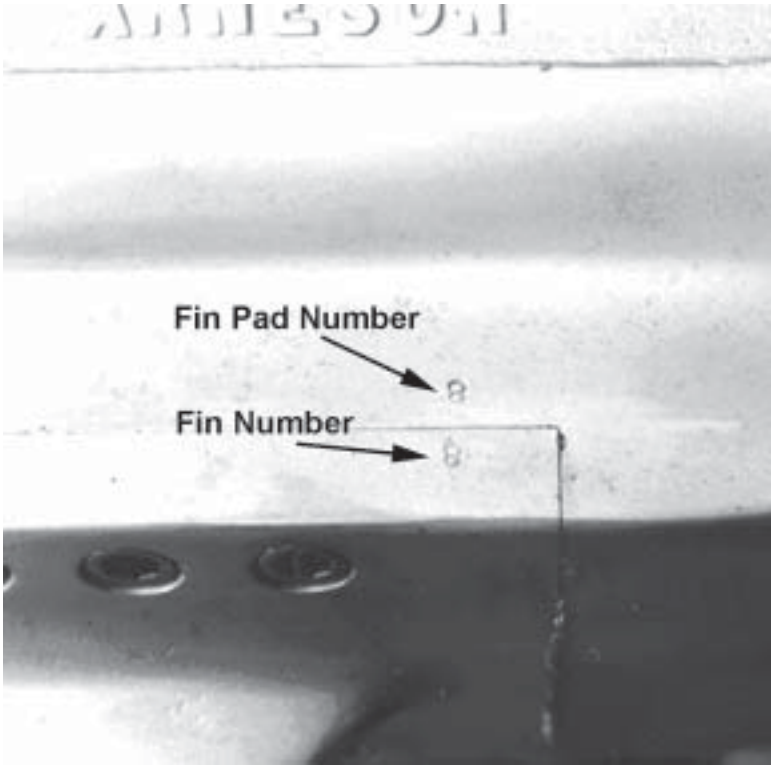


Figure 87. Identifying Fin and Fin Pad Numbers

2. Remove any rough edges or burrs from mating surfaces of thrust tube and fin pad. Clean with alcohol. Spread a thin layer of waterproof (marine grade) silicone sealer on thrust tube fin pad.

3. Place fin on fin pad and install socket-head screws, starting with the two lower and two upper screws. If necessary, tap fin with plastic mallet to align fin on base, then continue installing the remaining screws. Torque to 35 N-m (25 ft-lbs). Clean excess sealer from seam.

Figure 88. Installing Fin Bolts

Attaching Thrust Unit to Transom

1. Using suitable lifting device, cradle unit into place against transom with input shaft protruding through the hole in transom.

2. Align mounting bolt holes. Coat each bolt with marine transom sealant (3M Brand 5200 marine sealant or equivalent is recommended) to prevent leakage. Place a 1-inch A.N. washer under the bolt head and install 1 inch diameter mount bolts.

3. Install nuts and washers inside transom and torque to 175-200 N-m (130-150 ft-lbs.).

Hydraulic Cylinder Service

Servicing the Steering & Trim Cylinders

Special Tools:

1/2” hex bit socket
T-21549-33 steering cylinder thread and seal protector
T-21549-32 trim cylinder seal protector

Propeller steering and propeller trim are achieved through the use of hydraulic cylinders located outside the vessel, as shown below.

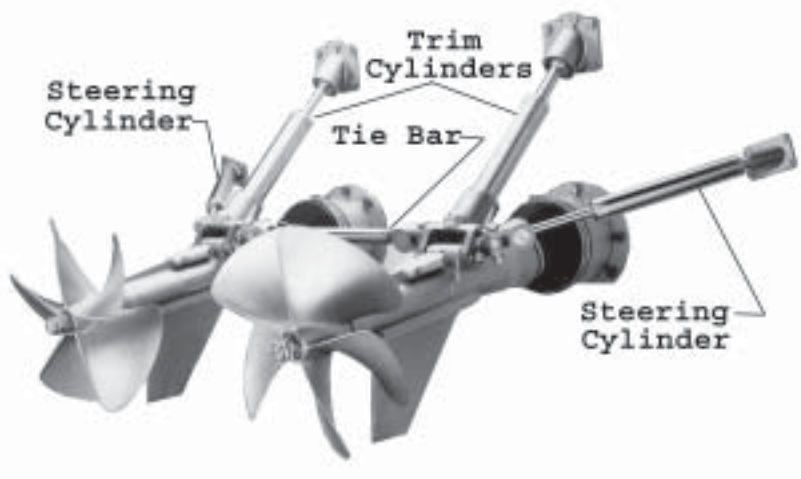


Figure 89. View of Dual Installation Showing Cylinders and Tie Bar.

The cylinders are mounted on the boat’s transom with ball joints. The trim cylinder is connected directly to the drive at the top of the thrust tube. The steering cylinder is connected directly to the drive either through the trim cylinder yoke (when the steering cylinders are mounted outboard), or through the trim yoke pin (when the steering cylinders are mounted inboard).

Steering Cylinder Service

Removal

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

2. If necessary, support the drive with 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.

3. Remove the steering cylinder clevis pin.

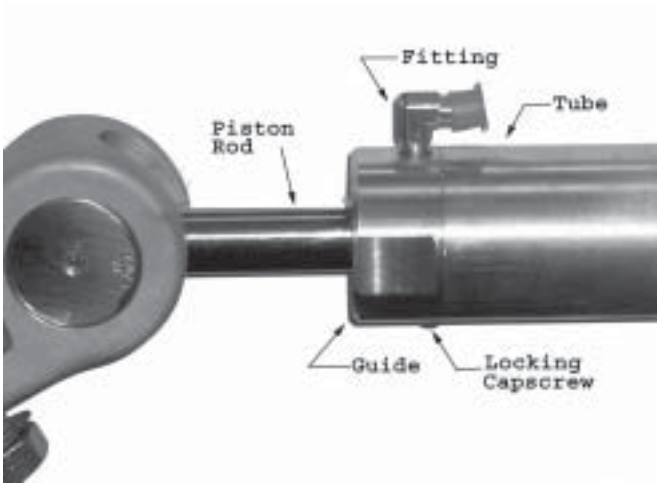


Figure 90. Steering Cylinder.

4. Disconnect and plug both hoses at the cylinder. Manually cycle the cylinder to remove the oil in it. Use a container to catch the oil.

5. Check the amount of play in transom mounting bracket. If there is any play (indicating that the ball joint is loose in the bracket), the bracket must be serviced by following the directions below. If there is no play in the ball joint, skip to the next section, Disassembly & Inspection.

6. While supporting the cylinder, remove the four (4) transom bracket mounting bolts, nuts, and washers.

7. Remove the steering cylinder from the vessel.

8. Remove the transom bracket setscrew closest to the hose fittings and tighten the large retaining nut inside the bracket to 75N-m (55 ft-lbs). Use a 1/2” hex bit socket to tighten the nut. After tightening, check to make sure there is no movement in the pivoting joint.

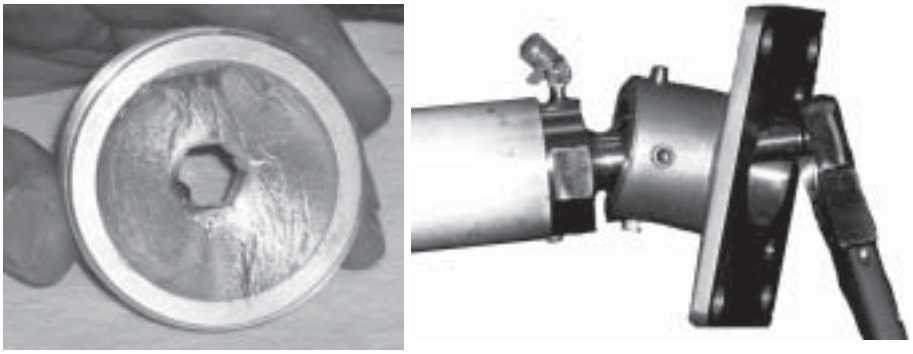


Figure 91. Use a 1/2”hex bit socket to tighten the large retaining nut.

9. Using a 1/4” drill bit, drill 1/8” into the retainer threads through the setscrew hole. This creates a spot for the setscrew to lock the retainer nut.

⚠ CAUTION

Do not let the drill bit contact the setscrew hole threads.

Figure 92. Drill 1/8” into the retainer threads.

10. Clean the hole of metal chips and hardened threadlocker thoroughly.

11. Reinstall the setscrew using Loctite® 242 or similar semi-permanent threadlocker. Torque setscrew to 8 N-m (6 ft-lbs).

Disassembly and Inspection

1. Remove the capscrew from the tube near the point where the rod protrudes out of the cylinder.

2. Hold the cylinder tube using a strap wrench or suitable split blocks.

3. Loosen the bronze rod guide using a suitable wrench. Thread the rod guide out and slide the entire rod/piston assembly from the tube. The guide will stay on the rod, as will the piston at this point.

4. Remove the flexloc nut and slide the piston and guide off the rod.

5. Remove all O-rings, seals and the wiper.

6. Using a cleaning solvent, clean the tube bore, rod, guide and piston.

7. Inspect the bore of the cylinder tube and the working area of the rod for scratches, nicks and other surface defects. If necessary, use a 400 grit (or finer) emery cloth to smooth the defects. Contact your local Twin Disc Distributor if either component is excessively damaged.

⚠ CAUTION

Do not remove excessive material or create flat spots. This could cause leakage past the seals.

Assembly

1. Replace all the rod guide and piston O-rings, seals and the wiper. Lubricate all of these components to aid in re-assembly.

   Note: When replacing the polypak seal in the guide, the O-ring portion of the polypak seal should face into the cylinder.

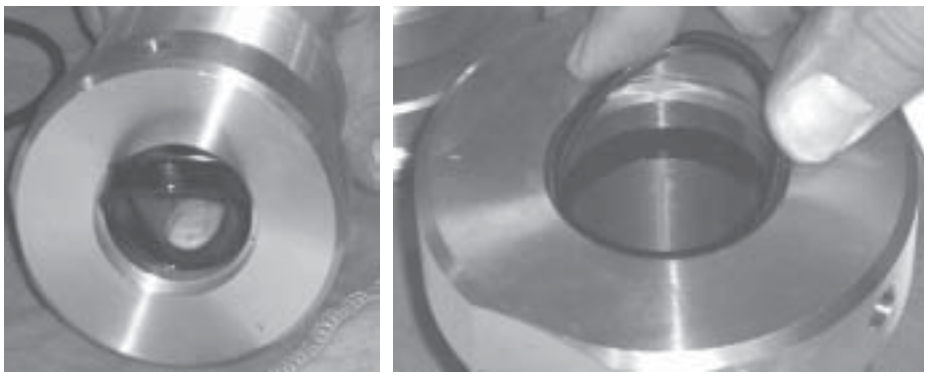


Figure 93. Install the polypak seal into the guide followed by the wiper.

2. Slide the guide back on the rod, being careful not to damage the seals or the rod threads.

   Note: Special tool T-21549-33 should be used to protect the rod guide seals.

Figure 94. Slide the guide on to the rod.

3. Slide the piston on to the rod, again being careful not to damage seals or rod threads.

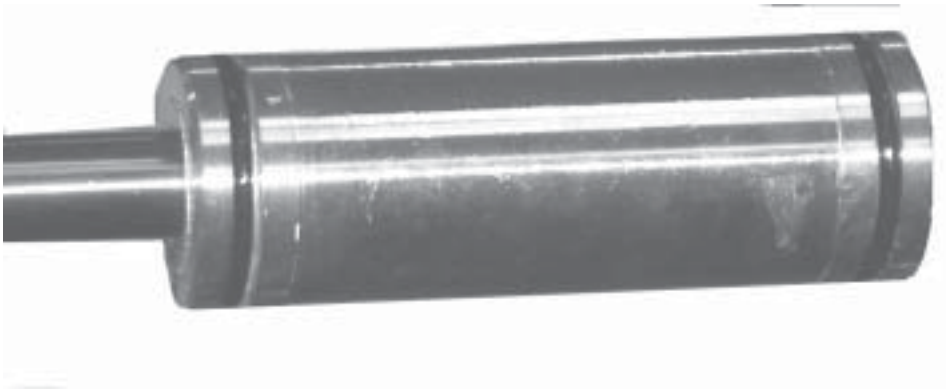


Figure 95. Slide the piston on to the rod.

4. The used flexloc nut should be discarded and replaced with a new one. Tighten to 100 N-m (75 ft.-lbs).

Figure 96. Tighten the flexloc nut.

5. Insert the piston rod assembly back into the tube, being careful not to damage the piston, O-rings or the tube threads.

Figure 97. Insert the piston rod assembly into the tube.

6. Tighten the guide until it is tight against the tube and the socket-head capscrew holes on the guide and on the tube are in alignment.

7. Remove any threadlocker compound still present in the hole from previous capscrew installation.

8. Replace the socket-head capscrew using Loctite® 242 or similar semi-permanent threadlocker. Tighten to 8 N-m (6 ft.-lbs).

9. If the cylinder was removed from the transom, mount the steering cylinder bracket with its backing plate and stainless steel 1/2 inch diameter nuts, bolts, and washers. Torque nuts to 60 N-m (45 ft. lbs). Apply a generous layer of marine transom sealant under the bracket and in the fastener holes to prevent water leakage. Do not turn the bolts when tightening them. Hold the bolts in place and only turn the nuts. If this procedure is not followed, leaks can develop in the holes.

Trim Cylinder Service

Removal

1. Make sure the battery cables are still disconnected and the key is not in the ignition.

2. If needed, support the drive with 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.

3. Remove trim cylinder yoke pin to disconnect the cylinder from the drive.

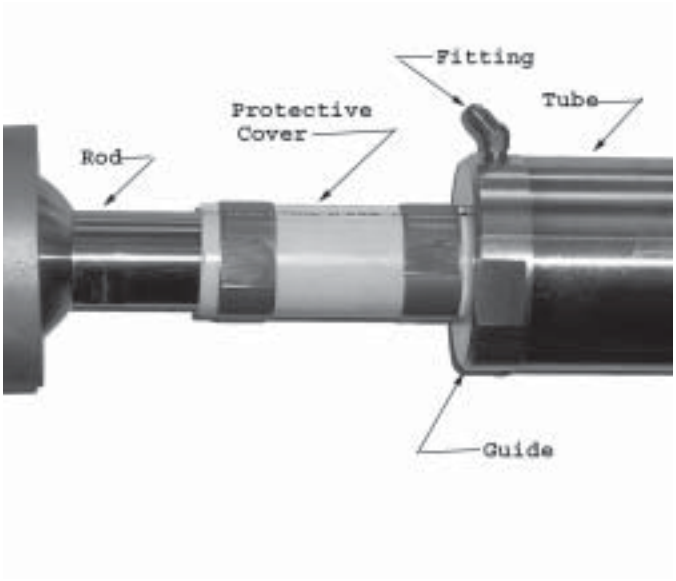


Figure 98. Trim Cylinder.

4. Disconnect and plug both hoses at the cylinder. Manually cycle the cylinder to remove the oil in it. Use a container to catch the oil.

5. Check the amount of play in transom mounting bracket. If there is any play (indicating that the ball joint is loose in the bracket), the bracket must be serviced by following the directions below. If there is no play in the ball joint, skip to the next section, Disassembly & Inspection.

6. While supporting the cylinder, remove the four (4) transom bracket mounting bolts, nuts, and washers.

7. Remove the trim cylinder from the vessel.

8. Remove the transom bracket setscrew closest to the hose fittings and tighten the large retaining nut inside the bracket to 75N-m (55 ft-lbs). Use a 1/2” hex bit socket to tighten the nut. After tightening, check to make sure there is no movement in the pivoting joint.

9. Using a 1/4” drill bit, drill 1/8” into the retainer threads through the setscrew hole. This creates a spot for the setscrew to lock the retainer nut.

⚠ CAUTION

Do not let the drill bit contact the setscrew hole threads.

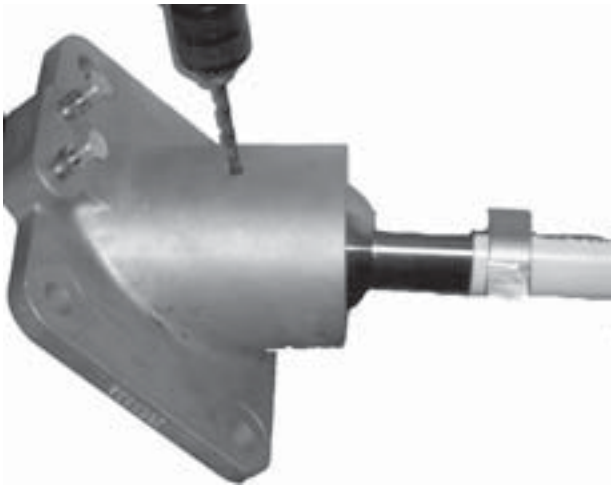


Figure 99. Drill 1/8” into the retainer threads.

10. Clean the hole of metal chips and hardened threadlocker thoroughly.

11. Reinstall the setscrew using Loctite® 242 or similar semi-permanent threadlocker. Torque setscrew to 8 N-m (6 ft-lbs).

Disassembly & Inspection

1. Remove the capscrew from the tube near the point where the rod protrudes out of the cylinder.

2. Hold the cylinder tube using a strap wrench or suitable split blocks.

3. Loosen the rod guide using a suitable wrench. Thread the rod guide out and slide the entire rod/piston assembly from the tube. The guide and piston will stay on the rod at this point.

4. Remove the setscrew in the side of the piston and, using a suitable wrench, carefully thread the piston off the rod.

5. Remove the guide from the rod.

6. Remove all O-rings, seals and the wiper.

7. Using a cleaning solvent, clean the tube bore, rod, guide and piston.

8. Inspect the bore of the cylinder tube and the working area of the rod for scratches, nicks, and other surface defects. If necessary, use a 400 grit (or finer) emery cloth to smooth the defects. Contact your local Twin Disc Distributor if either component is excessively damaged.

9. If damaged, repair the rod threads and clean the rod again.

⚠ CAUTION

Do not remove excessive material or create flat spots. This could cause leakage past the seals.

Assembly

1. Replace all the rod guide and piston O-rings, seals and the wiper. Lubricate all of these components to aid in re-assembly.

   Note: When replacing the polypak seal in the guide, the O-ring portion of the polypak seal should face into the cylinder.

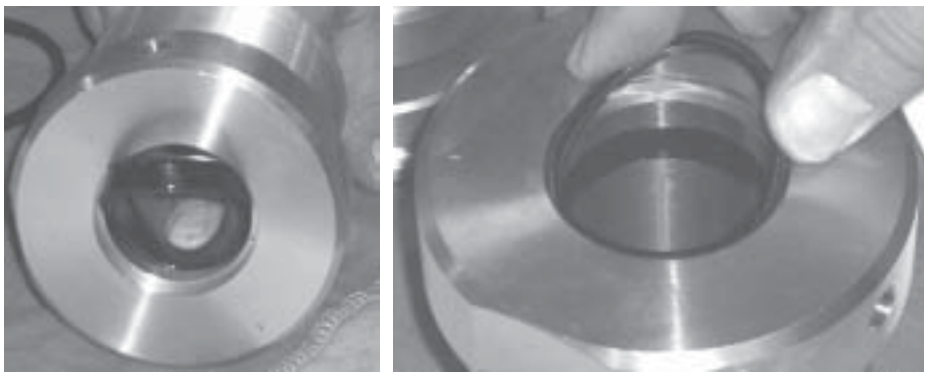


Figure 100. Install the polypak seal into the guide followed by the wiper.

2. Slide the guide back on the rod, being careful not to damage the seals or the rod threads.

Figure 101. Slide the guide on to the rod.

Note: Special tool T-21549-32 should be used to protect the guide seals.

Figure 102. Special tool T-21549-32

3. Thread the piston back on to the rod and tighten it using a suitable wrench.

Figure 103. Thread the piston back on to the rod.

4. Using a 1/4” drill bit, drill 1/8” into the rod threads through the setscrew hole. This creates a spot for the setscrew to lock the piston on the rod.

Figure 104. Drill 1/8” into the retainer threads.

5. Insert the setscrew to lock the piston on the piston rod. Coat the threads with Loctite® 242 or similar semi-permanent threadlocker. Tighten setscrew to 8 N-m (6 ft.-lbs).

Figure 105. Tighten the setscrew.

6. Insert the piston rod assembly back into the tube, being careful not to damage the piston O-rings or the tube threads.

Figure 106. Insert the piston rod assembly into the tube.

7. Tighten the guide until the guide is tight against the tube and the socket-head capscrew holes on the guide and on the tube are in alignment.

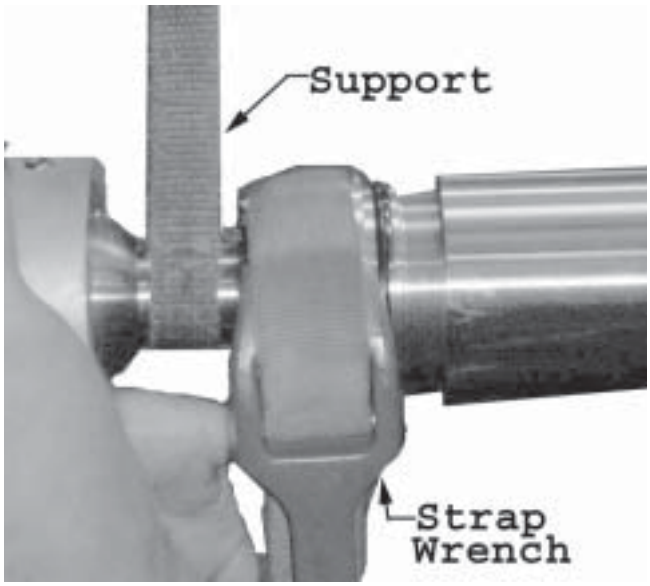


Figure 107. Tighten the guide.

8. Remove any threadlocker compound still present in the hole from previous capscrew installation.

9. Replace the socket-head capscrew using Loctite® 242 or similar semi-permanent threadlocker. Tighten to 8 N-m (6 ft.-lbs).

10. If the cylinder was removed from the transom, mount the trim cylinder bracket with its backing plate and stainless steel 3/4 inch diameter bolts, nuts, and washers. 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 to prevent water leakage. Do not turn the bolts when tightening them. Hold the bolts in place and only turn the nuts. If this procedure is not followed, leaks can develop in the holes.

11. Re-attach both the steering and trim cylinders. The trim cylinder yoke pin should be re-attached first, followed by re-attaching the steering cylinder clevis pin to the trim yoke.

12. Reconnect all hoses.

13. Refill the steering and trim cylinders with power steering fluid or Automatic Transmission Fluid (ATF).

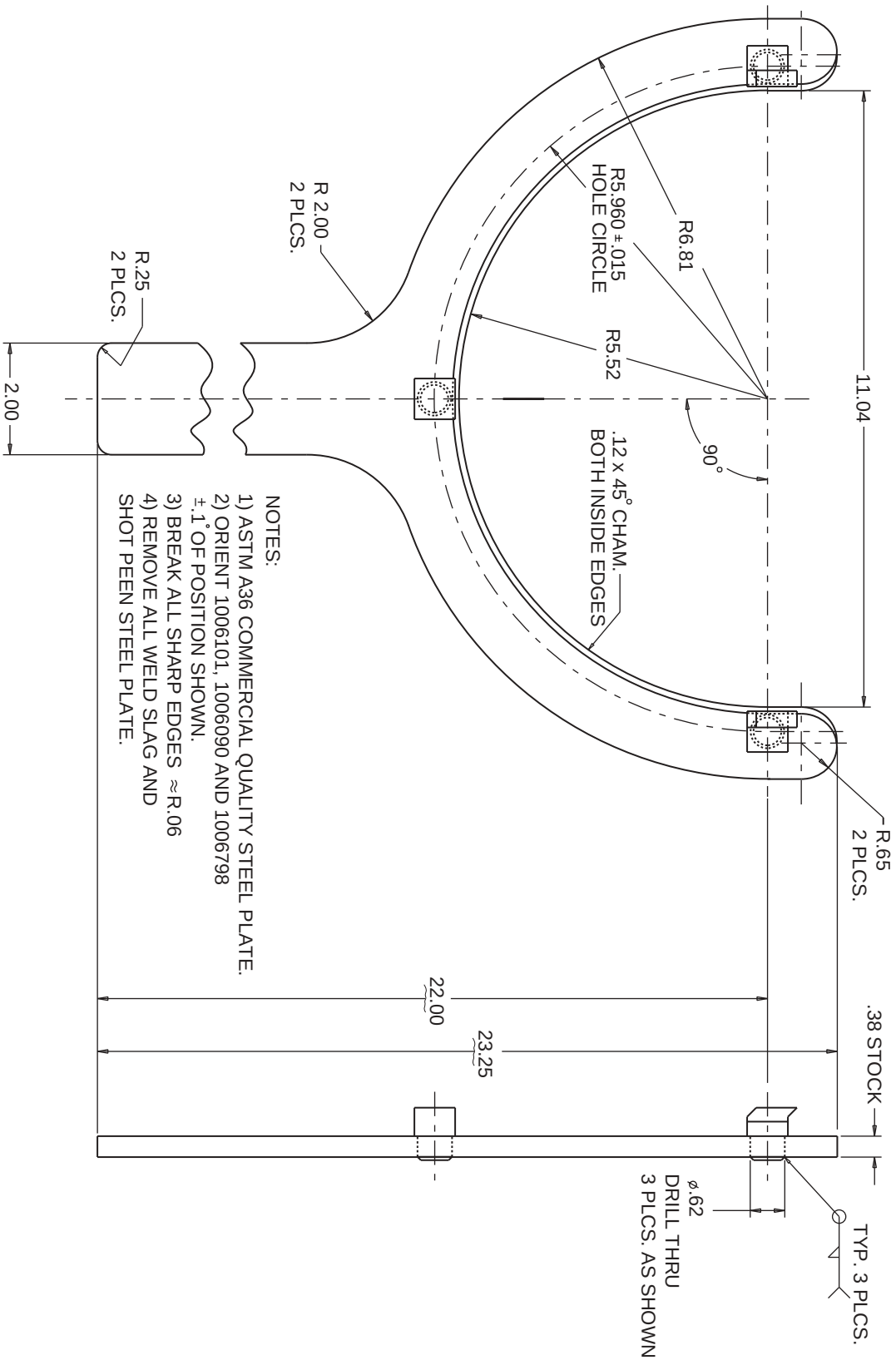
Special Tools

List of Special Tools

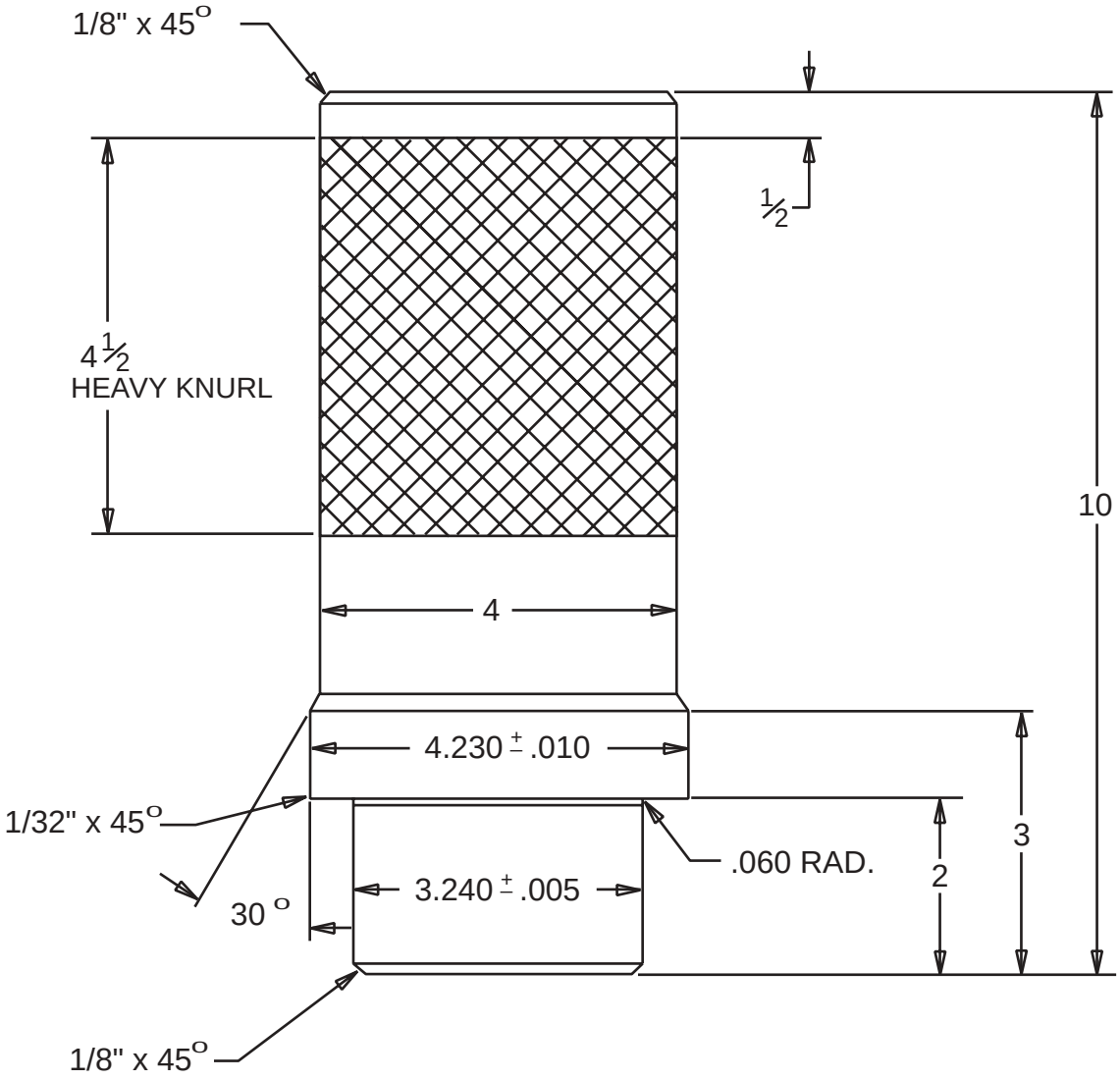
The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continue on the following page.

❑	1009229	Wrench
❑	T-18050-579	Thrust & Socket Roller Bearing Driver
❑	T-18050-640	Inner Bearing Cup Driver
❑	T-21085	Assembly Stand
❑	T-21085-1	Assembly Stand Component
❑	T-21085-2	Assembly Stand Component
❑	T-21085-3	Assembly Stand Component
❑	T-21085-4	Assembly Stand Component
❑	T-21172-2	Lifting Fixture
❑	T-21549-11	Indicator Holder (Propeller)
❑	T-21549-12	Drive Tightener
❑	T-18050-804	Seal Driver
❑	T-18050-805	Wear Sleeve Driver
❑	T-21549-32	Trim Cylinder Seal Protector
❑	T-21549-33	Steering Cylinder Thread and Seal Protector

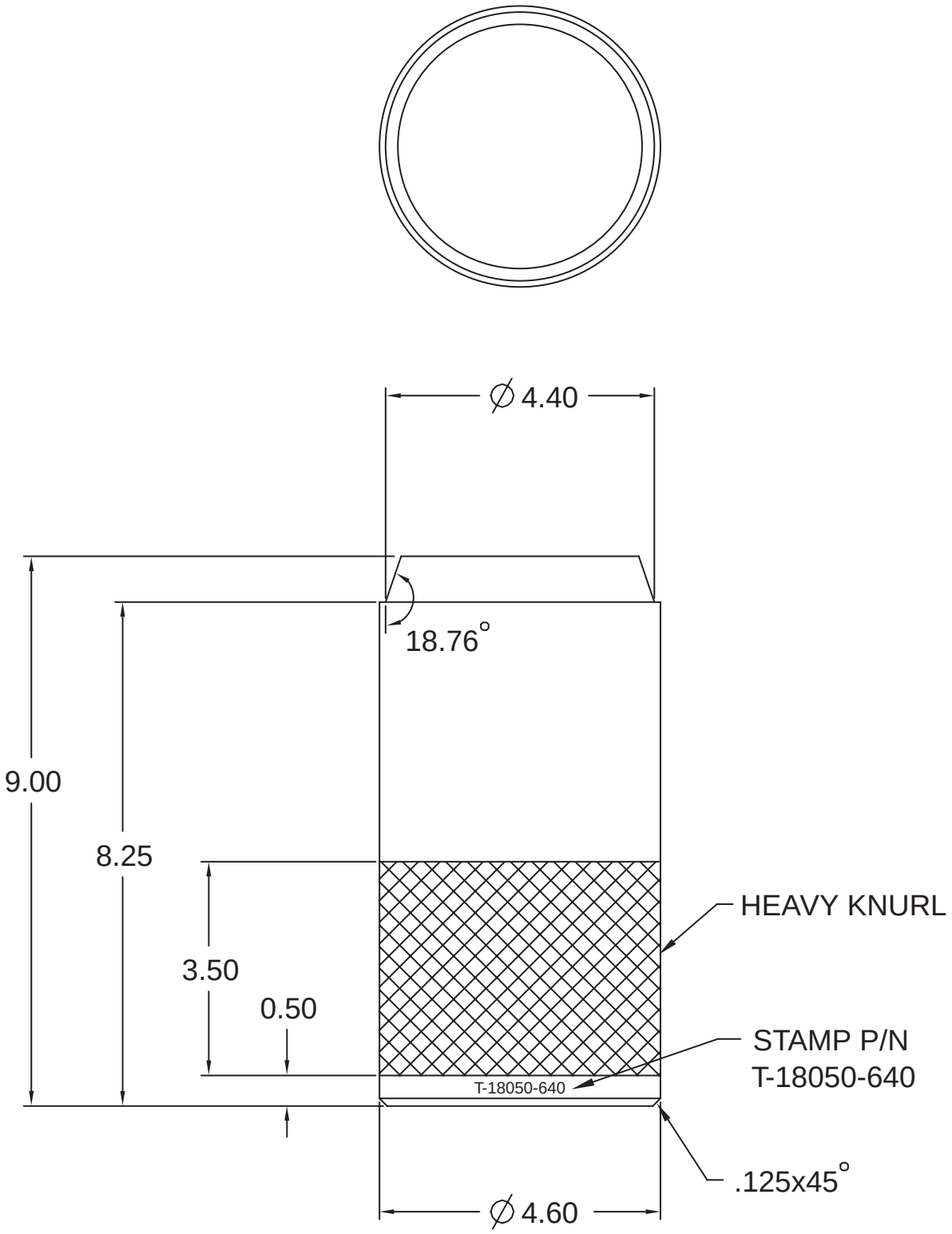
1009229 Wrench



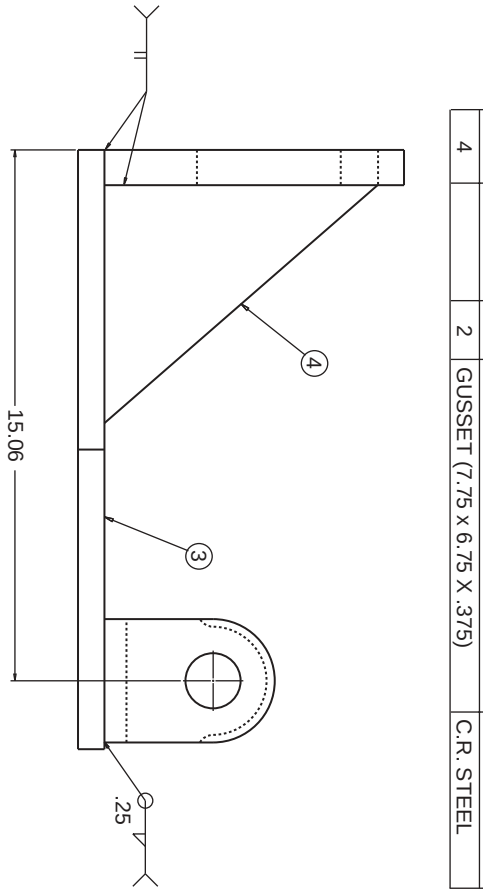
T-18050-579 Thrust & Socket Roller Bearing Driver



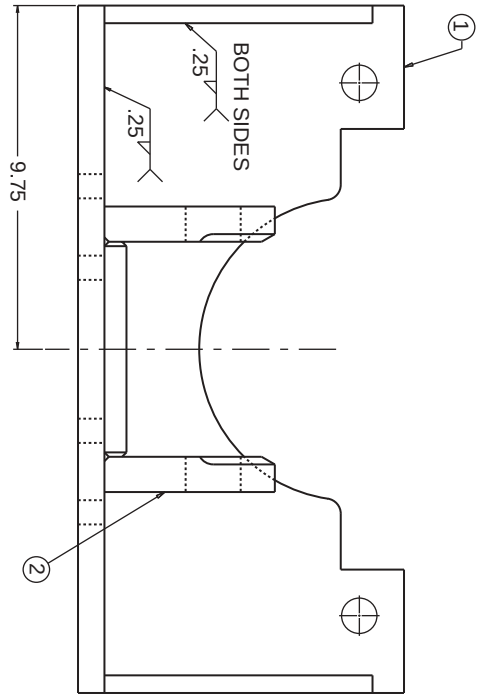
T-18050-640 Inner Bearing Cup Driver



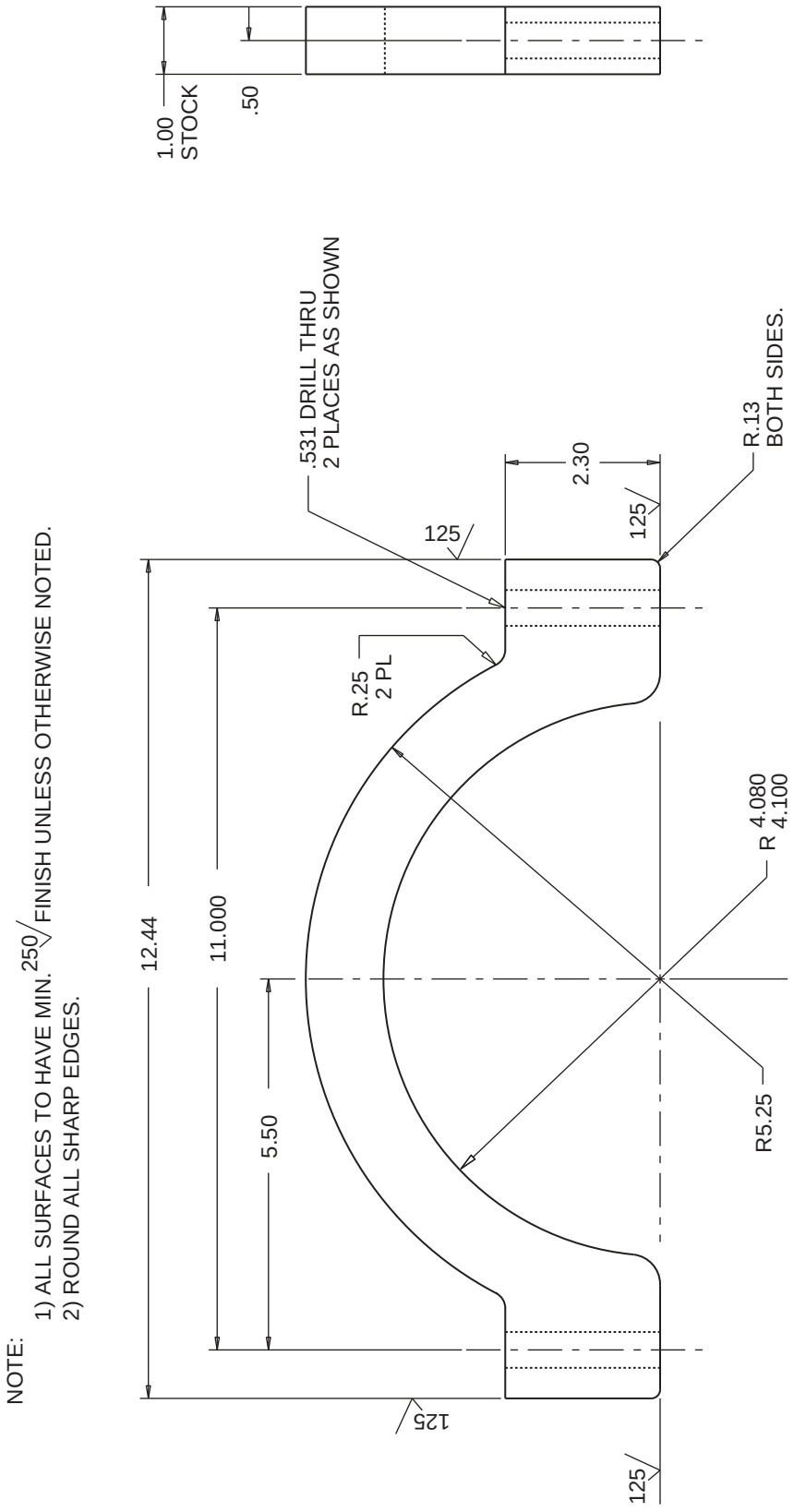
T-21085 Assembly Stand



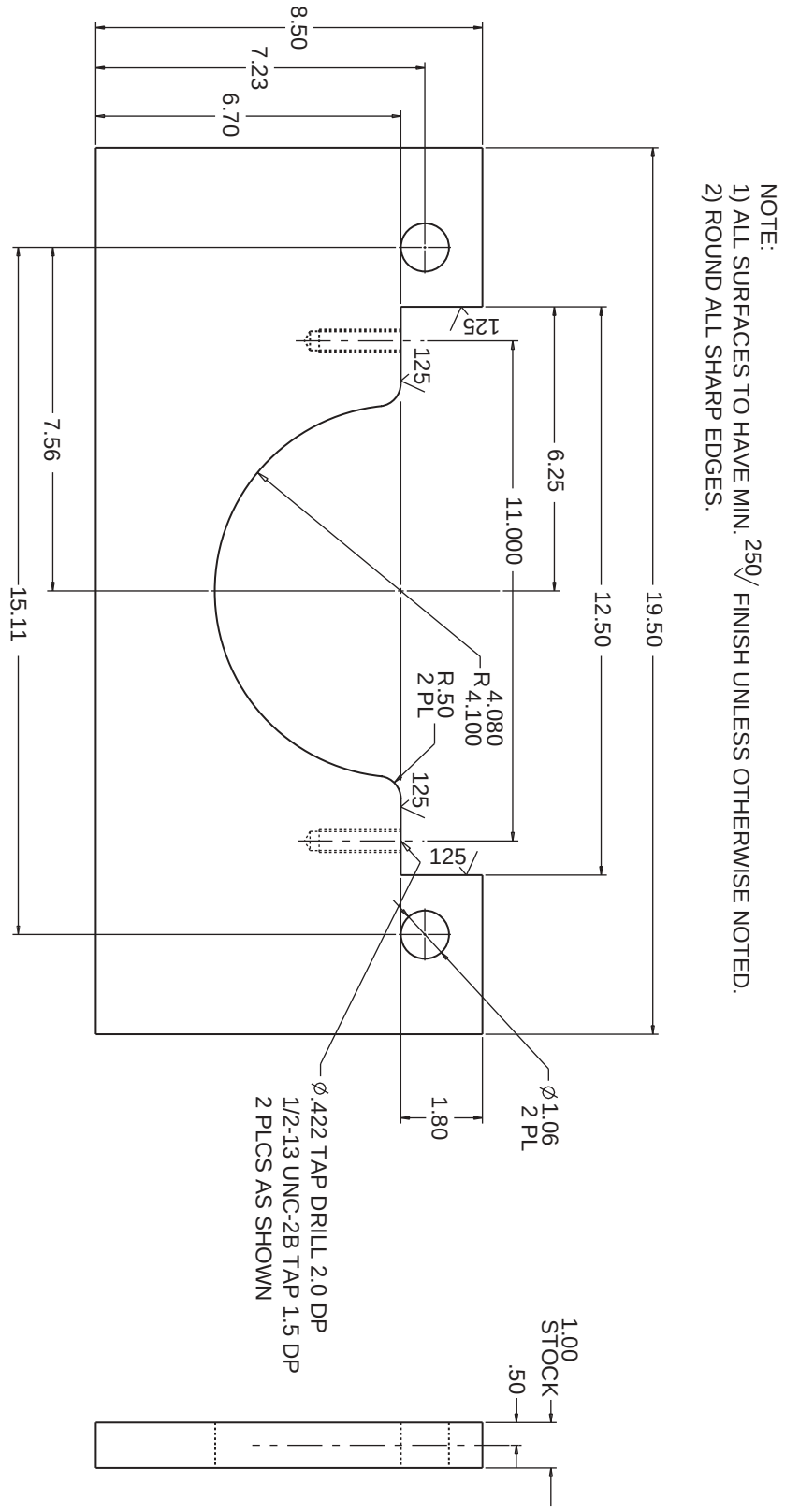
ITEM NO.	PART NO.	QTY.	PART DESCRIPTION	REMARKS
1	T-21085-2	1	PLATE	
2	T-21085-4	1	BRACKET ASSM.	
3	T-21085-3	1	PLATE	
4		2	GUSSET (7.75 x 6.75 X .375)	C.R. STEEL



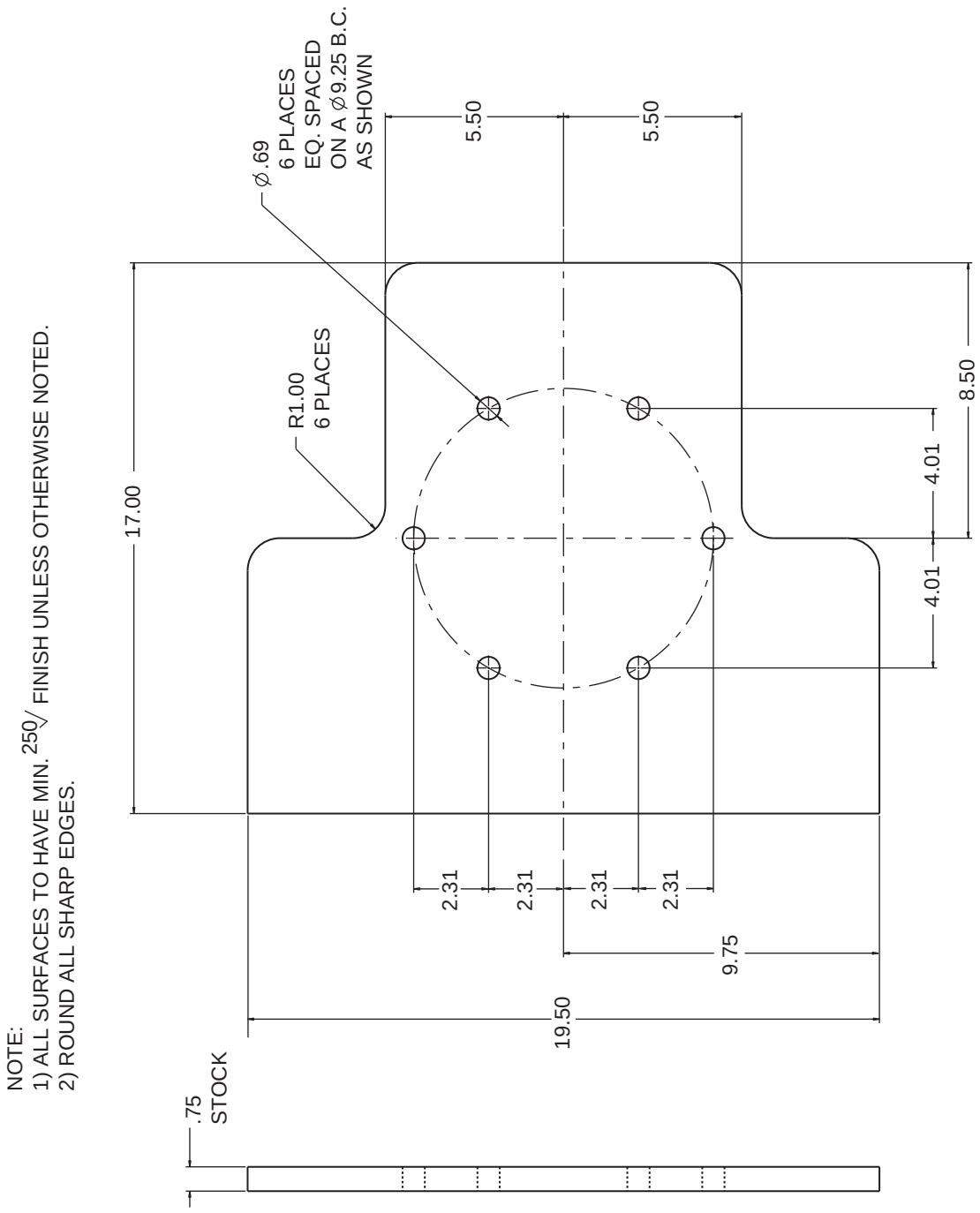
T-21085-1 Assembly Stand Component



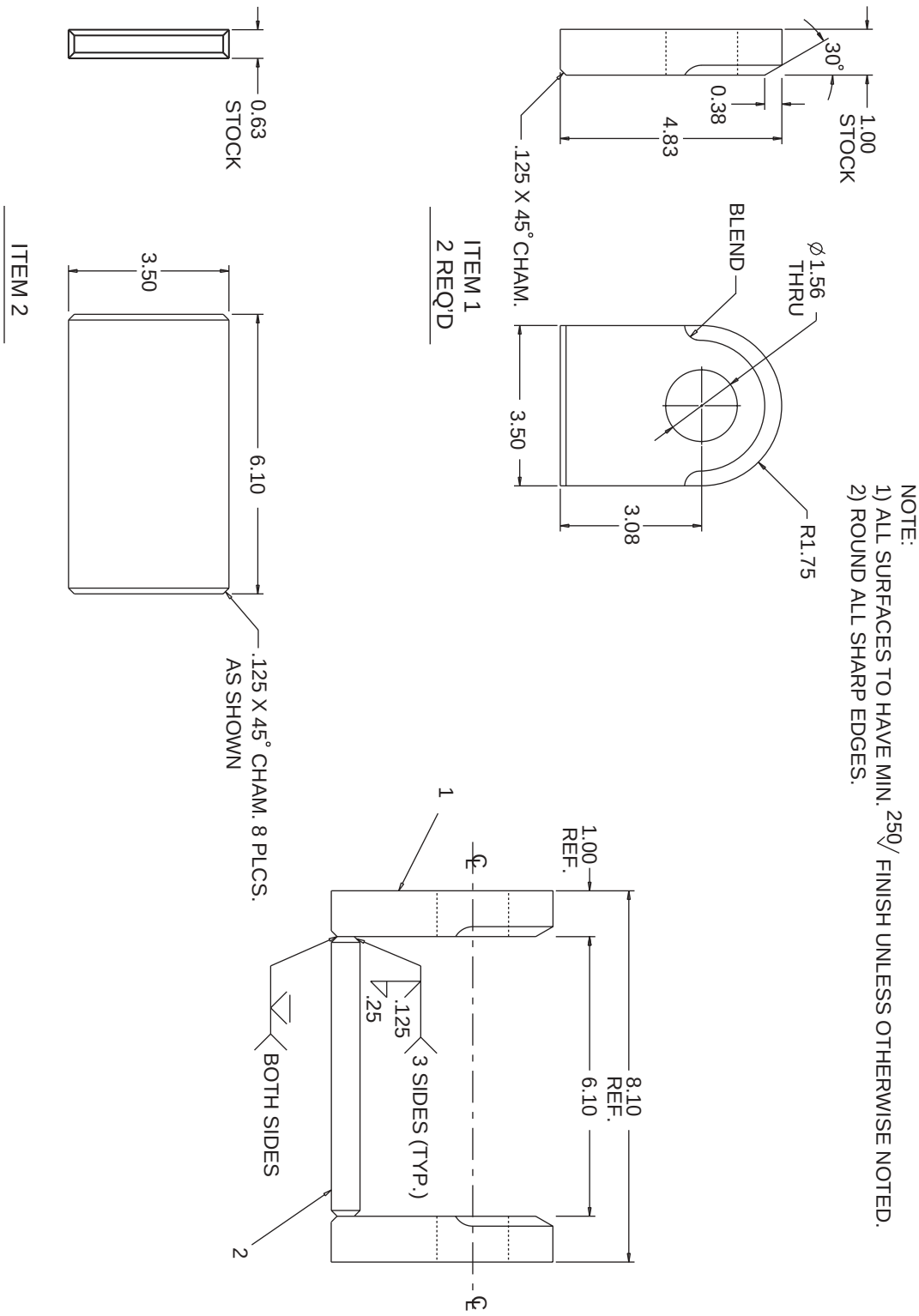
T-21085-2 Assembly Stand Component



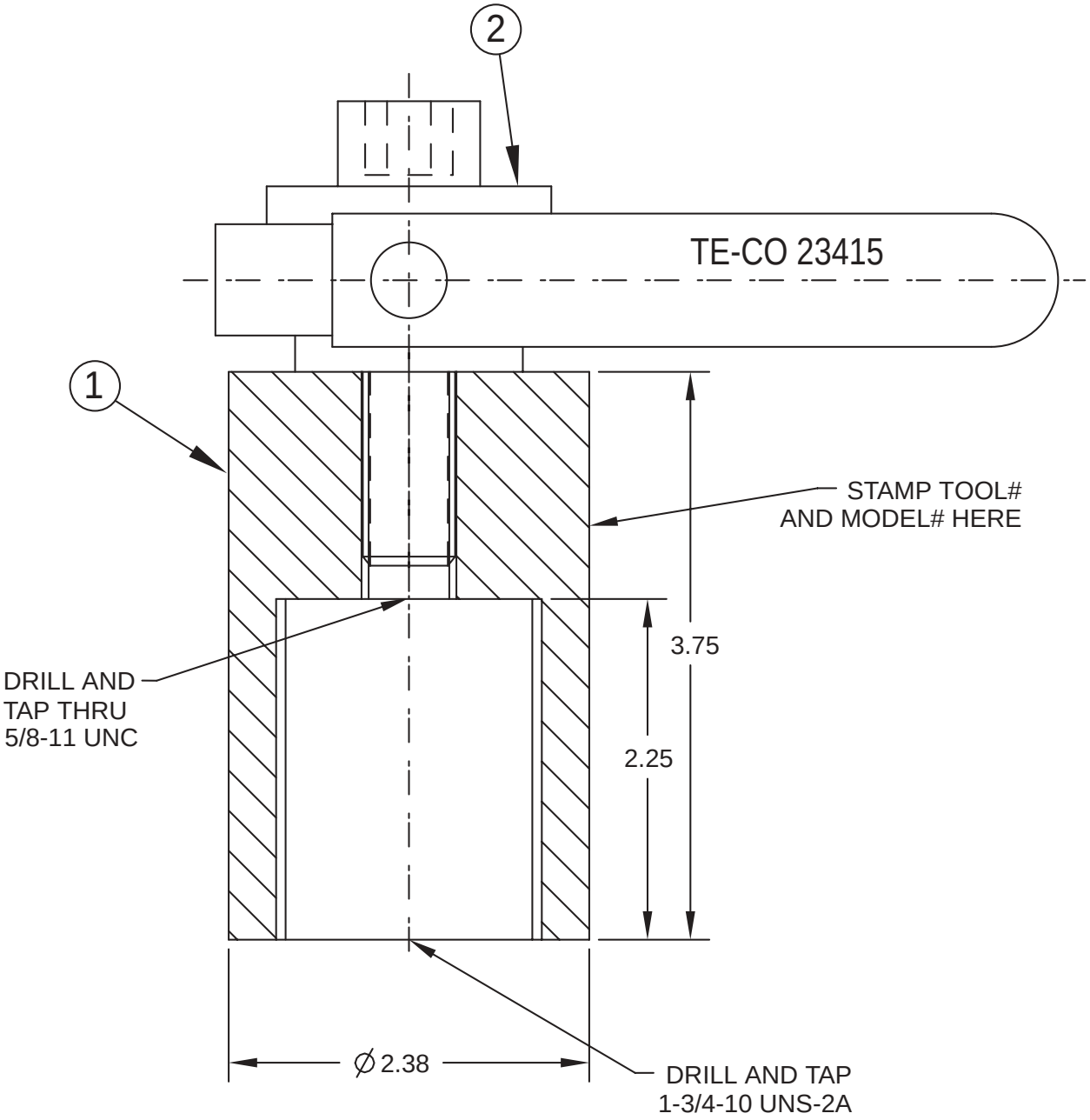
T-21085-3 Assembly Stand Component



T-21085-4 Assembly Stand Component

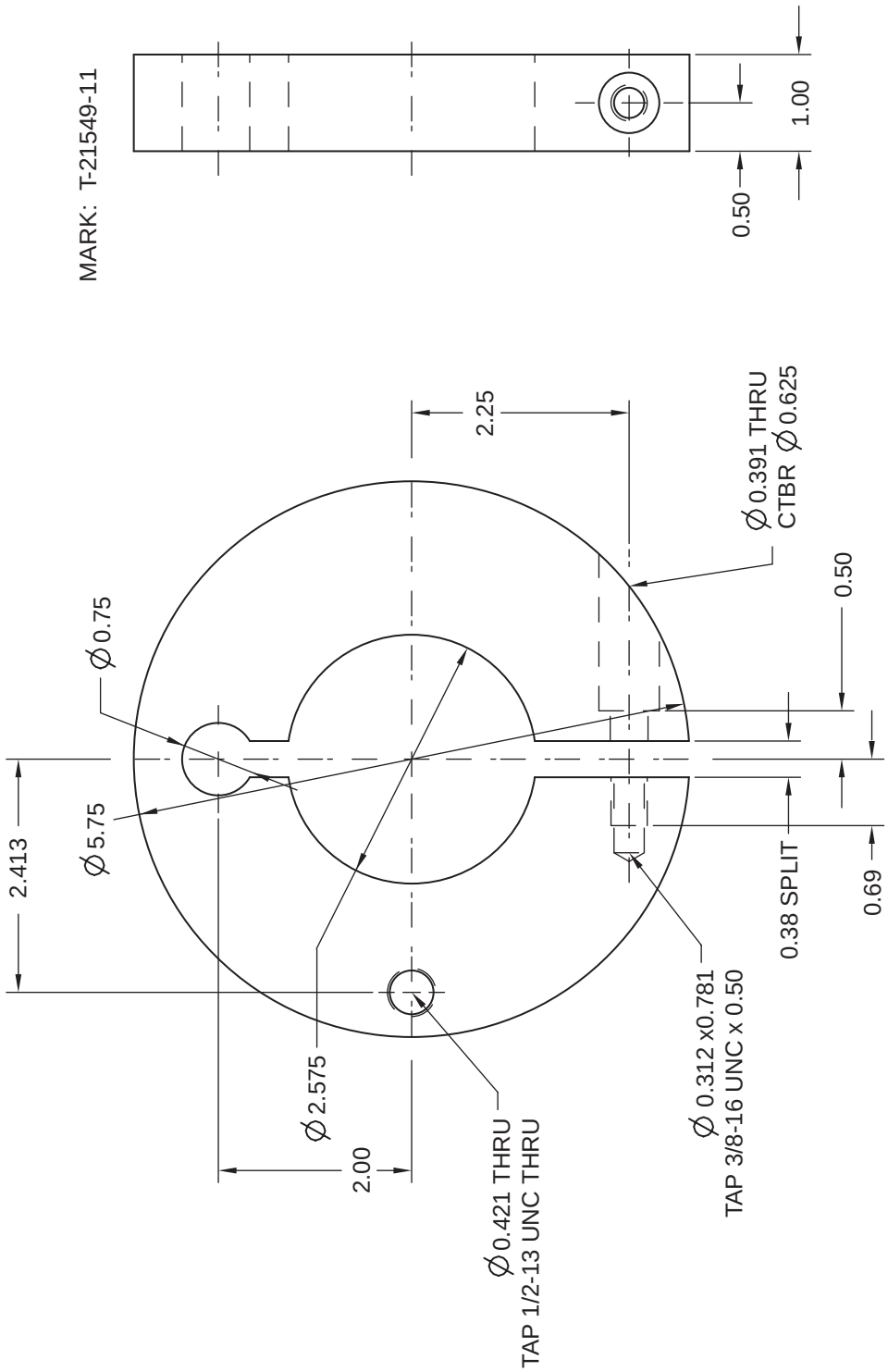


T-21172-2 Lifting Fixture



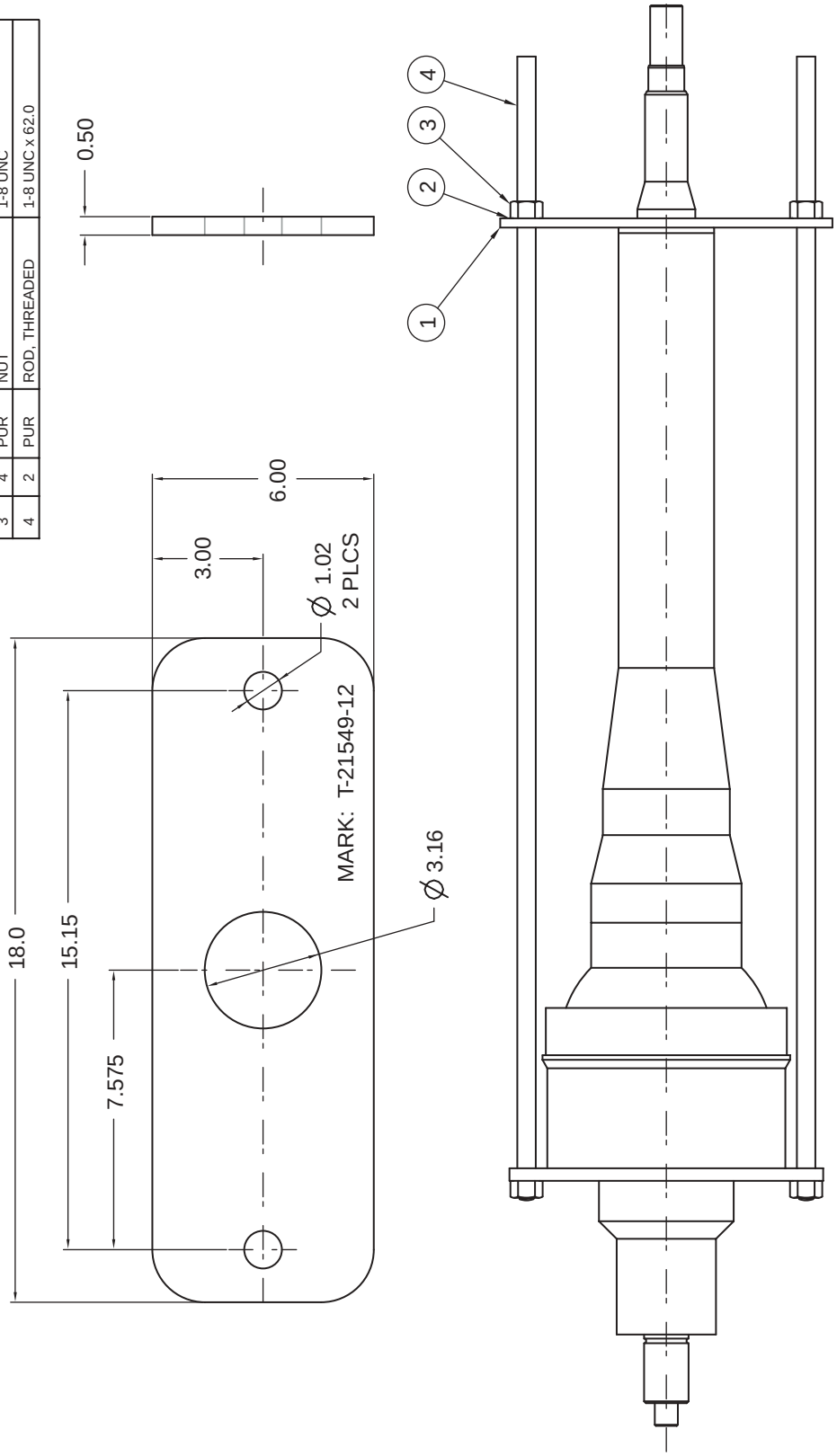
DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	4140	HOIST	∅2.38 x 3.81
2	1	PUR	CNTR PULL SWIVEL HOIST RING	TECO 23415

T-21549-11 Indicator Holder (Propeller)

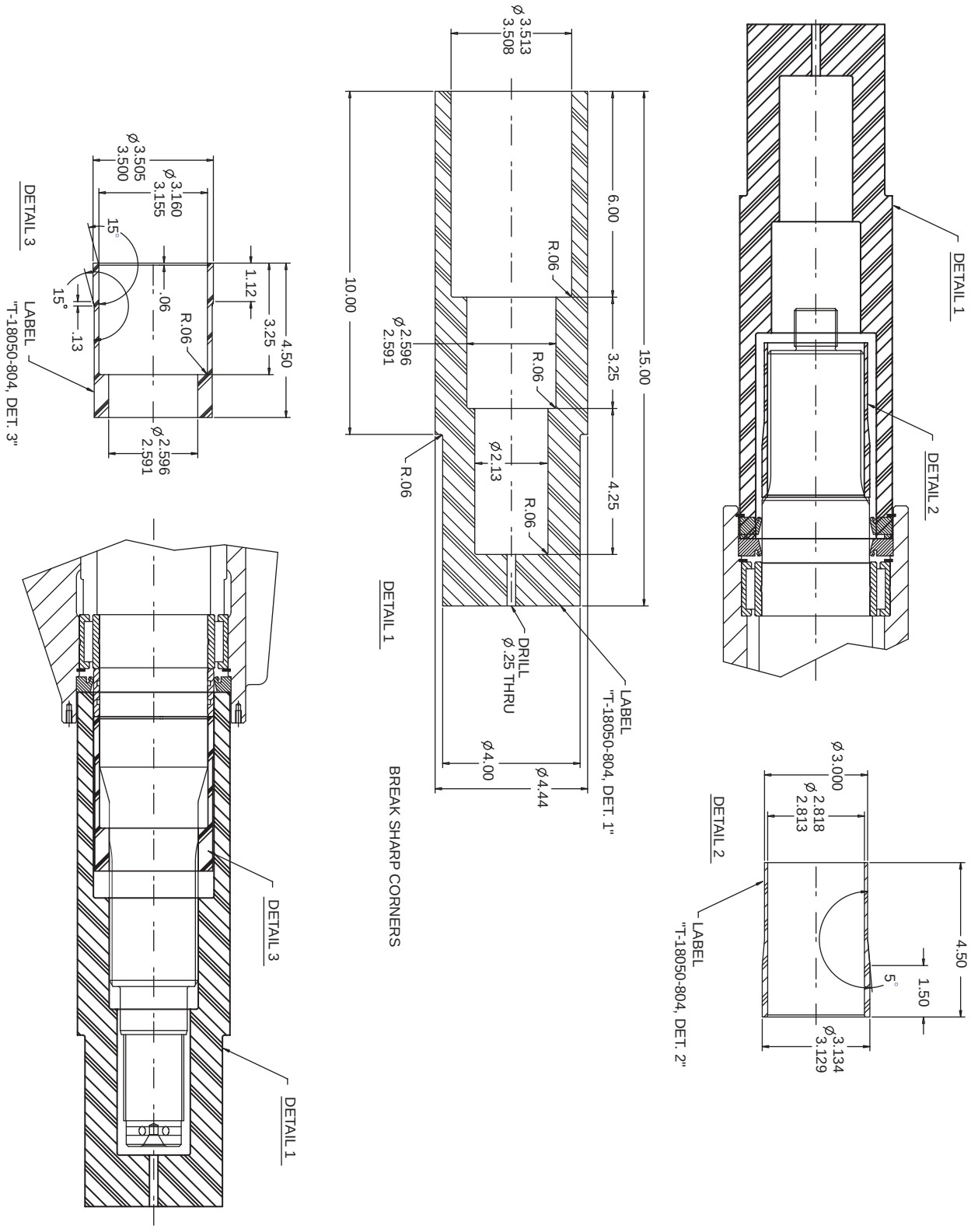


T-21549-12 Drive Tightener

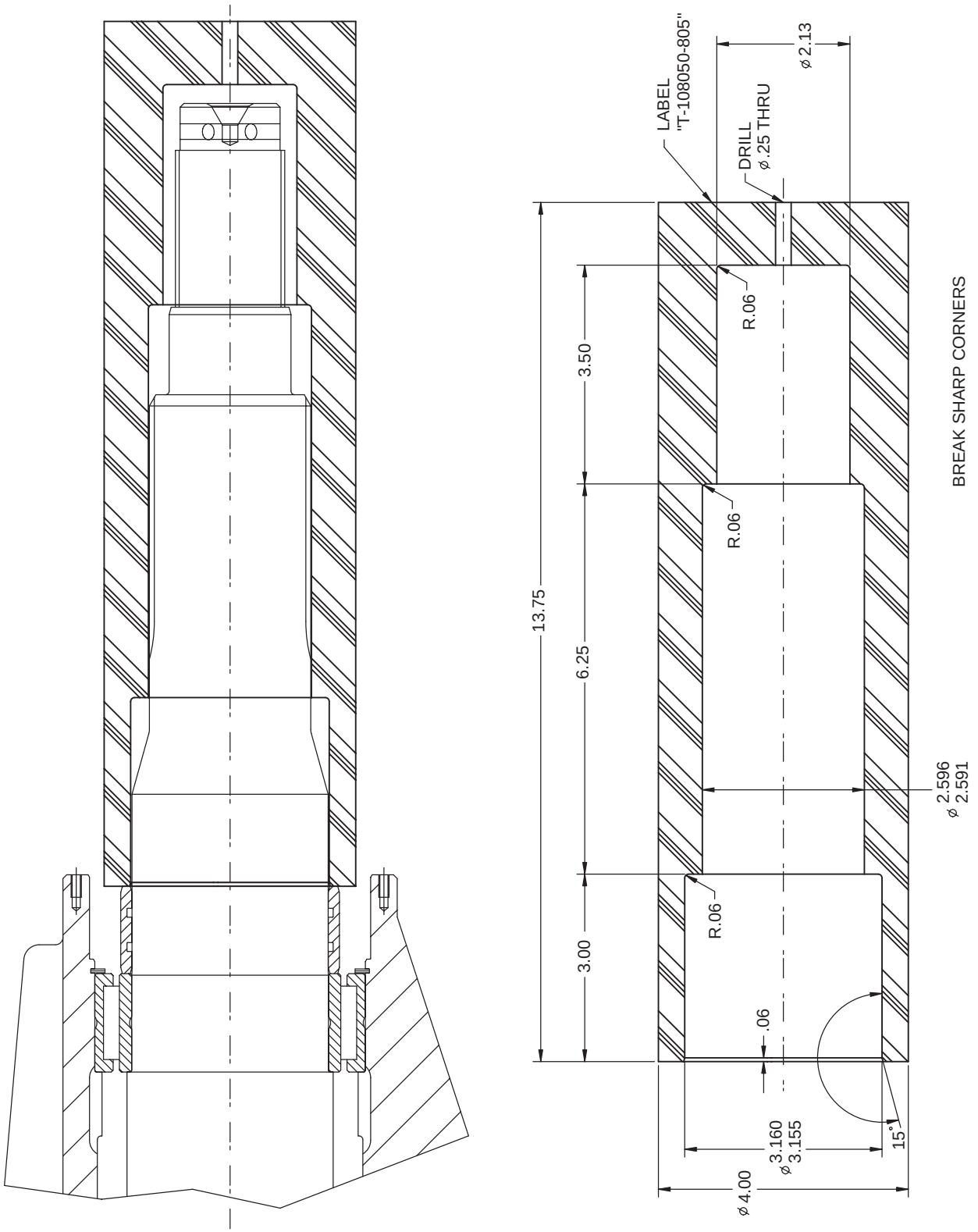
DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	STL	PLATE	18.00 x 6.00 x 0.50
2	4	PUR	WASHER	Ø1.00
3	4	PUR	NUT	1-8 UNC
4	2	PUR	ROD, THREADED	1-8 UNC x 62.0



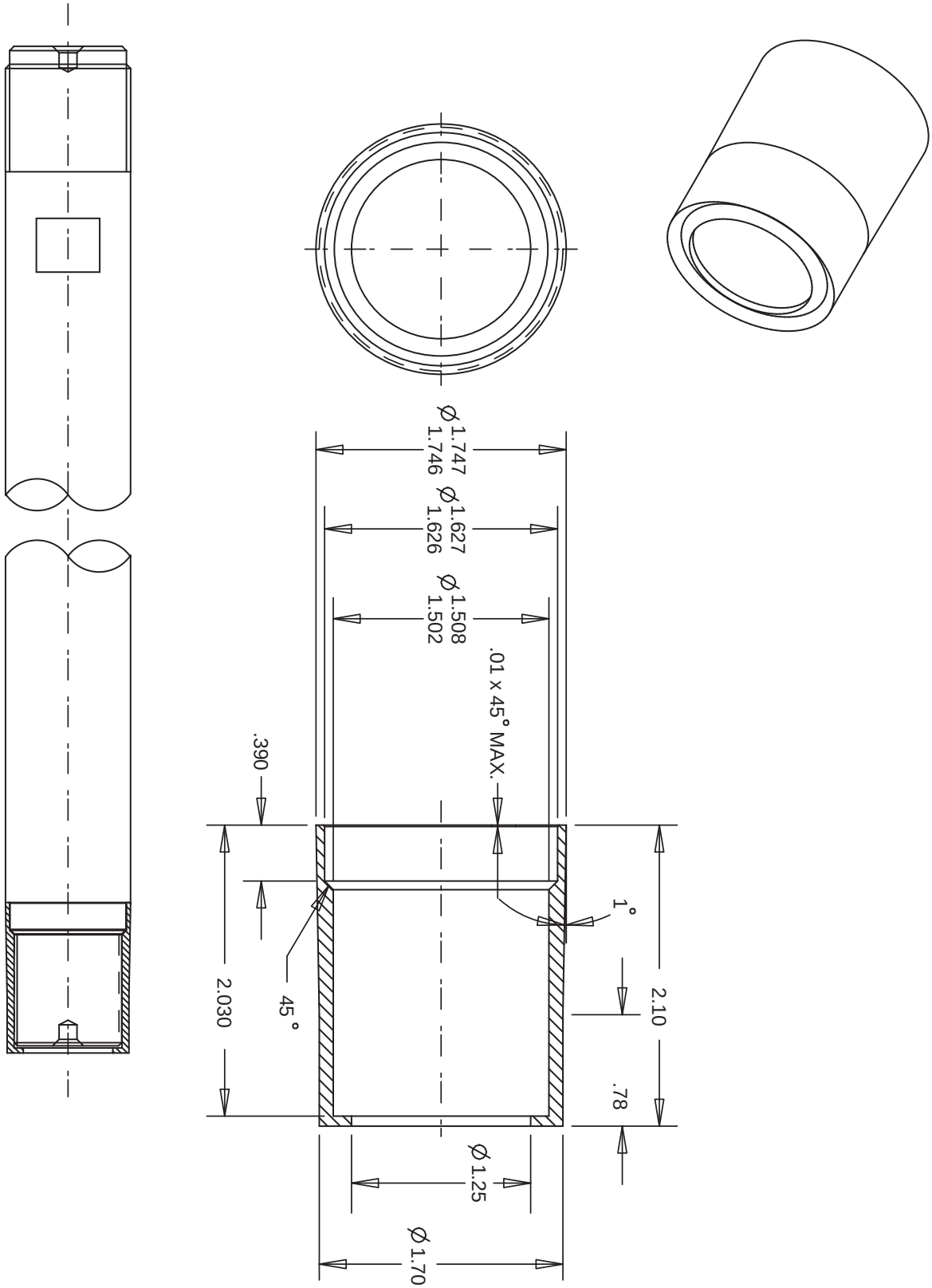
T-18050-804 Seal Driver



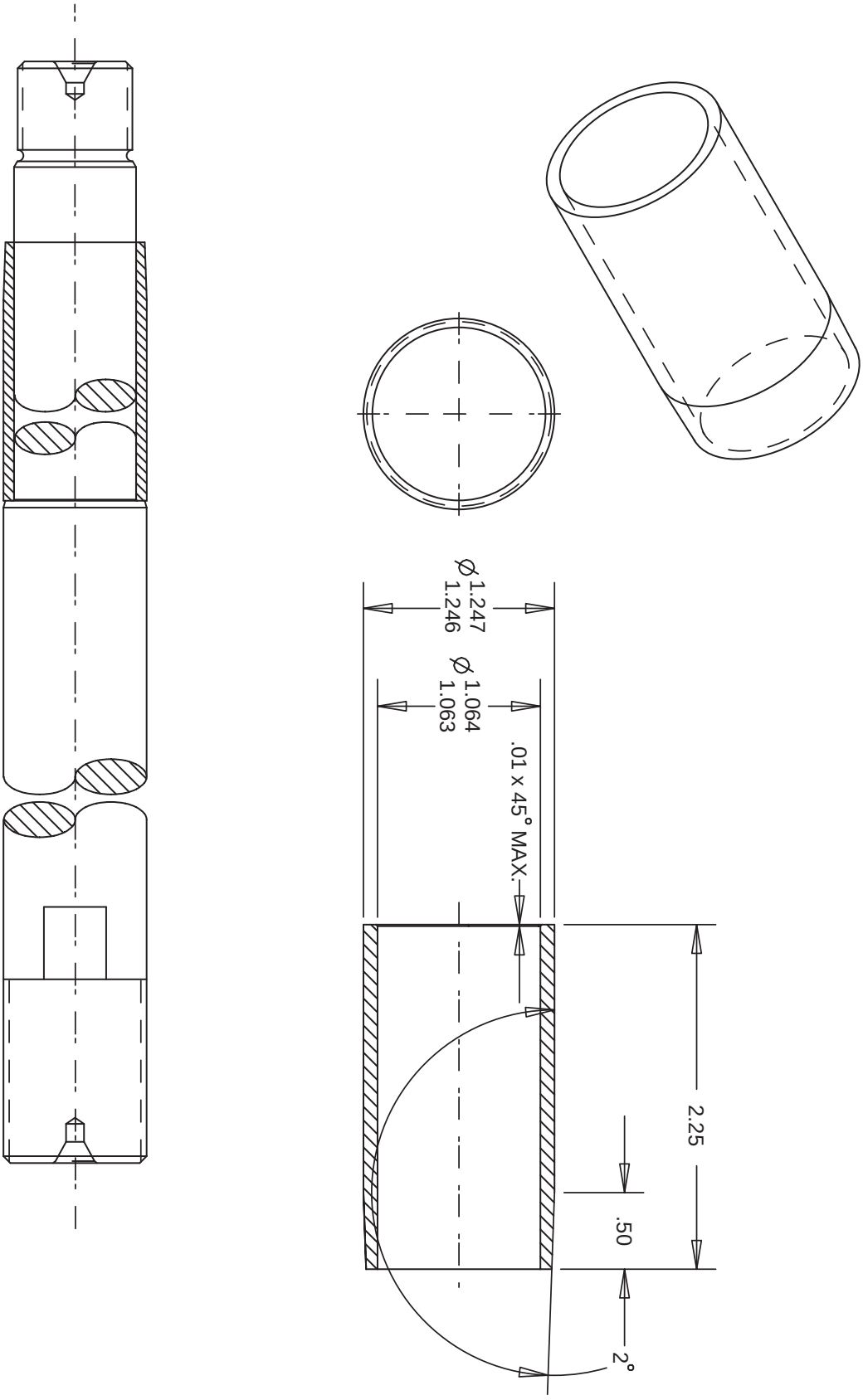
T-18050-805 Wear Sleeve Driver



T-21549-32 Trim Cylinder Seal Protector



T-21549-33 Steering Cylinder Thread and Seal Protector



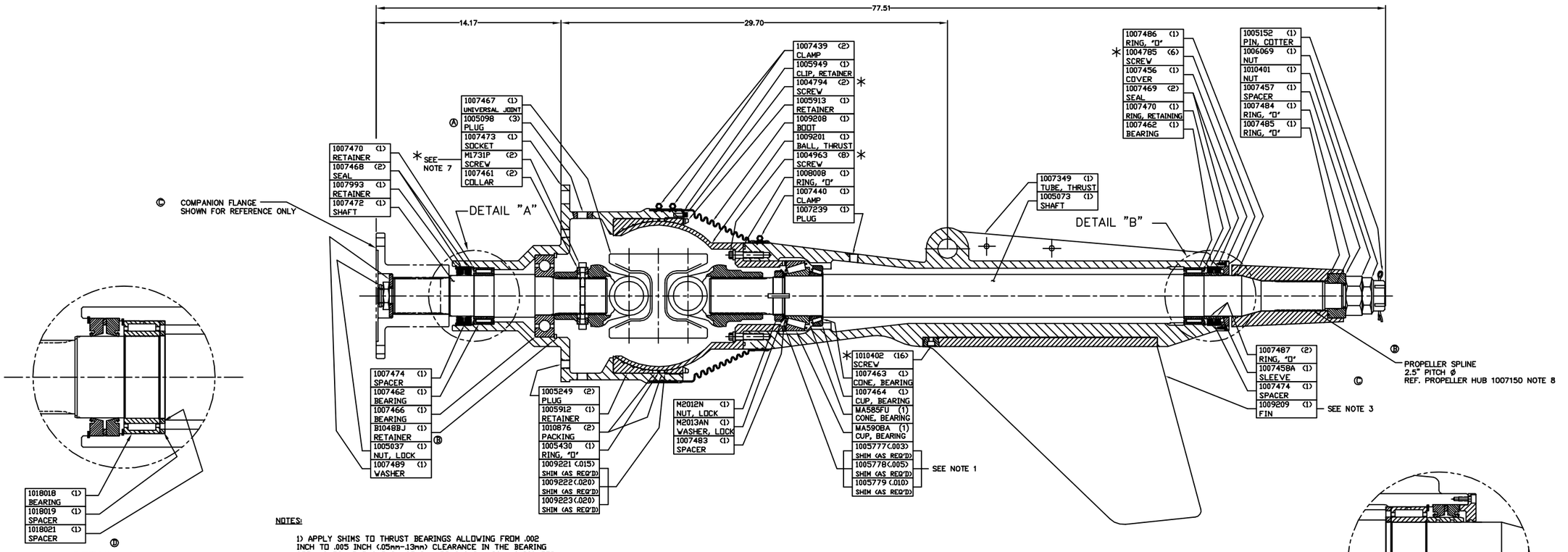
Engineering Drawings

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.

❑	1017817	ASD 12B1LU Drive Assembly Parts Drawing (Double Aft Seal)
❑	1022907	ASD 12B1LU Drive Assembly Parts Drawing (Triple Aft Seal)
❑	1017592	ASD 12B1LU Drive Installation Drawing
❑	1009236	Steering Cylinder
❑	1007432	Steering Cylinder - VRVT (electronic position indication)
❑	1009234	Trim Cylinder
❑	1007340	Trim Cylinder - VRVT (electronic position indication)
❑	1006786	Tie Bar Assembly
❑	1023448	Aft Seal Conversion Diagram (Double Seal to Triple Seal)



NOTES:

1) APPLY SHIMS TO THRUST BEARINGS ALLOWING FROM .002 INCH TO .005 INCH (.05mm-.13mm) CLEARANCE IN THE BEARING SET. CHECK THE CLEARANCE BY ATTACHING A DIAL INDICATOR TO THE PROPELLER SHAFT THEN PUSH AND PULL ON THE PROPELLER SHAFT. COMPARE INDICATOR READINGS TO DETERMINE THE END CLEARANCE.

2) DURING INSTALLATION OF THE SHAFTS INTO THE HOUSINGS, APPLY LUBRICANT ON AND BETWEEN LIP SEALS AND ON THE INPUT SHAFT AND THE PROPELLER SHAFT.

THE GREASE LUBRICANT USED ON THE LIP SEALS AND ELSEWHERE IN THIS SURFACE DRIVE MUST BE A MARINE GRADE LITHIUM GREASE FORMULATED FOR USE IN SALT WATER. TWIN DISC RECOMMENDS "RED LITHIUM GREASE" AVAILABLE FROM ZEP MANUFACTURING CO., ATLANTA, GEORGIA, USA. OR AN EQUIVELENT PRODUCT.

3) TORQUE VALUES FOR FASTENERS:

P/N	DESCRIPTION	DRY TORQUE VALUES	
		INCH	METRIC
1004785	SCREW (COVER)	20 IN-LBS	2260 N-mm
1010402	SCREW (FIN)	25 FT-LBS	35 N-m
1004963	SCREW (BALL)	100 FT-LBS	140 N-m
1005037	NUT, LOCK (INPUT FLANGE)	175 FT-LBS	245 N-m
M2012N	NUT, LOCK (THRUST BRG.)	100 FT-LBS MIN.	140 N-m MIN.
1004794	SCREW, (RETAINER)	65 IN-LBS	7350 N-mm
1010401	NUT, JAM (PROP)	450-500 FT-LBS	640-710 N-m
1006069	NUT, LOCK (PROP)	SEE NOTE #8	SEE NOTE #8
M1731P	SCREW (U-JOINT)	45 FT-LBS	65 N-m

4) RECOMMENDED LUBRICATING OIL:
API SERVICE CATEGORY CF OR HIGHER:
SAE 30 OIL - MIN. VISCOSITY 100 CST @ 100° F
SAE 40 OIL - MIN. VISCOSITY 141 CST @ 100° F
FILL DRIVE UNTIL EXTERNAL RESERVOIR IS ONE THIRD FULL. APPROXIMATE CAPACITY 20-22 QUARTS (19-19 3/4 LITERS).

LOCTITE INSTRUCTIONS:
(USE ALL APPLICABLE SOLVENTS, PRIMERS, AND ACTIVATORS)

5) COAT THE * MARKED THREADS WITH LOCTITE THREAD LOCKING COMPOUND NO. 242 (BLUE SEMI-PERMANENT).

5A) COAT THE ** MARKED THREADS WITH LOCTITE THREAD LOCKING COMPOUND NO. 270 (RED, PERMANENT).

5B) COAT PIPE THREADS WITH LOCTITE NO. 545 (PURPLE SEMI-PERMANENT).

6) AT ASSEMBLY, COAT PROPELLER AND INPUT SHAFTS AND THE BEARINGS AND SLEEVE I.D. WHERE THEY ARE IN CONTACT, COAT WITH DOW-CORNING CORP. "P-37 ASSEMBLY PASTE" OR EQUAL PRODUCT.

APPLY A THIN EVEN COATING OF PASTE ONTO COMPONENT SURFACES. RUB THOROUGHLY INTO SURFACES WITH A CLEAN LINT FREE CLOTH. LEAVING A COATING DEPTH OF ABOUT .0001 IN (.003 mm).

EXCESSIVE COATING DEPTH WILL RESULT IN SLEEVE AND BEARING DISTORTION AND MAY PREVENT BEARING ASSEMBLY AND REDUCE BEARING LIFE.

AFTER INSTALLING PROPELLER BEARING RACE AND PRIOR TO INSTALLING SLEEVE 1007458A, CLEAN EXCESS P-37 PASTE FROM PROPELLER SHAFT.

7) TWO SCREWS (M1731P) MUST NOT BE REUSED AFTER REMOVAL. ALTERNATELY TORQUE NEW SCREWS TO 45 FT-LBS. (65 N-m)

8) TORQUE LOCKNUT 1006069 TO 350-400 FT-LBS (500-570 N-m). APPROACH LOWER VALUE. IF SLOT DOES NOT ALIGN WITH HOLE IN SHAFT, INCREASE TORQUE UNTIL THE HOLE ALIGNS. DO NOT EXCEED MAXIMUM TORQUE.

9) SEE TWIN DISC SERVICE MANUAL NO. 1020481 FOR PROPELLER AND NUT TORQUEING SCHEDULE.

10) PLEASE SEE TWIN DISC SERVICE MANUAL FOR ALL OTHER PROCEDURES AND SPECIFICATIONS.

11) P/N (QTY) NAME

Ⓒ

FOR SERVICE ONLY-OBSOLETE FOR PRODUCTION

SUPERCEDED BY ASSEMBLY 1022907 (BOM 1022906)
REFER TO KIT 1023571 FOR SEAL CONVERSION

FEATURES:

- STAINLESS STEEL PROPELLER AND INPUT SHAFTS
- BRONZE HOUSINGS

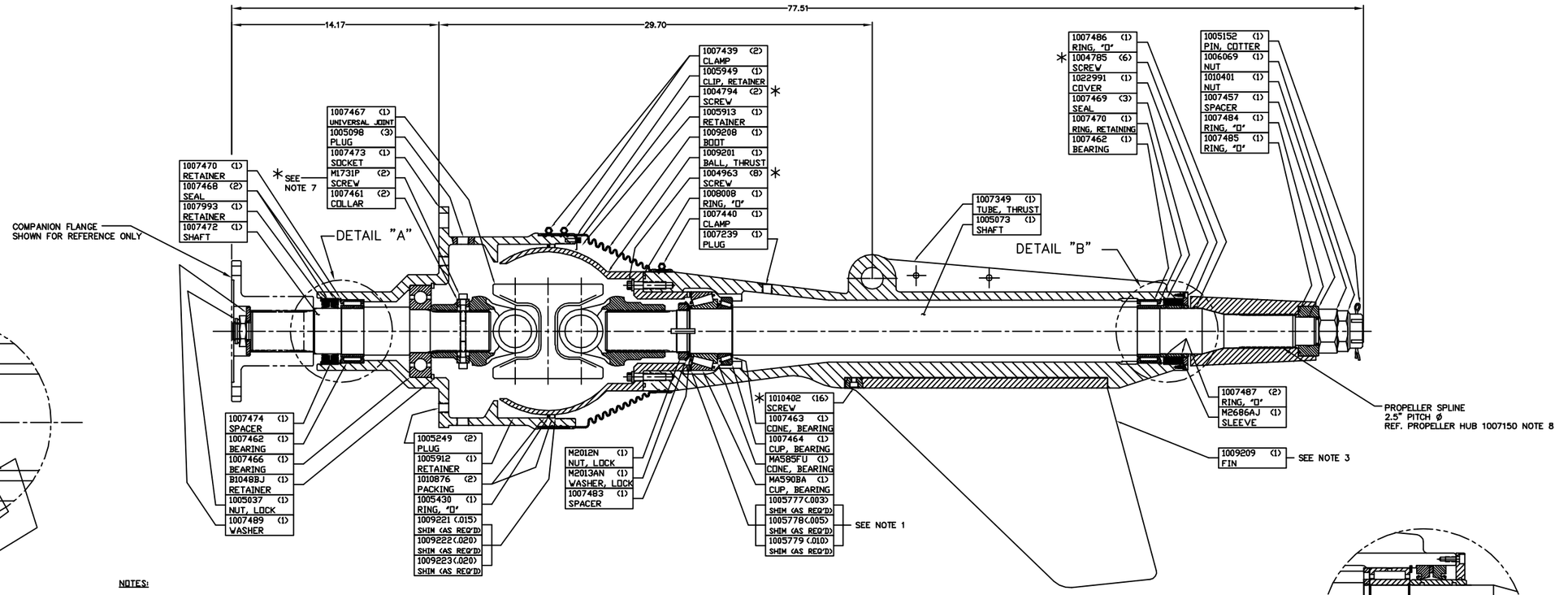
SUPPORTING DOCUMENTATION:

INSTALLATION DRAWING -------- 1017592
INSTALLATION MANUAL --------- 1020480
SERVICE MANUAL -------------- 1020481
MASS ELASTIC SYSTEM DWG. ---- B3504AL
BILL OF MATERIAL (BOM)----------1017817

Ⓒ

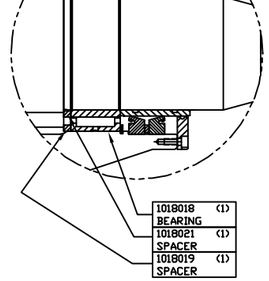
REV	ZONE	CH. NO.	DATE
E	A1	ECN14441	3-27-07
D	---	ECN12319	3-29-04
C	---	ECN11253	2-19-03
B	E3	28702	7/31/98
A	E5	28488	4/9/98

MATERIAL
HEAT TREAT
SURFACE TREATMENT
WEIGHT 600 LBS. (273 kg.)
WR² LBS. IN²
FIRST USE
ASSY.
MODEL ASD-12L
NAME DRIVE ASSEMBLY
UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS X.X ±0.030 X.XX ±0.010 X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
THIRD ANGLE PROJECTION
SIMILAR TO 1004836
DATE 10-6-97
SCALE 1 : 4
DRN. TBM
CHK. FN
APP'D. FN
TWIN DISC INCORPORATED RACINE, WI 53403 - USA
1017817
SHEET 1 OF 1 REV E



DETAIL "A"

VIEW OF ALTERNATE INPUT SHAFT BEARING AND ASSOCIATED SPACERS



DETAIL "B"

VIEW OF ALTERNATE PROPELLER BEARING AND ASSOCIATED SPACERS

NOTES:

1) APPLY SHIMS TO THRUST BEARINGS ALLOWING FROM .002 INCH TO .005 INCH (.05mm-.13mm) CLEARANCE IN THE BEARING SET. CHECK THE CLEARANCE BY ATTACHING A DIAL INDICATOR TO THE PROPELLER SHAFT THEN PUSH AND PULL ON THE PROPELLER SHAFT. COMPARE INDICATOR READINGS TO DETERMINE THE END CLEARANCE.

2) DURING INSTALLATION OF THE SHAFTS INTO THE HOUSINGS, APPLY LUBRICANT ON AND BETWEEN LIP SEALS AND ON THE INPUT SHAFT AND THE PROPELLER SHAFT.

THE GREASE LUBRICANT USED ON THE LIP SEALS AND ELSEWHERE IN THIS SURFACE DRIVE MUST BE A MARINE GRADE LITHIUM GREASE FORMULATED FOR USE IN SALT WATER. TWIN DISC RECOMMENDS "RED LITHIUM GREASE" AVAILABLE FROM ZEP MANUFACTURING CO., ATLANTA, GEORGIA, USA. OR AN EQUIVELENT PRODUCT.

3) TORQUE VALUES FOR FASTENERS:

P/N	DESCRIPTION	DRY TORQUE VALUES	
		INCH	METRIC
1004785	SCREW (COVER)	20 IN-LBS	2260 N-mm
1010402	SCREW (FIN)	25 FT-LBS	35 N-m
1004963	SCREW (BALL)	100 FT-LBS	140 N-m
1005037	NUT, LOCK (INPUT FLANGE)	175 FT-LBS	245 N-m
M2012N	NUT, LOCK (THRUST BRG.)	100 FT-LBS MIN.	140 N-m MIN.
1004794	SCREW, (RETAINER)	65 IN-LBS	7350 N-mm
1010401	NUT, JAM (PROP)	450-500 FT-LBS	640-710 N-m
1006069	NUT, LOCK (PROP)	SEE NOTE #8	SEE NOTE #8
M1731P	SCREW (U-JOINT)	45 FT-LBS	65 N-m

4) RECOMMENDED LUBRICATING OIL:
API SERVICE CATEGORY CF OR HIGHER:
SAE 30 W THROUGH SAE 90W OIL
FILL DRIVE UNTIL EXTERNAL RESERVOIR IS ONE THIRD FULL. APPROXIMATE CAPACITY 20-22 QUARTS (19-19 3/4 LITERS).

LOCTITE INSTRUCTIONS:
(USE ALL APPLICABLE SOLVENTS, PRIMERS, AND ACTIVATORS)

5) COAT THE * MARKED THREADS WITH LOCTITE THREAD LOCKING COMPOUND NO. 242 (BLUE SEMI-PERMANENT).

5A) COAT THE ** MARKED THREADS WITH LOCTITE THREAD LOCKING COMPOUND NO. 270 (RED, PERMANENT).

5B) COAT PIPE THREADS WITH LOCTITE NO. 545 (PURPLE SEMI-PERMANENT).

6) AT ASSEMBLY, COAT PROPELLER AND INPUT SHAFTS AND THE BEARINGS AND SLEEVE I.D. WHERE THEY ARE IN CONTACT, COAT WITH DOW-CORNING CORP. "P-37 ASSEMBLY PASTE" OR EQUAL PRODUCT.

APPLY A THIN EVEN COATING OF PASTE ONTO COMPONENT SURFACES. RUB THOROUGHLY INTO SURFACES WITH A CLEAN LINT FREE CLOTH. LEAVING A COATING DEPTH OF ABOUT .0001 IN (.003 mm).

EXCESSIVE COATING DEPTH WILL RESULT IN SLEEVE AND BEARING DISTORTION AND MAY PREVENT BEARING ASSEMBLY AND REDUCE BEARING LIFE.

AFTER INSTALLING PROPELLER BEARING RACE AND PRIOR TO INSTALLING SLEEVE 1007458A, CLEAN EXCESS P-37 PASTE FROM PROPELLER SHAFT.

7) TWO SCREWS (M1731P) MUST NOT BE REUSED AFTER REMOVAL. ALTERNATELY TORQUE NEW SCREWS TO 45 FT-LBS. (65 N-m)

8) TORQUE LOCKNUT 1006069 TO 350-400 FT-LBS (500-570 N-m). APPROACH LOWER VALUE. IF SLOT DOES NOT ALIGN WITH HOLE IN SHAFT, INCREASE TORQUE UNTIL THE HOLE ALIGNS. DO NOT EXCEED MAXIMUM TORQUE.

9) SEE TWIN DISC SERVICE MANUAL NO. 1020481 FOR PROPELLER AND NUT TORQUEING SCHEDULE.

10) PLEASE SEE TWIN DISC SERVICE MANUAL FOR ALL OTHER PROCEDURES AND SPECIFICATIONS.

11) P/N (QTY) NAME

FEATURES:

- STAINLESS STEEL PROPELLER AND INPUT SHAFTS
- BRONZE HOUSINGS
- TRIPLE PROPELLER SHAFT SEALS

SUPPORTING DOCUMENTATION:

INSTALLATION DRAWING -------- 1017592
INSTALLATION MANUAL --------- 1020480
SERVICE MANUAL -------------- 1020481
MASS ELASTIC SYSTEM DWG. ---- B3504AL
BILL OF MATERIAL (BOM)----------1022906

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE

MATERIAL
HEAT TREAT
SURFACE TREATMENT

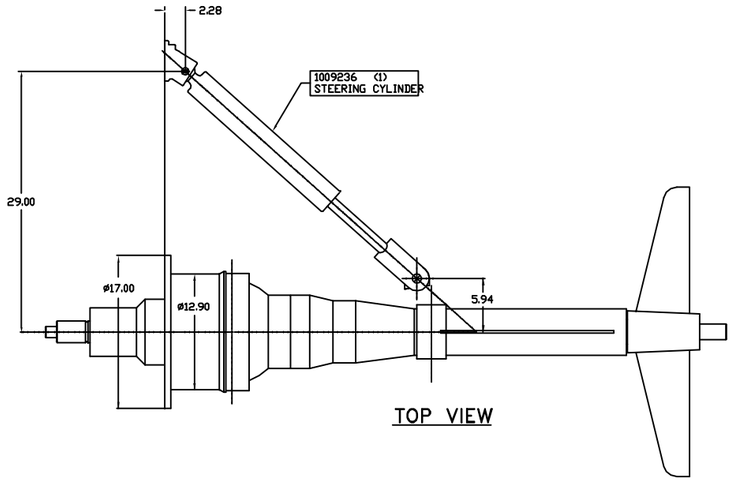
WEIGHT 600 LBS. (273 kg.)
WR² LBS. IN²
FIRST USE ASSY. ASD-12L MODEL
NAME DRIVE ASSEMBLY

UNLESS OTHERVISE SPECIFIED
MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

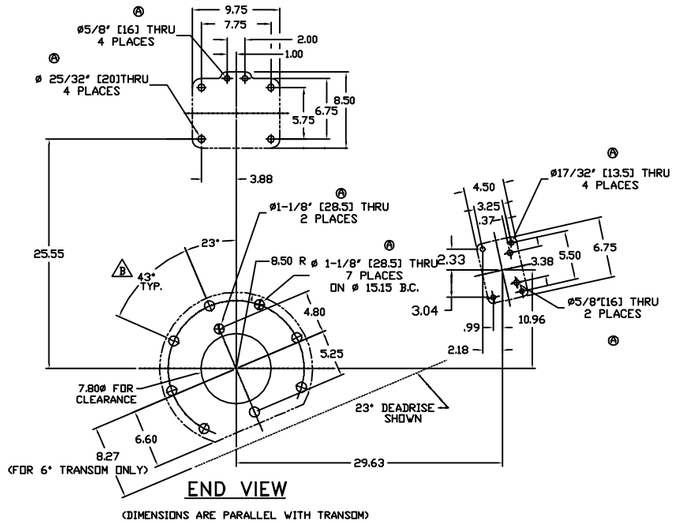
DATE 12-08-06
SCALE 1:4
DRN. J. Turk
CHK. J. Turk
APPD. F.Nystrom

THIRD ANGLE PROJECTION
SIMILAR TO 1004836

TWIN DISC INCORPORATED RACINE, WI 53403 - USA
1022907
SHEET 1 OF 1 REV (-)



TOP VIEW



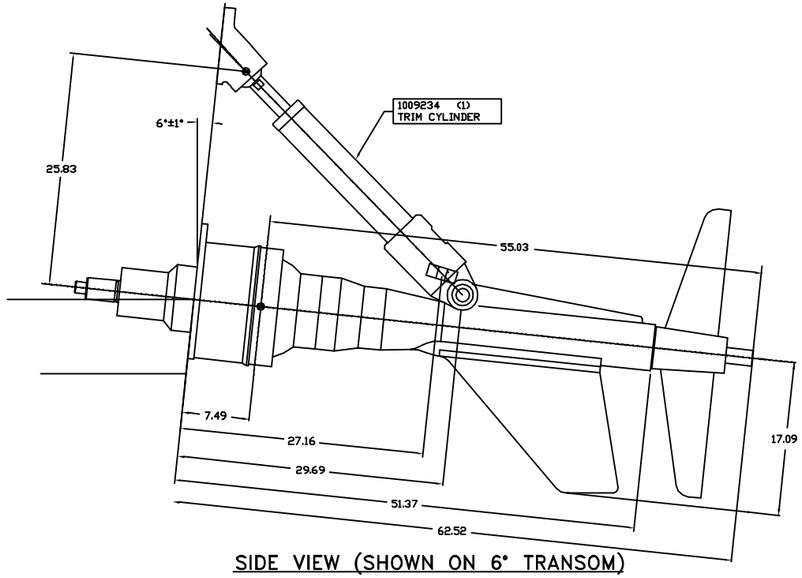
END VIEW

(DIMENSIONS ARE PARALLEL WITH TRANSOM)

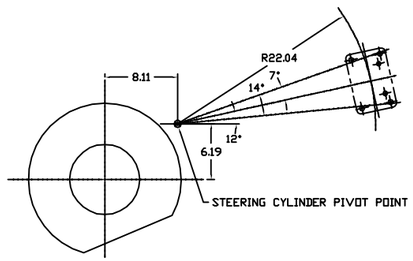
NOTES:

1. THIS DRAWING IS TO BE USED AS 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.

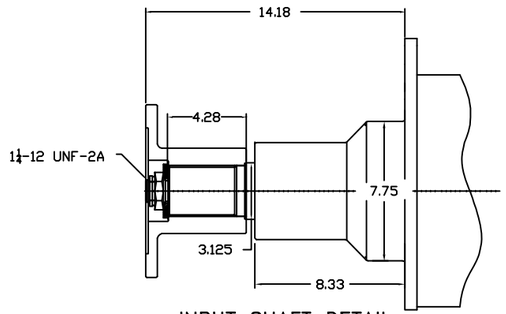
HUB: METRIC INTERNAL INVOLUTE SPLINE			
SPLINE TYPE			DIN 5480
REF. DIAMETER		dB	72
PRESSURE ANGLE			30
MODULE		m	2.5
NUMBER OF TEETH		Z	27
PITCH DIA.		d	67.5
BASE DIA.		da	58.457
TOLERANCE			9H
MEASURED BETWEEN Dm=4.5 PINS	BASIC		62.434
	MAX.		62.576
	MIN.		62.487



SIDE VIEW (SHOWN ON 6° TRANSOM)



OPTIONAL RANGE FOR STEERING CYLINDER LOCATION



INPUT SHAFT DETAIL

SCALE 2:1

REF. 002374

THIRD ANGLE PROJECTION

SIMILAR TO 1006974

REV	ZONE	CH. NO.	DATE
A	C5	ECN14659	2-20-07

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT LBS. | WR² LBS. IN²

FIRST USE ASSY. ASD-12L MODEL

NAME INSTALLATION

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 9-19-97
SCALE 1/8"=1"
DRN. T.Mittlested
CHK. F.Nystrom
APP'D. F.Nystrom

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1017592

SHEET 1 OF 1 REV A

NOTE:

1) APPLY LUBRICANT BETWEEN MATING EXTERNAL SURFACES SUCH AS BALL/BRACKET AND PIVOT/CLEVIS. LUBRICANT TYPE TO BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS ZEP RED LITHIUM GREASE.

2) TORQUE VALUES

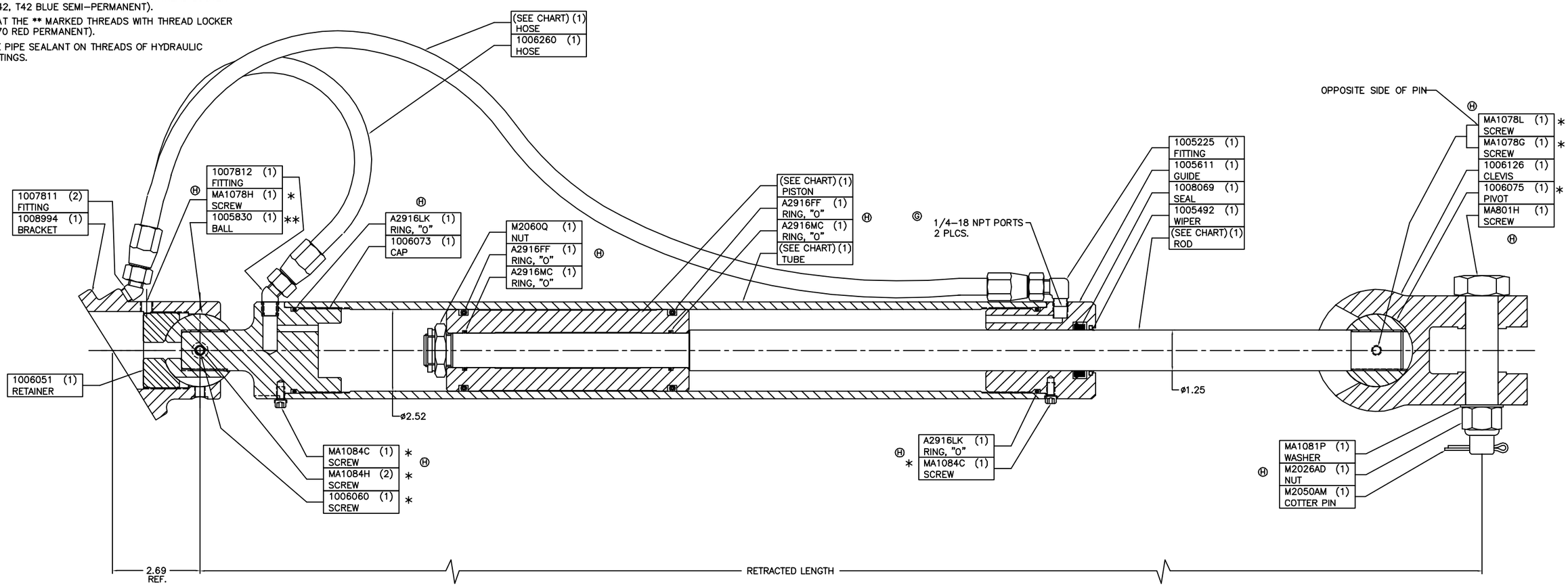
P/N	DESCRIPTION	TORQUE VALUES
1006051	RETAINER	55 FT-LB
1005830	BALL	150 FT-LB
M2060Q	NUT	75 FT-LB
MA1084C	SCREW	6 FT-LB
M2026AD	NUT	40 FT-LB

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

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

5) USE PIPE SEALANT ON THREADS OF HYDRAULIC FITTINGS.

STEERING CYL.	ROD P/N	TUBE P/N	PISTON P/N	HOSE P/N	RETRACTED LENGTH IN	STROKE IN
1009236 (12302E)	1009247	1009866	1005823	1006263	28.34	12.5
1009237 (12302E-2)	1009246	1006127	1005823	1006263	30.47	15.5
1009343 (14302E)	1005946	1009863	1005947	1004779	36.27	12.4
1007392	1007393	1009866	1005823	1006263	27.95	12.5
1018057	1018062	1009866	1005823	1006263	27.55	12.5
1018059	1018063	1009863	1005947	1004779	35.48	12.4



SHEET 1 ASSEMBLY DRAWING

SHEET 2 MANUFACTURING DRAWING

THIRD ANGLE PROJECTION

SIMILAR TO

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
F	1	E5	28320	1-21-98					
E	1	F4	27570	2/10/97					
D	1	D6	26205	6/6/95					
C	1	6F	25353	6/7/94					
B	1	E6	25230	4/5/94	H	1		ECN13194	6-23-05
A	1		24759	12/14/93	G	1 & 2		ECN10583	10-20-04

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT LBS. | WR² LBS. IN²

FIRST USE

ASSY.

MODEL ASD 12/14

NAME CYLINDER ASSM. (STEERING)

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS X.X ±0.030 X.XX ±0.010 X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 6/14/93
SCALE 1=1.5
DRN. J. KJAER
CHK. GAM
APPD. GAM

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1009236

SHEET 1 OF 2 | REV H

PERFORMANCE TEST REQUIREMENTS

THE FOLLOWING ARE PERFORMANCE & DIMENSIONAL CHECKS FOR EACH CYLINDER TO BE SUMMARIZED IN REPORT FORM.
THE PERFORMANCE TEST SHOULD BE DONE IN THE FOLLOWING LISTED ORDER.

A) CYCLE TEST
CYCLE CYLINDER AGAINST A 1000 PSI INTERNAL HYDRAULIC LOAD FOR 250 CYCLES.

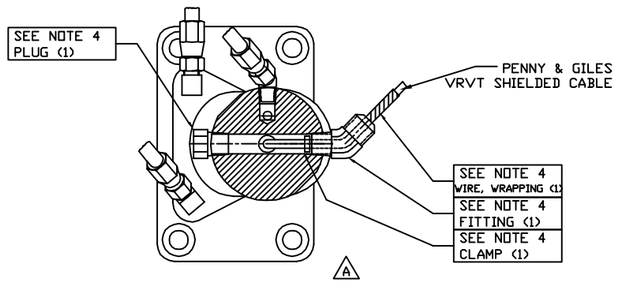
B) BREAKAWAY FORCE
RECORD BREAK FORCE TO INITATE CYLINDER TRANSLATION WITH NO EXTERNAL SIDE LOAD. RECORD THIS FORCE AT THE FULLY RETRACTED & MID STROKE POSITIONS.

C) LEAK TEST
1.) STATIC SEALS (VISUAL)
NO LEAKS ALLOWED FOR ALL STATIC O-RING SEALS AT 2500 PSI OPERATING PRESSURE.
2.) DYNAMIC SEALS
-RECORD LEAKAGE PAST THE PISTON SEALS PER TIME PERIOD.
-NO LEAKAGE ALLOWED PAST ROD GUIDE SEAL AT 2500 PSI OPERATING PRESSURE.

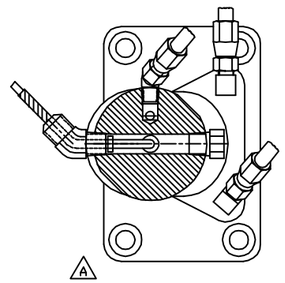
D) DIMENSIONAL CHECK
RECORD EXTENDED & RETRACTED CYLINDER LENGTHS.

VIEW "A"-"A"

HOSE ARRANGEMENT
1007432P
PORT CYLINDER



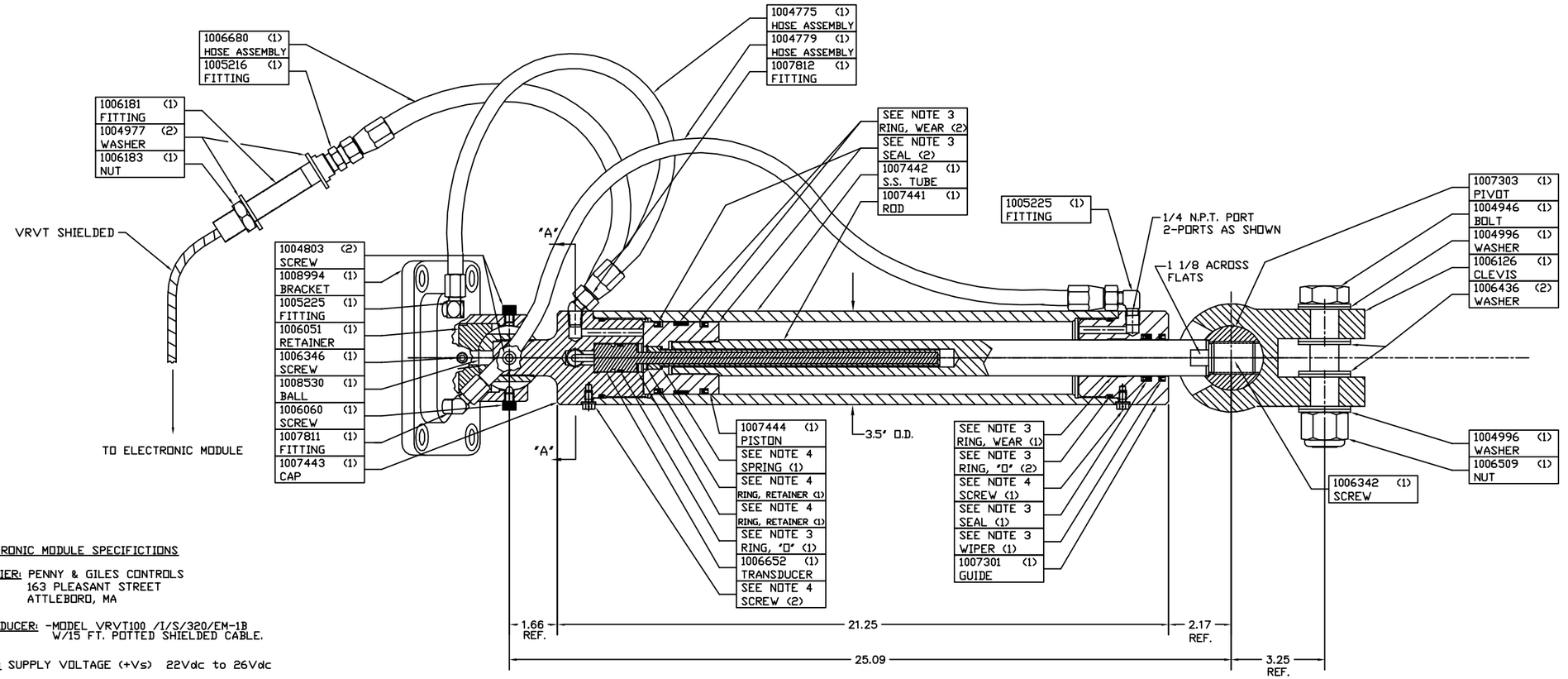
HOSE ARRANGEMENT
1007432S
STARBOARD CYLINDER



MILWAUKEE CYLINDER SPECIFICATIONS

MODEL NO.	D-13680	CUSHIONS	NONE
MOUNTING STYLE	H-62-S	OPER. MEDIA	STD. HYD. OIL
BORE	2 1/2	OPER. PRESS.	2500 P.S.I. MAX.
STROKE	12 1/2		
ROD DIA.	1 1/4		

NOTE: 1. MILW. CYL. STD. TOLERANCES APPLY TO ALL DIMENSIONS.
2. ETCH TWIN DISC PART No. 1007432 & MCC S/N TO BLIND END CAP.
3. PART OF 1007304 SERVICE KIT (SEALS)
4. PART OF 1007305 SERVICE KIT (HARDWARE)
5. TUBE IS 316 S.S. WITH XYLAN COATING ON THREADS.



ELECTRONIC MODULE SPECIFICTIONS

SUPPLIER: PENNY & GILES CONTROLS
163 PLEASANT STREET
ATTLEBORO, MA

TRANSDUCER: -MODEL VRVT100 /I/S/320/EM-1B W/15 FT. POTTED SHIELDED CABLE.

INPUT: SUPPLY VOLTAGE (+Vs) 22Vdc to 26Vdc

OUTPUT: OUTPUT VOLTAGE (Vo) ±5Vdc

POLARITY: ZERO ADJUST 100%

TEMPERATURE RANGE: -30°C TO 80°C

MODULE HOUSING: -CAST ALUMINUM ALLOY
-ELASTOMER ISOLATORS FOR VIBRATION CONTROL.

VENDOR: MILWAUKEE CYLINDER
CUDAHY, WI
REF. D-13680

REV	ZONE	CH. NO.	DATE
A	D5	27419	11/20/96

SIMILAR TO

MATERIAL
HEAT TREAT
SURFACE TREATMENT

WEIGHT LBS. | WR² LBS. IN²
FIRST USE
ASSY. ASD 12
MODEL

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS
XX ±0.030
XXX ±0.010
XXXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

NAME: CYLINDER ASSM. (STR.)

DATE 10/18/95
SCALE 1:2
DRN. J. KJAER
CHK. GAM
APPD. GAM

THIRD ANGLE PROJECTION

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1007432 SERIES

SHEET 1 OF 2 | REV A

TRIM CYLINDER	TUBE P/N	SPACER P/N	ROD, THREADED P/N	PLUG P/N	RETRACTED LENGTH IN	STROKE IN
1009234 (12301E-1)	1009799	1006112	1009350	1006068	32.4	4.48
1009336 (14301E-1)	1009797	1006111	1009349	1006068	37.9	4.95
1005559 (002270-002)	1009799	1006112	1009350	1005587	34.68	2.2
1008190 (002270-003)	1009797	1006111	1009349	1005587	40.18	2.67

NOTE:

1) APPLY LUBRICANT BETWEEN MATING EXTERNAL SURFACES SUCH AS BALL/BRACKET. LUBRICANT TYPE TO BE A MARINE GRADE LITHIUM GREASE WITH PROPERTIES FOR SALT WATER ENVIRONMENT SUCH AS ZEP RED LITHIUM GREASE, SOLD BY ZEP MANUFACTURING CO., ATLANTA, GA. USA 30301

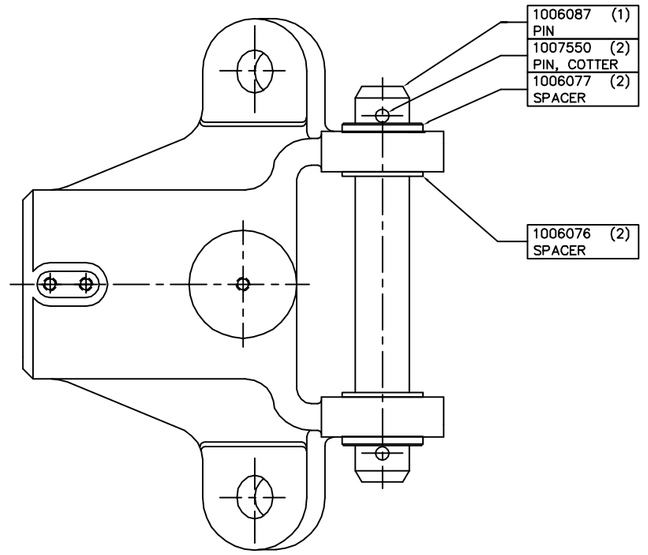
2) TORQUE VALUES

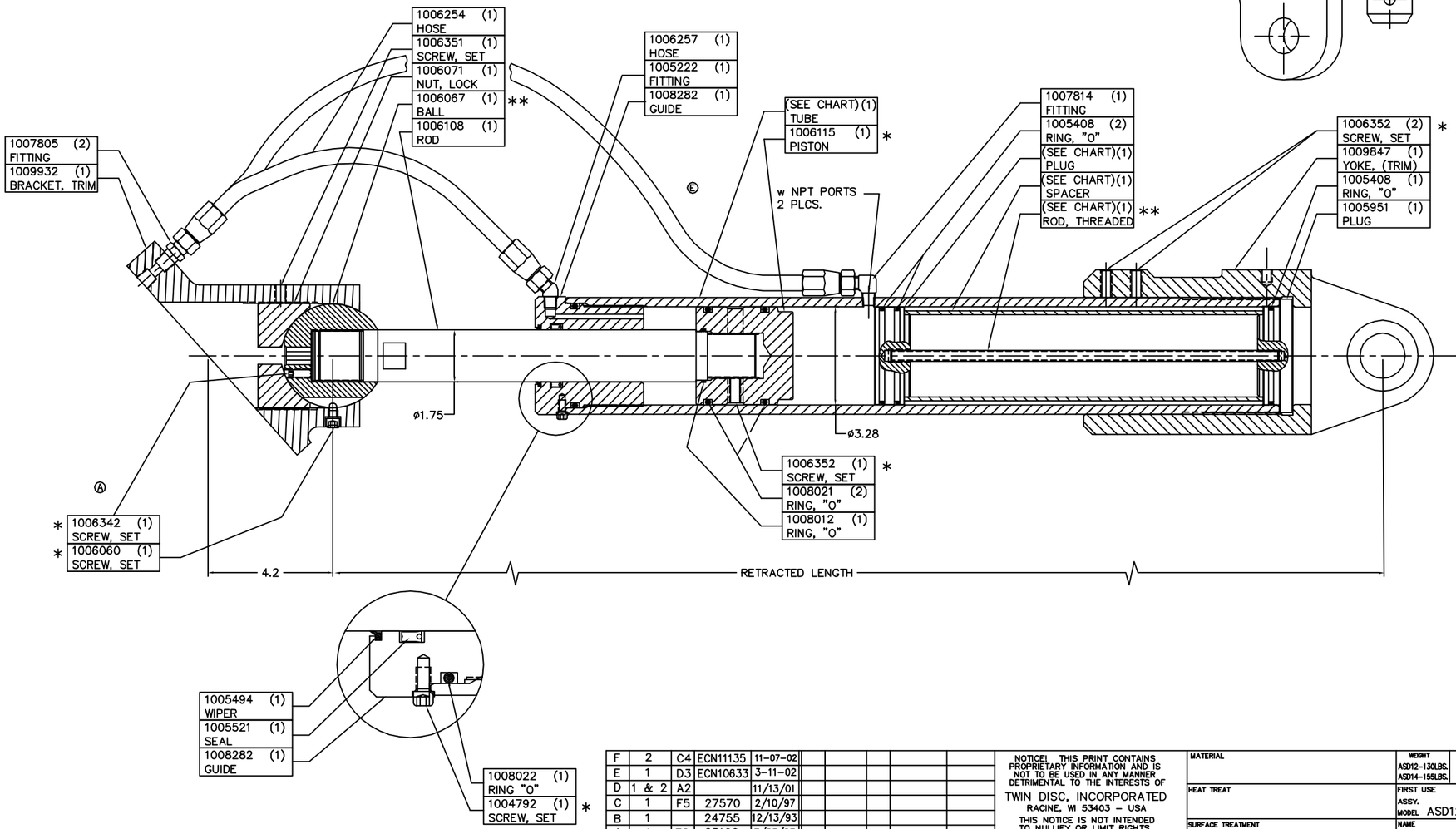
P/N	DESCRIPTION	TORQUE VALUES
1006067	BALL	150 FT-LB
1006071	NUT, LOCK	65 FT-LB
1004792	SCREW	6 FT-LB

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

4) COAT THE ** MARKED THREADS WITH THREAD LOCKER (270 RED PERMANENT).

5) USE PIPE SEALANT ON THREADS OF HYDRAULIC FITTINGS.





CAD FILE 1009234-1

SHEET 1 PARTS DRAWING

SHEET 2 MANUFACTURING DRAWING

THIRD ANGLE PROJECTION

SIMILAR TO

REV	SHEET	ZONE	CH. NO.	DATE
F	2	C4	ECN11135	11-07-02
E	1	D3	ECN10633	3-11-02
D	1 & 2	A2		11/13/01
C	1	F5	27570	2/10/97
B	1		24755	12/13/93
A	1	E2	25196	7/28/93

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT ASD12-130LBS. ASD14-155LBS. WR² LBS. IN²

FIRST USE ASSY. MODEL ASD12/14

NAME CYLINDER ASSEMBLY (TRIM)

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 7/28/93
SCALE 1/2
DRN. J. KJAER
CHK. GAM
APPD. GAM

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1009234

SHEET 1 OF 2 REV F

PERFORMANCE TEST REQUIREMENTS

REFER TO FOLLOWING PERFORMANCE & FUNCTION CHECKS AND SUMMERIZE A REPORT FORM FOR EACH CYLINDER. THE PERFORMANCE TEST SHOULD BE DONE IN THE FOLLING LISTED ORDER.

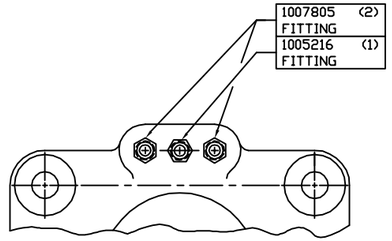
A) CYCLE TEST
CYCLE CYLINDER WITH A 1000 PSI INTERNAL HYDRAULIC LOAD FOR 250 CYCLES.

B) BREAKING FORCE
RECORD BREAKING FORCE TO INITATE CYLINDER TRANSLATION WITH NO EXTERNAL SIDE LOAD. RECORD THIS FORCE AT THE FULLY RETRACTED & MID STROKE POSITIONS.

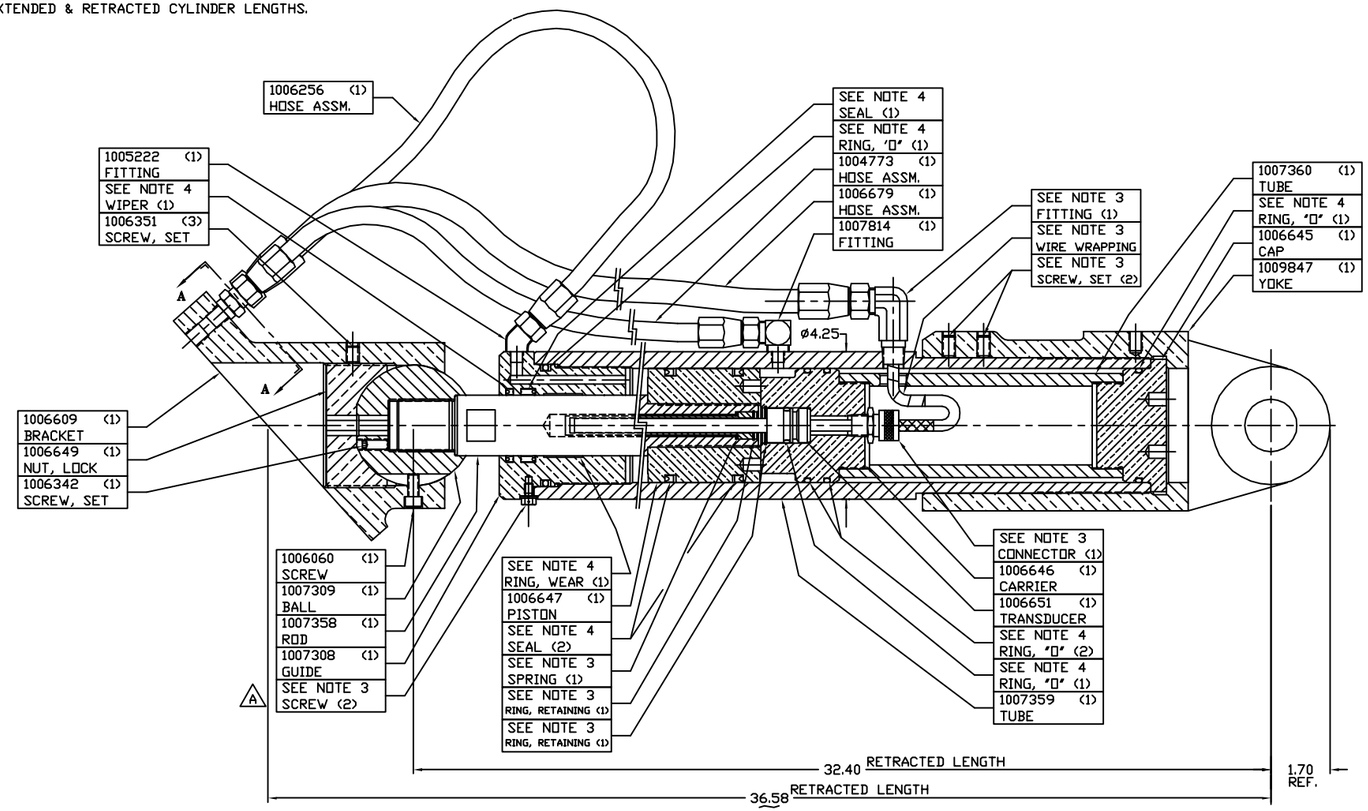
C) LEAK TEST
1.) STATIC SEALS (VISUAL)
NO LEAKS ALLOWED FOR ALL STATIC O'RING SEALS AT 2500 PSI OPERATING PRESSURE.

2.) DYNAMIC SEALS
-RECORD LEAKAGE PAST THE PISTON SEALS PER TIME PERIOD.
-NO LEAKAGE ALLOWED PAST ROD GUIDE SEAL AT 2500 PSI OPERATING PRESSURE.

D) DIMENSIONAL CHECK
RECORD EXTENDED & RETRACTED CYLINDER LENGTHS.



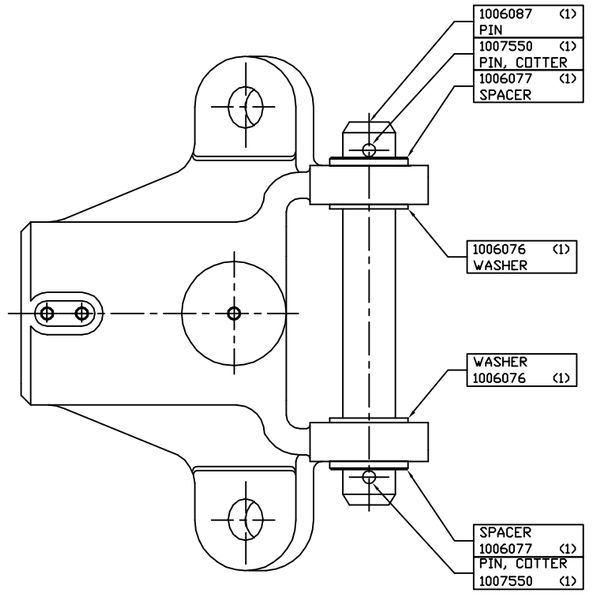
VIEW A-A



MILWAUKEE CYLINDER SPECIFICATIONS

MODEL NO.	D-13169	CUSHIONS	NONE
MOUNTING STYLE	H-61-S	OPER. MEDIA	STD. HYD. OIL
BORE	3 1/4	OPER. PRESS.	2500 P.S.I. MAX.
STROKE	4.48		
ROD DIA.	1 3/4		

NOTE: 1. MILW. CYL. STD. TOLERANCES APPLY TO ALL DIMENSIONS.
2. ETCH TWIN DISC PART NO. 1007340 AND MILWAUKEE CYLINDER SERIAL NO. TO ROD END CAP.
3. PART OF SERVICE KIT 1007310 (HARDWARE).
4. PART OF SERVICE KIT 1007311 (SEALS).



VENDOR: MILWAUKEE CYLINDER CUDAHY, WI

ELECTRONIC MODULE SPECIFACTIONS

SUPPLIER: PENNY & GILES CONTROLS
163 PLEASANT STREET
ATTLEBORO, MA

TRANSDUCER: -MODEL VRVT100/1/S/130/EM-1B W/15 FT. CABLE

INPUT: SUPPLY VOLTAGE (+Vs) 22Vdc to 26Vdc

OUTPUT: OUTPUT VOLTAGE (Vo) ±5Vdc

POLARITY: ZERO ADJUST 100%

TEMPERTURE RANGE: -30°C TO 80°C

MODULE HOUSING: -CAST ALUMINUM ALLOY
-ELASTOMER ISOLATORS FOR VIBRATION CONTROL.

NOTE: UNLESS OTHERWISE SPECIFIED, ALL PARTS SUPPLIED AND INSTALLED BY MILWAUKEE CYLINDER

REV	ZONE	CH. NO.	DATE
A	E3	26524	10/18/95

SIMILAR TO 1007313

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT LBS. | WR² LBS. IN²

FIRST USE ASSY. MODEL ASD 12

NAME CYLINDER ASSM.

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS X.X ±0.030 X.XX ±0.010 X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

THIRD ANGLE PROJECTION

DATE 1/9/95
SCALE 1:2
DRN. J. KJAER
CHK. GAM
APPD. GAM

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1007340

SHEET 1 OF 1 REV A

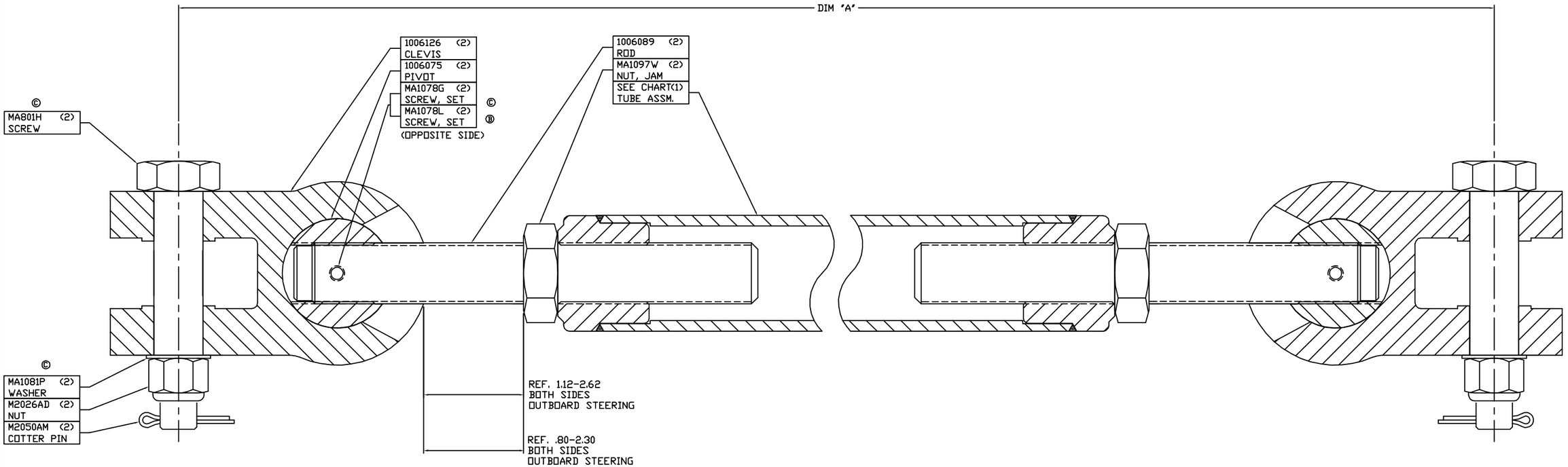
F E D C B A

NOTES:

1) CENTER TUBE ASSEMBLY FOR EQUAL THREADED ROD LENGTH.

TIE BAR ASSM.	TUBE ASSY. P/N	OUTBOARD STEERING		INBOARD STEERING	
		DRIVE CENTER INCHES	DIM 'A' INCHES	DRIVE CENTER INCHES	DIM 'A' INCHES
1006786	1006777	37-40	25.12-28.12	41-44	24.5-27.5
1006787	1006775	40-43	28.12-31.12	44-47	27.5-30.5
1006788	1006776	43-46	31.12-34.12	47-50	30.5-33.5
1006789	1006777	46-49	34.12-37.12	50-53	33.5-36.5
1006790	1006778	49-52	37.12-40.12	53-56	36.5-39.5
1006791	1006779	52-55	40.12-43.12	56-59	39.5-42.5
1006792	1006780	55-58	43.12-46.12	59-62	42.5-45.5
1006793	1006781	58-61	46.12-49.12	62-65	45.5-48.5
1006794	1006782	61-64	49.12-52.12	65-68	48.5-51.5
1006795	1006783	64-67	52.12-55.12	68-71	51.5-54.5
1006796	1006784	67-70	55.12-58.12	71-74	54.5-57.5
1006797	1006785	70-73	58.12-61.12	74-77	57.5-60.5
1006972	1006987	73-76	61.12-64.12	77-80	60.5-63.5
1006973	1006988	76-79	64.12-67.12	80-83	63.5-66.5
1006983	1006989	79-82	67.12-70.12	83-86	66.5-69.5

Ⓐ



REV	SHEET	ZONE	CH. NO.	DATE
C			ECN13194	6-23-05
B		E4	25978	3-7-95
A		B5	24823	1-20-94

UNLESS OTHERWISE SPECIFIED MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

WEIGHT

FIRST USE
ASSY. ASD 12/14
MODEL

INCH

THIRD ANGLE PROJECTION

MATERIAL

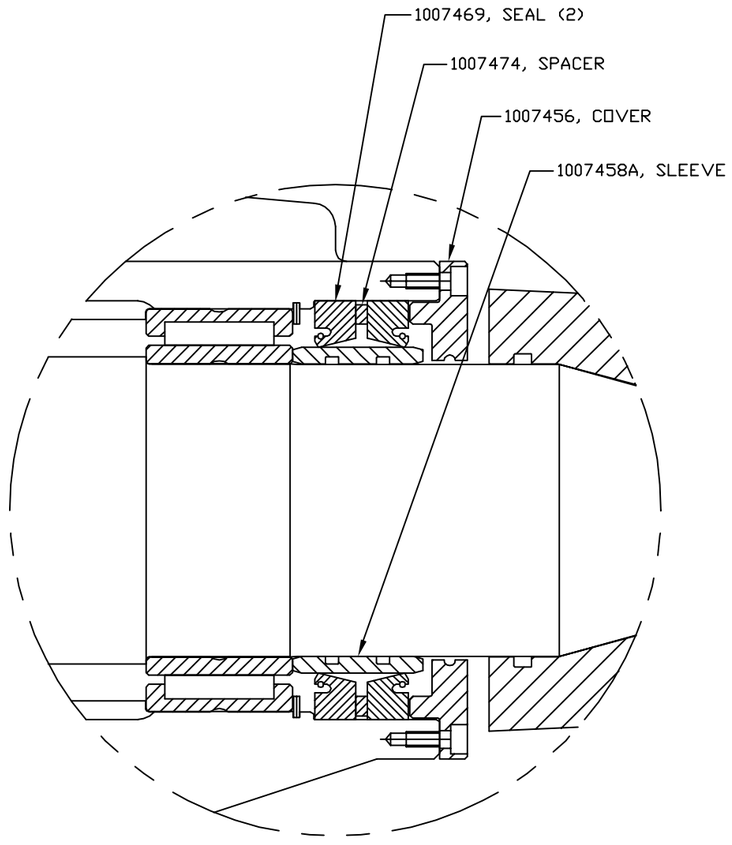
NAME
TIE BAR ASSEMBLY

DATE 4/23/93
SCALE FULL
DRN. J. Kjaer
CHK. G. Matranga
APPD. G. Matranga

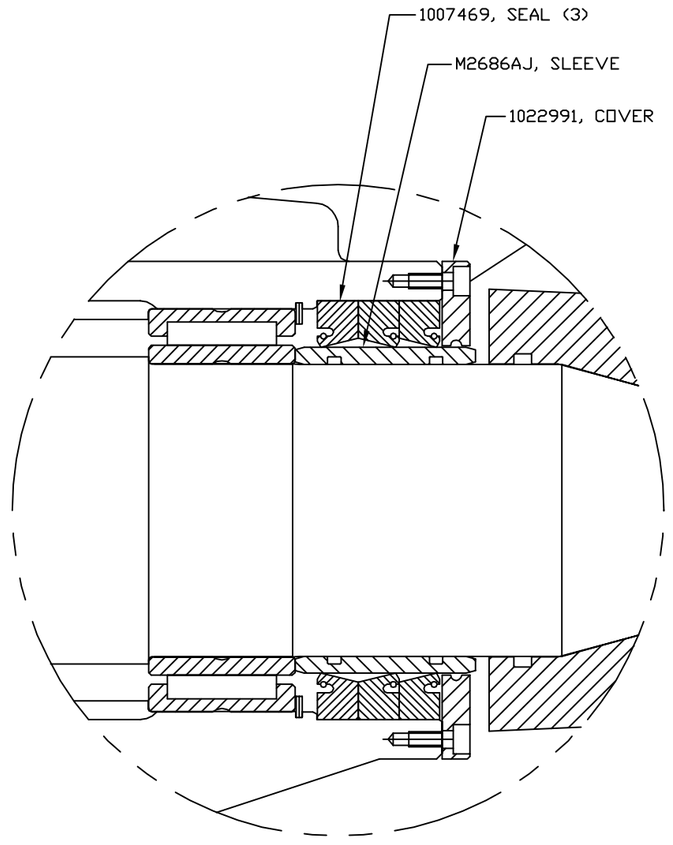
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1006786

DWG SIZE D | SHT. 1 of 1 | REV C



DOUBLE AFT SEAL ARRANGEMENT



TRIPLE AFT SEAL ARRANGEMENT
(CONVERT FROM DOUBLE SEAL WITH KIT 1023571: NEW COVER AND NEW WEAR SLEEVE)

REV	SHEET	ZONE	CH. NO.	DATE

UNLESS OTHERWISE SPECIFIED
MACHINED DIMENSIONS
X.X ±0.030
X.XX ±0.010
X.XXX ±0.005
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

WEIGHT LBS. | WR² LBS./IN²

FIRST USE
ASSY. ASD12
MODEL

INCH

THIRD ANGLE PROJECTION

MATERIAL

SIMILAR TO

HEAT TREAT

NAME DIAGRAM (AFT SEAL CONVERSION)

DATE 03-27-07
SCALE FULL
DRN. A. Gist
CHK. F.Nystrom
APPD. F.Nystrom

TWIN DISC
INCORPORATED
RACINE, WI 53403 - USA

1023448

DWG SIZE C | SHT. 1 of 1 | REV (-)

D C B A

4 3 2 1

#1022808 08/07

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