



Service Manual

Arneson Surface Drive™

Model:

ASD14B1L ASD14B1LM

Document Number: 1015710

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Arneson Surface Drive ™ Service Manual

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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.

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- 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.

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FLAT RATE SCHEDULE FOR COMMERCIAL MARINE TRANSMISSION (Hourly Labor Rate Must be Acceptable to Twin Disc, Incorporated.)

| (Hourly Labor Ra | te iviust be | Acceptable to 1 | win Disc, Incorpora Clutch Repair | R&R | R&R | Rebuild |
|---|--------------|-----------------|-----------------------------------|------------|------------|------------|
| Product Code / Model Series | R&R | Rebuild | (both packs) | Pump | Valve | Valve |
| 0432 - MG5010 & MG5011 SERIES | 10.0 | 8.0 | 2.0 | 1.0 | 1.0 | 0.5 |
| 0401 - MG506 SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0435 - MG5050 SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0437 - MG5061 & MG5062V SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0453 - MG5055A SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 1706 - MG5065A SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 1707 - MG5065X SERIES | 10.0 | 11.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0425 - MG5085 SERIES | 10.0 | 12.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0442 - MG5075A SERIES | 10.0 | 12.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0443 - MG5075SC SERIES | 10.0 | 12.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0476 - MG5082 SERIES | 10.0 | 12.0 | 4.0 | 1.0 | 1.0 | 0.5 |
| 0419 - MG5114 SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 0433 - MG5090 SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 0489 - MGX5114A SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 0490 - MGX5114SC SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 0491 - MGX51143C SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 1719 - MGX51141V SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 1728 - MG5095A SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 1729 - MG5095SC SERIES | 10.0 | 17.0 | 5.0 | 1.0 | 1.0 | 0.5 |
| 0405 - MG514 SERIES | 10.0 | 25.0 | 6.0 | 1.0 | 1.0 | 0.5 |
| 0447 - MG514 SERIES | 10.0 | 25.0 | 6.0 | 1.0 | 1.0 | 0.5 |
| 0448 - MG5145A GERIES | 10.0 | 25.0 | 6.0 | 1.0 | 1.0 | 0.5 |
| 0492 - MGX5135A SERIES | 10.0 | 25.0 | 6.0 | 1.0 | 1.0 | 0.5 |
| 0494 - MGX5145SC SERIES | 10.0 | 25.0 | 6.0 | 1.0 | 1.0 | 0.5 |
| 0426 - MG516 & MG5170 SERIES | 10.0 | 28.0 | 8.0 | 1.0 | 1.0 | 0.5 |
| 0477 - MG5170 SERIES | 10.0 | 28.0 | 8.0 | 1.0 | 1.0 | 0.5 |
| 0412 - MG5200 SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0412 - MG5200 SERIES 0416 - MG518 SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0459 - MG6557SC SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0461 - MG6557RV SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0473 - MG-520-1HP SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0479 - MG-5222DC SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0480 - MG-5225DC SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 1743 - MGX-5225DC SERIES | 10.0 | 32.0 | 10.0 | 1.0 | 1.0 | 0.5 |
| 0441 - MG-6650-00-SC SERIES | 12.0 | 32.0 | 16.0 | 1.0 | 1.0 | 0.5 |
| 0446 - MG-6848-00-SC SERIES | | | | | | |
| 0478 - MG-6690SC SERIES | 12.0 12.0 | 32.0 32.0 | 16.0 16.0 | 1.0 1.0 | 1.0 1.0 | 0.5 0.5 |
| 0484 - MGX-61500SC SERIES | | 32.0 | 16.0 | 1.0 | 1.0 | 0.5 |
| 0485 - MGX-6650 SERIES | 12.0 12.0 | 32.0 | 16.0 | 1.0 | 1.0 | 0.5 |
| 0487 - MGX-6690SC SERIES | 12.0 | 32.0 | 16.0 | 1.0 | | 0.5 |
| 0488 - MGX-6848SC SERIES | 12.0 | 32.0 | 16.0 | 1.0 | 1.0 1.0 | 0.5 |
| 1711 - MG-5321 SERIES | 12.0 | 32.0 | 16.0 | 1.0 | | 0.5 |
| 1711 - MG-5321 SERIES 1721 - MGX-6620SC SERIES | 12.0 | | | 1.0 | 1.0 | |
| | | 32.0 | 16.0 | | 1.0 | 0.5 |
| 1732 - MGX-5321DC SERIES | 12.0 | 32.0 | 16.0 | 1.0 | 1.0 | 0.5 |
| 1737 - MGX-6599A SERIES | 12.0 | 32.0 | 16.0 | 1.0 | 1.0 | 0.5 |
| 0408 - MG540 SERIES | 20.0 | 62.0 | 20.0 | 1.0 | 1.0 | 0.5 |
| 0418 - MG5600 SERIES | 20.0 | 62.0 | 20.0 | 1.0 | 1.0 | 0.5 |
| 1741 - MGX-5600 SERIES | 20.0 | 62.0 | 20.0 | 1.0 | 1.0 | 0.5 |

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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 |

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| T-18050-591 Thrust Tube Outer Bearing Cup Driver. | |
| T-18050-592 End Block Seal Driver & Seal Guide | |
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Introduction

General Information

This manual provides service procedures for the ASD 14B1L and ASD 14B1LM In-line Model Drives using a universal Cardan joint design. The information is current at the time of printing and is subject to change without prior notice.

The main differences between the two models are the ASD14B1L has aft lip seals, and the ASD14B1LM has an aft mechanical face seal and a shaft wear sleeve on the input shaft where the input seals run against it.

Any deviations from the procedures contained in this manual without permission from Twin Disc, Incorporated will constitute voiding of all warranties.

Twin Disc recommends that disassembly, or replacement of internal parts be performed by an authorized distributor, dealer or qualified boat yard. Failure to use Twin Disc replacement parts will constitute voiding of all warranties.

Twin Disc provides a complete rebuilding service for ASD units and hydraulic cylinders. Call or write Twin Disc for information on services, pricing and scheduling.

Twin Disc, Inc. 1328 Racine Street Racine, WI 53403

Telephone: (414) 638-4000

Fax: (414) 638-4480

Safety and General Precautions

General

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

Important Safety Notice

This "safety alert" symbol is used with the signal words "CAUTION" and "WARNING" in this manual to alert readers to hazards from improper operating and maintenance practices.

WARNING identifies a potential hazard that may result in personal injury or death if proper precautions are not taken.

CAUTION identifies unsafe or improper practices that may result in equipment damage. 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.

Products must be used in accordance with the engineering information specified. Observe proper installation, maintenance and operation procedures. Inspect as necessary to assure safe operations under prevailing conditions.

A WARNING

To prevent accidental starting of an engine while servicing the ASD Drive/ Driveline, battery cables should always be removed from the battery, and the ignition key removed from the switch.

A 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.

A 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.

A CAUTION

Hammering bearings and other parts for assembly and disassembly operations will cause damage resulting in drive unit failure.

A CAUTION

Do not damage the sealing surfaces of the ball, shafts and hydraulic cylinder rods. Scratches, nicks, etc. can cause premature seal failure and subsequent oil leakage.

A CAUTION

Maintain the internal cleanliness of the ASD unit for maximum service life. All lubricants must be clean and of a quality suitable for marine service. See Lubricant Specifications.

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

A 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

Contact Twin Disc for the nearest distributor and to obtain information on renewal parts and service parts kits.

Follow these instructions to order parts:

- 1. Specify the model, bill of material and serial number of the unit involved.
- 2. State exactly each item required, referencing the numbers on the crosssectional drawing.
- 3. Specify the quantity of each part required.
- 4. Furnish the complete shipping destination and postal address. All parts shipments made from the factory will be F.O.B. factory location, U.S.A.
- 5. State specifically whether the parts are to be shipped by freight, express, etc. If shipping instructions are not specified on the order, the equipment will be shipped the best way considering time and expense. Twin Disc, Incorporated will not be responsible for any charges incurred by this procedure.

Note: Do not order parts from the part numbers on the crosssectional 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.

Warranty

All Twin Disc/Arneson Surface Drives have a warranty (found at the front of this manual). For details of the warranty, contact any Twin Disc Distributor, Service Dealer, or the Warranty Administration Department, Twin Disc, Incorporated, Racine, Wisconsin, U.S.A.

Description and Specifications

General

The ASD 14B1L and ASD 14B1LM 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.

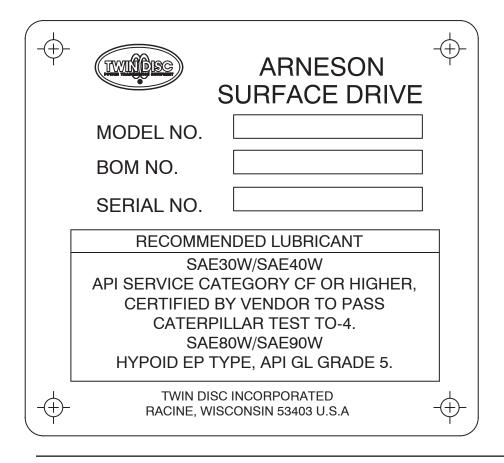


Figure 1. Nameplate for Arneson Surface Drive

Construction Features

Arrangement

The ASD 14B1L and ASD 14B1LM 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

The ASD 14B1L and ASD 14B1LM are comprised of three housings; the thrust tube, thrust ball, and thrust socket. They are all made of aluminum-bronze material.

Bearings

The input (engine driven) shaft is supported and located by two bearings, one cylindrical roller bearing and one ball bearing. 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.

Lubrication

The lubrication system consists of an oil reservoir that is located in the boat, a valve to allow removal and filling of the drive with an external pump (ASD 14B1LM only), and hoses, clamps, and push lock couplings. The internal drive cavity is completely filled with appropriate oil. The reservoir is filled to one third full to allow for expansion and agitation of the oil during operation.

Drive Oil Capacity

The approximate capacity of the drive and reservoir is 24 - 27 liters (6.5 - 7 gallons).

Lubrication Specifications

The lubricating oil is specified as:

- ☐ <u>SAE 30W/40W</u> 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.

Approximate Weight

Approximate dry weight of ASD 14B1L and ASD 14B1LM is 515 kg (1135 lbs.) This Includes drive assembly, trim cylinder, steering cylinder, backing plates, external mounting hardware, assembly wrench and internal tube assembly.

Approximate dry weight of ASD 14B1L and ASD 14B1LM tie bar assembly is 27 kg (60 lbs.)

Torque Values for Fasteners

Table 1.

Torque Specifications for Fasteners used in ASD 14B1L and ASD 14B1LM

| COMPONENT | DRY TORQUE VALUES | | |
|--|--------------------|-----------------|--|
| Screw (Aft cover)* | 20 in-lbs | 2250 N-mm | |
| Screw (Fin)* | 25 ft-lbs | 35 N-m | |
| Screw (Ball)* | 125 ft-lbs | 170 N-m | |
| Nut, Lock (Input Flange) | 200 ft-lbs | 270 N-m | |
| Nut, Lock (Tapered Bearings on Prop Shaft) | 100 ft-lbs min. | 135 N-m | |
| Screw, (Ball Retainer Clip)* | 65 in-lbs | 7300 N-mm | |
| Nut, Jam (Prop) | 750 - 800 ft-lbs | 1020 - 1085 N-m | |
| Nut, Lock (Prop) | 650 - 700 ft-lbs** | 875 - 950 N-m** | |
| Screw (U-Joint)* | 33 ft-lbs | 45 N-m | |

^{*} Apply Loctite® 242 or similar semi-permanent threadlocker

^{**} Approach lower torque value, then continue until cotter pin slot in nut aligns with hole in shaft. Do not exceed maximum torque.

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 14B1L and ASD 14B1LM are designed for a maximum intermittent torque loading of 8000 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.

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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. 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.

ACAUTION

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 820 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 1019886F should be applied to the wedge and not directly to the transom.

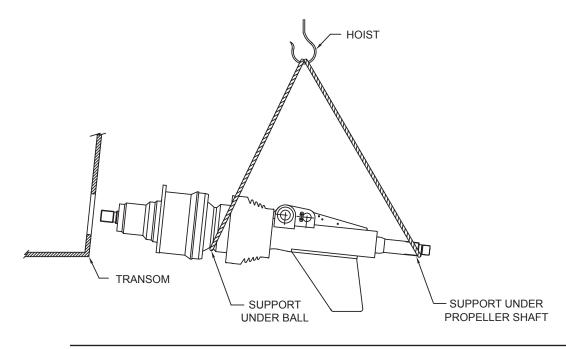


Figure 2. Support Unit for Installation

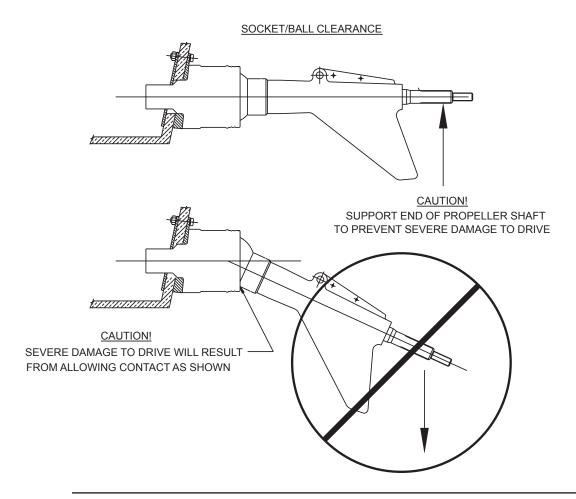


Figure 3. Protect Ball from Damage

 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 1019886F 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 1019886F should be applied to the wedge and not directly to the transom.

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

DRIVE CENTERLINE LOCATION DUAL ENGINE

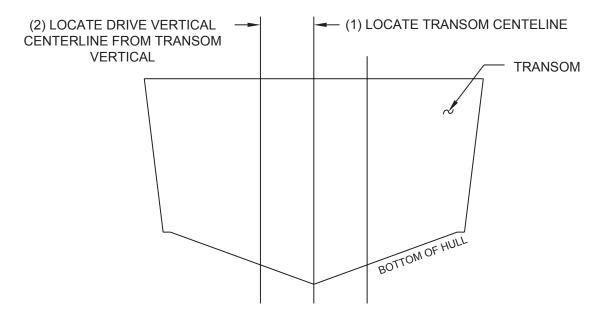


Figure 4. Drive Centerline Location

- 3. Use Template 1019886F to locate and mark drive centerline(s) as shown in Figure 5.
- 4.A For single drive installations, position centerline of Template 1019886F on transom centerline. Locate "Point C" on transom using template 1006615. Mark centers for mount holes (9), and lubrication holes (2).

Note: Template 1006615 shows 4 lubrication holes. Only drill the highest hole possible and lowest hole possible to assure proper lubrication of the drive.

4.B For twin drive installations, locate and match "Point C" on transom using template 1019886F. 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 (9) and lubrication holes (2).

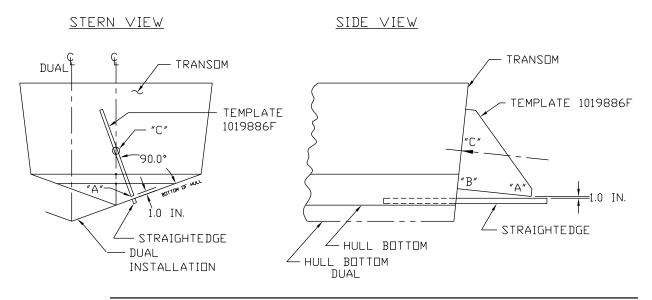


Figure 5. Mark Hull using Template 1019886F

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

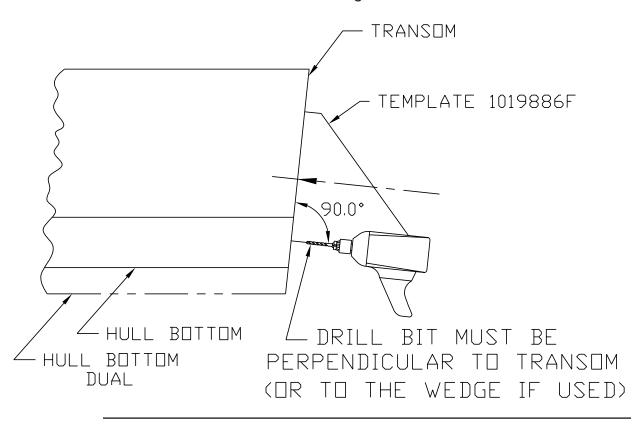


Figure 6. Drill Holes

- 6. Follow the pilot hole with a 228.6 mm (9 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 1006615.

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.

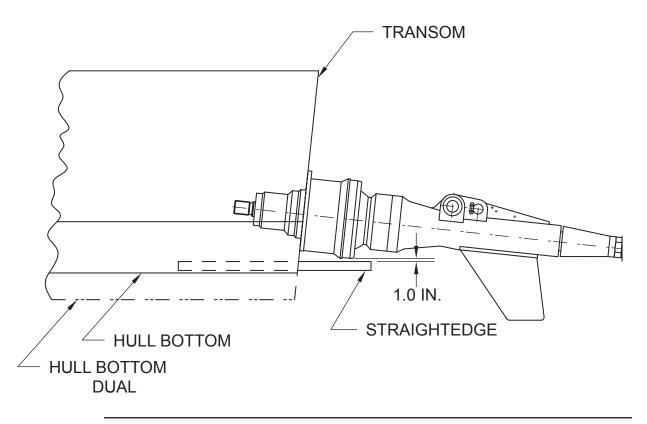


Figure 7. Measure for Clearance

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8. Remove the drive unit and drill (9) 28.5 mm (1.12 in.) diameter holes and (2) 28.5 mm (1.12 in.) lubrication holes using template 1006615, page 1. Holes should be drilled perpendicular to the transom.

Note: Template 1006615 shows 4 lubrication holes. Only drill the highest hole possible and lowest hole possible to assure proper lubrication of the drive.

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.

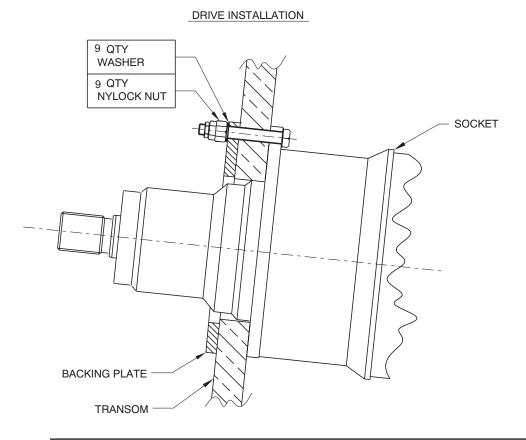


Figure 8. Drive Installation

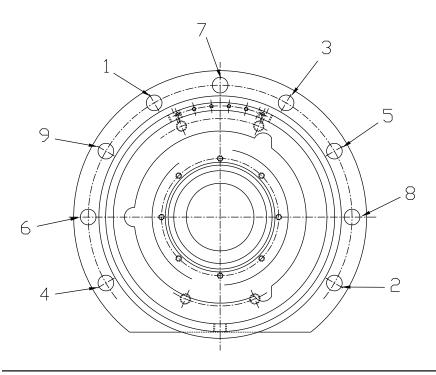


Figure 9. Torque Sequence for Socket to Hull

10. Install the input flange (companion flange) onto the input shaft. See Figure 10. Torque the flange retainer nuts to 270 N-m (200 ft-lbs.).

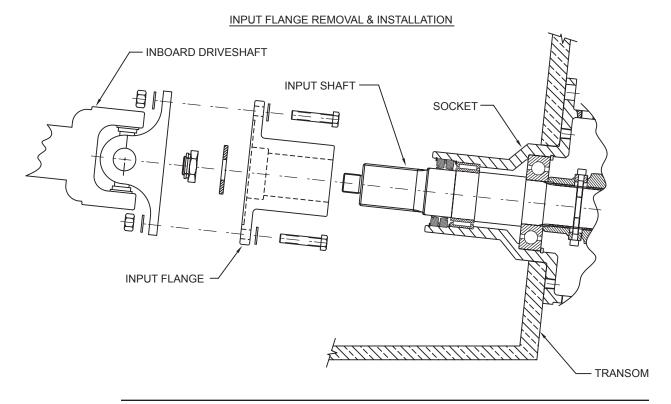


Figure 10. Input Flange Removal and Installation

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.

- 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.

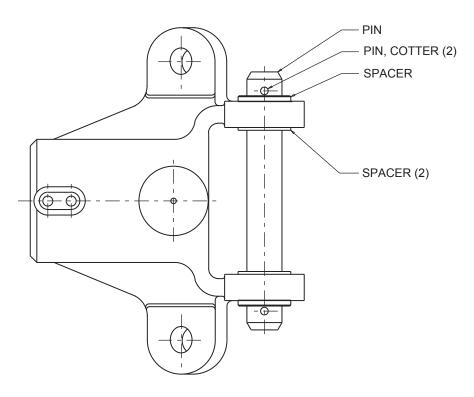


Figure 11. Trim Cylinder Mount

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*.

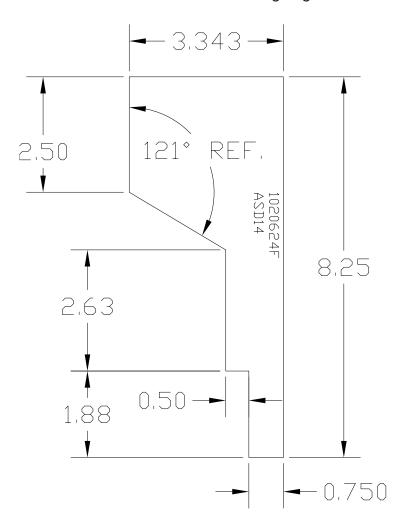


Figure 12. Drive Centering Template 1020624F

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.

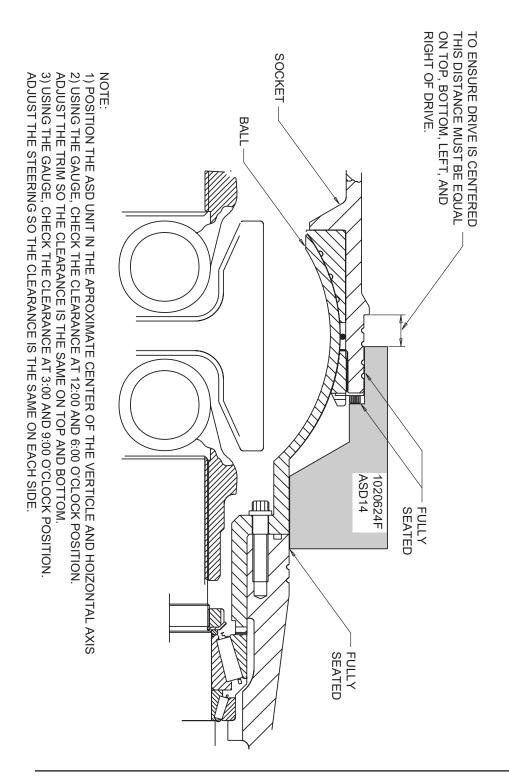


Figure 13. Center the Thrust Ball in the Socket

5. Transfer the trim bracket hole pattern and drill four 21 mm (0.81 in.) and two 16 mm (0.63 in.) diameter holes as shown in Figure 14 and drawings 1006615. 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.

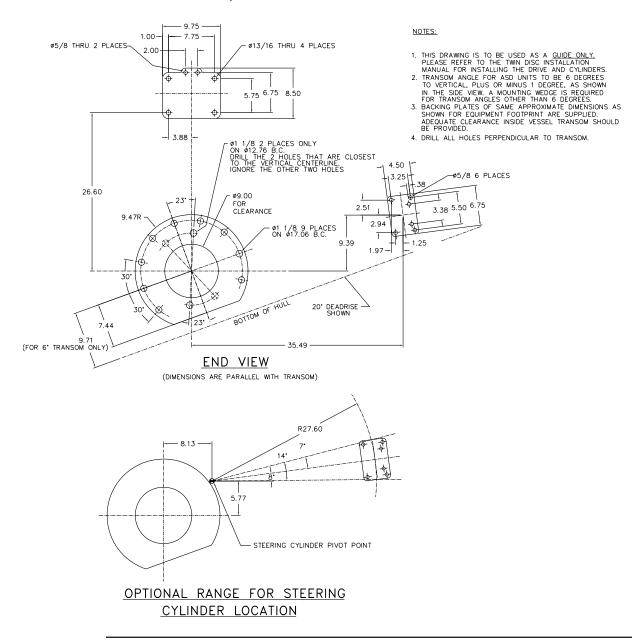


Figure 14. Transom Layout Dual Drive

Twin Disc, Incorporated Installation

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).

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.

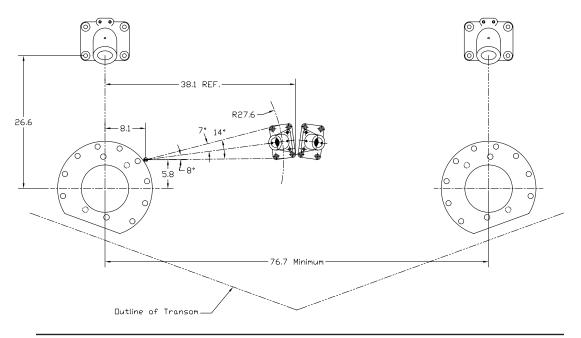


Figure 15. Transom with Optional Inboard Steering

- 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 six 16 mm (0.63 in.) diameter holes. Mount the steering cylinder bracket with its backing plate and stainless steel 1/2 in. diameter bolts, nuts, 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 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.

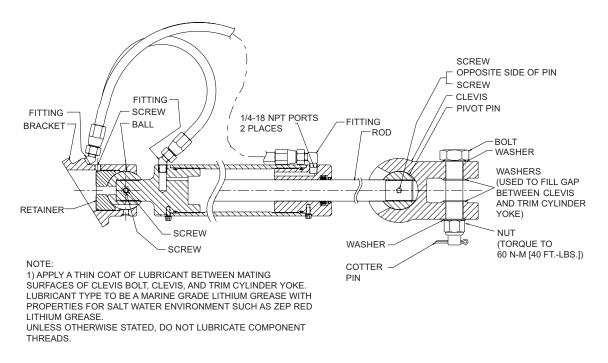


Figure 16. Steering Cylinder

7. A tie bar is required for twin drive installations on mono hull vessels. When ordering the tie bar, specify drive centerline-to-centerline distance. Installation of the tie bar is per Figure 17 using the mounting 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.

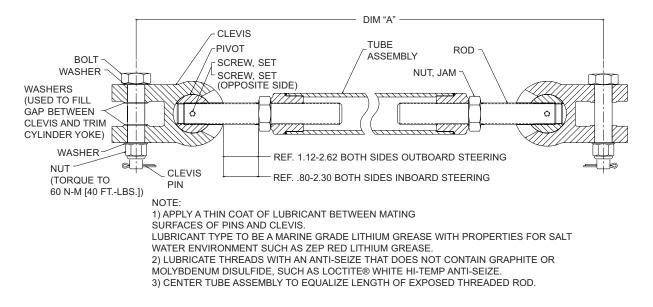


Figure 17. Tie Bar Assembly

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.

- 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.
- 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.

TRANSMISSION OUTPUT SHAFT CENTERLINE WILL NOT BE PARALLEL TO ARNESON INPUT SHAFT CENTERLINE

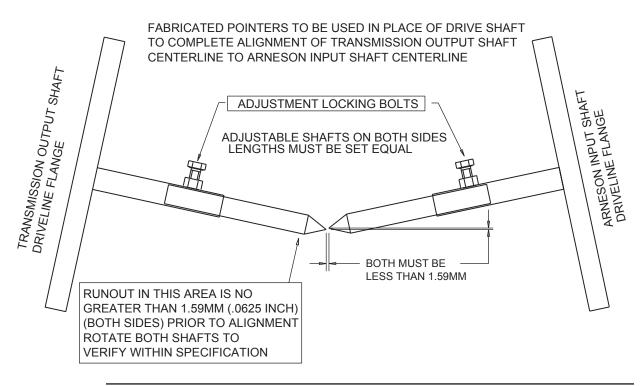


Figure 18. Remote or Island Mounted Alignment Tool, Shafts not Parallel

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

TRANSMISSION OUTPUT SHAFT CENTERLINE WILL BE PARALLELTO ARNESON INPUT SHAFT CENTERLINE

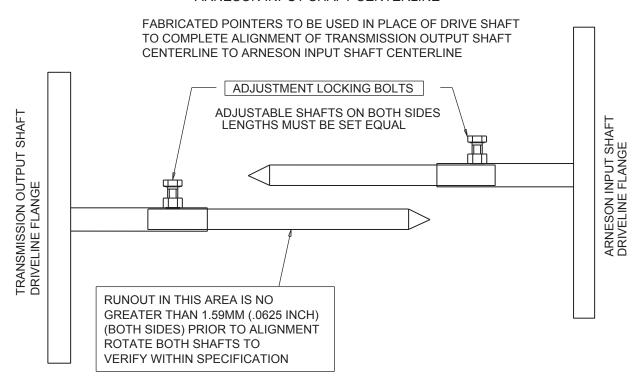


Figure 19. Remote or Island Mounted Alignment Tool, Shafts Parallel

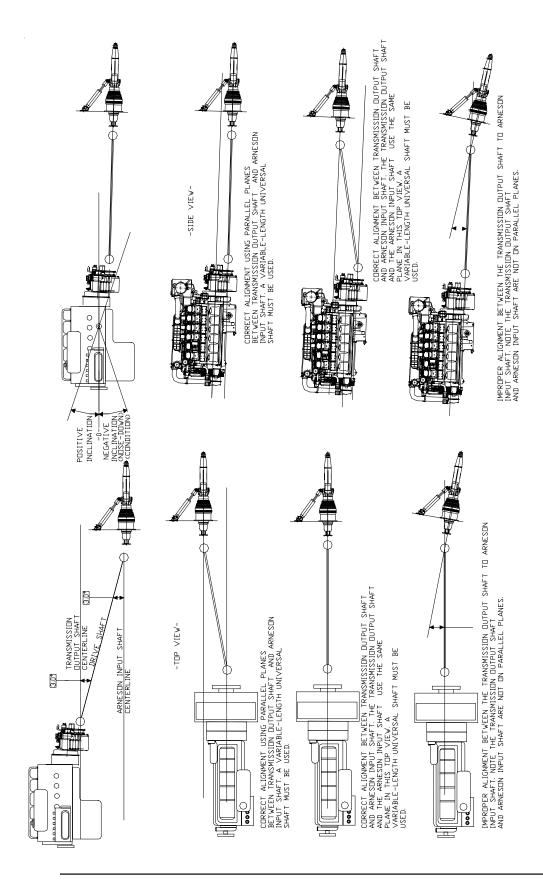


Figure 20. Examples of Proper and Improper Alignment

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 14 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.

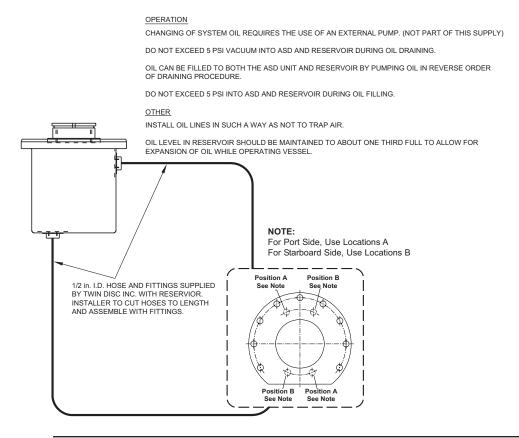


Figure 21. Lubrication System

highest hole possible and lowest hole possible first to assure proper lubrication of the drive.

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 onethird 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

- 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 1020 1085 N-m (750 800 ft.-lbs). Torque the jam (lock) nut to 875 950 N-m (650 700 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 schedule in Propeller Torque Maintenance section.

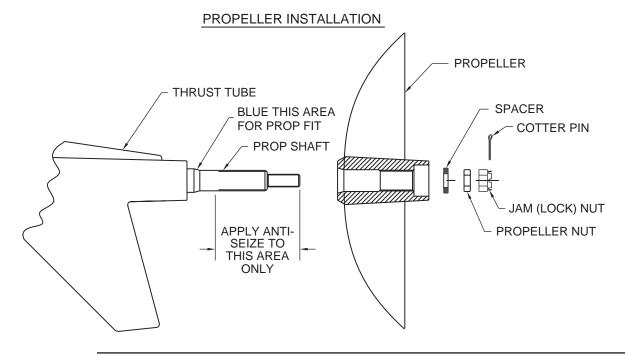


Figure 22. Propeller Installation

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.

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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.
- 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 ftlbs). 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.

Twin Disc, Incorporated Installation

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.

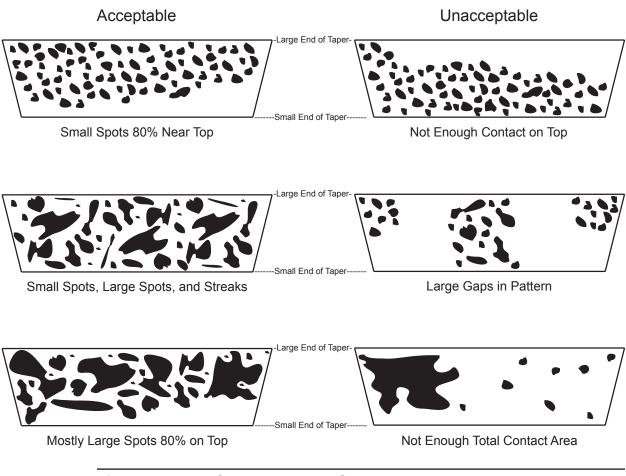


Figure 23. Dye Contact Pattern Samples

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.

ACAUTION

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.

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 | Х | | | |
| level: Check visually | | | | |
| Hydraulic oil filter: | | | Х | |
| Replacement | | | | |
| Propeller: Check for | Х | | | |
| damage | | | | |
| Propeller nut: Torque | See Propeller Torque Schedule on next page | | | |
| check | | | | |
| Socket, trim cylinder, | | | Х | Х |
| steering cylinder: Check | | | | |
| transom fasteners | | | | |
| Hydraulic system: | | X | X | Х |
| Perform manual and | | | | |
| emergency operation | | | | |
| Drive oil change: As | | Х | Х | Х |
| indicated by analysis | | | | |
| Hydraulic and drive | X | | | |
| system oil: Check for | | | | |
| leakage | | | | |
| Hydraulic system: Cycle | X | | | |
| lock to lock | | | | |
| Thrust Ball retaining | | | Х | Х |
| ring: Check that it is tight | | | | |

Propeller Torque Maintenance

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

Torque the propeller nut to 1020 - 1085 Nm (750 - 800 ft.-lbs). Torque the jam (lock) nut to 875 - 950 Nm (650 - 700 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, retorque 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, retorque 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, retorque 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, retorque 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 | Low hydraulic oil. | Check for leak. Repair or service the system. | | |
| failure | 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 | Misaligned inboard driveline. | Align.** | | |
| vibration | 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 | Leak in thrust ball/socket seal. | Tighten aft threaded retainer ring. | | |
| oil looks milky and | | Remove and replace packing and o-ring. | | |
| brown.) | 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 | Electrical fault on vessel. | Repair electrical fault, check bonding system, and replace anodes. | | |
| period of time in the water. | Stray current from marina or | Install galvanic isolator and/or check that it is | | |
| water. | another vesel. | working. If problem continues, investigate installing a polarization transformer. | | |
| | Not enough anodes. | Install additional anodes. | | |
| | Too much uncoated, more noble | Coat the more noble metals, i.e stainless | | |
| | metals. | steels, brasses, bronzes, etc. | | |
| Anodes are not | No problem. | No remedy needed. | | |
| corroding or corroding | Anodes not connected to bonding | Ensure that the anodes have less than 1.0 | | |
| extremely slowly. | system. | Ohm resistance with all metals they are protecting. | | |
| | Poor quality anodes. | Use anodes made per the proper MIL | | |
| | Anada an anna duith a i | 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: Direction steps or figures with an "L" suffix refer to model ASD14B1L. Direction steps with an "M" suffix refer to model ASD14B1LM. All other directions refer to both units.

Note: There are two methods to service an Arneson Surface Drive.

- 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 #1009308, provided with new surface drives)

A WARNING

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

 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.

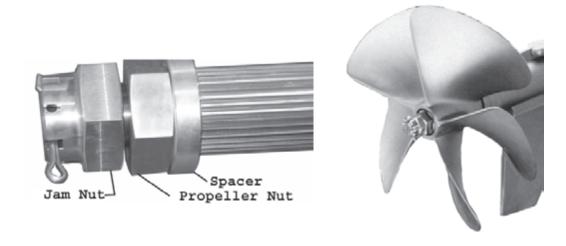


Figure 24. Propeller Retaining Parts (left), and Propeller Installed (right)

A 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.

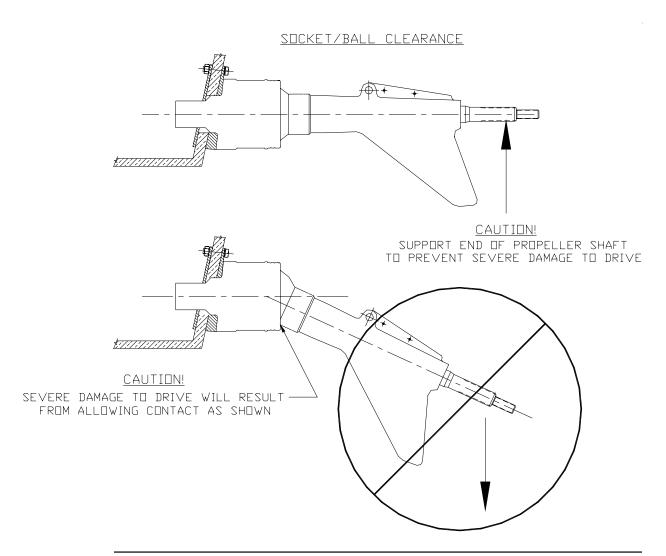


Figure 25. Protect Ball from Damage

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.

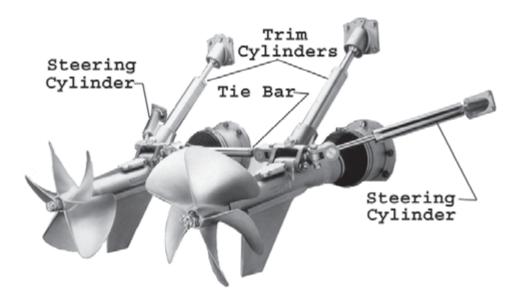


Figure 26. Rear View of Dual Installation Showing Cylinders and Tie Bar

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 #1009308) 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.

A 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.

A 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 ASD Unit From Transom

A WARNING

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

 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.

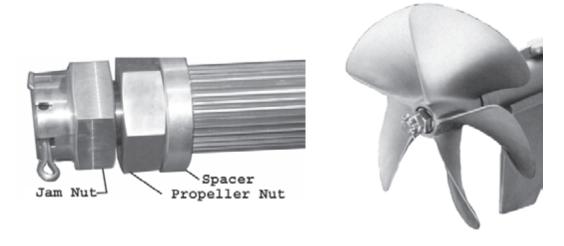


Figure 30. Propeller Retaining Parts (left), and Propeller Installed (right)

- 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.

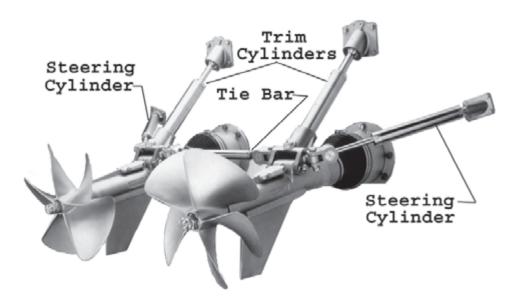


Figure 31. Rear View of Dual Installation Showing Cylinders and Tie Bar

A 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.

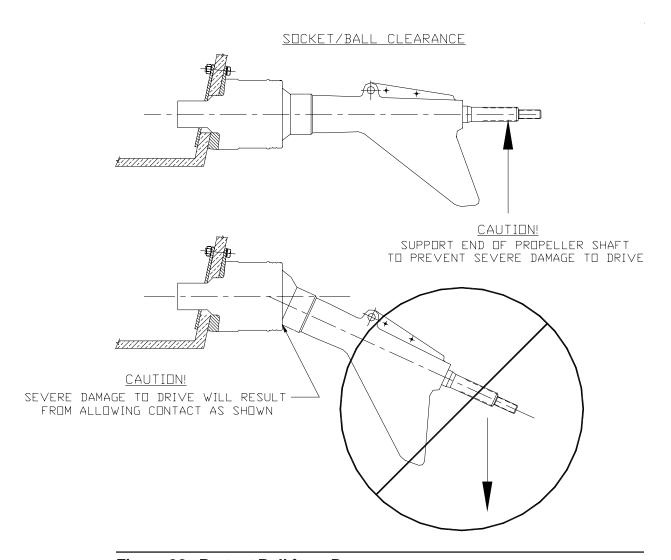


Figure 32. Protect Ball from Damage

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 it from falling when the mounting bolts are removed.

A CAUTION

Do not cradle the ASD 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 #1009308), 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

Note: Occasionally water enters the boot. This is ok and is not a cause for concern.

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

2. Unscrew and remove safety clip around aft retainer.



Figure 34. Aft Retainer Ring Lock Clip in the Notch Locking Tab

3. Using wrench (Special Tool #1009308) 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.

A CAUTION

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



Figure 35. Removing the Aft Retainer using Special Wrench

4. 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.

A CAUTION

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

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

Twin Disc, Incorporated Disassembly

Disassembly of the Thrust Tube

Note: Direction steps below with an "L" suffix refer to model ASD14B1L. Direction steps with an "M" suffix refer to model ASD14B1LM. All other directions refer to both units.

Special Tools:

- Assembly Stand T-21084 (Not required but very helpful. If a stand is not available, a suitable support should be made.)
- Eyebolt with 1/2-20 UNF screw

ASD14B1L (Aft Lip Seals)

1L. 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-21084) with front end facing up.



Figure 36. Rotate Thrust Tube Assembly so Ball is Up, Remove 12-point Capscrews

- 2L. Remove the screws holding thrust ball to the thrust tube. Use a 12-point socket.
- 3L. 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.

- 4L. Place ball aside and inspect for scratches, dents or rough edges. Smooth ball surface with 400 grit or finer emery cloth or similar material. Do not create flat spots on the ball's outside surface.
- 5L. 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.
- 6L. 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.

A CAUTION

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

Twin Disc, Incorporated Disassembly

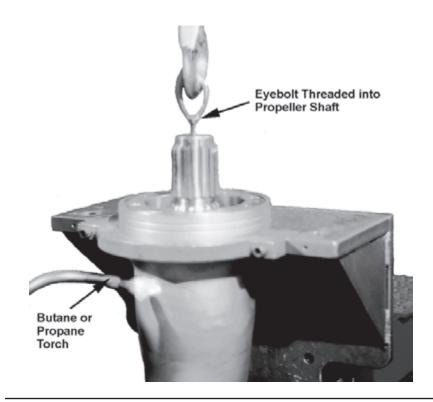


Figure 37. Heating thrust tube housing to remove propeller shaft

- 7L. 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.
- 8L. Rotate thrust tube in assembly stand so aft end is facing up. Remove eight retaining screws located on the face of the rear seal block assembly. Screw in the four pusher screws to remove the seal housing.
- 9L. Remove aft bearing retainer ring and two O-ring seals from aft end of tube.
- 10L. Rotate the thrust tube so that the forward end is facing up. Go to Step 11.

ASD14B1LM (Aft Mechanical Face Seal)

1M. Once the thrust tube assembly has been removed from the socket assembly, begin disassembly by placing the thrust tube vertically in the assembly stand (special tool T-21084) with the aft end facing up.

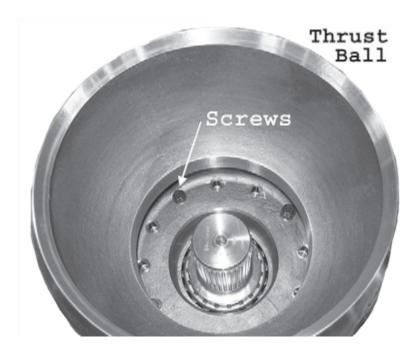


Figure 38. Rotate Thrust Tube Assembly so Ball is Up, Remove 12-point Capscrews

- 2M. Remove the mechanical seal by following directions 8.1 to 8.10 of Technical Manual for Special Type 2100 Seal at the end of this manual.
- 3M. Rotate the unit so that the forward end faces up. Remove the screws holding thrust ball to the thrust tube. Use a 12-point socket.
- 4M. 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.

5M. Place ball aside and inspect for scratches, dents or rough edges. Smooth ball surface with 400 grit or finer emery cloth or similar material. Do not create flat spots on the ball's outside surface.

6M. 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.

7M. 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.

ÀWARNING.

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

A CAUTION

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

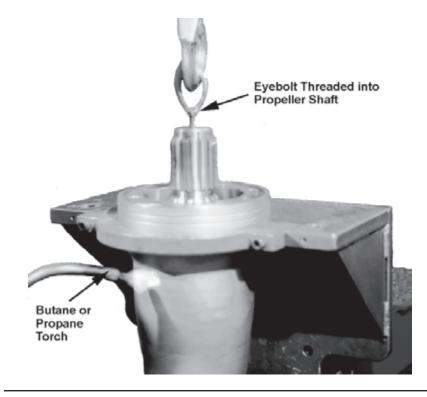


Figure 39. Heating thrust tube housing to remove propeller shaft

8M. As housing is heated, apply just enough lifting force to suspend drive. Apply heat slowly until bearing cup frees itself. See previous illustration Place the propeller shaft assembly aside. Go to step 11.

A CAUTION

Do not scratch or damage shaft when removing components. If damaged, yet repairable, use a 400 grit or finer emery cloth to smooth the surface.

ASD14B1L and ASD14B1LM

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.

A 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.

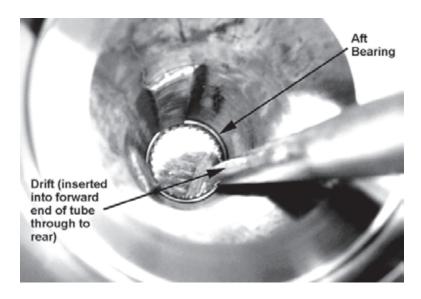


Figure 40. Inserting drift into thrust tube to remove aft bearing

- 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 Propellor Shaft

 On the forward end of the propellor 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.

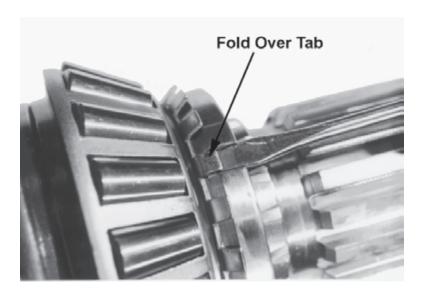


Figure 41. Bending Fold-Over Tab to Remove Lock Nut

- 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.

A 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.

A 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 propellor end of the shaft, remove shaft 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.

A 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.

Twin Disc, Incorporated Disassembly

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 1 1/8-inch 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-inch bolts.)
- Before disassembly of thrust socket can be accomplished, remove the thrust tube/ball assembly from thrust socket using instructions in the Disassembly of the 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.
- 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

Disassembly Twin Disc, Incorporated

4. Remove retaining ring or bolted retainer that holds the ball bearing in place.

5. Remove the screws holding socket assembly to the bench. Support the assembly about 15 cm (6 inches) 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, ball bearing, U-joint, and inner race because these items may be reused.

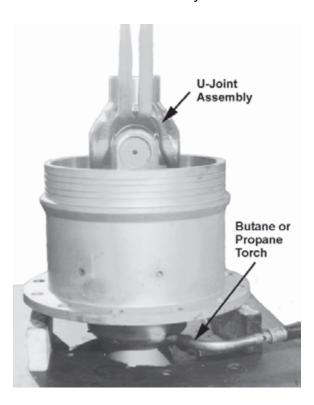


Figure 44. Heating Housing to Remove U-Joint Assembly

≜WARNING

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

A 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 retaining ring from small diameter end of socket. Remove oil seals and 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-inch 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.

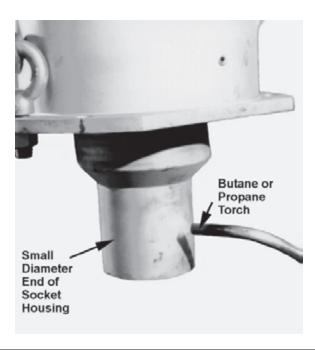


Figure 45. Heating Housing to Remove Roller Bearing from Small Diameter End

ÀWARNING.

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

A 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

Special Tools:

- U-Joint Wrench (T-21093)
- 1. Once input shaft with U-joint is removed from socket housing, separate the U-joint yoke from the shaft by first clamping the U-joint's H shaped center coupling in a vice. (The U-joint should be positioned so it looks like an H on its side with the bottom leg of the H in the vise.) Remove flex lock nut using U-joint wrench, special tool T-21093.



Figure 46. Removing Flex Lock Nut From Input Shaft Using Special Tool T-21093

Twin Disc, Incorporated Disassembly

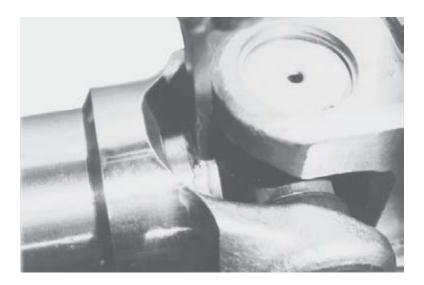


Figure 47. Removing Flex Lock Nut From Input Shaft Using Special Tool T-21093 (Closeup)

2. Remove washer and slide yoke off input shaft spline. Remove flanged bearing retainer, if applicable.

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. (ASD14B1LM only: First remove seal sleeve using this same method.)



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.

AWARNING

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

ACAUTION

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.

ACAUTION

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.

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.

ACAUTION

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, sleeves, and seals.

Note: The spherical surface of the two bronze retainers may have minor dents, scratches or low spots. Smooth edges of these imperfections by lightly sanding with emery cloth or 400 grit or finer sand paper. High spots are not acceptable and must be removed.

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.

U-Joint

Inspect for roughness of rotation. If the u-joint requires service, Twin Disc recommends the work be performed by qualified personnel familiar with u-joint disassembly and reassembly such as driveline specialty shops or a Twin Disc Distributor/Service Dealer.

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.

Mechanical Seal (on ASD14B1LM only)

See Technical Manual for Special Type 2100 Seal section of this manual.

NOTES

Assembly

Assembly Overview

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

Note: Assembly instructions with a "L" suffix refer to model ASD14B1L. Assembly instructions with a "M" suffix refer to model ASD14B1LM. All other directions refer to both units.

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

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

ÀWARNING.

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:

- Propeller and Socket Shaft Race Driver T-18050-586
- Propeller Shaft Bearing Cone Driver T-18050-588

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

- Two (2) Tapered Bearings
- Bearing Race
- Shaft Sleeve

≜WARNING

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

A CAUTION

Do not overheat components. Excessive heat will damage or distort them. They should not be heated above 121°C (250°F).

 Support the shaft in a horizontal position on blocks allowing enough radial clearance for installation of the bearings. Apply a thin coat of antiseize that does not contain graphite or molybdenum 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 and reduce bearing life.

 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). Seat the bearings with special tool T-18050-588, if necessary. Twin Disc, Incorporated Assembly



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

≜WARNING

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

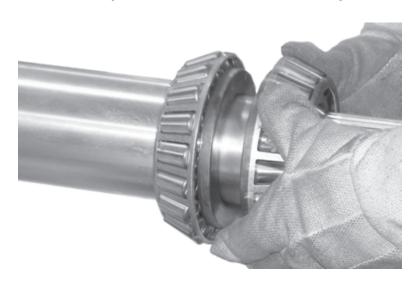


Figure 50. Install Tapered Roller Bearings

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

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

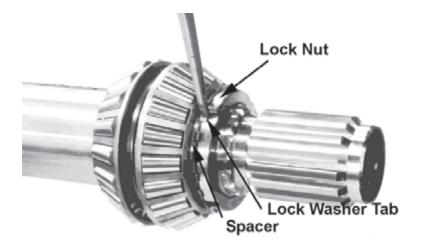


Figure 51. Securing Lock Nut by Bending Locking Tab

6. Slide the spacer, followed by the heated bearing race onto the aft end of the shaft (long spline end). Seat these components with special tool T-18050-586.

≜WARNING

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

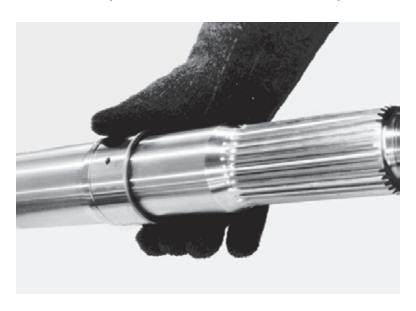


Figure 52. Sliding the Heated Bearing Race on the Shaft

7. Install o-rings into the inner bore of the heated shaft sleeve. Slide shaft sleeve onto the aft end of the shaft (long spline end). Lubricate aft end of shaft with oil. Seat with special tool T-18050-587.

Note: The tapered end of the sleeve must face the aft end of the shaft.

8. 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-21084
- 1/2"-20 UNF Eyebolt
- Prop Sleeve and End Block Driver T-18050-587
- Thrust Tube Roller Bearing Driver T-18050-589
- Thrust Tube Inner Bearing Cup Driver T-18050-590
- Thrust Tube Outer Bearing Cup Driver T-18050-591
- End Block Seal Driver T-18050-592, part 1
- End Block Seal Guide T-18050-592, part 2
- Shaft Endplay Indicator Holder T-21173-2
- Lifting Fixture T-21172-3

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.

Twin Disc, Incorporated Assembly

1. Place thrust tube vertically in assembly stand with propeller end (end with smaller housing diameter) facing up. Heat thrust tube bearing housing area with a butane or propane torch. Slide frozen roller bearing into aft bore of thrust tube. Seat bearing against shoulder with special tool T-18050-589, if necessary.





Figure 53. Installing Aft Thrust Tube Bearing

≜WARNING

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

A CAUTION

Do not overheat components above 121°C (250°F). Excessive heat will damage or distort them.

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



Figure 54. Installing Rear Bearing Spiral-Lock Retainer Ring

 Rotate the thrust tube in the assembly stand so the forward end of the tube (end with larger diameter) is facing up. Heat the thrust tube bearing housing area with a butane or propane torch. 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-18050-590.

ÀWARNING.

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

≜WARNING

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

A CAUTION

Do not overheat components above 121°C (250°F). Excessive heat will damage or distort them.



Figure 55. Installing First Bearing Cup

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Twin Disc, Incorporated Assembly

4. 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.

5. 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 56. Installing Propeller Shaft Assembly into Thrust Tube

6. 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.

7. 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. Use special tool T-18050-591, if necessary.

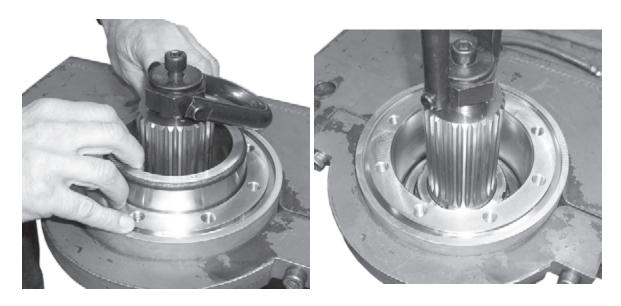


Figure 57. Install the Chilled Front Bearing Cup (left), and Raise the Shaft to Ensure End Play (right)

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 12-point socket head capscrews, evenly spaced. Torque the capscrews to 170 N-m (125 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-21173-2 onto the prop shaft.

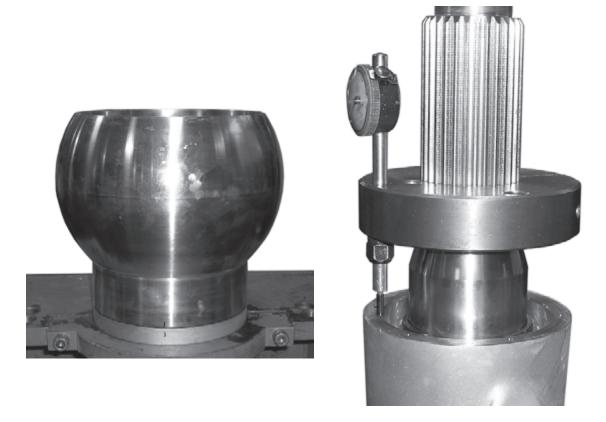


Figure 58. Lower Ball, Secure with Four Capscrews (left), and Turn Over and Install Dial Indicator T-21173-2 (right)

3. Use a hoist and special tool T-21172-3 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.

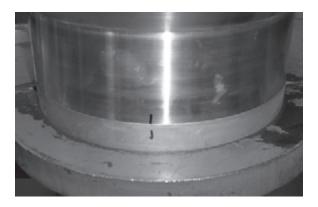


Figure 59. Thrust Ball Location Mark

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.

- 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.

Twin Disc, Incorporated Assembly

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 170 N-m (125 ft-lbs).

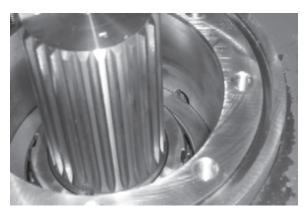




Figure 60. Case Slot (left), Thrust Ball Slot (right)

Aft Seal Installation

1. Rotate the thrust tube so the propeller end is facing up.

ASD14B1L (Aft Lip Seals)

- 2L. Install O-rings into grooves in the aft bore of the thrust tube. Coat interior of thrust tube with oil or water-resistant lithium grease to prepare for installation of seal block. Clean holes located on the aft face of the thrust tube.
- 3L. Double Seal Drives with Wiper
 - Assemble seal block by first installing wiper in aft end of block.
 Coat inside and outside of two seals with water-resistant lithium grease. Install seals back to back into the block with special tools T-18050-592 (driver) and T-18050-592-2 (seal guide).

A WARNING

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

Triple Seal Drives

 Coat inside and outside of three seals with water-resistant lithium grease. Install first two seals into the block with garter springs facing down. Install the third in with the garter spring facing up. Use special tools T-18050-592 (driver) and T-18050-592-2 (seal guide).

A WARNING

The garter spring of the two aft seals (the first two installed onto the block) <u>must</u> face aft. The garter spring of the forward seal <u>must</u> face forward.

Twin Disc, Incorporated Assembly

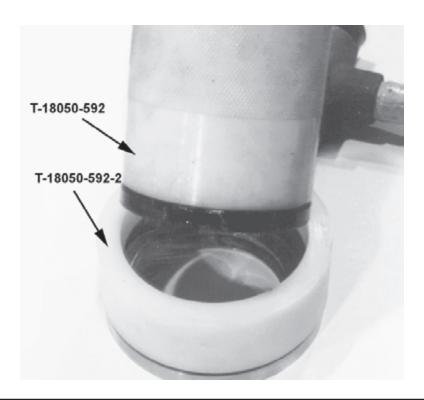


Figure 61. Installing Seals into Block

Note: Assure gap between the two seals is completely filled with grease.

4L. Install block in the aft end of the thrust tube using special tool T-18050-587. Secure the block with eight retaining screws that have been coated with LOCTITE® 242 or similar semi-permanent tread locker.

5L. Install four pusher (jacking) screws coated with LOCTITE® 242 or similar semi-permanent tread locker. Do not torque the pusher screws.



Figure 62. Installing pusher screws

6L. Go to Thrust Socket Assembly.

ASD14B1LM (Aft Mechanical Face Seal)

- 1M. Install O-rings into grooves in the aft end of the thrust tube.
- 2M. Follow directions 5.1 through 7.0 of Technical Manual for Special Type 2100 Seal at the back of this manual for mechanical seal installation.
- 3M. Install four pusher screws coated with LOCTITE® 242 or similar semipermanent tread locker, but do not torque them. They are only used to fill the holes in the mechanical seal housing for model ASD14B1LM.



Figure 63. Installing pusher screws

A CAUTION

Care must be taken not to have oil or imperfections on the ceramic sealing faces.

A CAUTION

Do not over-compress the mechanical seal. Damage to the seal may result.

4M. Go to Thrust Socket Assembly.

Input Shaft and Socket Assembly

Special Tools:

- Bearing Race Driver T-18050-586
- Thrust Tube Roller Bearing Driver T-18050-589
- Socket Shaft Bearing Guide T-18050-593
- U-joint Wrench T-21093
- Retaining Ring Installation/Removal Tool T-21094
- Seal Sleeve Driver T-21537
- 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 8 1/2-inch diameter and two 1 1/8-inch bolt holes 180° apart outside of the center hole. The bolt holes should have a 17-inch bolt hole center. When working at the bench, secure thrust socket to bench with two 1inch bolts.)

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

- Ball Bearing
- Forward Bearing Race

≜WARNING

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

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

Forward Socket Bearing

≜WARNING

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

 Install new heated ball bearing on output end (shorter shoulder end) of the input shaft. Be sure to hold the bearing against the shoulder of the shaft as it cools.

≜WARNING

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

2. Slide forward bearing race on input (longer shoulder end) of shaft using special tool T-18050-586. Lubricate bearings with oil.

3. (For **ASD14B1LM** only) Place shaft sleeve in special tool T-21537 with the inner diameter tapered end facing out of the tool. Warm the sleeve with a propane torch and push the sleeve onto the input shaft using the tool.

Note: The seal is properly seated when the tool bottoms on the shaft and cannot be driven further.

≜WARNING

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

If possible, orient the input shaft so its forward end is facing up. Use Loctite ® 290 on the forward end of the sleeve and let it seep between the shaft and sleeve. Make sure to wipe excess loctite off. The Loctite® seals the shaft and sleeve. Input shaft is now ready to have U-joint forward yoke bolted on.

4. Clamp the U-joint's H-shaped center coupling in a vice.

Note: The U-joint should be positioned so it looks like an H on its side with the bottom leg of the H in the vise.

- (For drives with ball bearing secured by bolted flanged retainer)
 Place retainer over aft end of input shaft with mounting flange facing the U-joint.
- 6. Insert input shaft (ball bearing end first) into long-splined end of U-joint yoke (counter bored end). Install washer and flex lock nut. Tighten flex nut to 270 N-m (200 ft-lbs) using U-joint wrench, special tool T-21093.

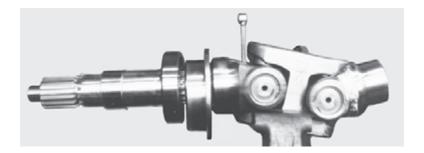


Figure 64. Attaching the Input Shaft to the U-Joint (bolted flanged retainer shown but not used in all drives)

7. 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).

A 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.

8. Install frozen forward socket bearing into small diameter end of the socket. Slide bearing down to shoulder in housing. Seat bearing against shoulder with special tool T-18050-589, if necessary. Install bearing retainer ring. Ensure ring is seated into groove.

≜WARNING

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



Figure 65. Installing Frozen Forward Socket Bearing into Socket

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

- 10. (For drives with ball bearing secured byspiral-lock retainer ring)
 Before installing input shaft and U-joint into socket, place spiral-lock retainer ring above bearing on input shaft.
- 11. Protect the input end of the shaft with special tool T-18050-593. Attach temporarily with flex-lock nut.

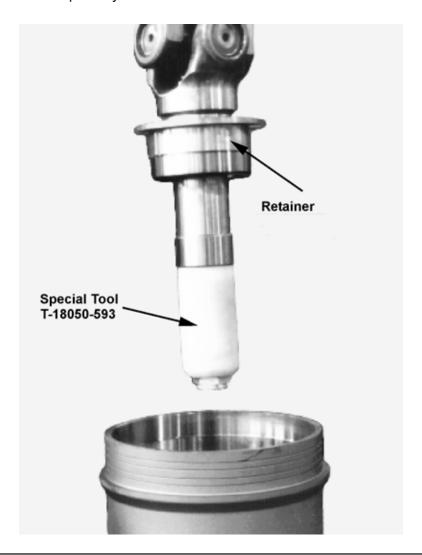


Figure 66. Installing Input Shaft and U-Joint into Socket (bolted flanged retainer shown but not used in all drives)

12. 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.

A WARNING

Keep shaft and bearing straight as they are installed into socket housing. Do not bind.



Figure 67. Installing Input Shaft and U-Joint into Socket

- 12. 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, ensure the roller bearing engages smoothly.
- 13A. (For drives with ball bearing secured byspiral-lock retainer ring)
 After socket shaft assembly is in place, install retainer ring (which was placed above the bearing before installation) into the retainer ring groove.
 Use ring spreader, special tool T-21094, to help spread spiral while fitting in grooves. Lubricate bearing with oil.

13B. (For drives with ball bearing secured by bolted flanged retainer)
After socket shaft assembly is installed, slide bearing retainer, which was placed above the bearing before installation, into the socket bearing bore. Align holes in retainer flange with tapped holes in face of socket bearing bore. Secure retainer with eight screws. Torque screws to 45 N-m (33 ft-lbs).

- 14. Slide forward thrust retainer ring into socket housing. The spherical side faces up.
 - **Note:** The spherical surface of the two bronze retainers may have minor dents, scratches or low spots. Smooth edges of these imperfections by lightly sanding with emery cloth or 400 grit or finer sand paper. High spots <u>are not acceptable</u> and must be removed.
- 15. 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.
- 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.

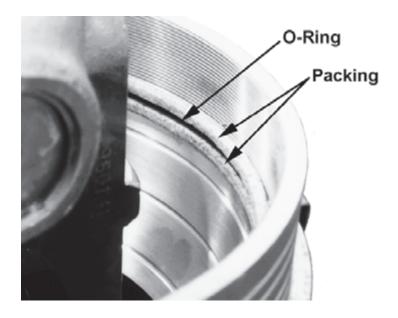


Figure 68. Replacement of Thrust Socket Packing and O-Ring

- 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-21084 (if socket has been removed from transom)
- Press Apparatus T-21092
- Wrench 1009308 (provided with original package)
- Seal Driver T-18050-595
- Seal Protector T-18050-594

To ensure 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.

AWARNING

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.

ACAUTION

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

3a. Inspect spherical surface of 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.

Note: The spherical surface of the two bronze retainers may have minor dents, scratches or low spots. Smooth edges of these imperfections by lightly sanding with emery cloth or 400 grit or finer sand paper. High spots <u>are not acceptable</u> and must be removed.

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-21092, 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 spherical surface of 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.

Note: The spherical surface of the two bronze retainers may have minor dents, scratches or low spots. Smooth edges of these imperfections by lightly sanding with emery cloth or 400 grit or finer sand paper. High spots <u>are not acceptable</u> and must be removed.

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-21092, 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 1810 mm (71.2 in.).

ACAUTION

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 70. 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.).

Twin Disc, Incorporated Assembly

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.

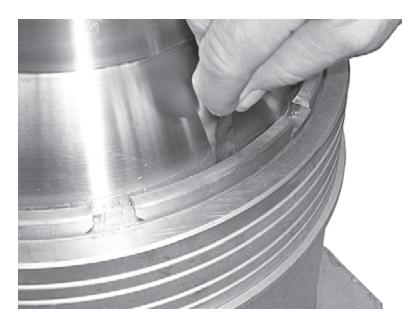


Figure 71. Measuring the Gap Between Thrust Ball and Aft Retainer

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.

| Gap | Required Gap | | | Extra Gap | | |
|-----------|--------------|-----------|---|-----------|-----|--------------|
| 0.20 mm | - | 0.05 mm | = | 0.15 mm |] - | Thickness of |
| 0.008 in. | - | 0.002 in. | = | 0.006 in. | | shims to |
| Extra Gap | | | | | | remove. |
| 0.15 mm | х | 0.25 mm | ÷ | 0.08 mm | = | 0.47 mm* |
| 0.006 in | | 0.010 in | | 0.002 in | | 0.020 in |

Table 4. Shim Calculation Example

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.

ACAUTION

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

^{*} Round to 0.50 mm

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 tools seal protector T-18050-594 and seal driver T-18050-595. 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 ensure proper lubrication.

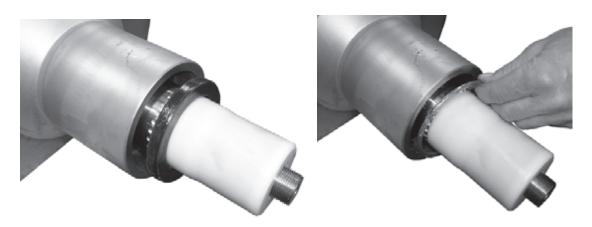


Figure 72. Installing Front Oil Seals and Spacer

15. Install spiral retaining ring.



Figure 73. 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 74. Aft Retainer Ring Lock Clip in the Notch Locking Tab

Twin Disc, Incorporated Assembly

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. Ensure 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. Ensure the clamp screws are on the top of the unit. Apply anti-seize that does not contain graphite or molybdenum disulfide (such as Loctite® White HI-Temp Anti-Seize), on clamp threads.



Figure 75. 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.

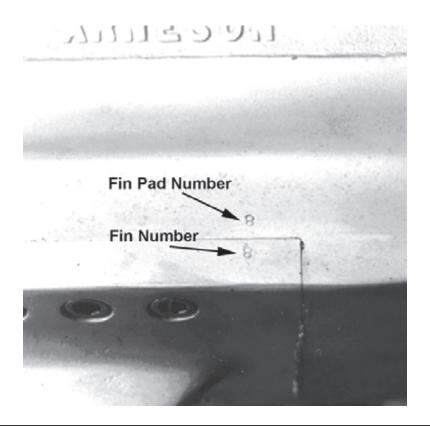


Figure 76. Identifying Fin and Fin Pad Numbers

- 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 20 screws. Torque to 35 N-m (25 ft-lbs). Clean excess sealer from seam.

Twin Disc, Incorporated Assembly



Figure 77. 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.

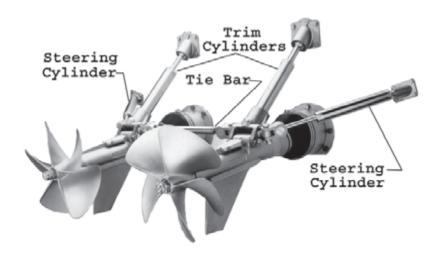


Figure 78. View of Dual Installation Showing Cylinders and Tie Bar.

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.

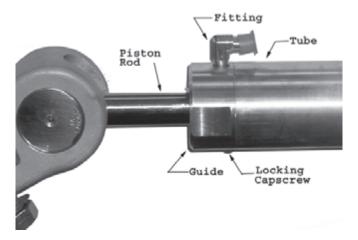


Figure 79. Steering Cylinder.

- 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. Disconnect and plug hoses from the two through-hull fittings inside the vessel.
- 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.

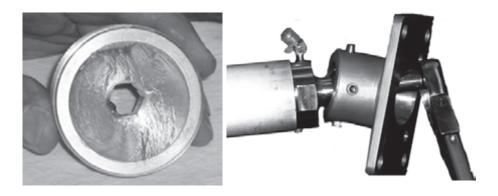


Figure 80. Use a 1/2"hex bit socket to tighten the large retaining nut.

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.

A CAUTION

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



Figure 81. 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.

A 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.

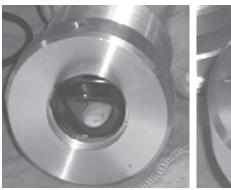




Figure 82. Install the polypak seal into the guide followed by the wiper.

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 83. 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.

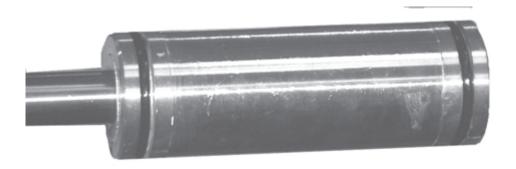


Figure 84. Slide the piston on to the rod.

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



Figure 85. 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 86. 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 semipermanent 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.

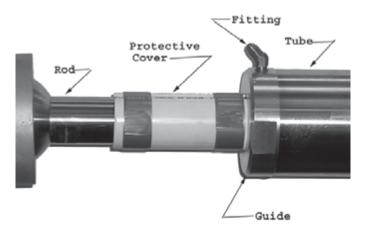


Figure 87. Trim Cylinder.

- 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. Disconnect and plug hoses from the through-hull fittings inside the vessel.

- 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.

A CAUTION

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

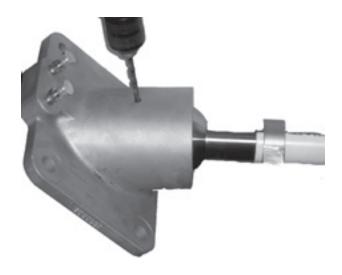


Figure 88. Drill 1/8" into the retainer threads.

- 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.

A 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 89. 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 90. Slide the guide on to the rod.

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



Figure 91. Special tool T-21549-32

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



Figure 92. 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 93. 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 94. 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 95. Insert the piston rod assembly into the tube.

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

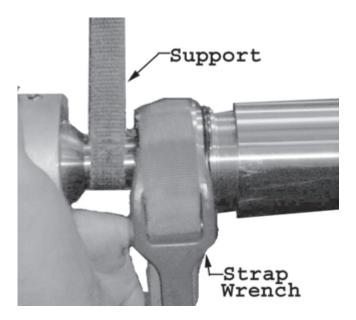


Figure 96. Tighten the guide.

- 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 semipermanent 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.
- 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).

Twin Disc, Incorporated Special Tools

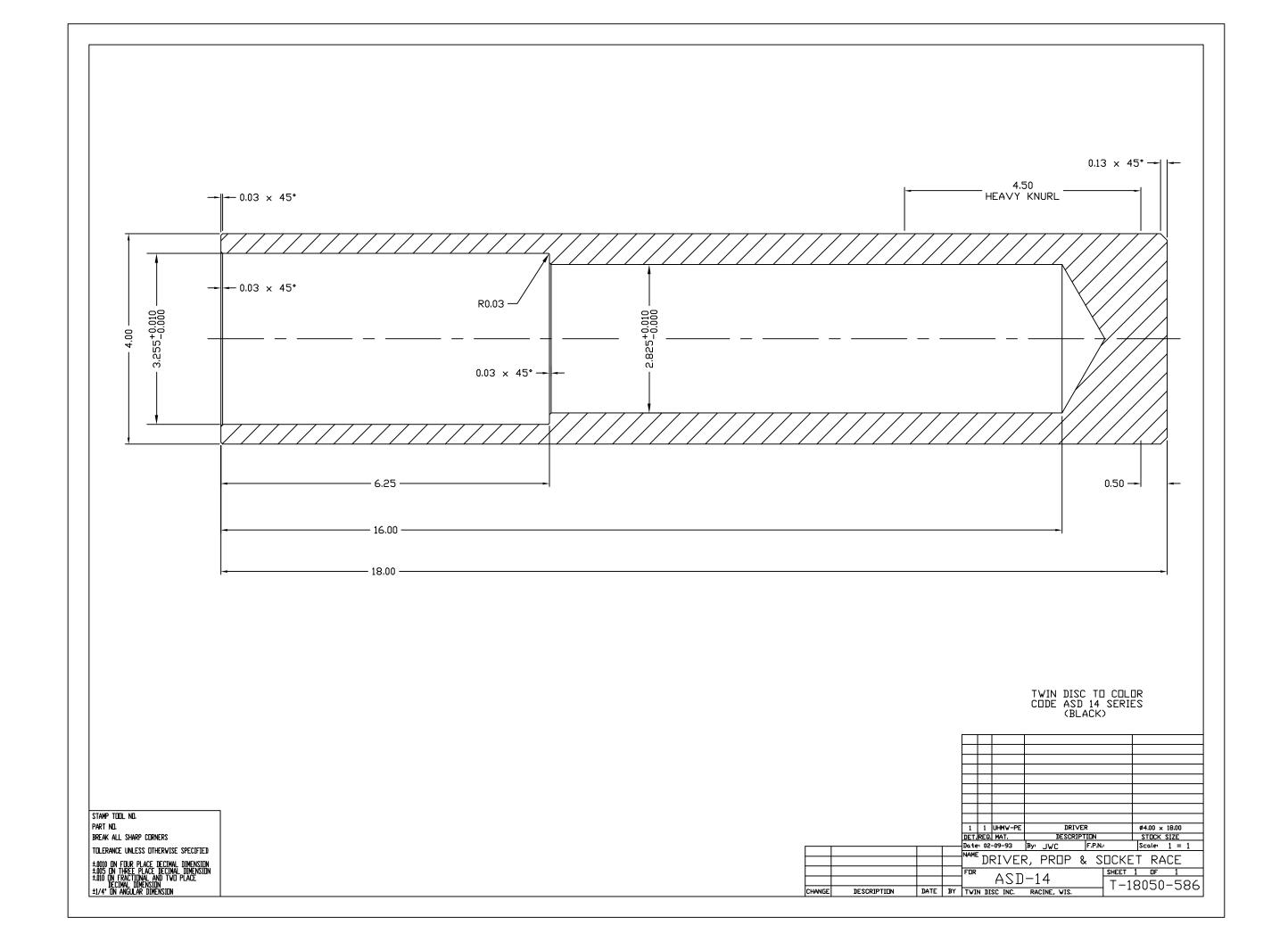
Special Tools

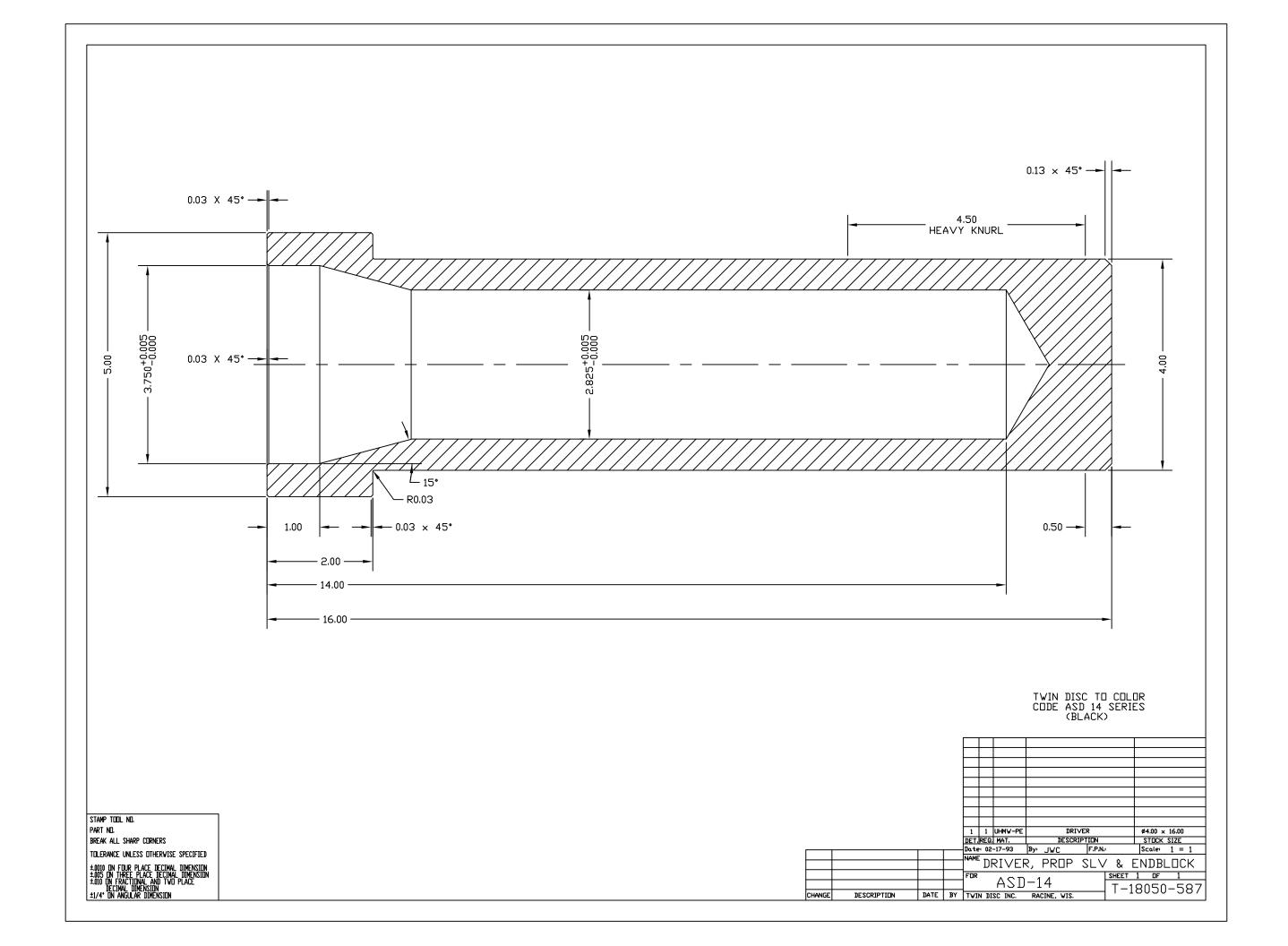
List of Special Tools

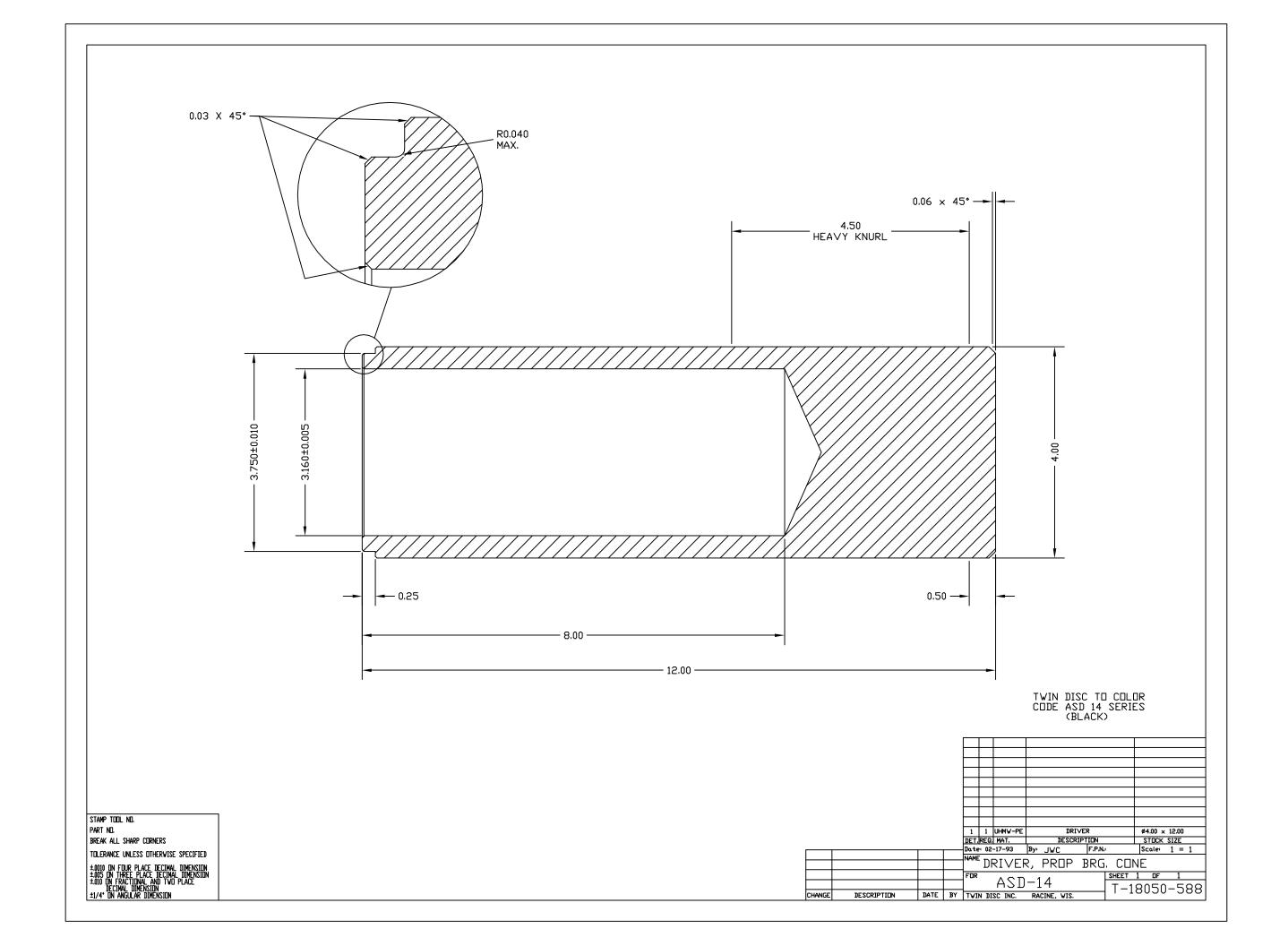
The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continue on the following page.

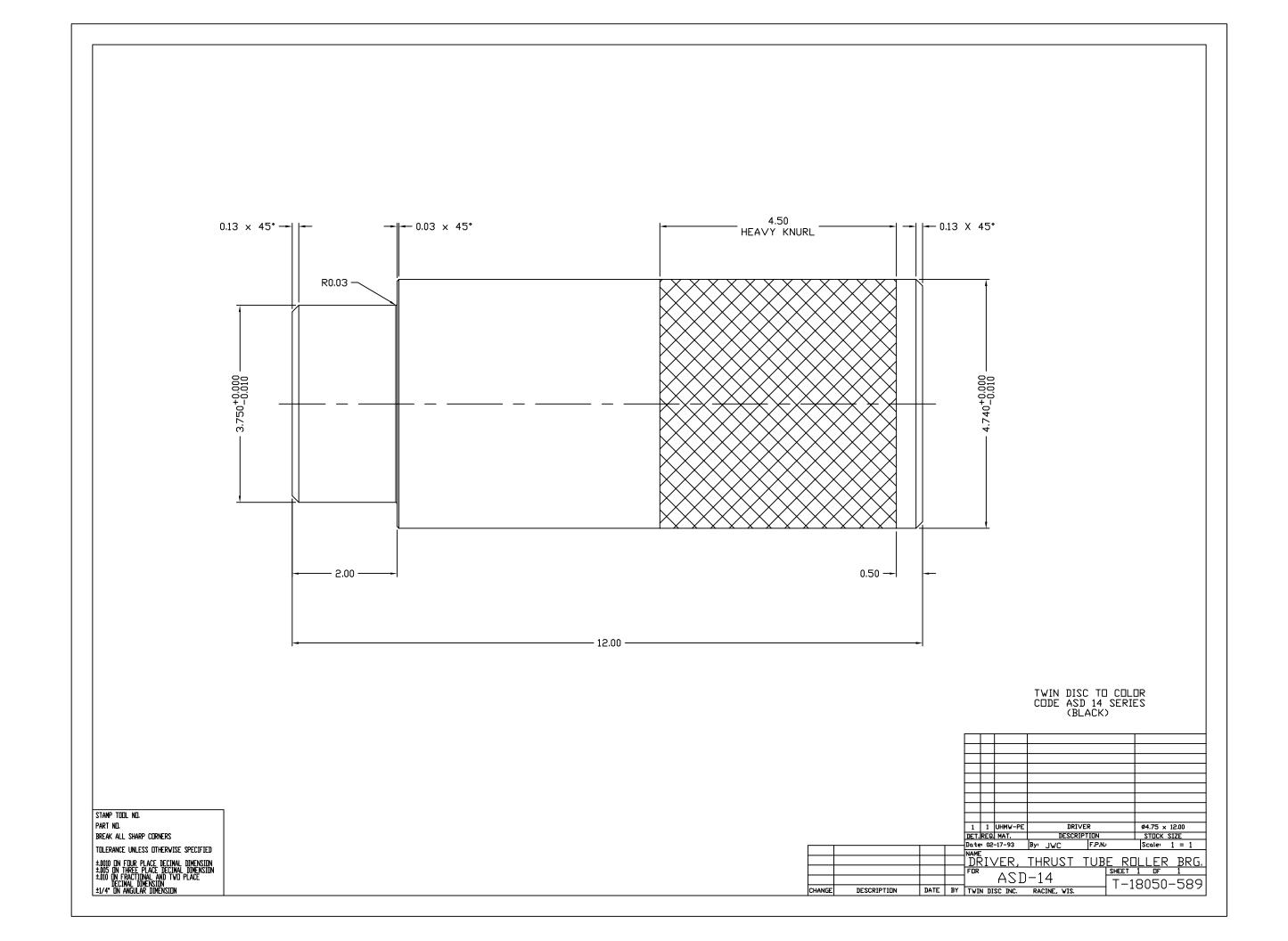
| T-18050-586 | Input Socket Shaft Race Driver |
|-------------|---------------------------------------|
| T-18050-587 | Propeller Sleeve & End Block Driver |
| T-18050-588 | Propeller Shaft & Bearing Cone Driver |
| T-18050-589 | Thrust Tube Roller Bearing Driver |
| T-18050-590 | Thrust Tube Inner Bearing Cup Driver |
| T-18050-591 | Thrust Tube Outer Bearing Cup Driver |
| T-18050-592 | End Block Seal Driver & Seal Guide |
| T-18050-593 | Socket Shaft Bearing Guide |
| T-18050-594 | Socket Seal Protector |
| T-18050-595 | Socket Seal Driver |
| T-21082 | Weldment |
| T-21082-1 | Plate |
| T-21082-2 | Plate |
| T-21082-3 | Plate |
| T-21082-4 | Bracket Assembly |
| T-21083 | Assembly Stand |
| T-21084 | Assembly Stand |

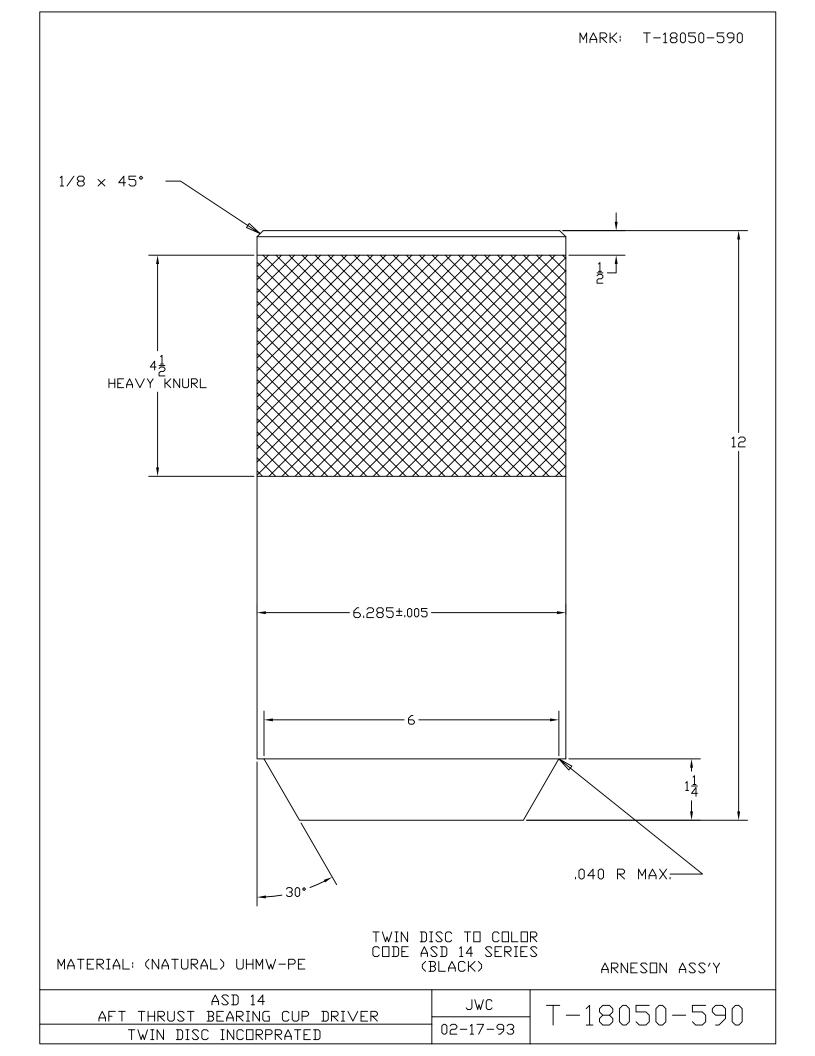
| T-21092 | Fixture |
|-----------|---------------------------------|
| T-21093 | Special Wrench |
| T-21094 | Spreader, Snap Ring |
| T-21172-3 | Lifting Fixture |
| T-21173-2 | Shaft End Play Indicator Holder |
| T-21537 | Wear Sleeve Installation Tool |
| 1009308 | Wrench |

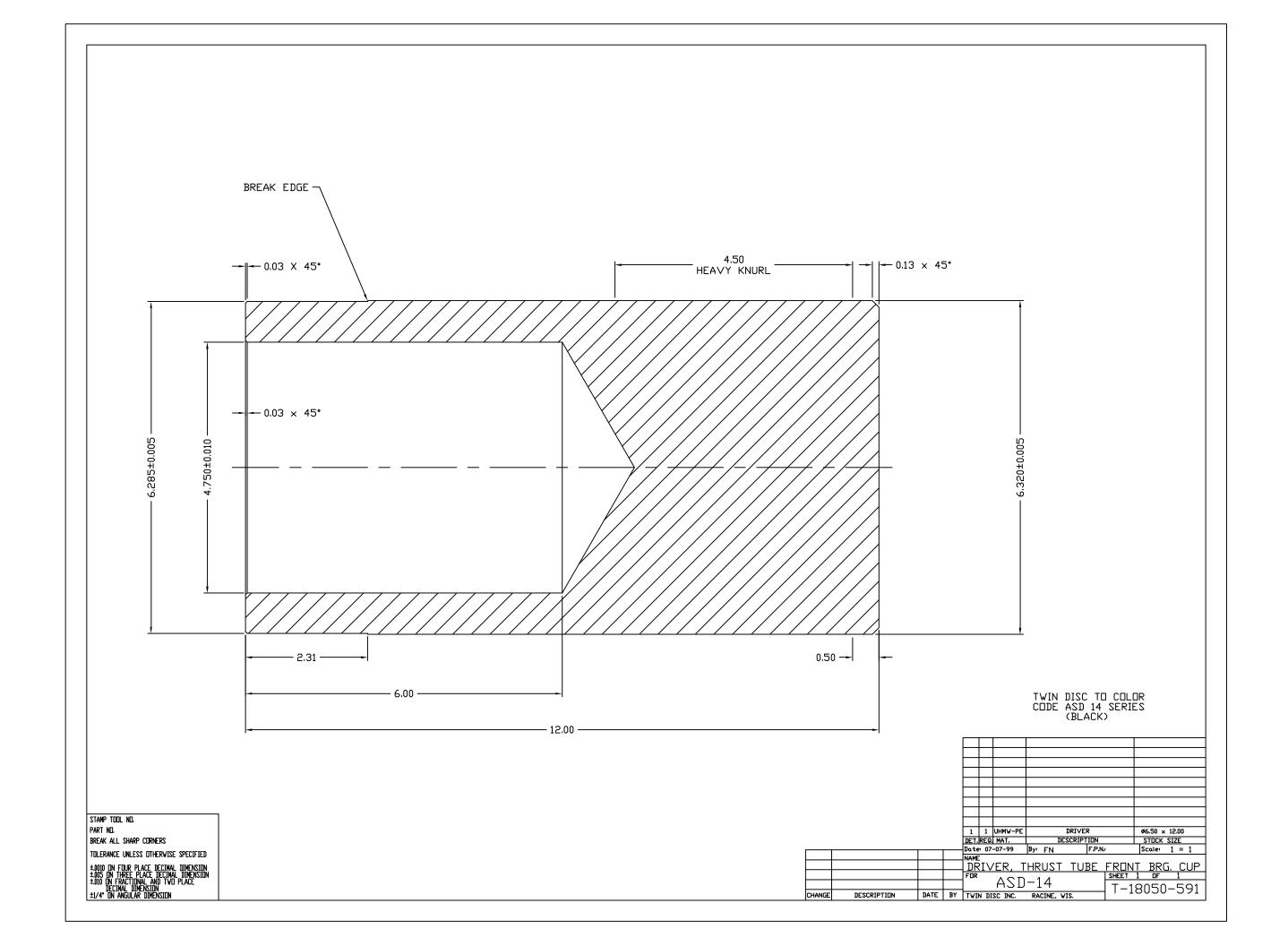


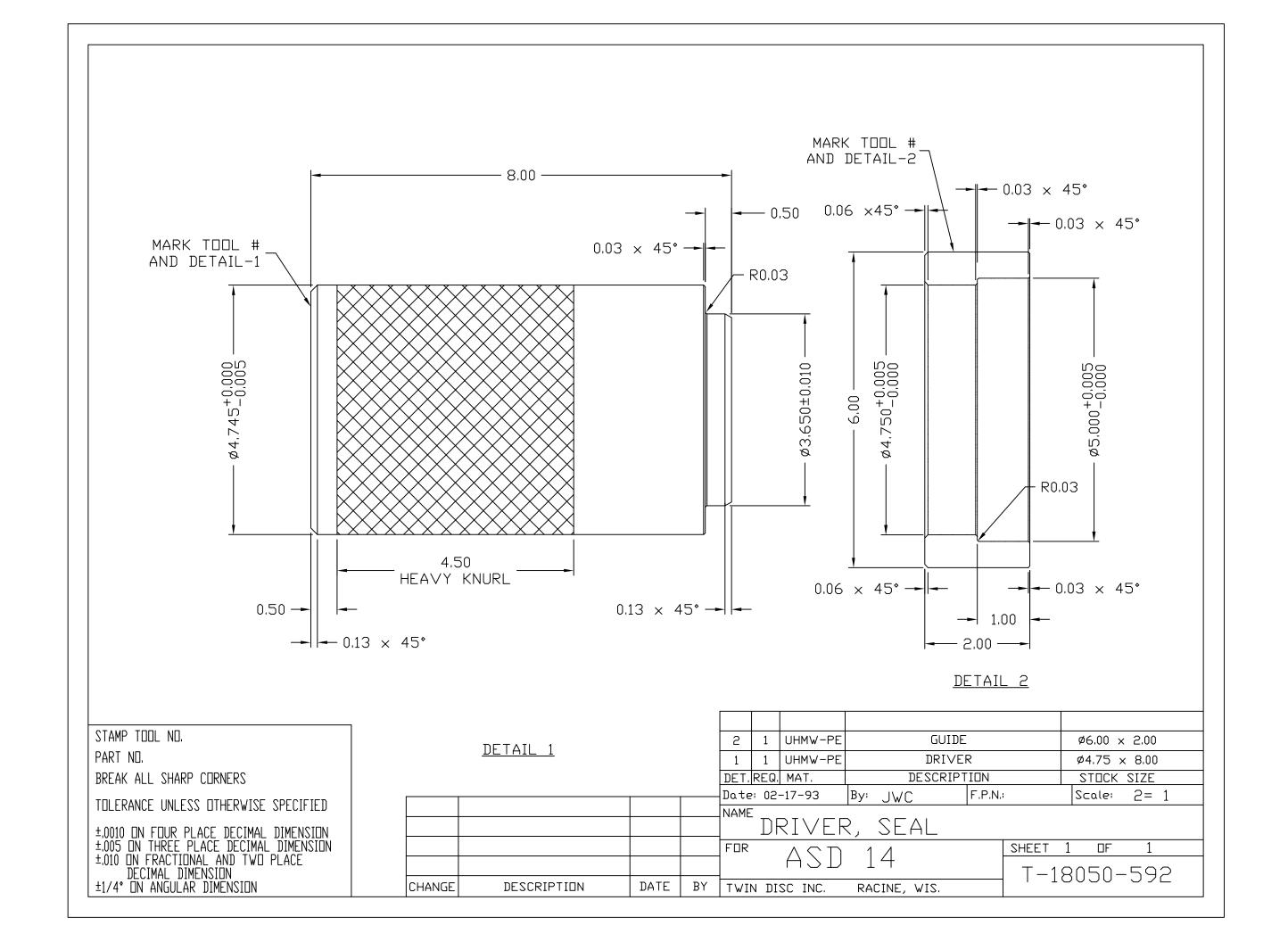


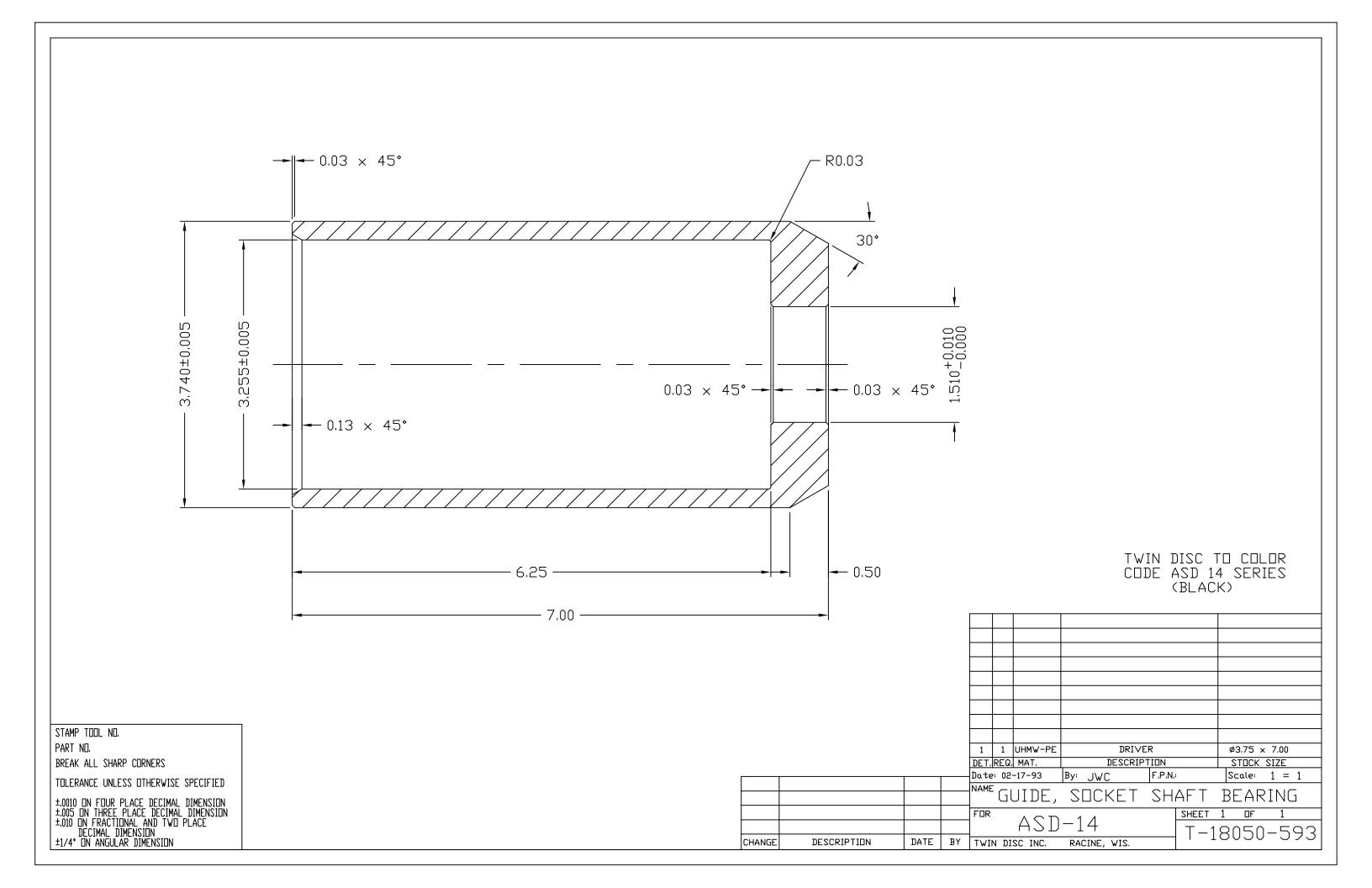


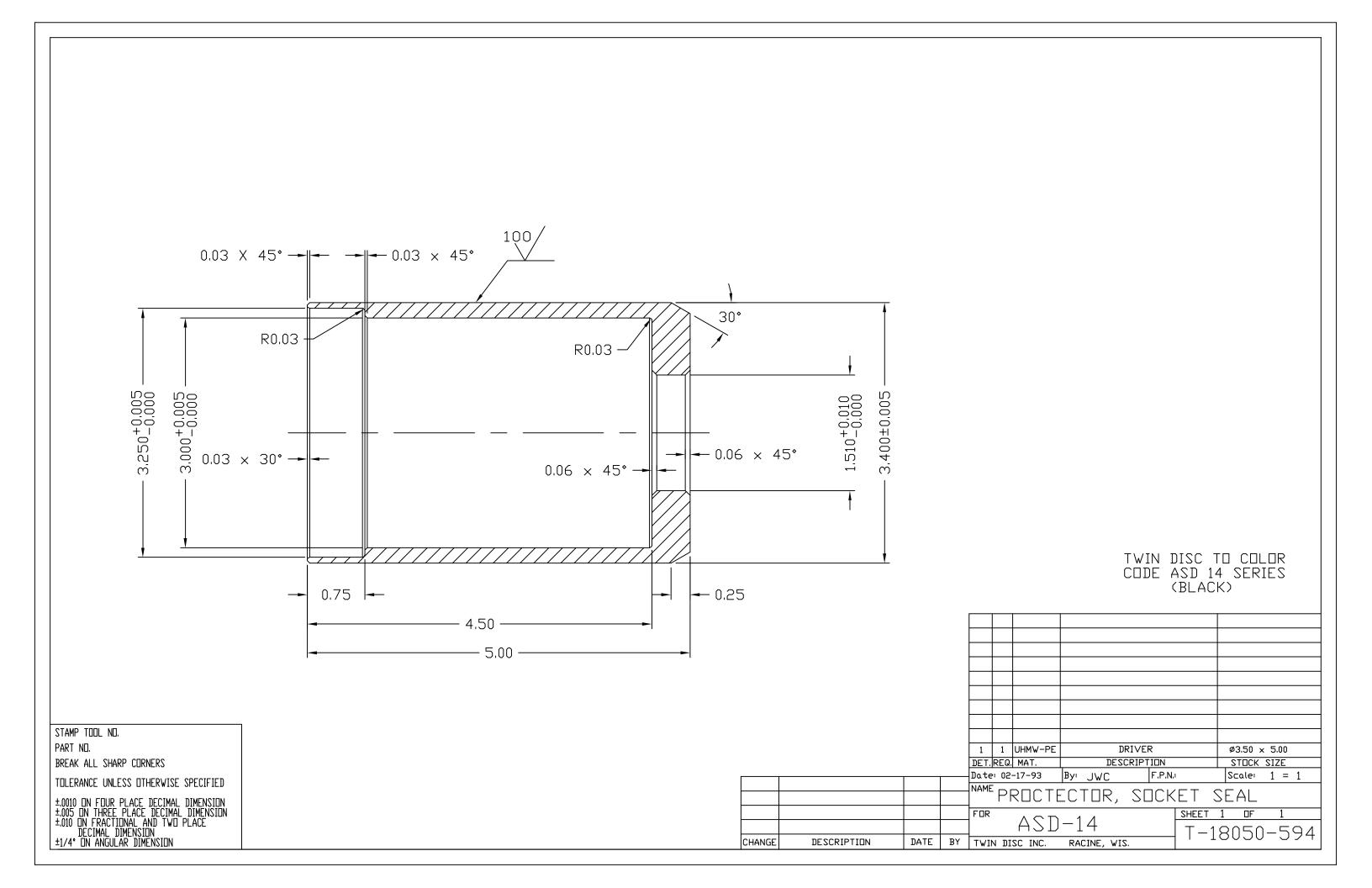


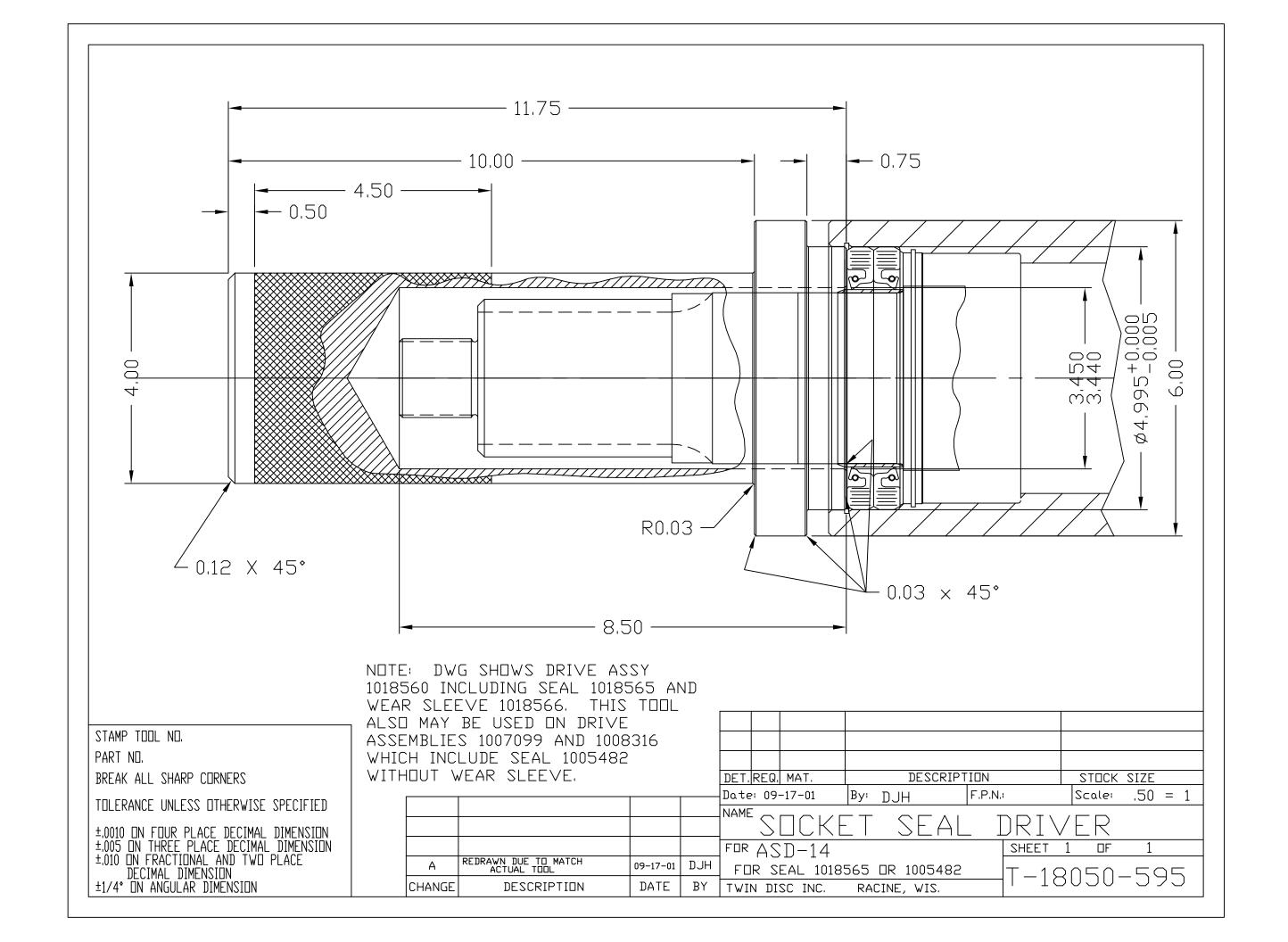




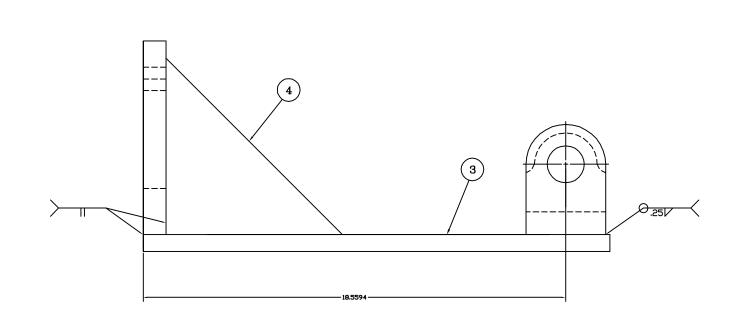


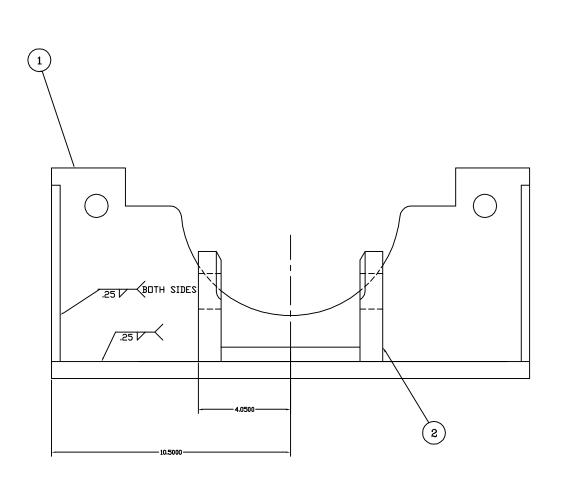






| ITEM N□. | PART NO. | QTY. | PART DESCRIPTION | REMARKS |
|-------------|-----------|------|-----------------------------------|------------|
| 1 | T-21082-2 | 1 | PLATE | |
| 2 | T-21082-4 | 1 | BRACKET ASSM. | |
| 3 | T-21082-3 | 1 | PLATE | |
| 4 | | 2 | GUSSET (7.75 x 7.75 X 45° x .375) | C.R. STEEL |
| | | | | |
| | | | | |





STAMP TIDL. NO.

PRET NO.

BREAK ALL SHARP CORNERS

TOLERANCE UNLESS DITHERVISE SPECIFIED

±0000 DN FORP PLACE BECHAL DIPHENSION
±005 DN THERE PLACE BECHAL DIPHENSION
±005 DN FRACTIONAL AND TVID PLACE
BECHAL DIPHENSION

| DET. | REQ. | NAT. | DESCR | IPTION | | STOCK | SIZE |
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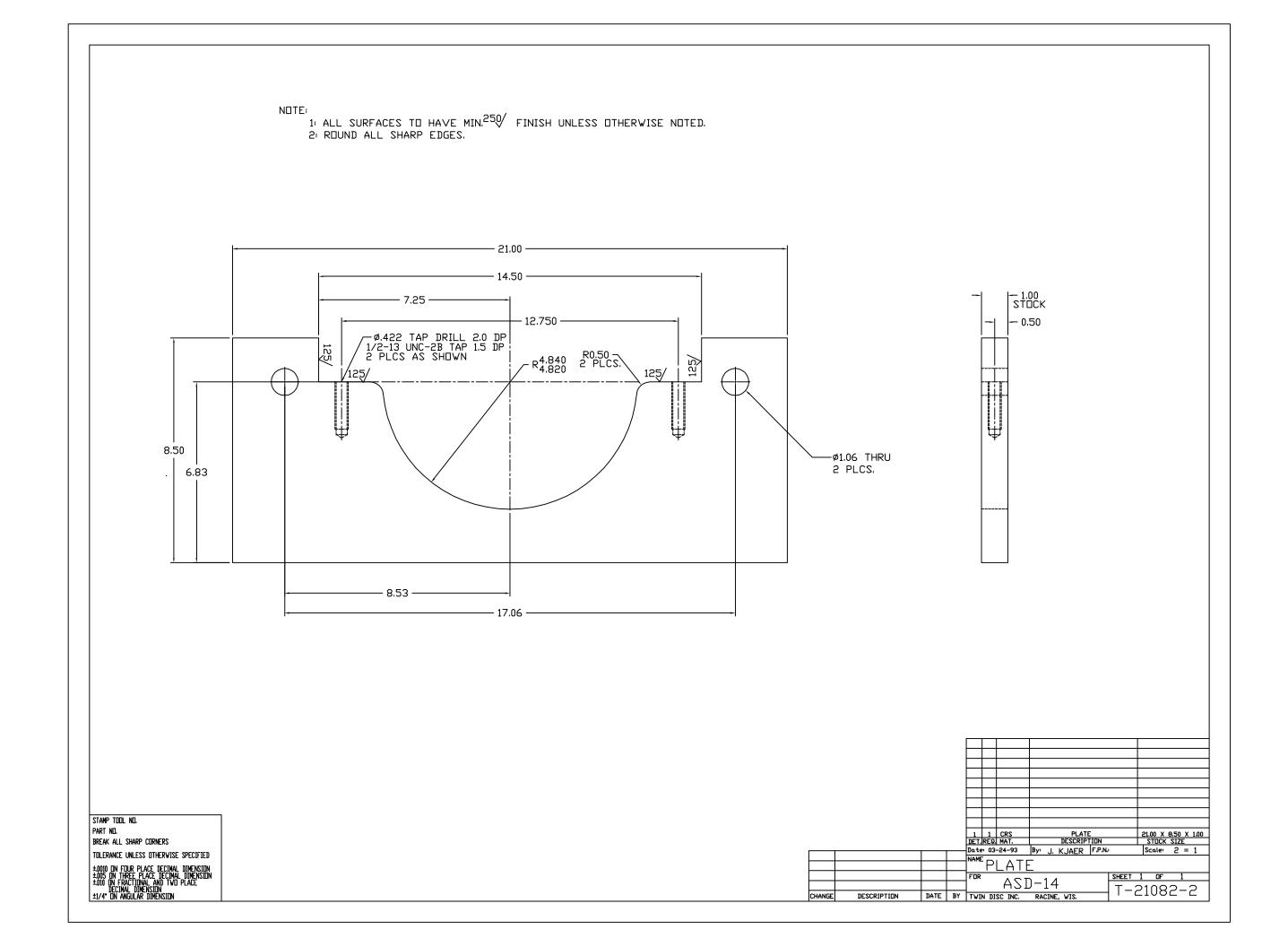
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FOR ASD-14

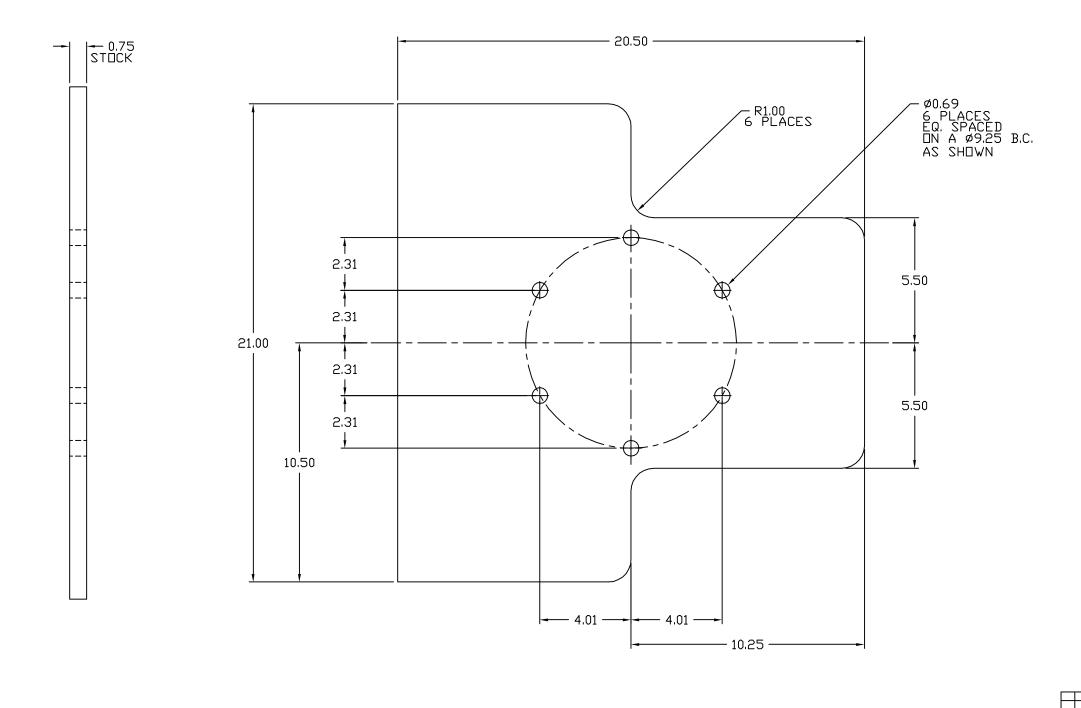
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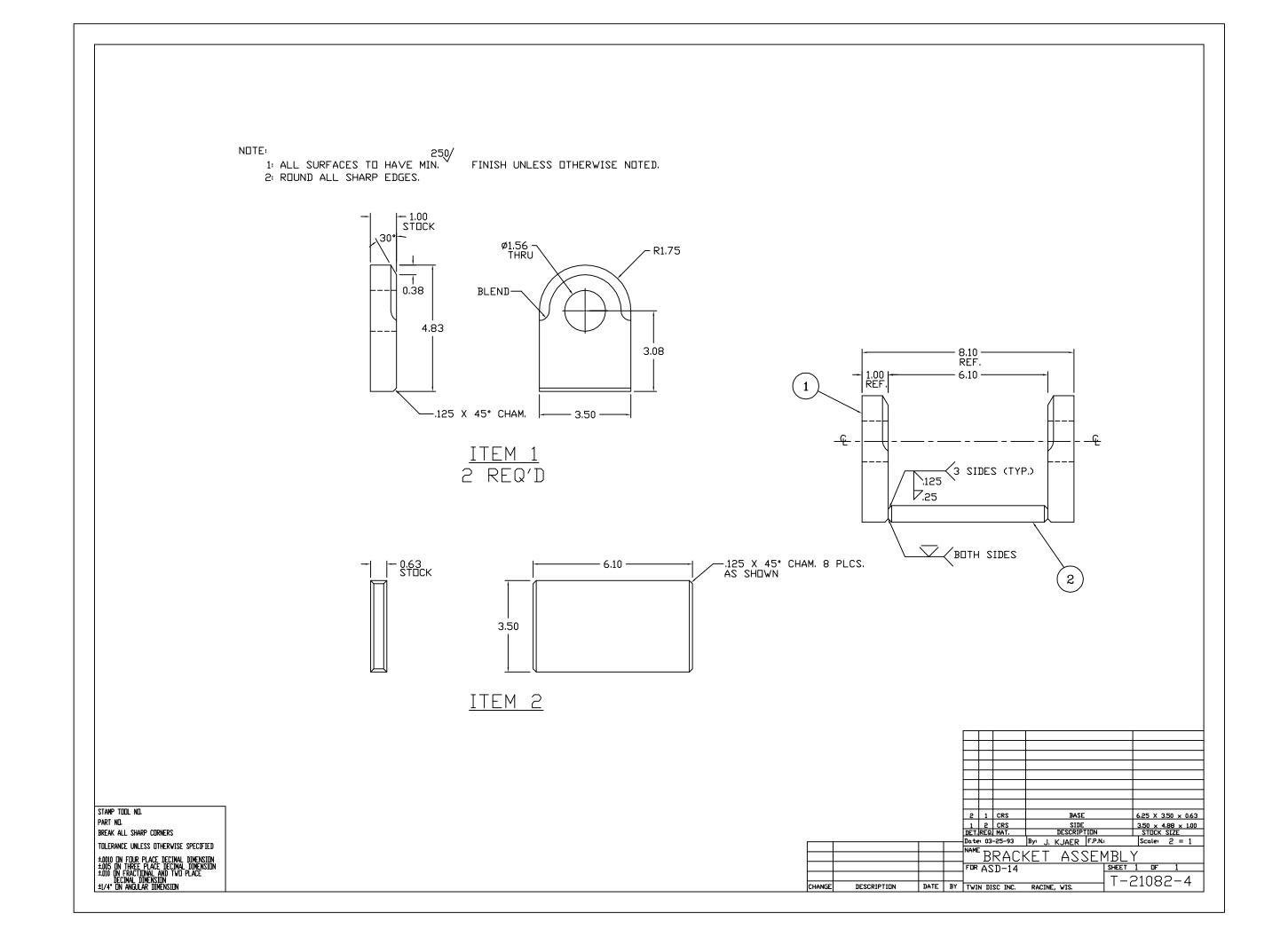
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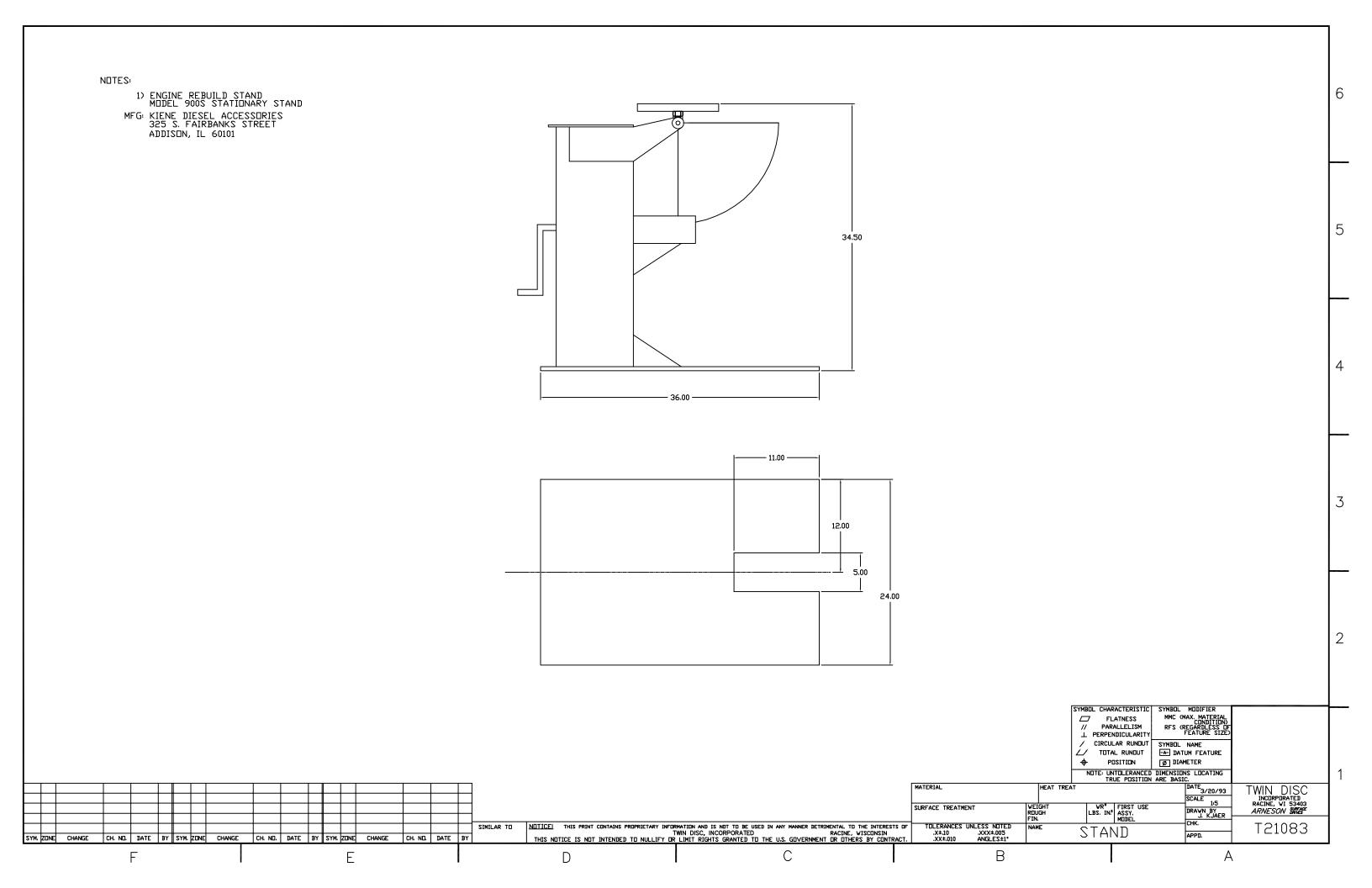
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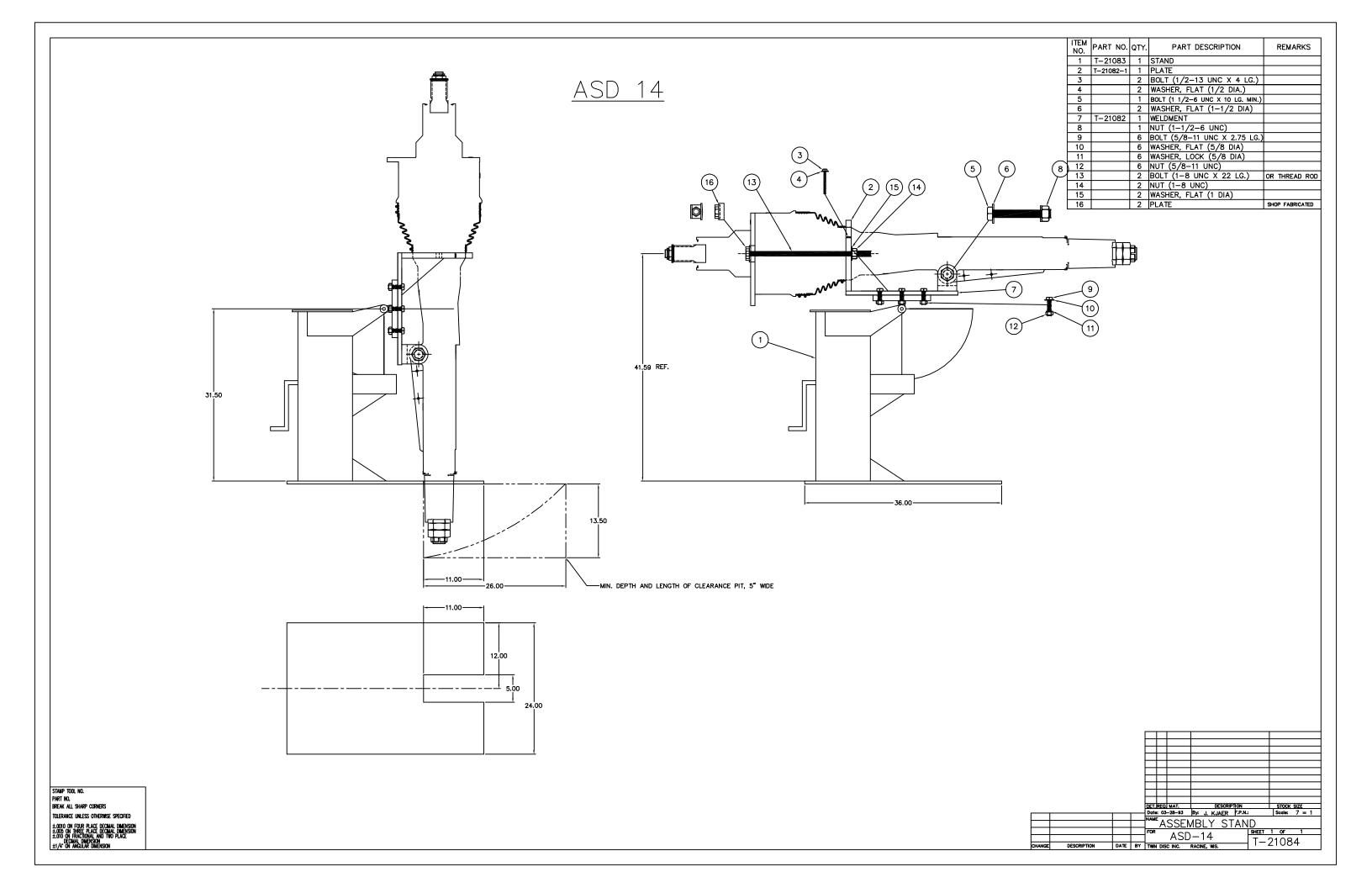


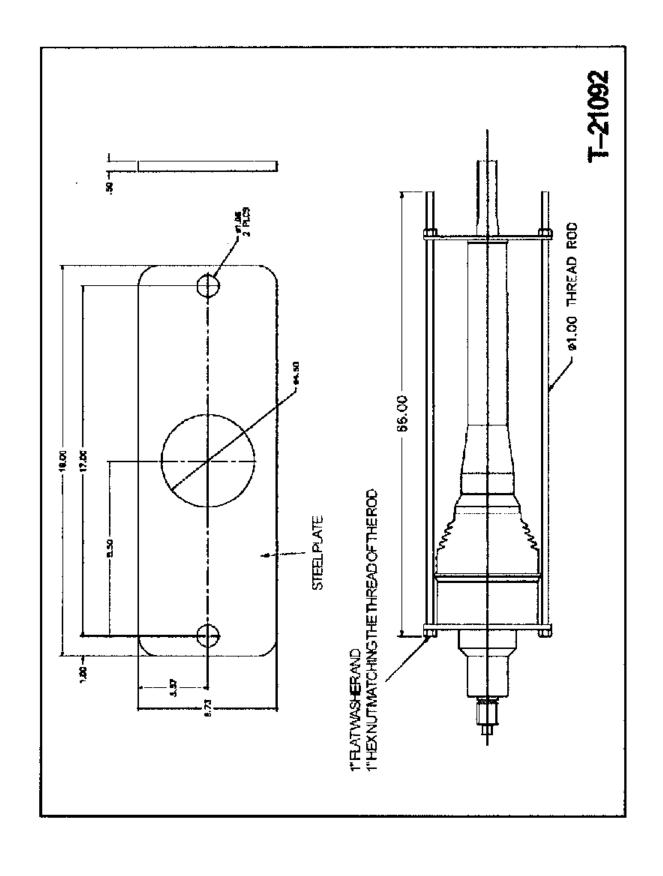
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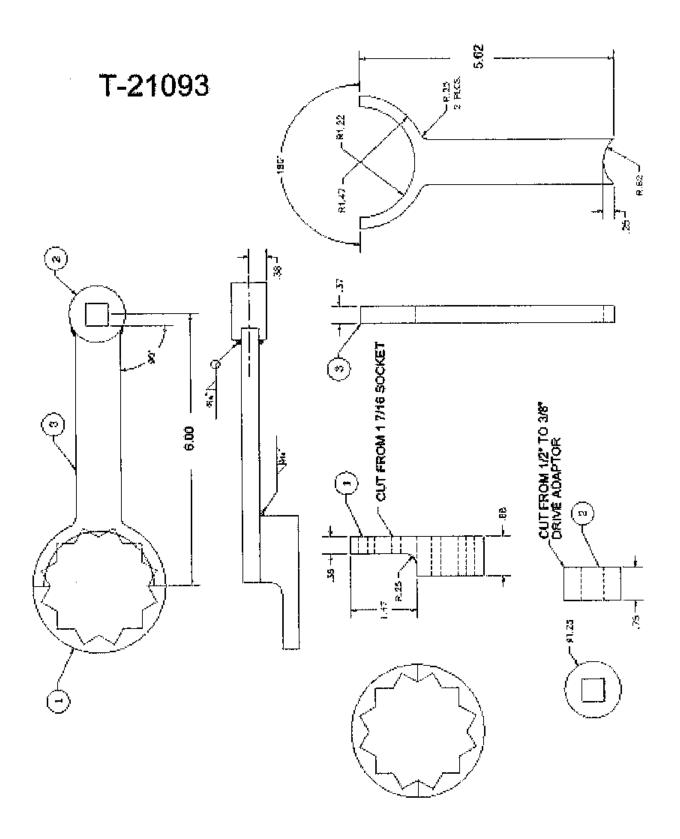
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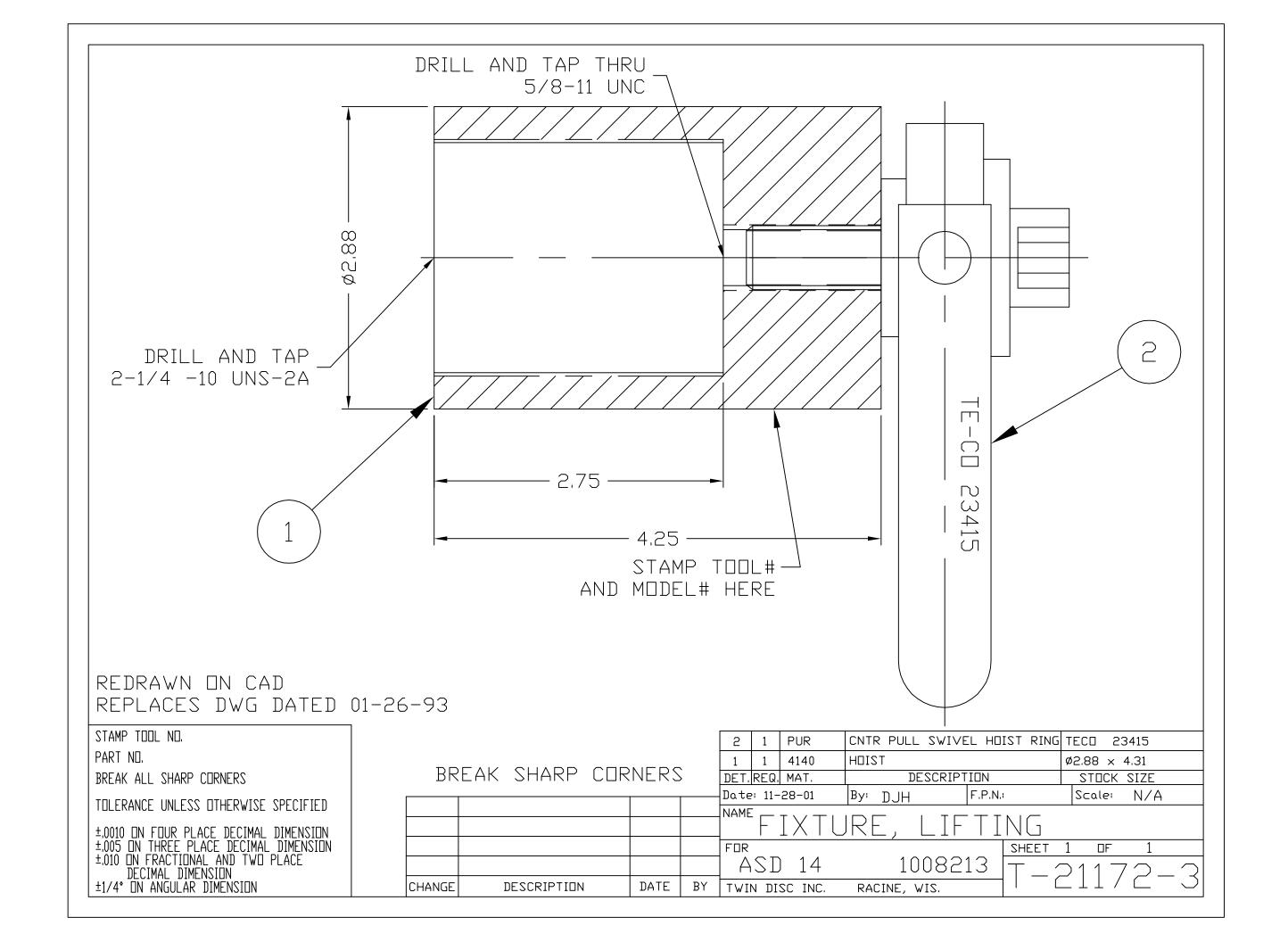


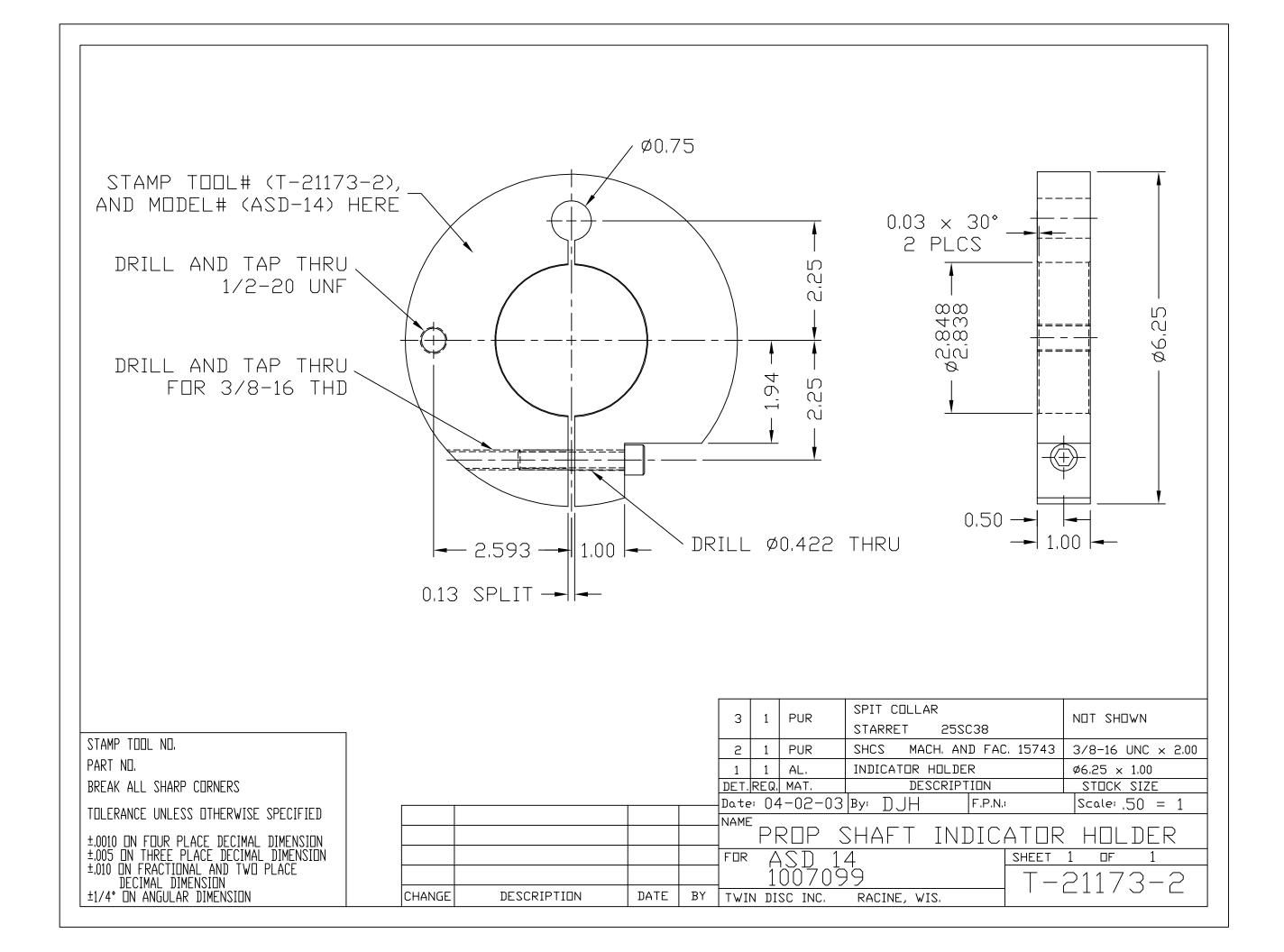


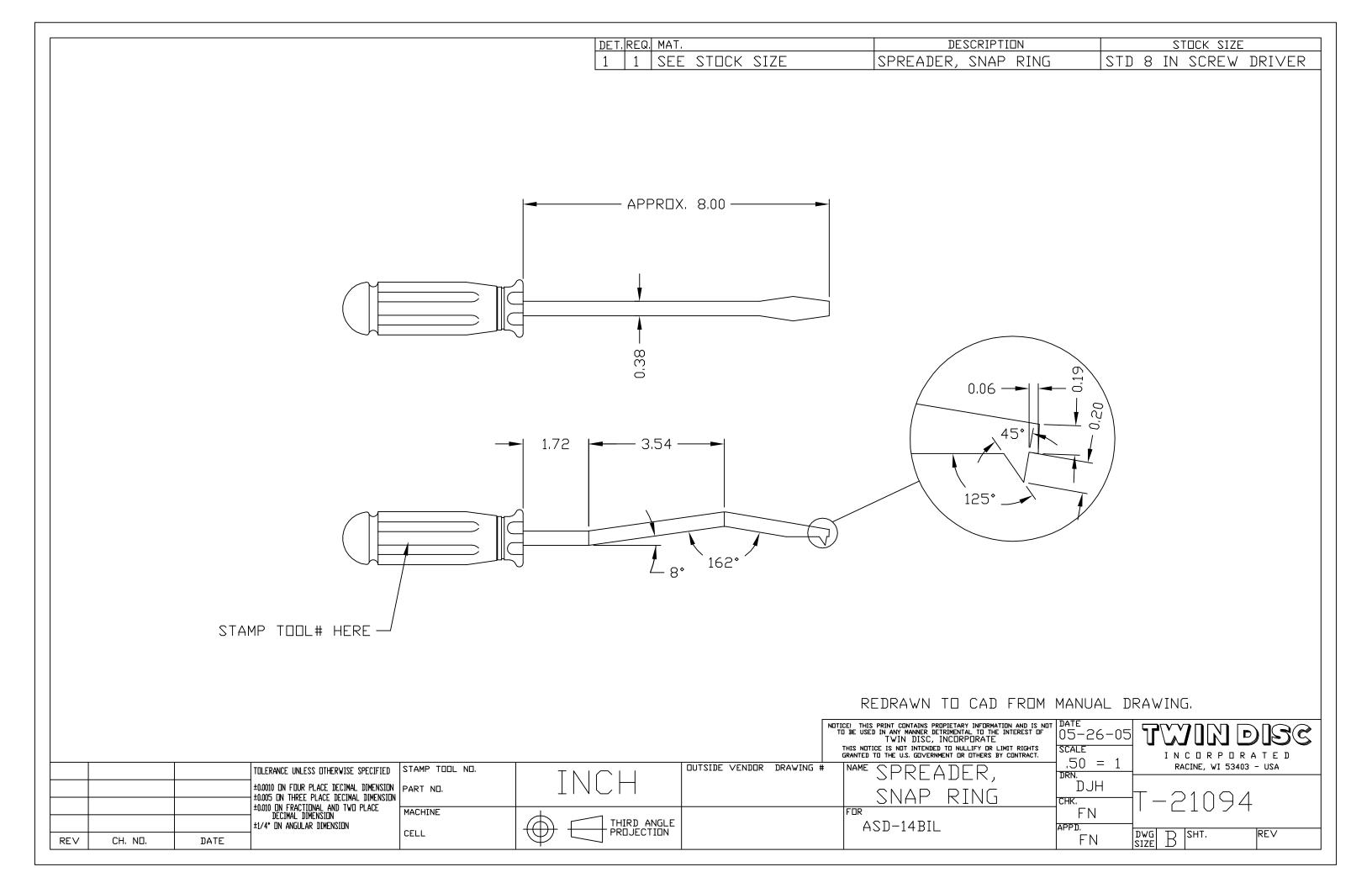


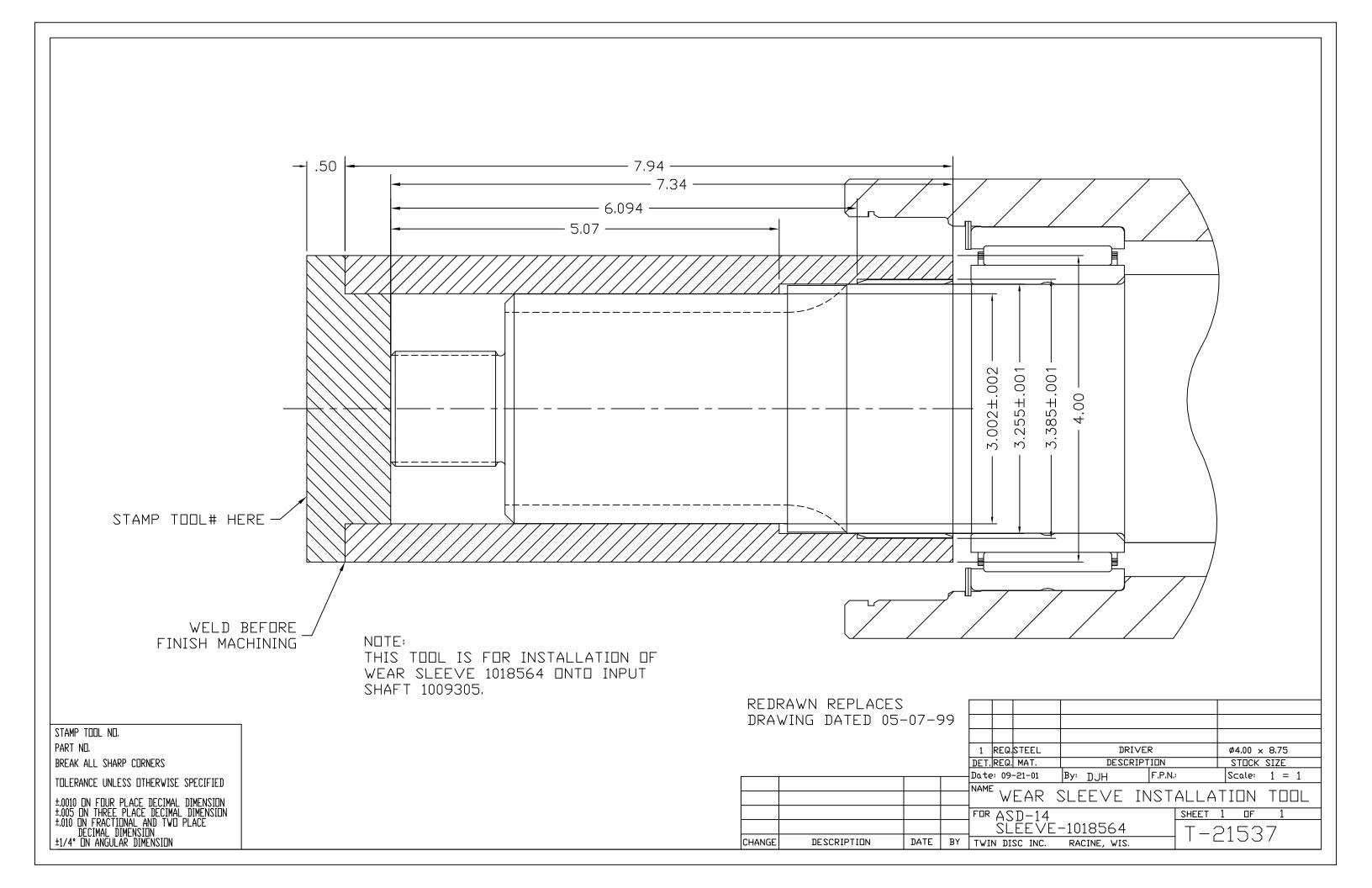


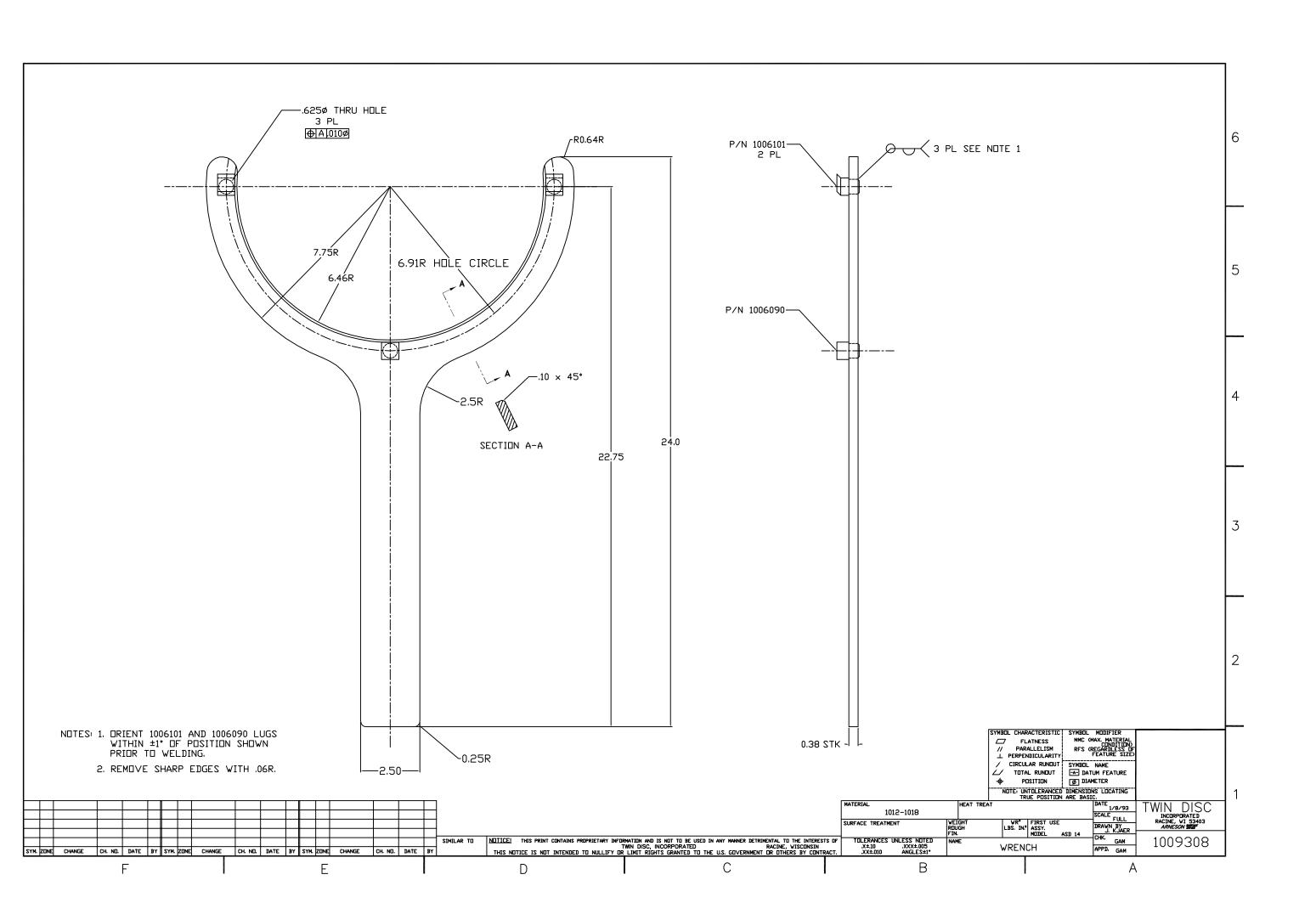












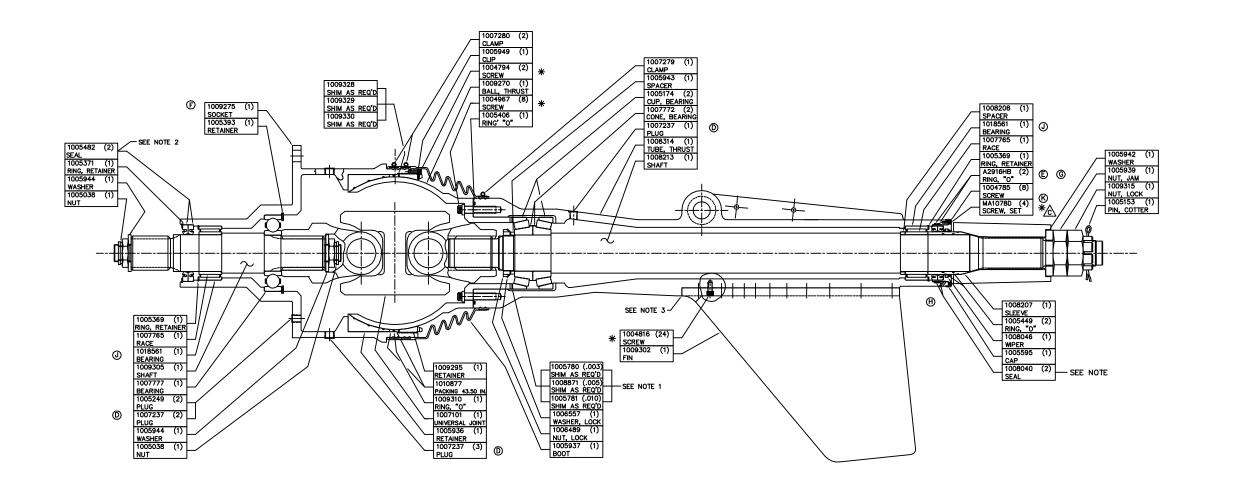
Engineering Drawings

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.

| 1008316 | ASD 14B1L Drive Assembly (Double Aft Seal) |
|---------|--|
| 1022909 | ASD 14B1L Drive Assembly (Triple Aft Seal) |
| 1018560 | ASD 14B1LM Drive Assembly (Mechanical Aft Seal) |
| 1011057 | ASD 14B1L(M) Installation Drawing |
| 1009234 | Trim Cylinder |
| 1009236 | Steering Cylinder |
| 1006786 | Tie Bar Assembly |
| 1023449 | Aft Lip Seal Conversion Diagram (Double Seal to Triple Seal) |



NOTES:

- 1) SHIM FOR .002 .005 IN.(0.05-0.13 mm) BEARING ENDPLAY.
- 2) APPLY LUBRICANT ON AND BETWEEN LIP SEALS.
 LUBRICANT TYPE TO BE A MARINE GRADE LITHIUM
 GREASE W/PROPERTIES FOR SALT WATER ENVIRONMENT
 SUCH AS RED LITHIUM GREASE, SOLD BY
 ZEP MANUFACTIRING CO., ATLANTA, GEORGIA, USA 30301
- APPLY MARINE GRADE SILICONE (NON HARDENING)
 ON THE FIN PAD SURFACE PRIOR TO INSTALLATION.
- 4) TORQUE VALUES

| P/N | DESCRIPTION | DRY TORQUE VALUES | |
|---------|--------------------------|-------------------|-----------------|
| 1004785 | COVER SCREW | 20 IN-LBS | (2250 N-mm) |
| 1004816 | FIN SCREW | 20 FT-LBS | (2250 N-mm) |
| 1004967 | THRUST BALL SCREW | 100 FT-LBS | (135 N-m) |
| 1005038 | INPUT & U-JOINT LOCK NUT | 175 FT-LBS | (240 N-m) |
| 1006489 | THRUST BEARING LOCK NUT | 100 FT-LBS MIN. | (135 N-m MIN.) |
| 1004794 | RETAINER KEY SCREW | 65 IN-LBS | (7300 N-mm) |
| 1005939 | PROPELLER (JAM) NUT | 750-800 FT-LBS | (1020-1085 N-m) |
| 1009315 | PROPELLER LOCK NUT | SEE NOTE 9 | SEE NOTE 9 |

5) LUBRICANT RECOMMENDATIONS:

API SERVICE CATEGORY OF 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
28 QUIABTS

- 6) COAT THE * MARKED THREADS WITH 242 (BLUE)
 LOCTITE OR EQUIVALENT PRIOR TO INSTALLATION.
- 7a) BEARING RACES AND SEAL SLEEVE MUST BE SHRUNK ONTO SHAFTS. HEAT TO ABOUT 120°C (250°F)
- 7b) AT ASSEMBLY, COAT PROPELLER AND INPUT SHAFTS AND THE BEARINGS AND SLEEVE I.D. WHERE THEY ARE IN CONTACT. COAT WITH DOW-CORNING "P-37 ULTRAPURE 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 LESS THAN .003mm (.0001 IN). EXCESSIVE COATING DEPTH WILL RESULT IN SLEEVE AND BEARING DISTORTION AND MAY PREVENT BEARING ASSEMBLY AND REDUCE BEARING LIFE.
- B) P/N (QT

Ð

- TORQUE LOCK NUT TO 650-700 FT-LBS (875-950 N-m).
 APPROACH LOWER TORQUE VALUE, THEN CONTINUE UNTIL COTTER PIN SLOT IN NUT ALIGNS WITH HOLE IN SHAFT.
- 10) SEE TWIN DISC SERVICE MANUAL No. 1015710 FOR SCHEDULE TO PERIODICALLY CHECK PROPELLER NUT TORQUE.
- 11) SEE TWIN DISC SERVICE MANUAL No. 1015710 FOR ALL OTHER PROCEDURES AND SPECIFICATIONS.

FEATURES:

A-2 ECN14254 7-12-06 E

B5 ECN13032 2-07-05 D

B4 ECN11551 5-12-03 B

ECN10839 5-17-02 A

J

ECN11657 10-22-04 C

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

STAINLESS STEEL SHAFTING ALUMINUM BRONZE HOUSINGS

SUPPORTING DOCUMENTATION:

INSTALLATION DWG. ----- 1011057
MASS ELASTIC SYSTEM DWG. - B3504AK
INSTALLATION MANUAL ----- 1021485 ®
SERVICE MANUAL ----- 1015710

ECN10807 4-26-02

30028 4/14/00

27554 1/29/97

26764 1/25/96

24290 1/8/93

B5 ECN10650 2-7-02

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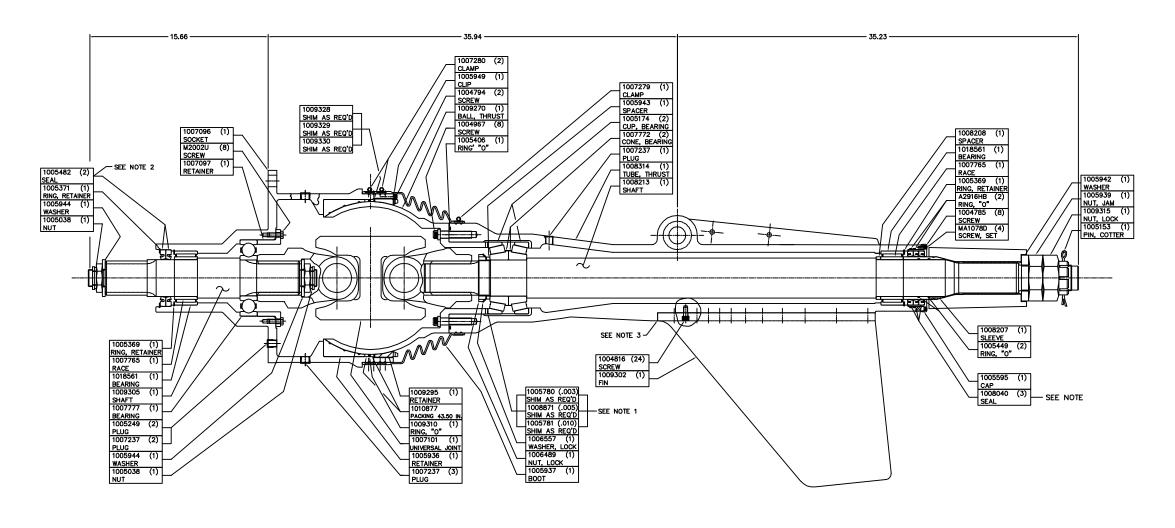
TWIN DISC, INCORPORATED

RACINE, WI 53403 - USA

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OBSOLETE FOR PRODUCTION

THIRD ANGLE PROJECTION



NOTES:

- 1) SHIM FOR .002 .005 IN.(0.05-0.13 mm) BEARING ENDPLAY.
- 2) APPLY LUBRICANT ON AND BETWEEN LIP SEALS.
 LUBRICANT TYPE TO BE A MARINE GRADE LITHIUM
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- 3) APPLY MARINE GRADE SILICONE (NON HARDENING)
 ON THE FIN PAD SURFACE PRIOR TO INSTALLATION.
- 4) TORQUE VALUES

| | • | | | |
|----|---------|--------------------------|-------------------|----------------|
| | P/N | DESCRIPTION | DRY TORQUE VALUES | |
| | 1004785 | COVER SCREW | 20 IN-LBS | (2250 N-mm) |
| ۵l | 1004816 | FIN SCREW | 25 FT-LBS | (35 N-m) |
| Θl | 1004967 | THRUST BALL SCREW | 125 FT-LBS | (170 N-m) |
| ۵l | 1005038 | INPUT & U-JOINT LOCK NUT | 200 FT-LBS | (270 N-m) |
| 1 | 1006489 | THRUST BEARING LOCK NUT | 100 FT-LBS MIN. | (135 N-m MIN.) |
| | 1004794 | RETAINER KEY SCREW | 65 IN-LBS | (7300 N-mm) |
| | 1005939 | PROPELLER (JAM) NUT | 750-800 FT-LBS | (1020-1085 N-m |
| | 1009315 | PROPELLER LOCK NUT | SEE NOTE 9 | SEE NOTE 9 |
| | M2002U | BALL BRG RETAINER SCREW | 33 FT-LBS | (45 N-m) |

5) LUBRICANT RECOMMENDATIONS:
SAE30W THROUGH SAE 90W OIL
FILL DRIVE UNTIL EXTERNAL RESERVOIR
IS ONE THIRD FULL. APPROXIMATE CAPACITY
28 QUARTS.

- 6) COAT THE * MARKED THREADS WITH 242 (BLUE) LOCTITE OR EQUIVALENT PRIOR TO INSTALLATION.
- 70) BEARING RACES AND SEAL SLEEVE MUST BE SHRUNK ONTO SHAFTS. HEAT TO ABOUT 120°C (250°F)
- 7b) AT ASSEMBLY, COAT PROPELLER AND INPUT SHAFTS AND THE BEARINGS AND SLEEVE I.D. WHERE THEY ARE IN CONTACT. COAT WITH DOW-CORNING "P-37 ULTRAPURE 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 LESS THAN .003mm (.0001 IN). EXCESSIVE COATING DEPTH MILL RESULT IN SLEEVE AND BEARING DISTORTION AND MAY PREVENT BEARING ASSEMBLY AND REDUCE BEARING LIFE.
- 8) P/N (QTY)
- 9) TORQUE LOCK NUT TO 650-700 FT-LBS (875-950 N-m). APPROACH LOWER TORQUE VALUE, THEN CONTINUE UNTIL COTTER PIN SLOT IN NUT ALIGNS WITH HOLE IN SHAFT.
- 10) SEE TWIN DISC SERVICE MANUAL No. 1015710 FOR SCHEDULE TO PERIODICALLY CHECK PROPELLER NUT TORQUE.
- 11) SEE TWIN DISC SERVICE MANUAL No. 1015710 FOR
- 12) SEE TWIN DISC SERVICE MANUAL No. 1015710 FOR ALL OTHER PROCEDURES AND SPECIFICATIONS.

FEATURES:

ECN14956 09/04/07

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STAINLESS STEEL SHAFTING NICKEL ALUMINUM BRONZE HOUSINGS TRIPLE PROPELLER SHAFT SEALS

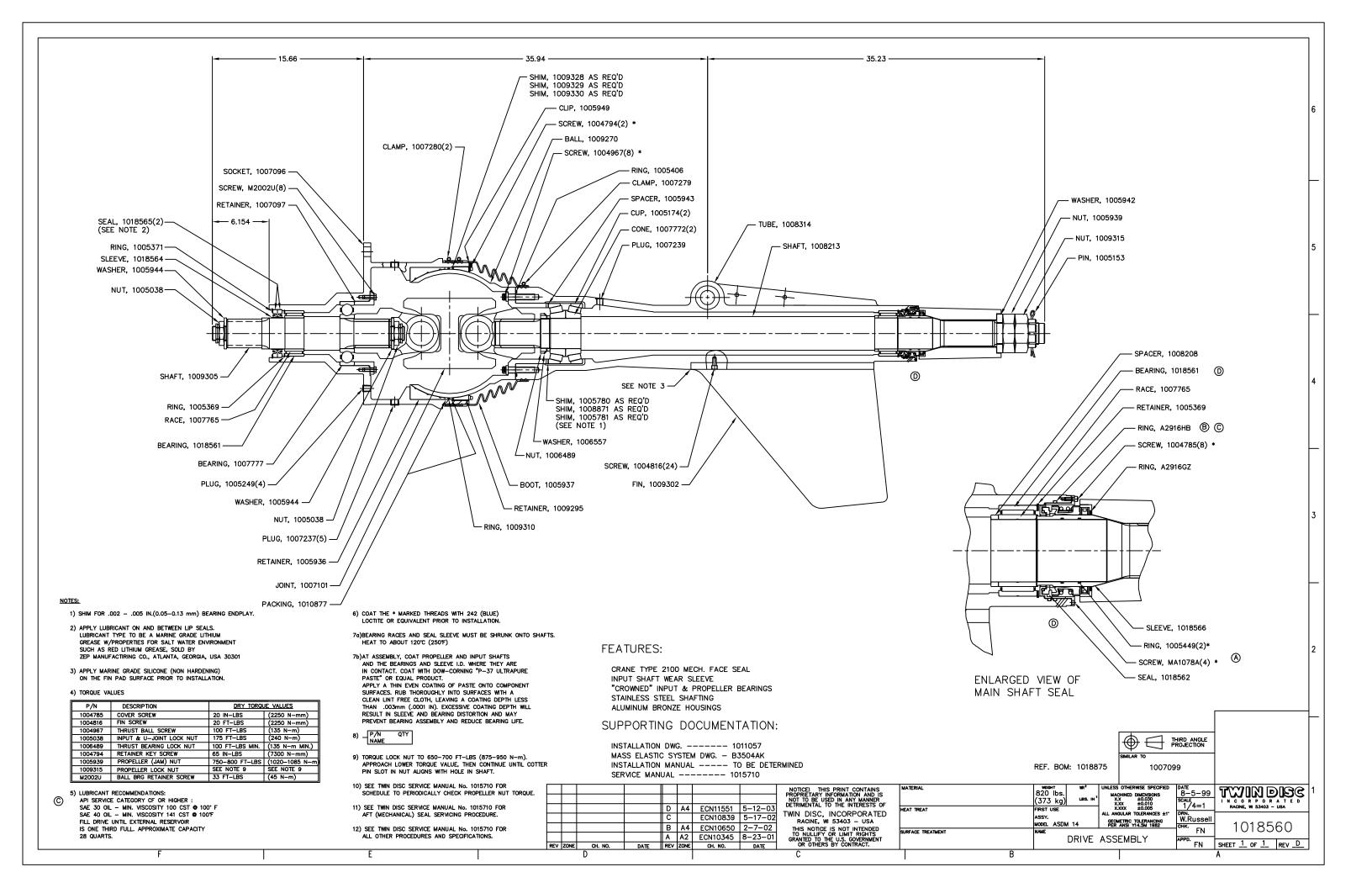
SUPPORTING DOCUMENTATION:

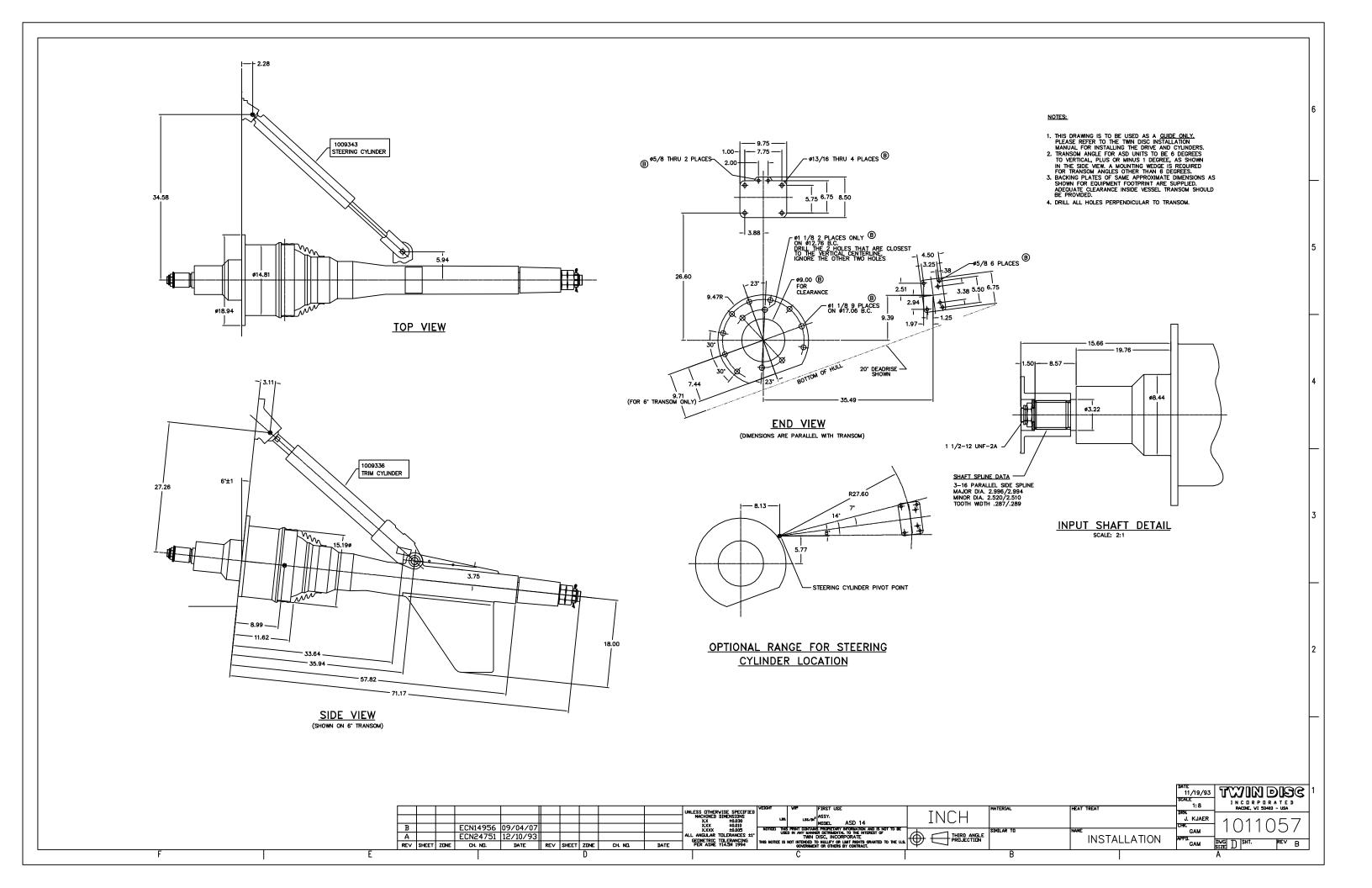
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MASS ELASTIC SYSTEM DWG. - B3504AK
INSTALLATION MANUAL ---- 1021485
SERVICE MANUAL ----- 1015710

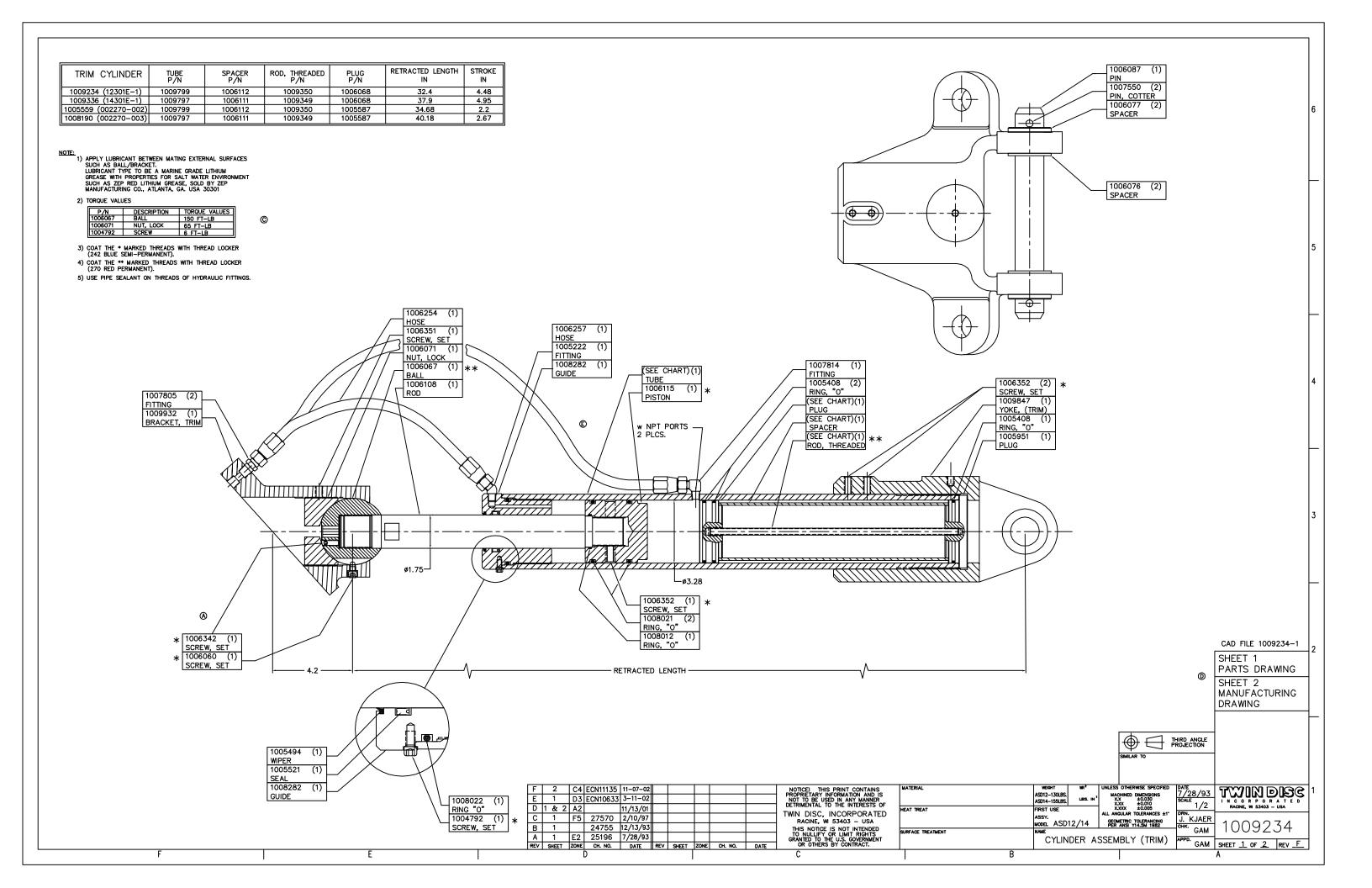
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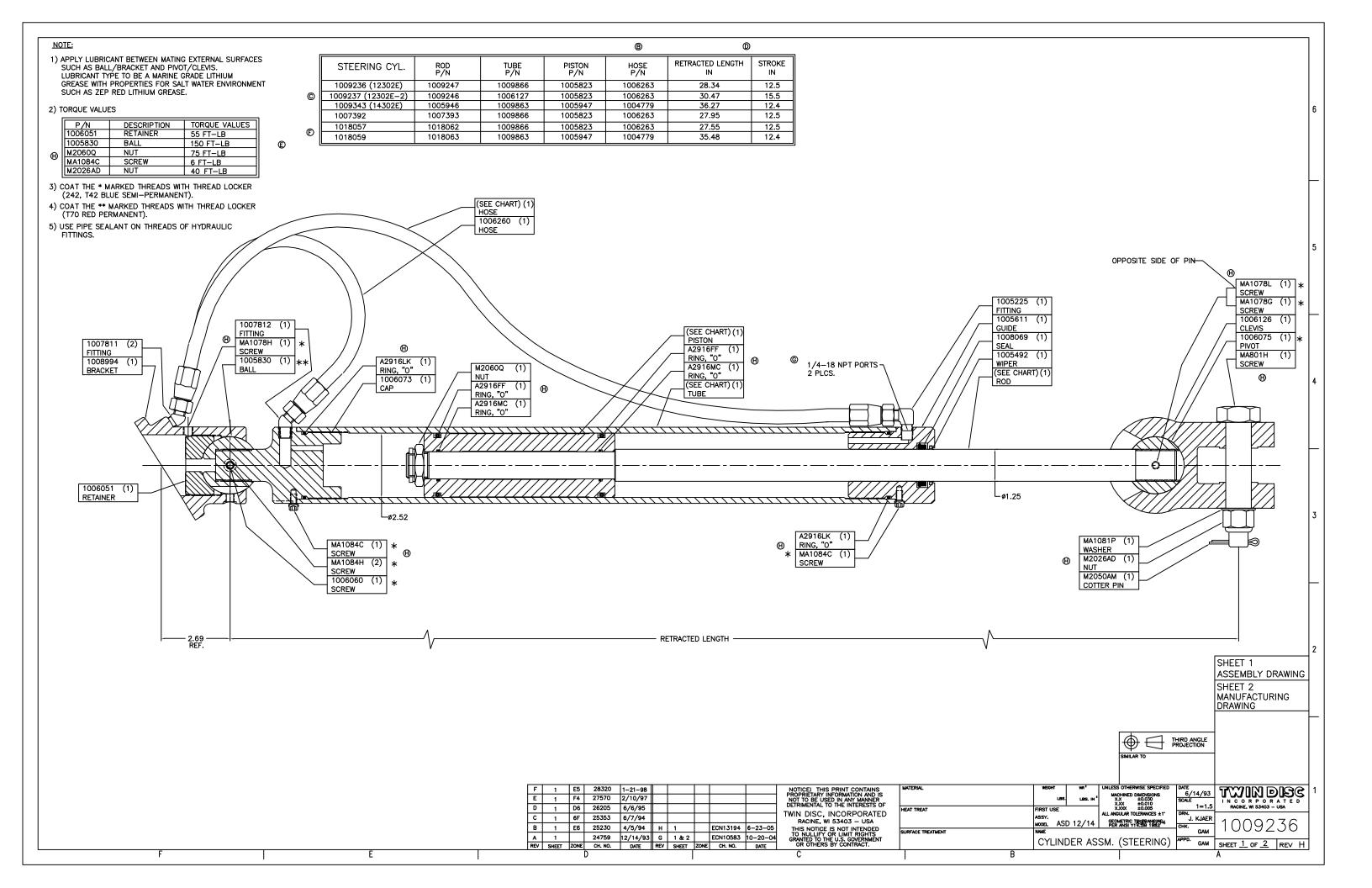
| | | SIMILAR TO | NOCEONION | |
|-------------------------|--|---|------------------------------------|---|
| ATERIAL NIBrAI HOUSINGS | 820 LBS. IN 2 (373 kg) LBS. IN 2 FIRST USE | MACHINED DIMENSIONS X.X ±0.030 X.XX ±0.010 X.XXX ±0.005 | DATE 7-12-06 SCALE 1: 4 | I N C O R P O R A T E D RAGINE, W 53403 - USA |
| RFACE TREATMENT | ASSY. MODEL ASD-14 NAME | GEOMETRIC TOLERANCING | DRN. J. Turk CHK. J. Turk | 1022909 |
| B | DRIVE | ASSEMBLY | APPD. F.Nystrom | SHEET _1_OF _1 REV _A |

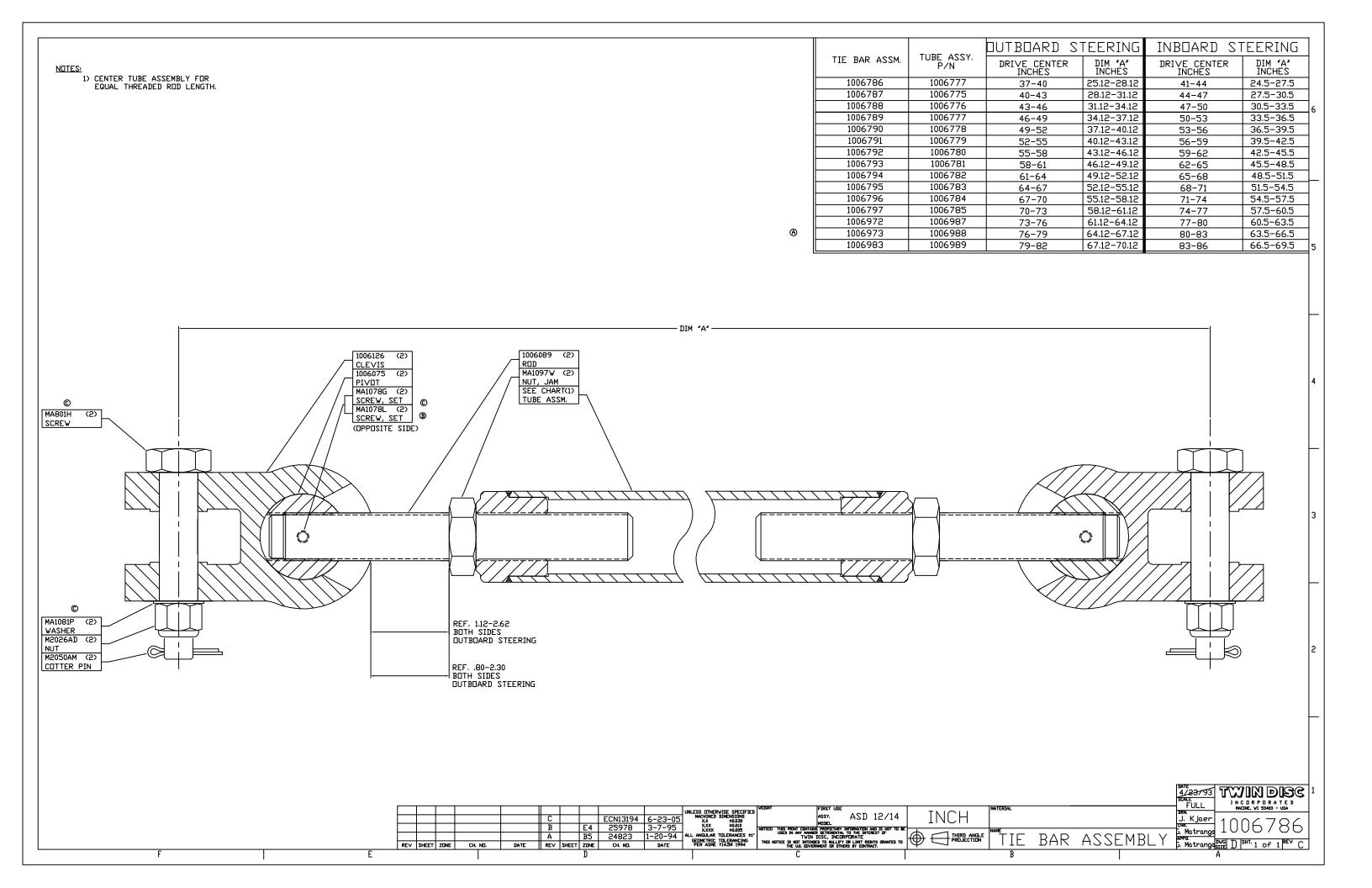
THIRD ANGLE

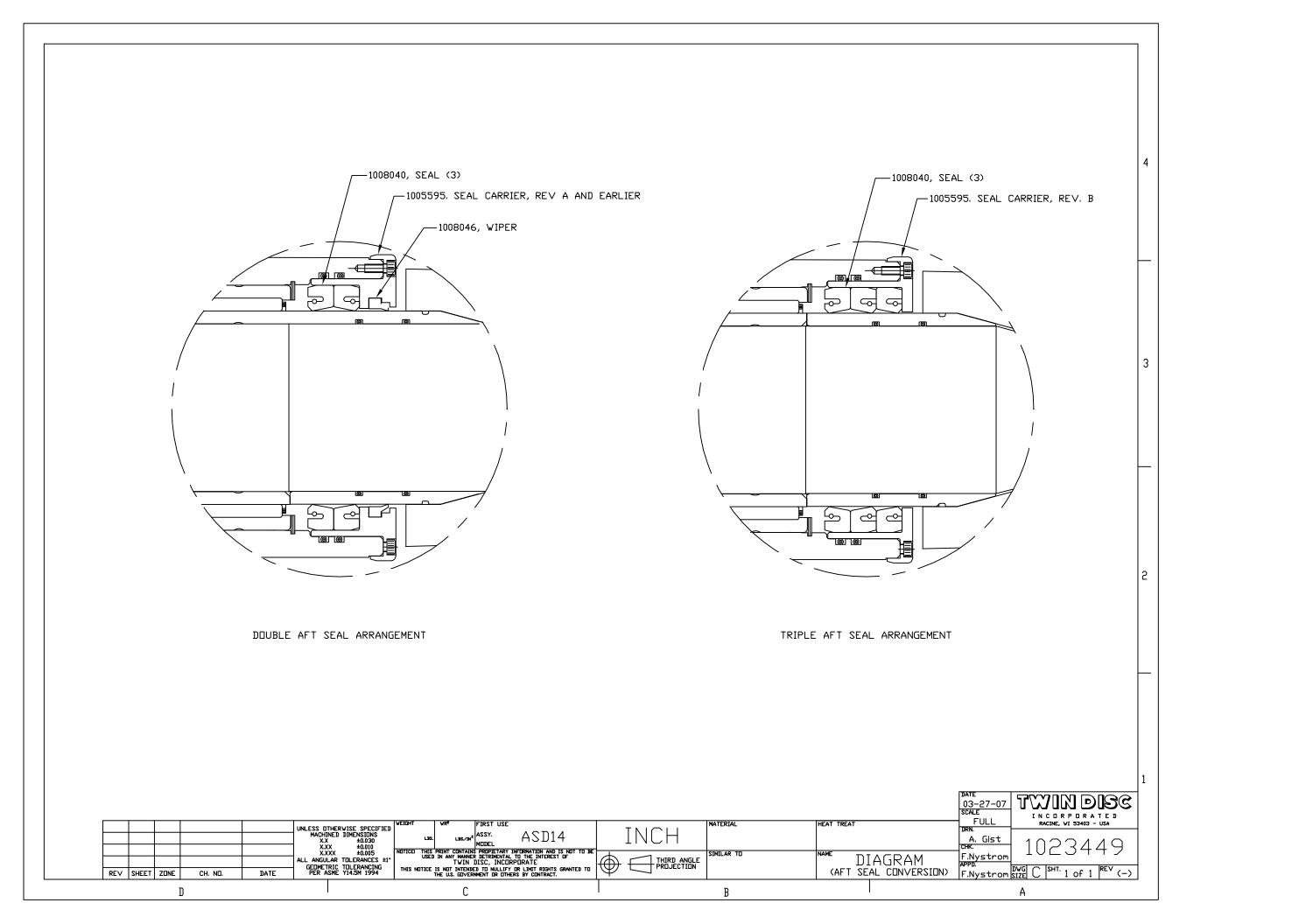












Technical Manual for Special Type 2100 Seal

TECHNICAL MANUAL

FOR

SPECIAL TYPE 2100 SEAL
FITTED TO TWIN DISC
ASD-14 UNITS

Based on G.A. Drawings:

H73903-01

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TM-2100-68828 ISSUE B

Issue Date: 8th July, 2005

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Specifications/Technical Data

1. SPECIFICATIONS / TECHNICAL DATA

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

STERNTUBE/SHAFT SEALS

Aft/Outboard Seal Forward/Inboard Seal(s)

 Type:
 2100 Special
 Type:

 Size:
 3.248" shaft (3.745" liner)
 Size:#

 Drawing No.:
 H73903-01
 Drawing No.:

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Introduction

2. <u>INTRODUCTION</u>

- **2.1.** The equipment described in this manual and the materials selected are the result of many years of research and experience in this field.
- **2.2.** However, the care and attention paid during installation, testing, operations and maintenance, do to a large extent determine the long-term operational reliability of the equipment.
- **2.3.** Thus, while it is our policy to allow the Installation and Maintenance of this equipment to be carried out by 3rd parties (in accordance with the guidance contained within this Technical Manual) we would always recommend that one of our Service Engineers is present to oversee any Installation or Maintenance.
- 2.4. When using this manual refer to the general arrangement drawing(s) in Section 10, plus any other referenced documents, which give the dimensions and data for the correct assembly and operation of the equipment.
- 2.5. There is no automatic provision to up-date this manual. However, the supply of a complete new assembly will be accompanied by the latest revision/issue Manual and Drawing(s).
- **2.6.** For further assistance please contact one of the companies listed below:

UNITED KINGDOM USA

Deep Sea Seals Ltd Wärtsilä Lips Inc.
4 Marples Way 3617 Koppens Way
Havant Chesapeake
Hants PO9 1NX VA 23323

Tel: 44 (0) 2392 492123 Tel: 1 757 385 5275 Fax: 44 (0) 2392 492470 Fax: 1 757 487 3658

Description of the Equipment

3. <u>DESCRIPTION OF THE EQUIPMENT</u>

- **3.1.** The Type 2100 is a compact, unitised, single spring, elastomeric bellows mechanical seal.
- **3.2.** The Type 2100 seals described in this Technical Manual are non-split units for use as Outboard sealing elements in Twin Disc ASD-14 units.
- **3.3.** These seals provide the separation between the lubricating oil within the thrust tube of the unit and the external water.
- **3.4.** Operational parameters for the seal are as described in the G.A. Drawing H73903-01 (See Attachments Section 10).

Storage and Handling

4. STORAGE AND HANDLING

- 4.1. All assemblies and components have been carefully inspected before shipment.
- **4.2.** Each component is suitably packed and protected to prevent damage or deterioration during shipment, transit or storage. Any specific storage or handling requirements will be clearly identified on the package label(s).
- **4.3.** Goods should be examined on receipt to verify the contents and their condition.
- **4.4.** Deep Sea Seals should be immediately advised of any damage or discrepancy in the scope of supply. Damage clearly due to handling in transit should be notified to the carrier (copy to us).
- **4.5.** Keep goods in their original packing until just prior to installation in order to best protect them.
- **4.6.** If goods have to be stored for long periods, they should be kept in their original packing, stored flat and unobstructed in a dry, cool and dark environment. To ensure a satisfactory life expectancy for any rubber components, exposure to sunlight, ultraviolet light and ozone should be prevented.
- **4.7.** Care must be taken during handling to prevent any mechanical damage occurring due to dropping, crushing etc. Particular care and attention should be paid to the running/sealing surfaces of the face and seat which are made from Silicon Carbide.

Preparation

5. PREPARATION

- **5.1.** The shaft and liner upon which the seal is to be fitted must be within the limits as specified on General Arrangement Drawing.
- **5.2.** There must be no sharp edges on the length of the shaft or liner over which the seal must travel whilst being fitted.
- **5.3.** A lead on must be provided where the seal first engages with the liner as shown on the G.A. Drawing.



- **5.4.** Ensure that the seal operating envelope dimensions are all correct to the General Arrangement Drawing.
- **5.5.** Ensure that all interfacing surfaces (e.g.: shaft, liner, thrust tube and propeller boss) are machined to the parameters, dimensions and tolerances as shown on the G.A. Drawing.
- **5.6.** The surfaces to which the seal housing (3-1) mounts (the thrust tube end) and is located (the liner surface) should be clean and free of grease or oil.

Note: It is **essential** to use a suitable lubricant when fitting the seal.

The recommended lubricants for the elastomeric bellows are soft hand soap or glycerine.

Do **not** use washing-up liquid, liquid soap or hand cleaning gel.

Do **not** use hydrocarbon based liquids.

Do **not** use grease – including Silicon grease, on any elastomer bellows.

5.7. It is **essential** that the running surface of the face and seat are protected at all times during storage, transit and installation in order to promote correct operation of the seal unit.

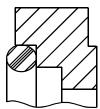
Even minor damage to these surfaces can result in leakage.

Installation

6. **INSTALLATION.**

6.1. Before mounting the seal housing (3-1) to the thrust tube/bearing housing unit, the seat (2-1) must be fitted into the seal housing (3-1).

First, position the O-ring (2-2) around the seat as shown.

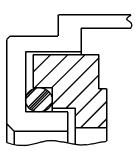


Lightly lubricate the inside diameter of the O-ring with soap (**Do not use oil** or grease – See Section 5.6 in Preparation).

Carefully push the seat (2-1) and O-ring into the housing (3-1) until it is in its final position.

Take particular care when handling the Silicon Carbide seat.

Ensure that the seat and it O-ring are correctly fitted into the seal housing and that the seat is evenly entered through 360°.



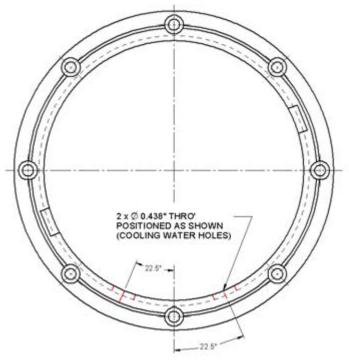
Ensure that the Twin Disc supplied O-rings fitted into the bore of the thrust tube/bearing housing are correctly positioned in their grooves and have been suitably lubricated.

6.2. Position the seal housing (3-1) complete with the seat assembly (2), onto the thrust tube/bearing housing.

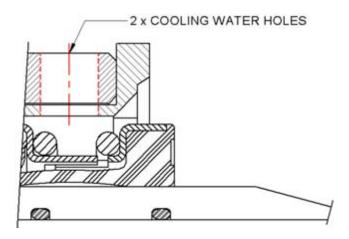
IMPORTANT NOTE:

The thrust tube and the seal housing (3-1) both have 2 of \emptyset 0·438 inch through holes in them for cooling water flow.

These holes are positioned 22.5° either side of B.D.C. (Bottom Dead Centre) in the end of the thrust tube.



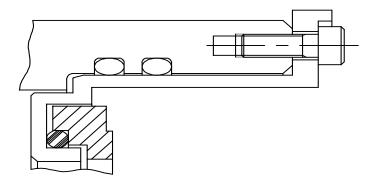
It is important when entering the seal housing into the thrust tube, that the holes in the housing are correctly aligned with those in the thrust tube.



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Insert and evenly tighten the eight Twin Disc supplied retaining screws. (Twin Disc Inc. advises that these fasteners should be torqued to 20 inch – lbs (2259 N-mm).

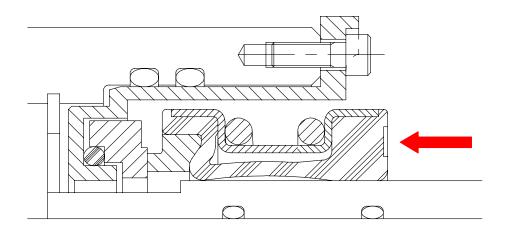


After insertion, check the concentricity of the seat to the shaft liner. It should be within c. 0.5 mm.

If greater than this then the seat is not bedded into the seal housing/O-ring correctly.

Remove the housing (3-1), strip down, clean and inspect all components and return to Section 6.1. and repeat the installation as necessary.

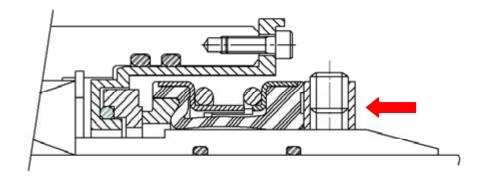
6.3. Ensure that both seal face and seat are undamaged and are clean and free from oil or grease. Carefully push the seal along the liner until the face makes gentle contact with the seat. A noticeable resistance will confirm face and seat contact, (if a lubricant is necessary only soap is to be used not oil or grease).



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6.4. Position the backing ring (1-2) behind the seal. Before fitting the backing ring over the liner slacken or remove the screws (1-3).



6.5. Push the ring forward using the compression tool (shown as follows).

0.50

TACKWELD ALL AROUND

TACKWELD ALL AROUND

2.30 Ø

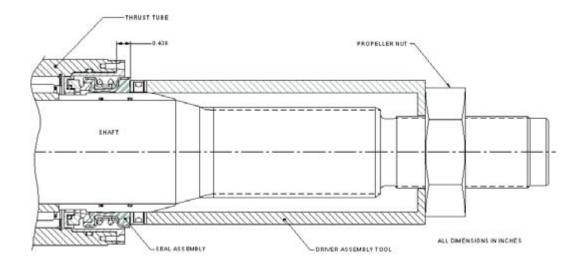
TYPE 2100 SEAL - DRIVER ASSEMBLY TOOL

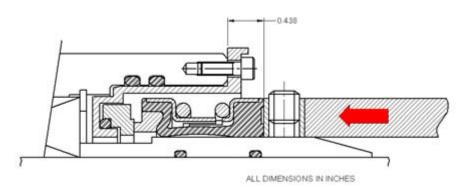
ALL DIMENSIONS IN INCHES

Using the propeller nut against the end of the compression tool, slowly and carefully do up the nut until the forward edge of the backing ring (i.e. where it contacts the seal) is 0.438 inches (\pm 0.020") behind the thrust tube end.

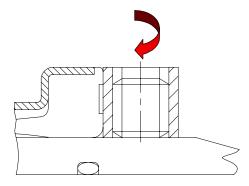
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6.6. Apply liquid thread locker to each of the backing ring screws (1-3) and fully insert them into the backing ring. Evenly tighten, then torque to the value stated, on the General Arrangement Drawing. (13 ft – lbs (18 Nm)).



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Testing

7. TESTING

The seal should be pressurised to its normal operating pressure.

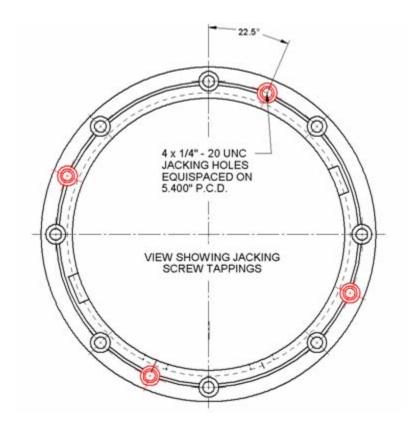
'Wetness' around the face and seat area is acceptable but any excessive leakage or fluid observed from another area must be investigated.

After test and before putting the unit into service, slowly turn the shaft (by hand if possible) to ensure free rotation.

Maintenance

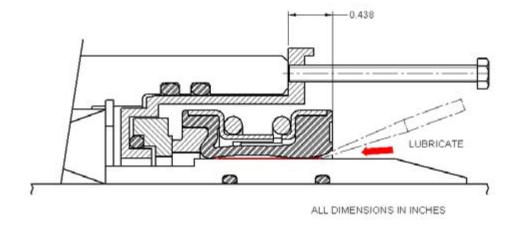
8. MAINTENANCE

- **8.1.** To dismantle the seal, undo the backing ring screws (1-3), which will allow the seal to relax. Slide back and then remove the backing ring (1-2). Lubricate the liner behind the seal with soap before sliding/jacking the seal back.
- **8.2.** Undo and remove the 8 off Customer supply 8-32 UNC screws, securing the seal housing (3-1) to the thrust tube.
- **8.3.** Install jacking screws in the four off $\frac{1}{4}$ " 20 UNC tapped holes in the seal housing flange (see view on arrow "A" on the G.A. Drawing).



Note: The jacking screws should be at least two inches long.

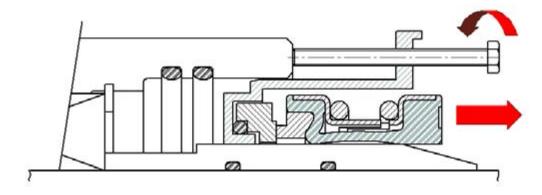
8.4. Before attempting to move the seal, and being careful not to scratch the shaft liner, gently insert/wedge a thin (but not sharp) object between the Nitrile rubber of the seal rotary assembly and the shaft liner.



Provide/inject ample lubricant between the rotating assembly and the shaft liner.

Remove the wedge.

8.5. Carefully and evenly jack the seal assembly aft (about 1 ") until the rotating assembly is clear of the thrust tube housing. Be very careful when jacking the seal assembly. Ensure that it is done evenly and in a controlled manner so as not to damage the seal face or seat.

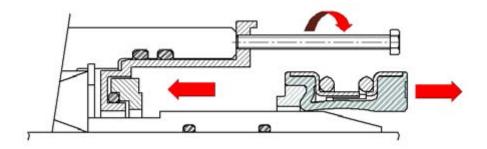


After about $\frac{3}{4}$ inch of travel, the seal housing (3-1) should disengage from the thrust tube O-rings, and should then move more freely.

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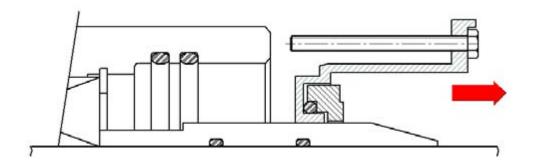
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8.6. Slide the stationary assembly (the seal housing (3-1)) and the seat assembly (2) back into the thrust tube, leaving the rotating assembly (1-1) clear of the stationary.



Carefully pull the rotating assembly from the liner/shaft.

8.7. Now jack the outer assembly, the seal housing and seat, fully out of the thrust tube, and remove these from the liner/shaft also.



- **8.8.** Carefully pack the seal in its original packing and box (or use suitable soft packing materials in an adequate protective box). Do not pack the seal with the face and seat touching or in contact. Keep the rotary and stationary elements of the seal separated and well packed and protected against shock or mishandling.
- **8.9.** It is recommended that the items identified in Section 9.3 of "Spare Parts and their Storage" are changed at routine overhaul periods.
- **8.10.** Refit the new and any re-used components in accordance with the instructions given in Section 6 Installation.

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Spare Parts and Their Storage

9. SPARE PARTS AND THEIR STORAGE

- **9.1.** For the Type 2100 seal, as it is basically a cartridge assembly, the requirement for Spare Parts is limited.
- **9.2.** None of the assemblies/components are considered to be refurbishable items.
- **9.3.** The components that may be held as spares are as follows:

| <u>DESCRIPTION</u> | <u>ITEM</u> |
|--------------------|---------------|
| Seal Rotary | H73903-01-1-1 |
| Seat | H73903-01-2-1 |
| O-ring | H73903-01-2-2 |

However: due consideration must be given to possibly lengthy storage of rubber components

- **9.4.** All parts held as spares, should be kept in their original packaging as they will have been inspected and packed prior to despatch as described in Section 4 (Storage and Handling).
- **9.5.** All components must be protected from damage or deterioration by maintaining their original packing and careful storage to prevent physical damage (with special care being taken of any fine machined surfaces or critical components).

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

Attachments

10. ATTACHMENTS

The following attachments are covered by this Technical Manual (TM-2100-68825)

H73903-01 G.A. Drawing of Special Type 2100 Seal.

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

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

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

The attachments referenced above, now follow:

