TWIN DISC
INCORPORATED

TWIN DISC
POWER TRANSMISSION EQUIPMENT
®

Service Manual

Marine Transmission

Components:
MG-5321DC

Document Number: 1022294

NOTICE

Document Number
1022294

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Marine Transmission Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY
COMMERCIAL MARINE TRANSMISSION

A. Twin Disc, Incorporated warrants all assembled products and parts, (except component products or parts on which written warranties issued by the respective manufacturers thereof are furnished to the original customer, as to which Twin Disc, Incorporated makes no warranty and assumes no liability) against defective materials or workmanship *for a period of twenty-four (24) months from the date of shipment by Twin Disc, Incorporated to original customer, but not to exceed twelve (12) months of service, whichever occurs first.* **This is the only warranty made by Twin Disc, Incorporated and is in lieu of any and all other warranties, express or implied, including the warranties of merchantability or fitness for a particular purpose and no other warranties are implied or intended to be given by Twin Disc, Incorporated.** The original customer does not rely upon any tests or inspections by Twin Disc, Incorporated or on Twin Disc, Incorporated's application engineering.

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

The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in warranty repair.
2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.
3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.
4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.
6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

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

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

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

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

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE
COMMERCIAL MARINE TRANSMISSION

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

COMMERCIAL MARINE TRANSMISSIONS ALL RATIOS:

MODEL SERIES	R&R	UNIT REBUILD	CLUTCH REPAIR (BOTH PACKS)
• MG502, MG5005, MG5010, MG5011, MG5012, MG5015, MG5020	10.0	8.0	-
• MG506, MG5061, MG5062,MG5065, MG5050, • MG5055	10.0	11.0	-
• MG507, MG5081, MG5085, MG5090 MG5075, MG5091	10.0	12.0	-
• MG5112, MG5113, MG5085, MG5090, MG509, MG 5111, MG5114, MGX5114	10.0	17.0	-
• MG514C, MG514M, MG5141, MG514CHP MGX5135, MGX5145, MGX5147	10.0	25.0	6.0
• MG516, MG5161, MG5170	10.0	28.0	8.0
• MG518-1	10.0	32.0	10.0
• MG520-1, MG 5202, MG5203, MG5204, MG5205, MG6449, MG6557	10.0	32.0	10.0
• MG530, MG530M, MG5301,MG6650, MG6690, MG6848, MG6598, MG6600, MG6619, MG6620, MG6984, MG61242, MGX6650, MGX6690, MGX6848	12.0	32.0	16.0
• MG540, MG5506, MG5600	20.0	62.0	20.0
• MGN80, MGN232, MGN233, MGN272, MGN273, MGN332, MGN334, MGN335, MGN432, MGN433, MGN472, MGN493	10.0	32.0	10.0
• MGN650, MGN800, MGN1000, MGN1400, MGN1600	20.0	62.0	40.0
• PUMP (ALL MODELS)	1.0	-	
• VALVE (ALL MODELS)	1.0	.5	

Table of Contents

Introduction

General Information

This publication provides service information for the Twin Disc MG-5321DC marine transmission. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA.

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

Safety and General Precautions

General

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

Important Safety Notice

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

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

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

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

⚠ WARNING

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

⚠ CAUTION

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

Preventative Maintenance

Frequent reference to the information provided in the Marine Transmission Owner's Manual, 1016313, regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment.

Towing

⚠ WARNING

Under the conditions described below, the prop shaft must be locked in place to prevent backdriving. Failure to do this can damage the marine transmission due to lack of component lubrication

Backdriving (also called windmilling) occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller, which, in turn, rotates the components in the marine transmission. During backdriving conditions, the transmission does not receive proper lubrication.

Conditions where backdriving may occur:

- ❑ Vessel is being towed.
- ❑ One or more engines on a multiple-transmission vessel are shut down while under way.
- ❑ Sailboat under sail with auxiliary engine shut down.
- ❑ Vessel tied up or docked in a heavy current.

Any of the following solutions are applicable if any of the above conditions are present:

- ❑ Lock the propeller shaft to prevent rotation.
- ❑ Add an optional trailing oil pump into the lubrication circuit.

Refer to the hydraulic system schematics for more details on the optional trailing pump specifications for the applicable transmission, or contact your Twin Disc Authorized Distributor.

Ordering Parts and Obtaining Services

⚠ WARNING

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

Ordering Service Parts

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

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

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, resulting 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

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

NOTES

Description and Specifications

General

The MG-5321DC is a reverse and reduction transmission. It is enclosed in a nodular iron housing, and is available either with or without torsional input coupling (freestanding). The output shaft is parallel to the input shaft.

The transmission is controlled by hydraulics; both the primary and secondary clutches are operated by main pressure oil supply. Bearings, clutches and gears are lubricated and cooled with low pressure oil. Helical gearing provides quiet operation and is currently available in the following ratios: 6.39:1, 5.96:1, 5.46:1, 4.96:1, 4.42:1, 4.06:1, and 3.35:1.

Components of transmission are identified on drawing no. 1015339A

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 your transmission.

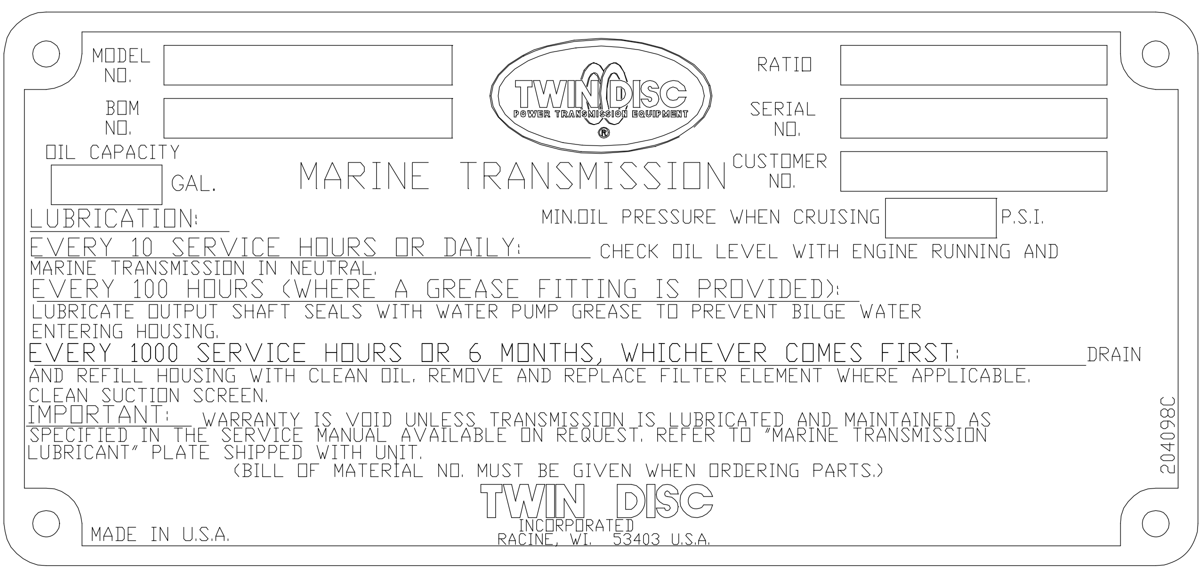


Figure 1. Nameplate for MG-5321DC Marine Transmission

Power Ratings

The MG-5321DC transmission can be operated through either the primary shaft or secondary shaft at its full rated horsepower when driven by a standard right hand rotation engine (counterclockwise flywheel rotation when viewing rear of engine). This transmission cannot be driven by a left hand rotation engine. Contact an authorized Twin Disc distributor for more information.

Transmission clutches are hydraulically applied using main oil pressure. All bearings, clutches and gears are lubricated and cooled with low-pressure oil.

Always reference the Bill of Materials (BOM) or specification number when ordering service parts.

Changing Rotation

These units can be used only with engines of R.H. rotation.

Direction of Drive

The primary (input) clutch shaft and driving transfer gear always rotate in engine direction. The secondary clutch shaft and driven transfer gear always rotate in anti-engine direction because the driven transfer gear is meshed with the driving transfer gear on the primary clutch shaft. When the primary clutch is engaged, the primary input pinion rotates in engine direction. The output gear, which is secured to the output shaft, is meshed with the primary input pinion and so the output gear and shaft are driven in anti-engine direction. When the secondary clutch is engaged, the secondary input pinion rotates in anti-engine direction. The output gear is meshed with the secondary input pinion and, therefore, the output gear and shaft are driven in engine direction.

Construction Features

Housings

The transmission has a one-piece main housing. Front housings in sizes SAE No. 0 and SAE No. 00 are available. A top cover, bearing carrier, and manifold (sealed with gaskets) complete the housing enclosure.

Bearings

The primary and secondary clutch shafts and pinions are supported and located by a combination of straight and tapered roller bearings. Bearing clearances for each clutch shaft and pinion assembly are set by use of a single shim pack at the rear-tapered roller bearing on each shaft. A combination of straight and tapered roller bearings support the output shaft and have bearing clearance adjusted by use of shims in the rear bearing carrier.

Gears

All gears are helical, carburized, hardened and ground for smooth quiet operation. All gears are in constant mesh. The primary and secondary transfer gears and the output gear are mounted on keyless tapers.

Oil Pump and Drive

The oil pump is driven by the secondary clutch shaft.

Lubrication Features

The lubrication tube in the transmission extends from the front to the rear of the inside of the housing. Holes drilled in the tube force the oil to spray the transfer gears and the primary and secondary pinions. Bearings and clutches on the primary and secondary shafts are lubricated through drilled passages in the shafts. Output shaft bearings are gravity and splash lubricated.

Suction Screen

A serviceable suction strainer located below the oil pump, between the sump and oil pump in the hydraulic circuit. The strainer can be replaced if necessary.

Filter Assembly

An canister-style filter is located between the oil pump outlet and the selector valve in the hydraulic circuit. The replacement element is Twin Disc part number 1016502. This should be replaced at 1000 hour or six month intervals, whichever comes first.

Flexible Torsional Input Coupling

The purpose of the torsional coupling is to transmit power from the engine to the marine transmission through a rubber or silicone element that will:

- ❑ Dampen torsional vibrations.
- ❑ Change the natural frequencies of a system to move critical frequencies out of the operating speed range.
- ❑ Accommodate a certain amount of misalignment.
- ❑ Absorb shock and reduce noise.
- ❑ Minimize gear “rattle.”

Several couplings are available from Twin Disc, and are selected based on the customer supplied engine information. Final coupling selection must be confirmed by the packager based on the torque/rpm ratings and the results of the system torsional vibration analysis (TVA), and on engine rotation. Care must be taken when servicing that replacement couplings are matched to this criteria.

Heat Exchanger

The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing raw or fresh water through the heat exchanger.

HEAT EXCHANGER (H.E.) REQUIREMENTS			
PERMISSIBLE OIL TEMPERATURE INTO HEAT EXCHANGER			
RATIO	OIL VISCOSITY	MAX.	MIN.
ALL RATIOS	SAE 40	85°C(185°F)	65°C(150°F) *
ALL RATIOS	SAE 50	93°C(200°F)	80°C(175°F)

MIN HEAT TRANSFER CAPACITY (APPLY APPROPRIATE SERVICE FACTOR FOR FRESH AND RAW WATER)	kW(Btu/min) PER ENGINE RTD. kW(hp)	
	CONT. & MED. DUTY	INT., LIGHT, & P.C. DUTY
	.035 (1.484)	.030 (1.272)
APPROX. OIL FLOW TO H.E.	5.91 L/min(1.56 gpm) PER 100 ENGINE rpm	
PEAK OIL PRESSURE AT H.E. (PROOF TEST H.E. AT 1.5 X kPa(psi))	690 kPa(100 psi)	

MAX. ALLOWABLE OIL PRESSURE DROP ACROSS H.E. WITH 66mm²/s (300) SUS OIL AT RATED ENGINE rpm	207 kPa (30 psi)
MAX. ALLOWABLE WATER PRESSURE DROP ACROSS H.E.	10.3 kPa (1.5 psi)

WATER FLOW TO H.E. - USE 1.5 TO 3.0 TIMES OIL - L/min (gpm)

H.E. WATER PRESSURE RATING, MIN., = 1.5 X H.E. INLET WATER kPa(psi)

DATA H.E. PURCHASER MUST ALSO TELL VENDOR

STATE IF RAW (OPEN CHANNEL & SEA) OR FRESH (CLOSED ENGINE JACKET AND/OR KEEL COOLER) WATER WILL COOL H.E. *

STATE MAX. WATER TEMP. INTO H.E. - TYPICAL: RAW WATER 29°C-32°C (85°F-90°F) KEEL COOLER WATER 46°C-60°C (115°F-140°F) ENGINE JACKET WATER 74°C-85°C (165°F-185°F). *

STATE MIN., ALSO MAX. L/min (gpm) OF WATER FLOW TO H.E.

H.E. INSTALLATION & SERVICE REQUIREMENTS

OIL LINES, TRANSMISSION TO H.E. AND RETURN ----

(1) MAX. VELOCITY IN FITTINGS,PIPE,HOSE AND TUBES-7.6m/s (25ft/s)

(2) BURST PRESSURE, MIN., = 4 x PEAK OIL PRESSURE AT H.E.

(3) HOSE - PER S697-E

(4) PROTECT LINES FROM MECHANICAL DAMAGE. ZINC ANODES PROTECT H.E. RAW WATER PASSAGES FROM CORROSION. CHECK & REPLACE THEM FREQUENTLY.

Figure 2. Heat Exchanger Specification Information

Specifications and Maintenance

Frequent reference to this data, and application of the information will result in better service from the transmission.

Dry Weight

With SAE #0 housing:	1,570 kg. (3,458 lbs.)
With SAE #00 housing:	1,620 kg. (3,568 lbs.)

Maximum Input Speed

MG-5321DC	2400 rpm

Oil Capacity

37.9 liters (10.0 gal)

Type of Oil and Viscosity

Note: Multi-viscosity oils (e.g., 10W-20) should not be used in Twin Disc marine transmissions.

Recommended oil is specified on the lubricant data plate mounted on the transmission housing.

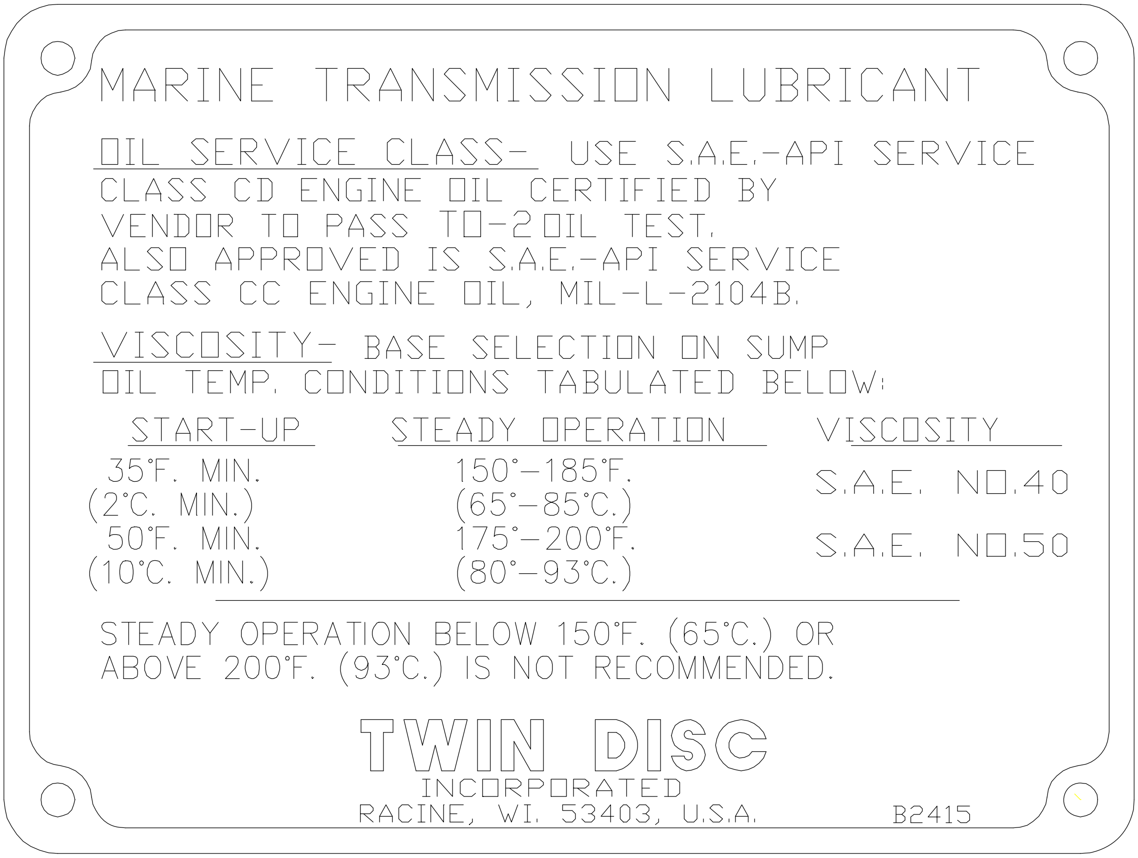


Figure 3. Oil Specification Plate Example

Oil Pressures

Table 1.

Limits for Marine Transmission equipped with 1020941C Control Valve and 2415 kPa (350 psi) proportional valve, and 1000 mA supply current. (P = primary; S = Secondary; N = Neutral)												
rpm	Range	Valve Inlet			Primary		Secondary		Lube*			Cooling Temp °C °F
		Min kPa (psi)	Act kPa (psi)	Max kPa (psi)	Min kPa (psi)	Act kPa (psi)	Min kPa (psi)	Act kPa (psi)	Min kPa (psi)	Act kPa (psi)	Max kPa (psi)	
1800	P	1960 (285)		2140 (310)	1960 (285)		0 (0)		100 (15)		380 (55)	
	S	1960 (285)		2140 (310)	0 (0)		1960 (285)		100 (15)		380 (55)	
	N	1960 (285)		2140 (310)	0 (0)		0 (0)		280 (40)		450 (65)	
600	P	1960 (285)		2140 (310)	1987 (275)		0 (0)		7 (1)		69 (10)	
	S	1960 (285)		2140 (310)	0 (0)		1987 (275)		7 (1)		69 (10)	
	N	1960 (285)		2140 (310)	0 (0)		0 (0)		20 (3)		140 (20)	

*Cooling Temperature Range: Delvac 1110 oil @ 29 - 35° C (85 - 95° F).
Required: Primary lube pressure = secondary lube pressure within 21 kPa (3 psi).
A reading outside limiting range could mean:

- Valve inlet pressure: Faulty valve springs; sticky valve; pump flow too low; forgotten, or cut seal rings.
- Primary and secondary pressure: Broken seal ring at collectors or piston.
- Lube pressure: Out of tolerance, or missing orifice; broken rear seal ring; faulty lube relief valve or check valve.

Table 2.

Limits for Marine Transmission equipped 1020941C Control Valve with 2415 kPa (350 psi) Proportional Valve and 320 mA supply current						
Range	Min. kPa (psi)	Act. kPa (psi)	Max. kPa (psi)	Min. kPa (psi)	Act. kPa (psi)	Max. kPa (psi)
Primary	303 (44)		483 (70)	0 (0)		0 (0)
Secondary	0 (0)		0 (0)	303 (44)		483 (70)

Table 3.

Limits for Marine Transmission equipped with 1017172Q/1017546F or 1018084 Control Valve 2000 kPa (290 psi) Spring (P = primary; S = Secondary; N = Neutral)												
rpm	Range	Valve Inlet			Primary		Secondary		Lube*			Cooling
		Min kPa (psi)	Act kPa (psi)	Max kPa (psi)	Min kPa (psi)	Act kPa (psi)	Min kPa (psi)	Act kPa (psi)	Min kPa (psi)	Act kPa (psi)	Max kPa (psi)	Temp °C °F
1800	P	1960 (285)		2140 (310)	1960 (285)		0 (0)		100 (15)		380 (55)	
	S	1960 (285)		2140 (310)	0 (0)		1960 (285)		100 (15)		380 (55)	
	N	550 (80)		1034 (150)	0 (0)		0 (0)		280 (40)		450 (65)	
600	P	1860 (270)		2000 (290)	1860 (270)		0 (0)		7 (1)		69 (10)	
	S	1860 (270)		2000 (290)	0 (0)		1860 (270)		7 (1)		69 (10)	
	N	255 (37)		310 (45)	0 (0)		0 (0)		20 (3)		140 (20)	

*Cooling Temperature Range: Delvac 1110 oil @ 29 - 35° C (85 - 95° F).

Required: Primary lube pressure = secondary lube pressure within 21 kPa (3 psi).

ALL SHIFTS MUST BE DONE AT OR BELOW 1800 RPM

A reading outside limiting range could mean:

Valve inlet pressure: Faulty valve springs; sticky valve; pump flow too low; wrong valve spring shims or quantity of shims, leakage -- broken, forgotten, or cut seal rings.

Primary and secondary pressure: Broken seal ring at collectors or piston.

Lube pressure: Out of tolerance, or missing orifice; broken rear seal ring; faulty lube relief valve or check valve.

Table 4.

Limits for Marine Transmission Equipped with 1017546F or 1018084 Control and Trolling Valve with 2000 kPa (290 psi) Spring									
Trolling valve in minimum trolling position & control valve per shift given below (600 rpm input)	Primary kPa (psi)			Secondary kPa (psi)			Lube kPa (psi)		
	Min.	Act.	Max.	Min.	Act.	Max.	Min.	Act.	Max.
Primary	69 (10)		110 (16)	0 (0)		0 (0)	28 (4)		69 (10)
Secondary	0 (0)		0 (0)	69 (10)		110 (16)	28 (4)		69 (10)
Neutral	0 (0)		0 (0)	0 (0)		0 (0)	34 (5)		83 (12)
*With the trolling valve in the non-trolling position, valve inlet, primary, secondary, and lube pressures must be the same as charted in Table 3.									

Table 5.

Limits for Marine Transmission equipped with Hydraulic Clutch PTO						
Input rpm	PTO Control Vlave Disengaged			PTO Control Valve Engaged		
	Min. kPa (psi)	Act. kPa (psi)	Max. kPa (psi)	Min. kPa (psi)	Act. kPa (psi)	Max. kPa (psi)
600	0 (0)		0 (0)	1900 (275)		2140 (310)
1800	0 (0)		0 (0)	1965 (285)		2140 (310)

Note: With hydraulic PTO, lube pressure may be less than values charted on table 1 by following amounts:

34 kPa (5 psi) less in primary, neutral or secondary at 1800 rpm

14 kPa (2 psi) less in primary, neutral or secondary at 600 rpm, but not less than 10 kPa (1.5 psi).

Table 6.

Limits for Marine Transmission equipped with mounted Trailing Pump			
Input rpm	Min. kPa (psi)	Act. kPa (psi)	Max. kPa (psi)
600	69 (10)		207 (30)
1800	345 (50)		483 (70)

Assembly Specifications

Table 7. Advance Specifications

Component	Minimum mm (in.)	Maximum mm (in.)
Primary Transfer Gear Advance	2.67 (0.105)	3.71 (0.146)
Secondary Transfer Gear Advance	2.67 (0.105)	3.71 (0.146)
Output Gear Advance	9.45 (0.372)	11.00 (0.433)
Output Flange Advance	8.13 (0.320)	9.91 (0.390)

Table 8. Bearing Shimming Adjustment

Primary and Secondary Tapered Roller Bearing Endplay	
Minimum	**Maximum**
0.013 mm (0.0005 in.)	0.063 mm (0.0025 in.)
Output Shaft Bearing Endplay	
Minimum	**Maximum**
0.05 mm (0.002 in.)	0.15 mm (0.006 in.)

Table 9 . Front Housing Maximum Runout Limits

Measurement Location	Maximum allowable total indicator reading
Face of SAE #0 and SAE #00 housing from input spline	0.41 mm (0.016 in.)
Pilot of SAE #0 and SAE #00 housing from input spline	*0.30 mm (0.012 in.)
Face of propeller flange near O.D. from main housing	0.10 mm (0.004 in.)
Pilot of propeller flange from main housing	0.10 mm (0.004 in.)
*This note applies to a continuous 270 degrees arc if the balance of the plot is negative in readings; otherwise it means all 360 degrees.	

Table 10. Drag Limit

Gear Ratio	Drag Limits @ 600 rpm input speed -- in neutral	Ratio Check @ 1800 rpm
	Max. Pull Tangent* N (lbf)	Output rpm
6.39:1	202 (45.5)	281.7
5.96:1	189 (42.4)	302
5.46:1	179 (40.1)	329.7
4.96:1	157 (35.3)	362.9
4.42:1	140 (31.1)	407.2
4.06:1	129 (28.9)	443.3
3.35:1	106 (23.8)	537.3
*at 320.0 mm (12.8 in.) dia. Output flange hole circle.		

Optional Equipment

Trailing Pump

Two types of trailing pumps are available:

115 VAC electric powered trailing pump identified as part number 1016473. An engineering drawing is included in this manual.

Mechanically driven trailing pump identified as part number 1020513 or 1020513A.

Power Take-off

A live pump mount PTO is available in sizes SAE-J744 No. 32-4 and SAE J744 No 38-4.

A clutchable pump mount PTO is available in sizes SAE-J744 No. 32-4 and SAE J744 No 38-4.

Metric to NPTF Adapter Kit

Adapter kits are available to convert the oil drain plug opening, the pressure test ports, and the heat exchanger connections from metric to NPTF threads. Kit K1195 is for units with an integral heat exchanger, and kit K1245 is for units with a remote heat exchanger.

Mounting Brackets

Steel fabricated mounting brackets for rigid mounting are available under Twin Disc part number 1016428-AC.

Torsional Input Coupling

Several models of torsional input couplings are available, including Vulkan VL3411S and Centa CF-R couplings in both SAE #0 and SAE #00 sizes.

Companion Flange

Two different companion flanges are available: For non-propeller shaft brake applications, the flange assembly is Twin Disc part number 1017084. For disc type propeller shaft brake applications, the Twin Disc part number is 1019642.

Torque Values for Fasteners

Note: Lubricate all threads and bearing face with light oil film prior to assembly.

Use Grade 5 and Property Class 8.8 specs when threading into aluminum.

Table 11. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	lb•ft	N•m	lb•ft	N•m	lb•ft	N•m
M6	6.5 - 7.5	9-10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	987 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 12. U.S. Standard Fine and Coarse Thread Capscrews, Bolts, and Nuts

Thread Diameter	SAE Grade 5		SAE Grade 8	
	lb - ft	**Nm**	**lb - ft**	**Nm**
1/4	6 - 8	8 - 11	10 - 12	14 - 16
5/16	13 - 17	18 - 23	20 - 24	27 - 32
3/8	25 - 29	34 - 39	35 - 41	48 - 55
7/16	37 - 43	51 - 58	55 - 65	75 - 88
1/2	60 - 70	81 - 95	83 - 97	113 - 131
9/16	82 - 98	111 - 132	120 - 140	163 - 190
5/8	120 - 140	163 - 190	165 - 195	224 - 264
3/4	205 - 245	278 - 332	295 - 345	400 - 467
7/8	330 - 390	448 - 528	470 - 550	638 745
1	495 - 585	671 - 793	715 - 835	970 - 1132
1 1/8	615 - 735	834 - 997	1015 - 1185	1377 - 1606
1 1/4	850 - 1000	1163 - 1355	1375 - 1625	1865 - 2203

Table 13. Straight Threaded Tube Fittings, Hose Fittings, and O-ring Plugs

Nominal Thread Diameter	Nm + or - 5%	lb•ft + or - 5%	Nominal Thread Diameter	Nm + or - 5%	lb•ft + or - 5%
5/16	5	3.5	1 5/8	108	80
3/8	11.5	8.5	1 7/8	108	80
7/16	16	12	2 1/2	108	80
1/2	20	15	M10x1.0	12	9
9/16	24	18	M12X1.5	16	12
5/8	24	18	M14X1.5	20	15
11/16	34	25	M16X1.5	24	18
7/8	54	40	M18X1.5	34	25
1 1/16	75	55	M22X1.5	54	40
1 3/16	88	65	M27X2.0	75	55
1 1/4	88	65	M33X2.0	88	65
1 5/16	108	80	M42X2.0	108	80
1 3/8	108	80	M48X2.0	108	80

Table 14. Tapered Pipe Plugs (with thread lubricant)

Torque Values for Lubricated Pipe Plugs			
Recommended Torque in Nm (ft-lb)			
PT Size	**NPTF Size**	**Installed in Cast Iron or Steel**	**Installed in Aluminum**
1/16 - 28	1/16 - 27	11.5 ± 1.3 (8.5 ± 1.0)	7.5 ± 0.9 (5.5 ± 0.7)
1/8 - 28	1/8 - 27	14.2 ± 1.8 (10.5 ± 1.3)	8.8 ± 1.1 (6.5 ± 0.8)
1/4 - 19	1/4 - 18	34 ± 4 (25 ± 3)	22 ± 3 (16 ± 2)
3//8 - 19	3/8 - 18	37 ± 4 (27 ± 3)	23 ± 3 (17 ± 2)
1/2 - 14	1/2 - 14	68 ± 8 (50 ± 6)	41 ± 5 (30 ± 4)
3/4 - 14	3/4 - 14	73 ± 10 (54 ± 7)	46 ± 5 (34 ± 4)
1 -11	1 - 1-1/2	109 ± 13 (80 ± 10)	68 ± 8 (50 ± 6)
1-1/4 - 11	1-1/4 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)
1-1/2 - 11	1-1/2 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)

Note: The lubricant is to be John Crane insoluble plastic lead seal No. 2 (or equivalent) or Loctite® No. 92 (or equivalent) and plugs are to be capable of removal with out damage. Overtightening may cause initial leakage plus potential removal damage.

An option of a maximum of two full turns after finger tightening the plug may be used if required and if removal conditions are met.

Clutch Plate Wear Limits

Clutch Steel Plates:

Maximum cone: 0.20 mm (0.008 inch)

Clutch Friction Plates:

Maximum cone: 0.25 mm (0.010 inch)

Minimum thickness: 3.48 mm (0.137 inch)

Operation

General

The Control Valve is used to obtain neutral, primary clutch engagement, and secondary clutch engagement in this transmission. When these positions are selected, the control valve directs high-pressure oil through internal passages to instantaneously and smoothly engage the clutches. The pressure-rate of rise provides a rapid, smooth, clutch engagement.

There are three different valves that can be used to control the transmission. They will be discussed individually in the following pages.

GP Control Valve with Electronic Interface (1020941C)

The General Purpose (GP) control valve is a hydraulic valve assembly for use with Twin Disc Marine Transmissions, that may include an integral electronic interface control module. The valve assembly contains current controlled proportional cartridges.

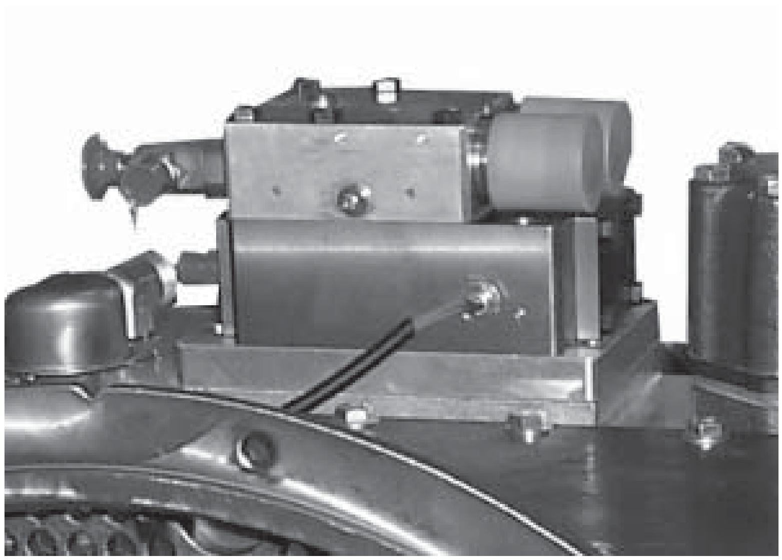


Figure 2. GP Valve Assembly mounted on Marine Transmission (typical).

GP Control Valve Hydraulic Portion

The hydraulic portion of the GP Control Valve is made up of two blocks, a lower main regulator valve body, and an upper valve body. These valve bodies contain two electrically actuated proportional cartridges, a hydraulic pressure regulator and a manual direction control cartridge valve. The regulating valve body contains a ball check valve assembly in parallel with an orifice with a filter that provides rapid fill and damping for the rear cavity of the regulator valve. The manual direction control cartridge valve contains a switch that is closed when the valve is in the neutral position. Separate identical proportional cartridges are used for the primary and secondary clutch actuation. When the primary or secondary clutch is selected by the operator, the control valve directs high pressure oil through internal passages to operate the clutches. The pressure rate of rise (profile) is controlled electronically by the GP Control Valve Electronic Interface (Profile or E-Troll Module) to provide a rapid, smooth, oil pressure increase in the clutch hydraulic passages during engagement.

CAUTION

The proportional valve coils are low resistance devices that are current driven. The use of an uncontrolled power source may supply too much current and damage the proportional valve.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

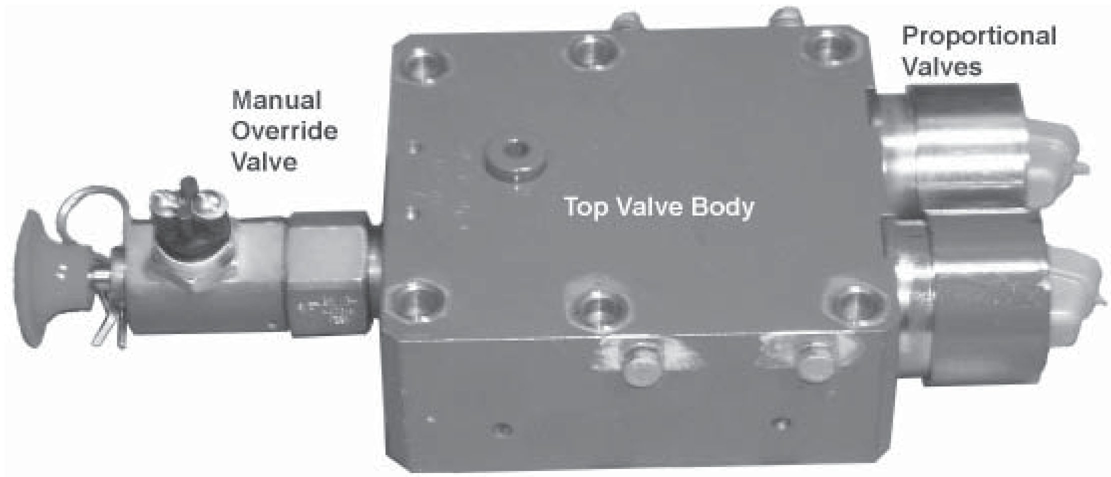


Figure 3. Top Hydraulic Valve Body Assembly

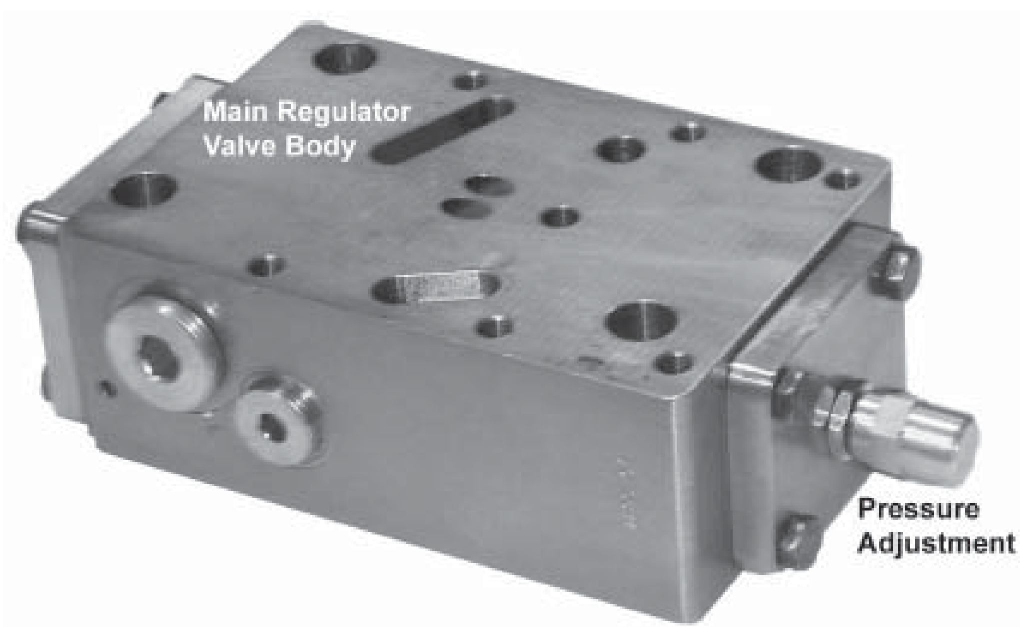


Figure 4. Main Regulator Hydraulic Valve Assembly

GP Control Valve Electronic Control Interface (Profile or E-Troll Module)

Note: Some installations will consist of the hydraulic portion of this valve, and the Electronic Control Interface will be replaced by an appropriate electronic control system.

The electronic portion of the GP Control Valve fastens to the hydraulic portion of the GP Control Valve, and is located on the top surface.

WARNING

If the ambient temperature of this mounting location exceeds 180°F, the Electronic Control Interface must be relocated to a cooler area. Contact Twin Disc for proper harnessing instructions.

This module contains the electronic circuitry to control the proportional cartridges that are used to engage the clutches based on the commands from the operator. Clutch apply pressure rate of rise (profile) is factory set with the use of internal circuitry. The initial fill level is factory set with an adjustment screw that is embedded in the bottom surface of the Profile or E-Troll Module, and sealed. This can be field adjusted if necessary by authorized personnel with the proper instrumentation. There are different control module types for marine transmissions (MG), both with and without the trolling (E-Troll) feature. All electrical wiring for the marine transmission system controls are routed through this interface module. The vessel battery power (12 vdc or 24 vdc) is supplied to the electronic interface only, and never directly to the hydraulic proportional valves. Two red led lights are used to identify the proportional cartridge valve that is energized, and a green led is used to identify when power is provided to energize one of the clutches. Flashing lights are used in troubleshooting. Signals are provided to power a customer supplied relay to allow engine starting only when in neutral. A Transmission oil temperature sensor is required for some marine transmission (MG) models. Engine speed and Propeller speed sensors are required for transmissions with E-Troll. The following figures show the various versions of the Electronic Profile or E-Troll Module.

WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

Figure 5. Electronic Profile Module (MG non-troll)

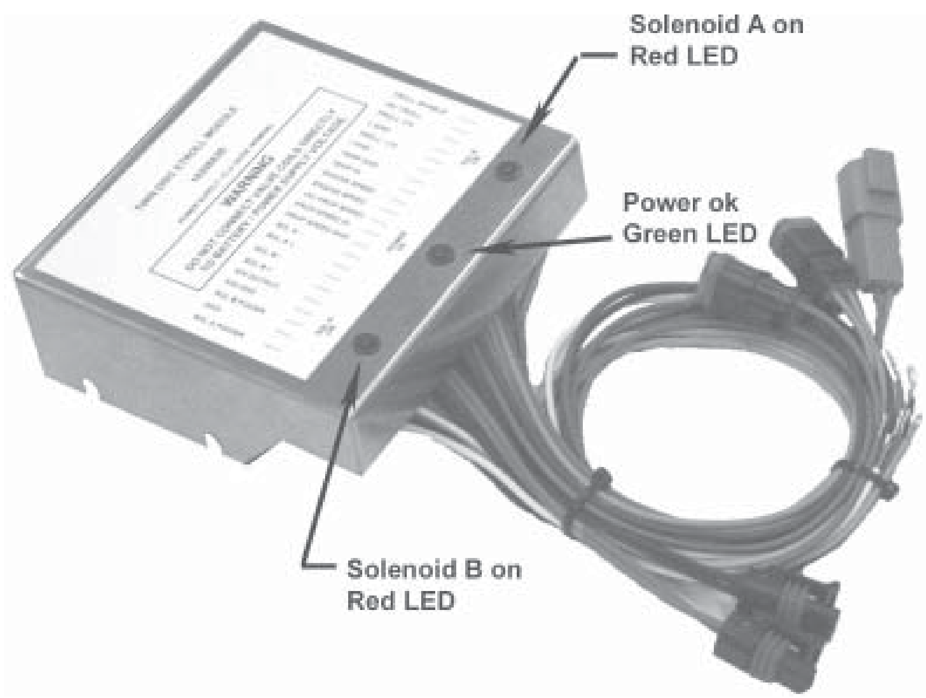


Figure 6. Electronic E-Troll Module (MG E-Troll)

Hydraulic System with GP Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the heat exchanger to the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil is supplied to the main pressure regulating relief pilot cartridge and the main regulating valve cartridge, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings.

Main pressure is supplied to the inlet of each proportional valve, and to the inlet of the manual direction control valve. In Neutral, the inlet port of both clutches is connected to the sump. Since the area behind the clutch pistons is open to sump, the clutches are disengaged.

When one of the clutches is commanded to engage, the proportional valve directs main pressure to engage the selected clutch pack. The rate-of-rise is controlled electronically and pre-fills the engaging clutch at a predetermined level, and then increases to full pressure, following a predetermined timing sequence. The initial pre filled level is factory adjustable by means of an adjustment screw embedded in the bottom surface of the electronic interface. Field adjustment of this feature should never be attempted without special equipment and knowledge of its use to prevent serious mechanical damage to the marine transmission or vessel.

The electronic interface portion of the control valve allows only one proportional valve to be energized at a time, thus, only one clutch can be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

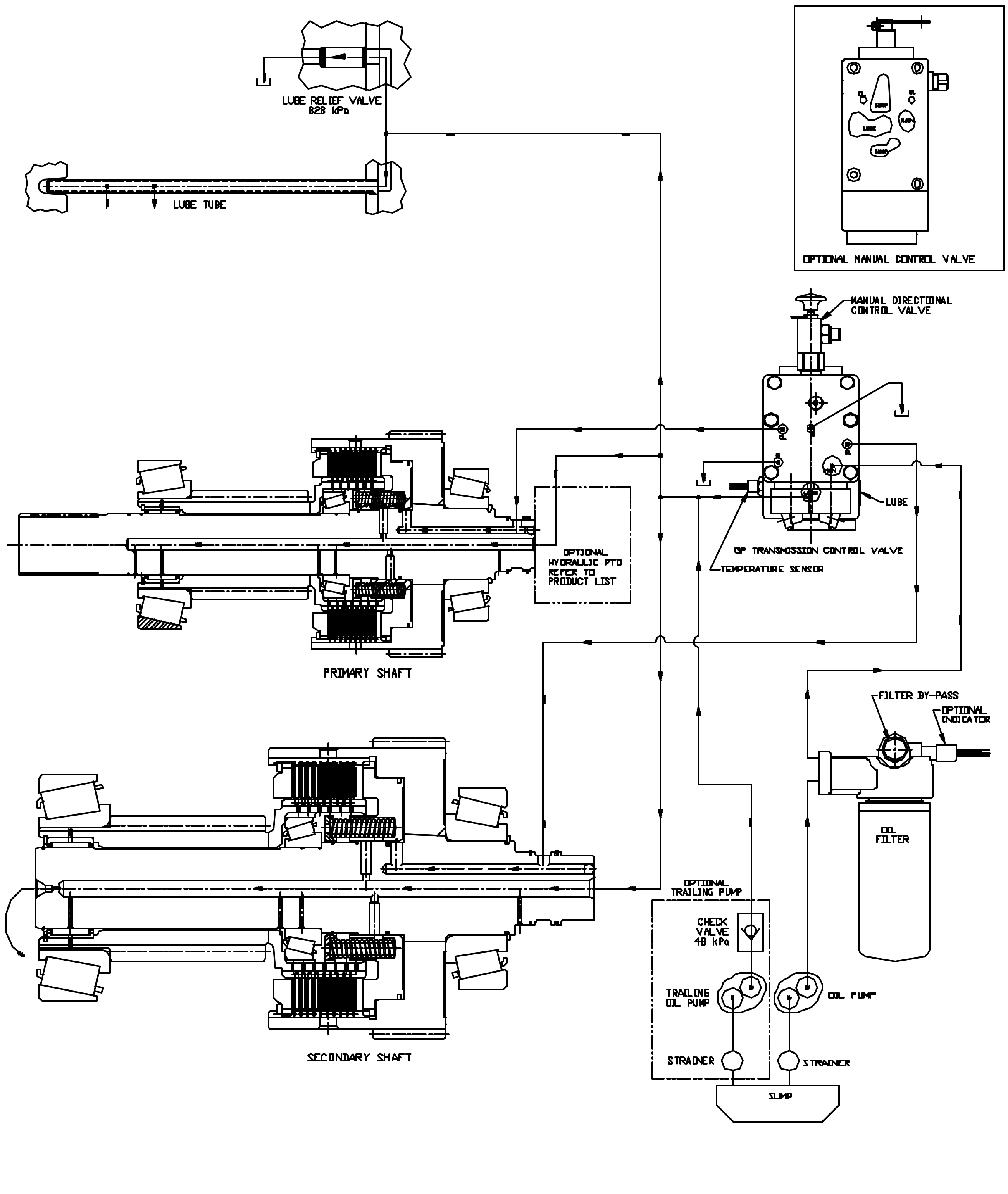


Figure 7. Hydraulic Schematic (GP control valve)

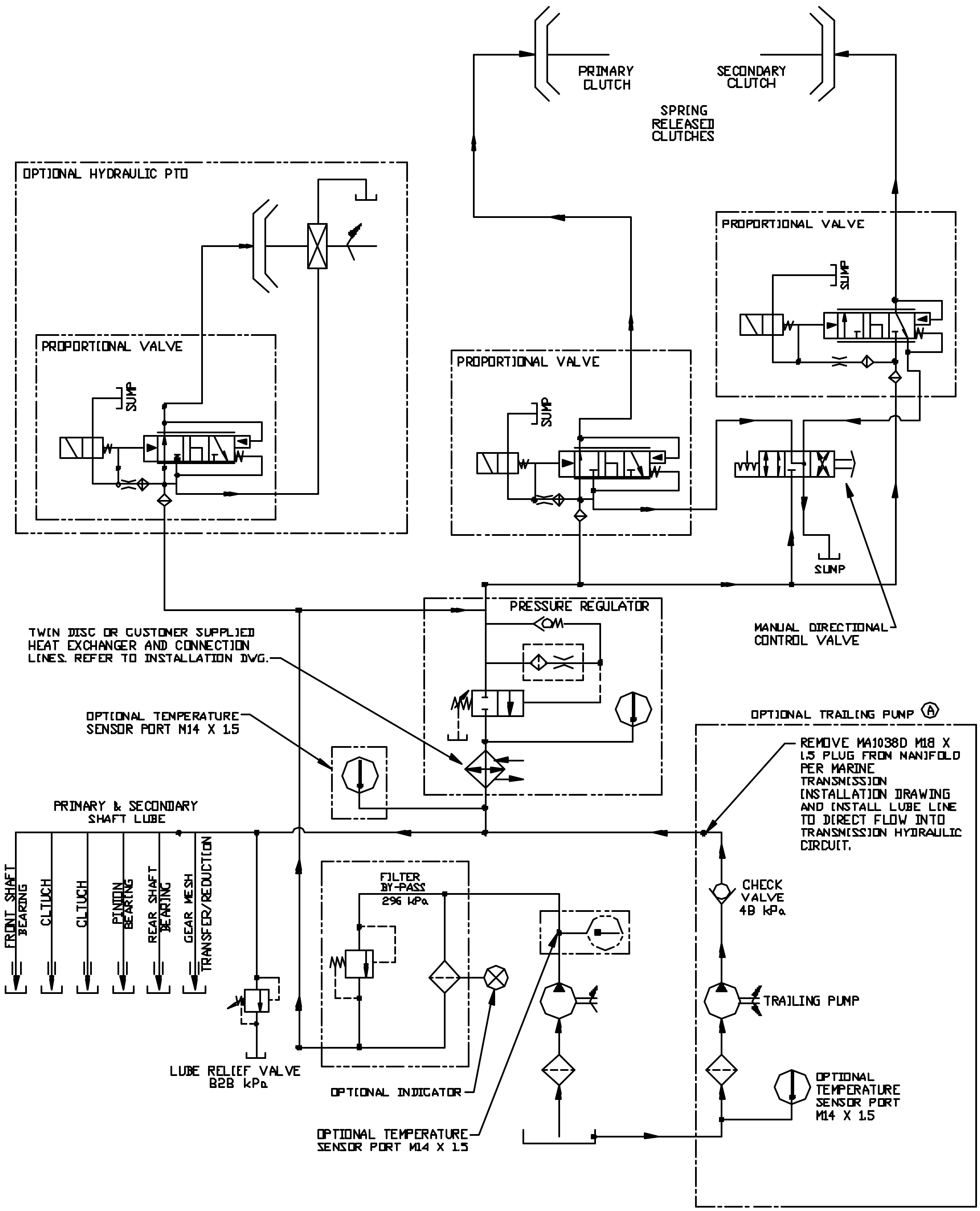


Figure 8. Hydraulic Schematic (GP control valve)

Manual Direction Control Valve Operation

The manual direction control valve is locked in the NEUTRAL (center) position during normal operation. There are three possible positions of the manual direction control valve stem. If conditions exist that the operator wishes to manually operate the transmission for any reason, the operator can remove the locking pin from the direction control valve, and push the stem into the valve for the engagement of clutch A, or pull it out of the valve for the engagement of clutch B. The manual direction control valve has an integral switch with contacts that are closed only when the manual direction control valve is in the NEUTRAL position. This switch must be wired such that the engine cannot be started while clutch A or clutch B is engaged.

CAUTION

Engagement of a clutch with the Manual Direction Control Valve should only be done with the engine at idle speed.

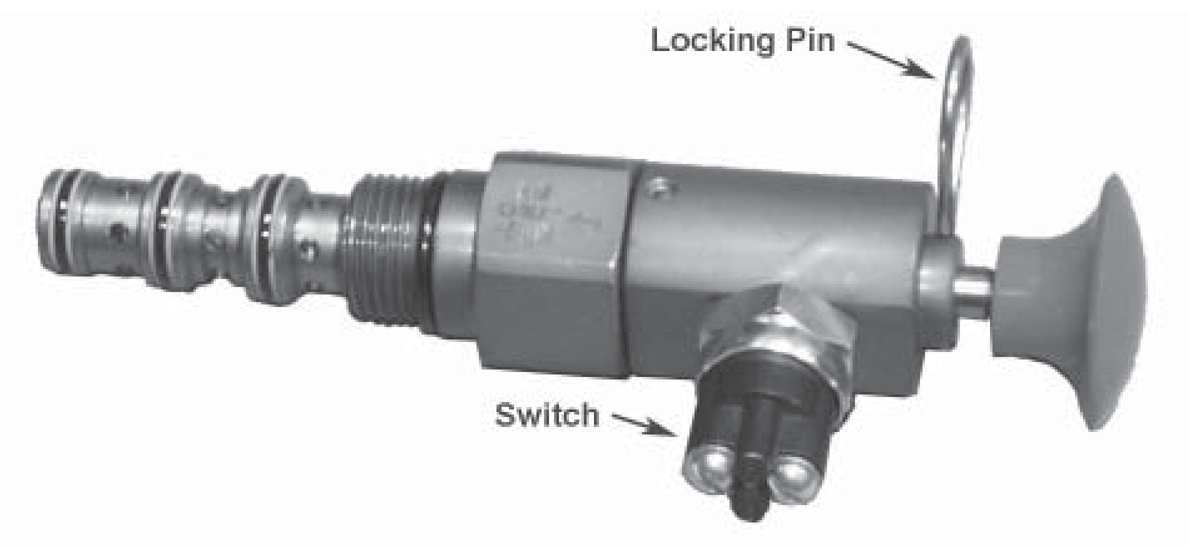


Figure 9. Manual Direction Control Valve

Manual Control Valve (1017172 or 1017546)

Note: The mechanical control valve (1017172) is basically the mechanical override portion of the 1018084 electric control valve. The 1017546 includes the trolling valve.

Hydraulic System with Manual Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil forces the pressure regulator piston against the springs to open the path to the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the heat exchanger to the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings. There is a lubrication oil pressure relief valve to limit maximum lubrication oil pressure to approximately 690 kPa (100 psi).

In Neutral, the inlet port of both clutches is connected to the atmosphere. Since the area behind the clutch pistons is open to sump, the clutches are disengaged. Oil is distributed through the lubrication system. The area between the pressure regulating piston and the rate-of-rise piston is connected to sump at all times to prevent any leakage oil from affecting the pressure regulation.

The pressure in the rate-of-rise chamber is controlled by a ball that is spring loaded against the orifice plate. The passage behind the ball and spring is connected to the sump (atmosphere) in Neutral and to main pressure when either clutch is engaged. A shuttle ball, connected to both clutch pressure ports, permits pressurizing this passage with oil from the engaged clutch without allowing oil to flow to the disengaged clutch.

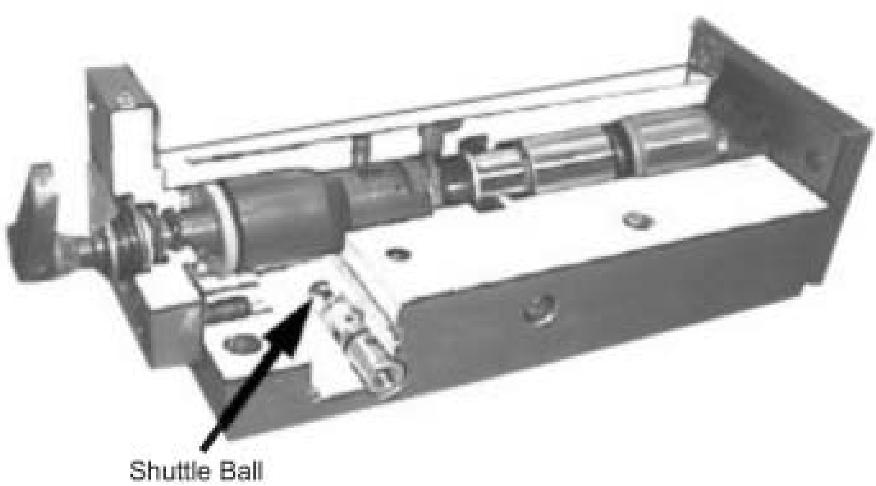


Figure 10. Location of Shuttle Ball

When the control valve is shifted to engage either clutch, the valve directs main pressure to engage the selected clutch pack. Oil is also directed to move the rate-of-rise piston, compressing the pressure regulator springs. This progressively increases the clutch engaging pressure causing the clutches to engage at a controlled rate.

The control valve allows only one clutch to be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Control Valve Assembly in Neutral

Some of the main pressure oil from the oil inlet chamber flows through a passage to the orifice in the orifice plate. The small flow of oil through this orifice fills and begins to pressurize the rate-of-rise chamber.

Both clutches are connected to sump when the control valve is in Neutral. Since there is no pressure acting on the shuttle ball from either clutch, the passage behind the ball and spring regulator is also connected to sump. This allows the oil pressure in the rate-of-rise chamber to be regulated by the ball and spring, since the overage oil can flow to sump. The oil pressure in the rate-of-rise chamber acting on the rate-of-rise piston causes it to stroke over partially, which compresses the pressure regulating springs additionally.

This additional spring compression further resists the movement of the pressure regulating piston, resulting in a force balance between the area at the pressure regulator, the springs, and the area behind the rate-of-rise piston. Neutral main pressure of approximately 40 psi is maintained by relieving excess oil behind the rate-of rise piston through the ball and spring regulator.

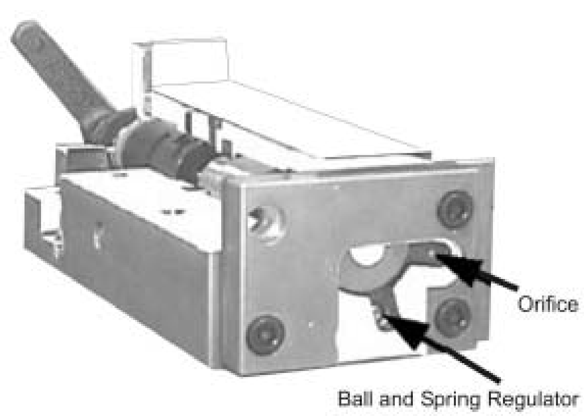


Figure 11. Neutral Regulator and Rate of Rise Orifice

Control Valve Assembly in Primary or Secondary

Pressurized oil is directed to one of the transmission's clutches to engage it. The pressurized oil in the clutch port of the engaged clutch acts on the shuttle ball, sealing off the passage to the opposite clutch. The pressurized oil also forces the ball of the ball and spring regulator against its seat on the orifice plate, stopping the flow of oil from the rate-of-rise chamber to sump. Since oil continues to flow into the rate-of-rise chamber through the orifice, the oil pressure in the rate-of-rise chamber increases. This increased oil pressure forces the rate-of-rise piston to stroke over to its stop in the valve body, compressing the pressure regulating springs even further yet.

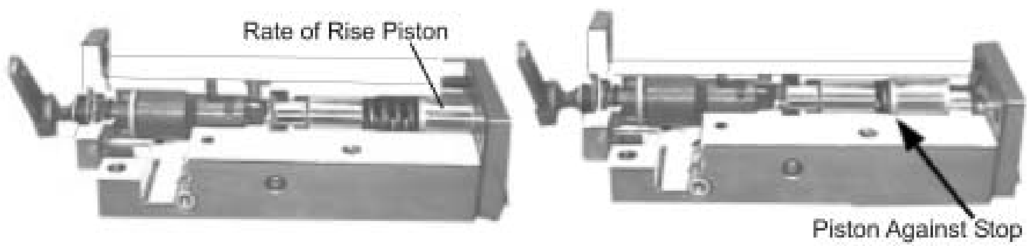


Figure 12. Rate of Rise Piston in Neutral (left) and Rate of Rise Piston with Clutch Engaged (right)

The travel rate of the rate-of-rise piston (and resulting pressure rate-of-rise) is controlled by the orifice size, regulator spring stiffness and the final main pressure after completion of the rate-of-rise cycle. Neutral main pressure controls the start time of the rate-of-rise cycle. When the rate-of-rise piston is against the stop (pressure regulating springs are compressed the most), the main oil pressure reaches approximately 290 psi.

When the control valve is shifted to Neutral, the clutch that was engaged is vented to sump within the valve. As a result, the passage behind the ball and spring regulator is vented to sump and induces a high differential pressure between the rate-of-rise chamber and the passage behind the ball and spring. Since the pressure in the rate-of-rise chamber is much greater than the pressure it is to be regulated at, the ball unseats from the orifice plate, allowing main oil pressure to return to the neutral pressure level rapidly and again be regulated by the ball and spring regulator. The ball returns to the pressure regulating position once the spring force is equal to force induced by the pressure at the rate-of-rise piston.

Electric Control Valve (1018084)

Hydraulic System with Electric Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil forces the pressure regulator piston against the springs to open the path to the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the heat exchanger to the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings. There is a lubrication oil pressure relief valve to limit maximum lubrication oil pressure to approximately 690 kPa (100 psi).

In Neutral, the inlet port of both clutches is connected to the atmosphere. Since the area behind the clutch pistons is open to sump, the clutches are disengaged. Oil is distributed through the lubrication system. The area between the pressure regulating piston and the rate-of-rise piston is connected to sump at all times to prevent any leakage oil from affecting the pressure regulation.

The pressure in the rate-of-rise chamber is controlled by a ball that is spring loaded against the orifice plate. The passage behind the ball and spring is connected to the sump (atmosphere) in Neutral and to main pressure when either clutch is engaged. A shuttle ball, connected to both clutch pressure ports, permits pressurizing this passage with oil from the engaged clutch without allowing oil to flow to the disengaged clutch.

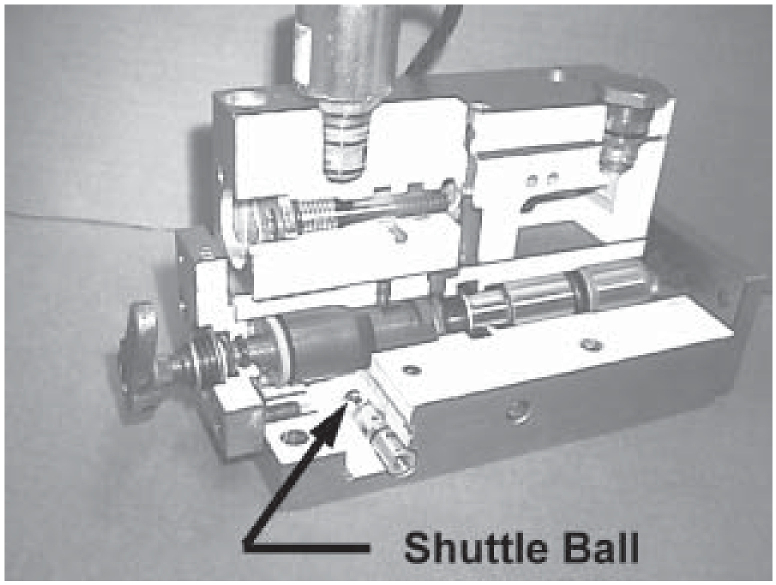


Figure 13. Location of Shuttle Ball

The electric control valve can be used in a manual override mode in the event of an electrical power failure.

When the control valve is energized or shifted to engage either clutch, the valve directs main pressure to engage the selected clutch pack. Oil is also directed to move the rate-of-rise piston, compressing the pressure regulator springs. This progressively increases the clutch engaging pressure causing the clutches to engage at a controlled rate.

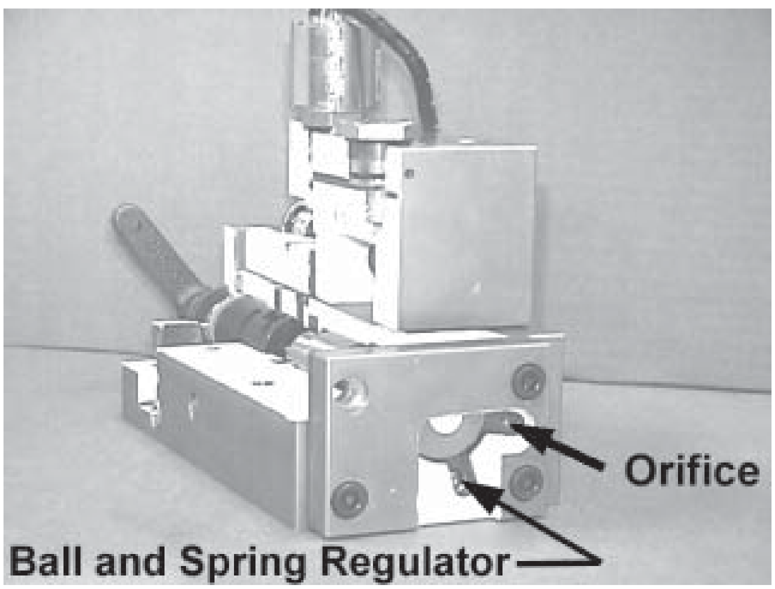
The control valve allows only one clutch to be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Control Valve Assembly in Neutral

Some of the main pressure oil from the oil inlet chamber flows through a passage to the orifice in the orifice plate. The small flow of oil through this orifice fills and begins to pressurize the rate-of-rise chamber.

Both clutches are connected to sump when the control valve is in Neutral. Since there is no pressure acting on the shuttle ball from either clutch, the passage behind the ball and spring regulator is also connected to sump. This allows the oil pressure in the rate-of-rise chamber to be regulated by the ball and spring, since the overage oil can flow to sump. The oil pressure in the rate-of-rise chamber acting on the rate-of-rise piston causes it to stroke over partially, which compresses the pressure regulating springs additionally.

This additional spring compression further resists the movement of the pressure regulating piston, resulting in a force balance between the area at the pressure regulator, the springs, and the area behind the rate-of-rise piston. Neutral main pressure of approximately 40 psi is maintained by relieving excess oil behind the rate-of rise piston through the ball and spring regulator.



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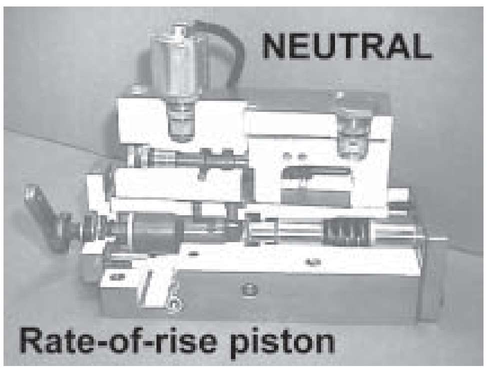
Pressurized oil is directed to one of the transmission's clutches to engage it. The pressurized oil in the clutch port of the engaged clutch acts on the shuttle ball, sealing off the passage to the opposite clutch. The pressurized oil also forces the ball of the ball and spring regulator against its seat on the orifice plate, stopping the flow of oil from the rate-of-rise chamber to sump. Since oil continues to flow into the rate-of-rise chamber through the orifice, the oil pressure in the rate-of-rise chamber increases. This increased oil pressure forces the rate-of-rise piston to stroke over to its stop in the valve body, compressing the pressure regulating springs even further yet.



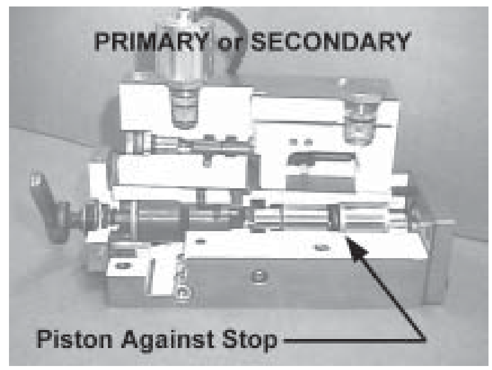


Figure 15. Rate of Rise Piston in Neutral (left) and Rate of Rise Piston with Clutch Engaged (right)

The travel rate of the rate-of-rise piston (and resulting pressure rate-of-rise) is controlled by the orifice size, regulator spring stiffness and the final main pressure after completion of the rate-of-rise cycle. Neutral main pressure controls the start time of the rate-of-rise cycle. When the rate-of-rise piston is against the stop (pressure regulating springs are compressed the most), the main oil pressure reaches approximately 290 psi.

When the control valve is shifted to Neutral, the clutch that was engaged is vented to sump within the valve. As a result, the passage behind the ball and spring regulator is vented to sump and induces a high differential pressure between the rate-of-rise chamber and the passage behind the ball and spring. Since the pressure in the rate-of-rise chamber is much greater than the pressure it is to be regulated at, the ball unseats from the orifice plate, allowing main oil pressure to return to the neutral pressure level rapidly and again be regulated by the ball and spring regulator. The ball returns to the pressure regulating position once the spring force is equal to force induced by the pressure at the rate-of-rise piston.

Electric Operation

The transmission normally operates with the control valve in the electric mode. Two spools, each controlled by a solenoid operated pilot valve, control clutch engagement. When a solenoid is energized, it opens the pilot valve and allows main pressure oil to flow to the end of the spool. The pressure acting on the end of the spool overcomes the return spring at the opposite end, causing the spool to stroke over and connect the clutch passage with main pressure passage.

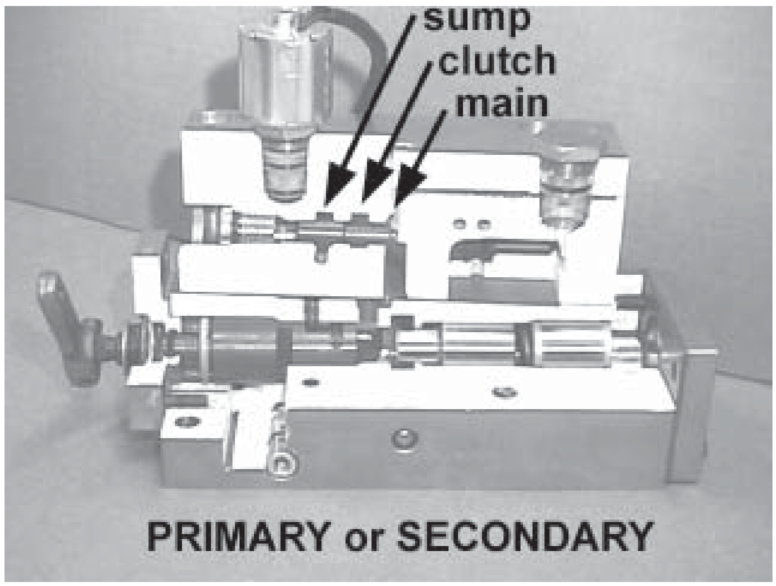


Figure 16. Pilot Spool Passages

Main pressure oil flows from the spools above to the clutch passages of the transmission below via connecting slots in the manual override stem. These connecting slots are aligned with passages in the valve body when the valve is in the electric mode.

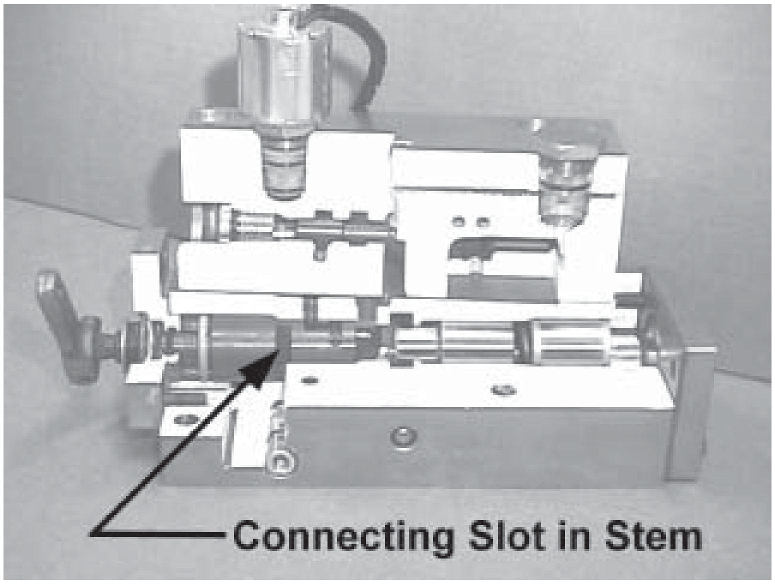


Figure 17. Flow Path in Override Spool

Main pressure from the energized solenoid operated pilot valve also acts on a pin on the return spring side of the opposite spool to ensure the opposite spool is connecting its clutch to sump. The clutch engagement cycle is outlined in the previous section.

Hydraulic Lock Feature (some models)

Some control valve models have a hydraulic lock feature, and are identifiable by a third solenoid operated pilot valve. This feature keeps the engaged clutch pressurized as long as the engine remains running, should electrical power fail or malfunction occur while the clutch is engaged. The hydraulic lock is accomplished by allowing pressurized oil (from the pressurized clutch passage) to flow inside the spool. Oil pressure inside the spool forces the dowel pin against the O-ring plug.

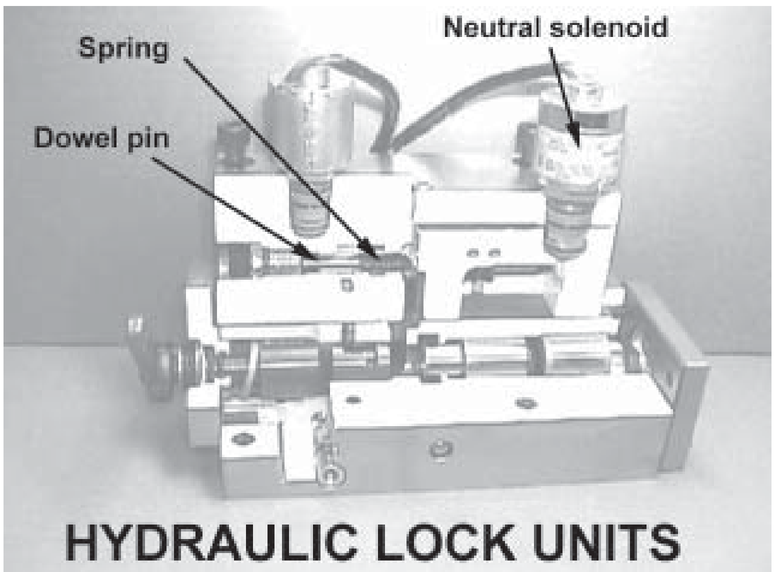


Figure 18. Hydraulic Lock Units

The resulting reaction is a force on the spool that overcomes the spool's return spring force. Should the solenoid become de-energized while the spool has its clutch pressurized, oil pressure will keep the spool in that position. This keeps the transmission in gear as long as the engine is running.

The hydraulic lock is disabled when either the engine is stopped, or the neutral solenoid is energized. When the neutral solenoid is energized, it sends pressurized oil to the dowel pins at the return spring end of each spool.
Since the dowel pin used at the return spring side of the spool is larger in diameter than the dowel pin inside the spool, the hydraulic force acting on the larger pin forces the spool to connect the clutch passage to sump with assistance from the return spring.

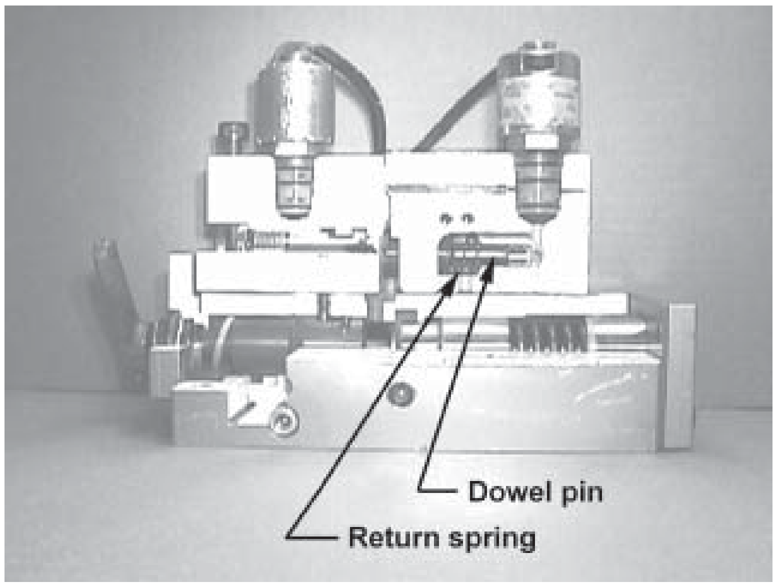


Figure 19. Neutral Solenoid Engaged

Manual Override Operation

The control valve has a manual override feature, which is a lever operated selector. When the manual override lever is rotated counterclockwise and pulled outwards, the upper portion of the valve is disabled because the connecting slots in the manual override stem are no longer aligned with the oil passages in the valve body. Oil pressure from the solenoid operated pilot valve controlled spools cannot reach the clutch pressure passages in the transmission. The main oil pressure regulator, shuttle ball, neutral pressure regulator, and rate-of-rise functions remain exactly the same as when the valve is in the electric mode. In the manual override position, shifting is controlled by rotating the lever on the manual override stem.

In the Neutral position, both clutches are vented to sump by two pockets in the stem.

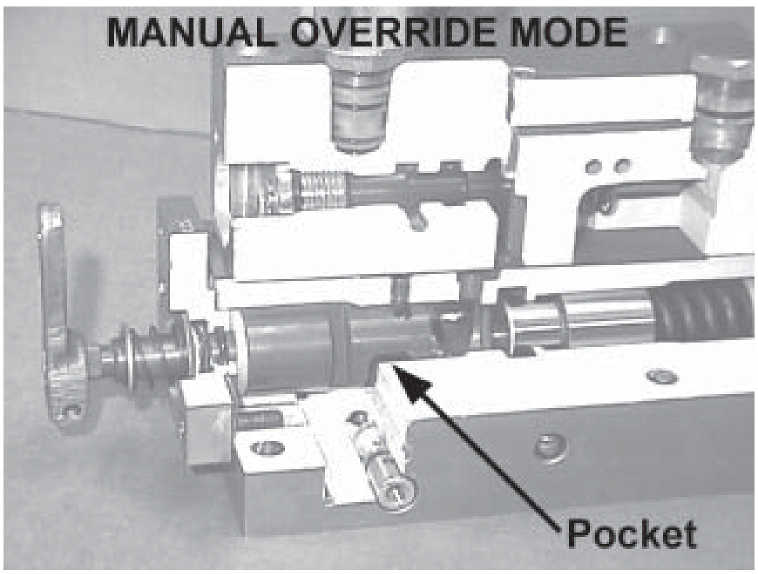


Figure 20. Stem Pocket or Passage

Main pressure oil can flow through the hole in the end of the stem to a narrow slot between the two pockets. This slot does not connect to any other passages when the stem is in the Neutral position.

When the lever and stem are rotated to engage either the primary or secondary clutch, main pressure oil flows through the slot in the stem to the appropriate clutch pressure port. The opposite clutch port passage remains connected to sump by the same pocket in the stem as when the stem was in the Neutral position. When the stem is rotated back to the Neutral position, the main pressure oil slot in the stem is no longer aligned with either clutch port. Both clutches are again vented to sump by the two pockets in the stem.

Trolling Valve (Optional)

The trolling valve is used to reduce and control propeller speed below that normally attained by operating the engine at low idle. Actuating the trolling function reduces clutch apply pressure to reduce the propeller speed.

E-Troll Electronic Interface

An E-Troll electronic interface module is available for use with the GP Control Valve.

1017555 Mechanical Trolling Valve

This trolling valve is a variable orifice that controls the pressure in the rate-of-rise chamber. The pressure in the rate-of-rise chamber determines the rate-of-rise piston position, which ultimately controls the main and clutch pressures for the transmission.

When the trolling valve lever is in the detent (non-trolling) position, the orifice in the trolling valve is closed. Oil cannot exit from the rate-of-rise chamber through the trolling valve's orifice, and the rate-of-rise chamber is fully pressurized (the ball and spring regulator is blocked when either clutch is engaged). This full pressure causes the rate-of-rise piston to remain against its stop in the valve body bore, and main oil pressure is not reduced.

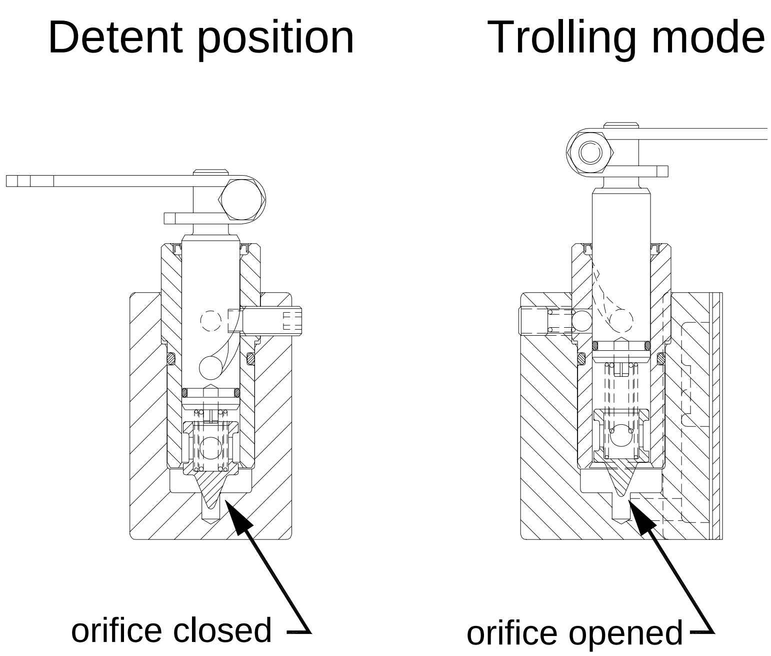


Figure 21. Mechanical Trolling Valve

Rotating the trolling valve lever into the trolling mode opens the variable orifice, allowing some of the oil to escape from the rate-of-rise chamber to sump. This reduces the oil pressure in the rate-of-rise chamber. Since oil is always flowing into the rate-of-rise chamber through the orifice in the orifice plate, the pressure in the rate-of-rise chamber is controlled by how much oil is allowed to exit through the trolling valve's variable orifice. The trolling valve lever position determines the pressure in the rate-of-rise chamber, which determines main oil pressure. Main oil pressure is always the same as the oil pressure in the engaged clutch with this type of trolling valve.

1017554 Electric Trolling Valve

This trolling valve is a variable orifice that controls the pressure in the rate-of-rise chamber. The pressure in the rate-of-rise chamber determines the rate-of-rise piston position, which ultimately controls the main and clutch pressures for the transmission. The only difference between the electric trolling valve and the previously described mechanical trolling valve is that the electric trolling valve's orifice size is controlled by electrical current instead of a lever.

When the trolling valve is in the cruise (non-trolling) mode, the orifice in the trolling valve is closed. Oil cannot exit from the rate-of-rise chamber through the trolling valve's orifice, and the rate-of-rise chamber is fully pressurized (the ball and spring regulator is blocked when either clutch is engaged). This full pressure causes the rate-of-rise piston to remain against its stop in the valve body bore, and main oil pressure is not reduced.

The trolling valve is actuated by sending a controlled amount of current through the valve's coil. As the current is increased, the orifice progressively opens, allowing oil pressure from the rate-of-rise chamber to escape to sump. Since oil is always flowing into the rate-of-rise chamber through the orifice in the orifice plate, the pressure in the rate-of-rise chamber is controlled by how much oil is allowed to exit through the trolling valve's variable orifice. Since the oil pressure in the rate-of-rise chamber is reduced, clutch pressure is reduced which allows the clutch plates to slip. The amount of clutch slip is controlled by the current flow (amps) through the valve's coil. Decreasing the current through the valve's coil will increase clutch pressure and therefore reduce clutch slip. Main oil pressure is always the same as the oil pressure in the engaged clutch with this type of trolling valve. The 1017170 valve contains no user serviceable parts, and is available only as an assembly.

Power Take-off (Optional)

There is a separate manual (part number 1020075) which describes the operation, installation, troubleshooting, and service of the optional Power Takeoffs (PTO) for this marine transmission.

Live Power Take-off (1017177)

The live PTO drives accessories using engine horsepower. Since the live PTO connects the accessory to the primary shaft of the transmission via a direct coupling, the accessory is driven whenever the engine is running.

Hydraulic Clutched Power Take-off (1017820E)

The 1017820E model has internal splines and accepts an SAE J744 size "C" pump.

The hydraulic clutched PTO also allows accessories to be driven using engine horsepower. Since the PTO is attached to the primary shaft of the transmission, the accessories can be driven any time the engine is running. The PTO is engaged by closing a customer supplied switch.

The hydraulic clutched PTO operates with an engaged clutch pressure equal to that of the transmission's primary and secondary clutches. The pressure is set by the main pressure regulator valve in the General Purpose Control Valve.

Trailing Pump (Optional)

The trailing pump is used to supply oil flow to the transmission lubrication circuit when the transmission is in a backdriving condition. Backdriving (sometimes referred to "windmilling") occurs when the engine is shut down and the transmission output shaft is being driven by water flow across the propeller.

An optional mechanically driven trailing pump is available, and is mounted on the lower left rear of the transmission. A serviceable suction screen is located below the trailing pump.

An optional electric motor driven trailing pump is available, and oil flow from the trailing pump flows through a check valve into the transmission's lubrication circuit via one of the pressure test ports.

Power Flow

Input power to the transmission is through a torsional coupling mounted on the engine flywheel. The coupling is mounted to the front end of the primary clutch shaft causing the primary shaft to rotate in engine direction during engine operation. Power is transmitted to the secondary shaft by means of the transfer gear teeth on the outer diameter of the primary clutch housing. These teeth are in constant mesh with gear teeth on the of the secondary clutch housing causing the secondary shaft to rotate in anti-engine direction. The primary and secondary pinions on their respective shafts are in constant mesh with the output gear, which is connected to the output shaft through a keyless tapered joint.

Application of the primary clutch locks the primary pinion to the primary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in anti-engine direction. Application of the secondary clutch locks the secondary pinion to the secondary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in engine direction.

Note: The following power flow illustrations are shown merely as examples of power flow and may not pertain specifically to your unit.

Neutral

When in neutral the primary and secondary shafts, transfer gears and clutch friction plates rotate at engine

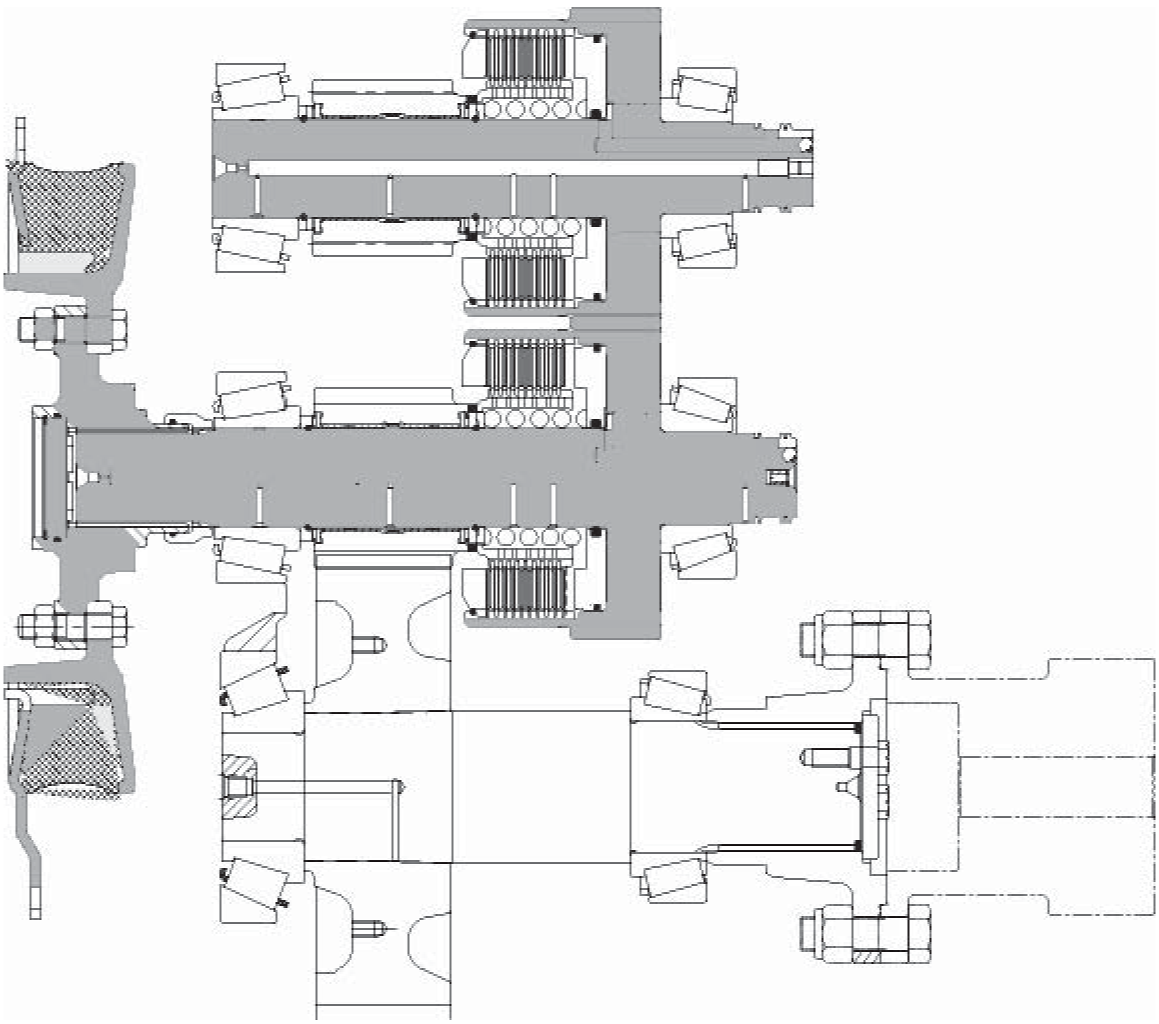


Figure 22. Example of Power Flow in Neutral

Primary

When the primary position is selected, hydraulic pressure is applied to the primary clutch piston clamping the friction and steel clutch plates together. The primary input pinion will then rotate at engine speed and direction because the steel plates are spline connected through the clutch hub assembly to the pinion. Because the primary input pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The secondary input pinion will be backdriven (engine direction) when the unit is in the primary position.

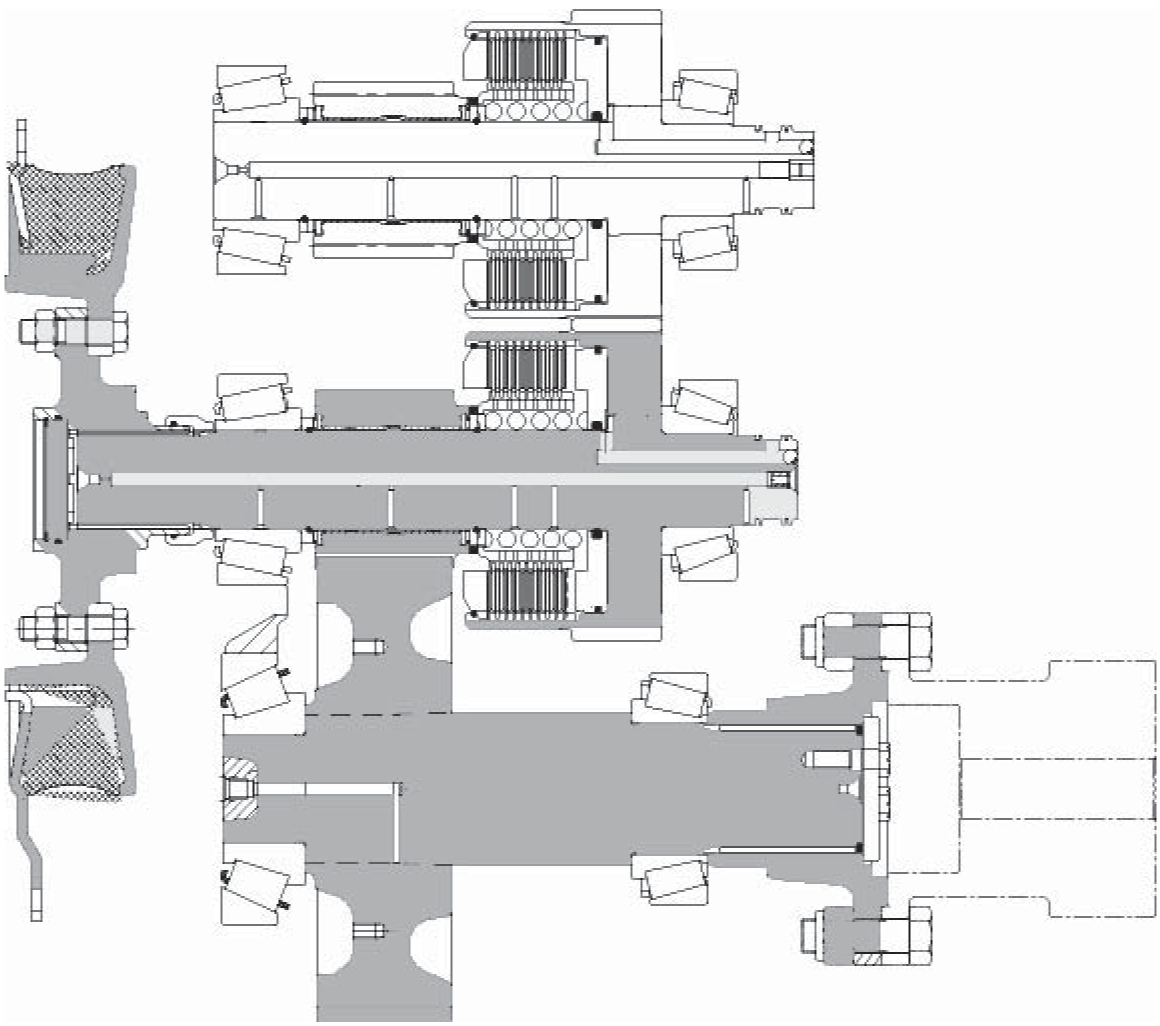


Figure 23. Example of Power Flow with Primary Clutch Engaged

Secondary

In secondary, the same parts are turning that were turning in neutral. When the secondary position is selected, hydraulic pressure is applied to the secondary clutch piston clamping the friction and steel plates together. The secondary input pinion will then rotate at engine speed and anti-engine direction, because the steel clutch plates are spline connected through the clutch hub assembly to the input pinion. Because the secondary input pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The primary input pinion will be backdriven (anti-engine direction) when the unit is in the secondary position.

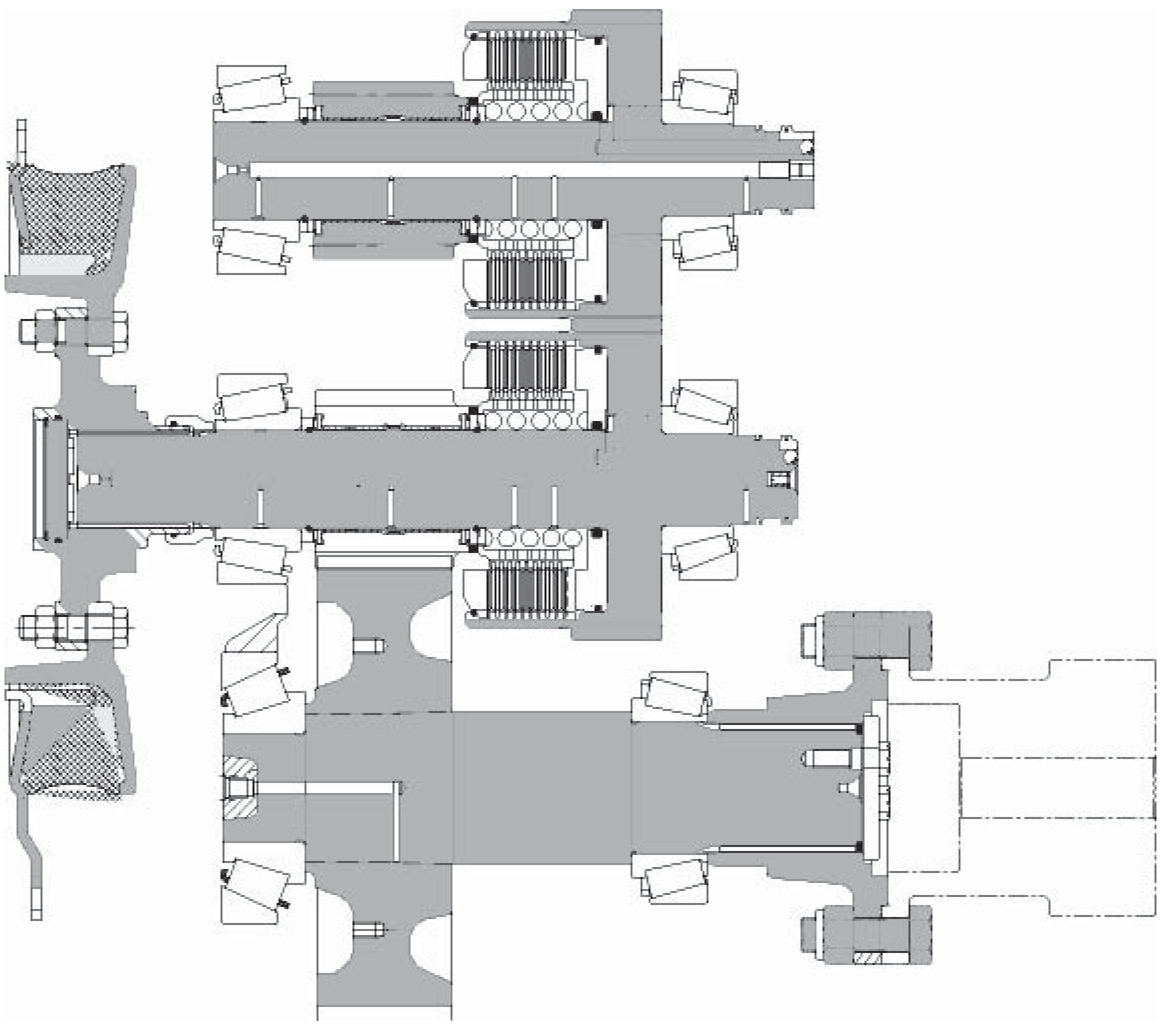


Figure 24. Example of Power Flow with Secondary Clutch Engaged

Preventative Maintenance

In-boat Maintenance and Repair

Certain transmission maintenance/repair procedures can be accomplished in the boat provided sufficient space exists to work. These procedures are:

- ❑ Removing and installing the oil pump.
- ❑ Changing the filter.
- ❑ Removing, cleaning and installing the suction strainer.
- ❑ Removing and installing the control valve.
- ❑ Removing and installing the manifold.

Note: Further disassembly/reassembly of the primary or secondary shafts will require removal from the engine, and the use of tools and equipment normally not available on board the vessel.

Lubrication

Grease the oil seals on the output end of the output shaft through the grease fitting with water pump (lithium soap based NLGI No. 2) grease. Apply grease every 100 hours, or when the boat is docked.

No other lubrication is required beyond the daily oil check.

General Maintenance

Overhaul Interval

A complete overhaul and thorough inspection of the unit should be made at the same time as the scheduled engine overhaul. Refer to Cleaning and Inspection for more detailed inspection instructions.

Oil System

Oil Level

The oil level should be checked daily or every 10 hours. Check oil level before starting the engine to confirm that the transmission has oil in it. With the engine running at low idle and the transmission in Neutral, check the oil again. The oil level should be near the “low” oil level mark. Transmission oil temperature should be in the normal operating range prior to finalizing the oil level between the low and full marks on the oil level gauge.

Oil and Filter Change Interval (Maximum)

Note: A suction screen is located in the suction line to the pump, and the oil filter is located in the pump outlet line. Both should be checked and cleaned at the stated intervals.

With a new transmission, change the oil and filter element, and clean the suction strainer (screen) within the first 50 hours of operation. Change oil and filter element and clean the screen after each 1000 hours thereafter or more often if conditions warrant.

For a rebuilt transmission, check the filter element (and/or screen) after eight hours of operation. If the filter and/or screen is clean, install a new filter element and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service or more often if conditions warrant.

Draining

Drain the transmission by removing the O-ring plug at the rear side at the bottom. Use a 38 mm wrench to loosen the drain plug.

Oil Suction Strainer

Remove and clean the pump suction strainer at every oil change or sooner if necessary. The suction strainer is located in the manifold below the pump. See Engineering Drawings for suction strainer location. (See discussion under oil change interval.)

Type Oil Recommended

See Description and Specifications.

Filling

1. Remove the filler breather in the top of the transmission.
2. Fill the transmission's sump with the proper weight and type oil. See Description and Specifications for oil recommendations.
3. Start the engine and let it idle with transmission in neutral until oil is circulated throughout the hydraulic system. Add oil if necessary to bring the oil level up to the "low" mark with the engine at low idle.
4. With the oil at operating temperature, transmission in neutral, and the engine running at low idle, check the oil level with the oil gauge. Add or remove oil if necessary to bring the oil level to "FULL" mark on the oil gauge. Allow the oil temperature to cool to normal cold oil conditions (perhaps overnight). Check the oil level while cold at low idle engine speed while in neutral. This is the proper oil level with cold oil. Make note of the oil level in the cold conditions for future reference. **DO NOT** overfill the transmission. The oil level should not be over the full mark at operating temperature.

⚠ IMPORTANT

Liquid sealant must cure for a minimum of 24 hours prior to contact with oil.

Periodic Visual Inspection

General

- ❑ Check the mountings for tightness or damage such as cracks. Tighten loose mountings and replace damaged parts.
- ❑ Check pressure and temperature gauge where applicable.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.
- ❑ Inspect unit nameplates for looseness and corrosion. Tighten mounting screws that are loose and replace nameplates that are corroded.
- ❑ Inspect and oil the exposed stem of the Manual Direction Control Valve for corrosion protection.

Torsional Coupling

DO NOT obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. The ambient temperature of the air around the coupling should be between -6° C (22° F) and 80° C (176° F). Assure baffles are installed properly so hot air is ported out of the housing.

Visually inspect the element after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. The above-described items affect the life of the coupling element. Perform a complete inspection whenever the transmission is removed from the engine for any reason.

When inspecting the flexible coupling, look for evidence or conditions identified in the following steps:

- ❑ Cracks in the surface of the rubber. May be caused by torsional vibrations, excessive misalignment or exposure to contaminants (heat, petroleum products, chemicals, ozone, ultraviolet radiation, etc.) excessive system torques.
- ❑ Separation of rubber from flex plate on coupling plate or deterioration of the rubber-to-metal bond. See above.
- ❑ Deterioration of the rubber element, as evidenced by sponginess or by black carbon-like dust on rubber surface may be caused by contaminants or excessive heat, either external or internal to the coupling.
- ❑ Cracked, bent or otherwise damaged flex plate or coupling plate.
- ❑ Bolt holes in flex plate or coupling plate elongated or deformed. This could be caused by improperly assembled parts, loose parts, vibration or improperly torqued parts.
- ❑ Bolts/nuts bent, worn or stripped threads.

Inspect the hub, looking for the following:

- ❑ Damaged or worn splines.
- ❑ Cracked parts.
- ❑ Oil seal surface for wear or damage.

Replace any defective parts including defective fasteners that are found.

Heat Exchanger Check

Inspect heat exchanger oil lines for leaky connections, kinks, cracks or other damage. Replace damaged lines.

Heat exchangers furnished by Twin Disc to be used for salt water applications have zinc rods installed at the inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection.

Excessive corrosion of the zinc rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or external grounded electric current. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign materials, they should be cleaned with a wire brush.

Troubleshooting

Troubleshooting of Mechanical and Electric Control Valve

General

Note: Some troubleshooting procedures may vary depending on the type of control valve that is installed on the transmission. A thorough understanding of the valve operation is important to properly troubleshoot the problem that is occurring.

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

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Pressure Test Kit

The Digital Pressure Transducer Kit (BOM 42168) provides two pressure transducers (0 to 500 psi) with hydraulic quick couplings, a power supply box for the transducers, and cables needed to connect the transducers to the power supply box and the signals out of the power supply box to a customer supplied digital volt meter. Contact the Twin Disc Service Department, Racine Wisconsin for specific information concerning this test kit.

One principle of troubleshooting is to start with the simple and move to the more difficult. Check the simple items first. Run the simple test first. Then move to the more difficult.

Figure 25. Test kit 42168

Table 15. Troubleshooting Chart
Mechanical and Electric Control Valves

Symptom	Cause	Remedy
1. Low main oil pressure	1-1. Partially clogged oil strainer.	1-1. Remove and clean oil strainer.
	1-2. Stuck pressure regulator.	1-2. Disassemble the valve.
	1-3. Broken piston rings on clutch shaft(s).	1-3. Remove the collector and inspect piston rings.
	1-4. Damaged or worn oil pump assembly.	1-4. Replace damaged or worn oil pump assembly.
	1-5. Incorrect linkage adjustment to control valve assembly.	1-5. Adjust linkage so that valve stem is indexed properly by detent.
	1-6. Clogged or plugged orifice in orifice plate of control valve assembly.	1-6. Remove orifice plate cover. Clean parts.
	1-7. Shimming required between regulator springs and rate-of-rise piston.	1-7. Shim as required.
	1-8. Engine idle speed too low.	1-8. Raise engine speed.
2. No oil pressure or erratic low pressure at control valve tap.	2-1. Oil pump strainer plugged.	2-1. Remove and clean strainer.
	2-2. Oil level low.	2-2. Check oil level and correct.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive on reverse clutch shaft broken.	2-4. Disassemble and repair as required.
	2-5. Regulating valve stuck in open position.	2-5. Remove, disassemble, clean and repair the regulating valve.
	2-6 Oil pump defective.	2-6. Replace oil pump.
	2-7. Leaking heat exchanger has caused oil to be lost overboard.	2-7. Replace heat exchanger.
3. High main oil pressure.	3-1. Regulating valve stuck.	3-1. Remove, clean regulating valve.
	3-2 Improperly shimmed.	3-2 Shim as required.
	3-3. Lube relief valve malfunction.	3-3. Inspect, repair or replace parts as necessary.

Table 15. Troubleshooting Chart (continueed)
Mechanical and Electric Control Valves

Symptom	Cause	Remedy
4. High temperature.	4-1. Improper oil level.	4-1. Check and fill (or drain) with proper oil to correct level.
	4-2. Faulty heat exchanger.	4-2. Inspect, repair or replace heat exchanger.
	4-3. Clutches slipping.	4-3. Check clutch apply oil pressure. If pressure is normal, remove, disassemble and repair slipping clutch.
	4-4. Bearing failure.	4-4. Overhaul marine transmission.
	4-5. Air leak on suction side of pump.	4-5. Inspect and correct cause of suction leak.
	4-6. Control valve malfunction.	4-6. Inspect, repair or replace control valve.
5. Excessive noise.	5-1. Bearing failure.	5-1 Overhaul marine transmission.
	5-2 Worn or damaged input coupling.	5-2. Remove marine transmission. Replace worn or damaged coupling.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional coupling.
	5-4. Worn or damaged gears.	5-4. Overhaul marine transmission.
	5-5. Improper alignment.	5-5. Check alignment of engine transmission output flange to propeller shaft. Correct as necessary.
	5-6. Damaged propeller.	5-6. Repair propeller.
	5-7. Misfiring engine.	5-7. Repair engine.
6. No neutral.	6-1. Clutch plates warped.	6-1. Remove clutch plates.
	6-2. Control valve incorrectly indexed.	6-2. Check and adjust control
	6-3. Solenoid malfunction (units equipped with electric selector valve).	6-3. Inspect, repair or replace parts as necessary.
	6-4. Hydraulic lock piston stuck (units equipped with electric selector valve).	6-4. Inspect, repair or replace hydraulic lock spool.

Table 15. Troubleshooting Chart (continueed)

Mechanical and Electric Control Valves

Symptom	Cause	Remedy
7. Harsh engagement.	7-1 Regulating piston or rate-of-rise piston stuck.	7-1. Disassemble control valve. Clean parts. Replace parts if necessary.
	7-2. Orifice plate ball in control valve not seating properly.	7-2. Remove orifice plate cover. Clean parts. Replace parts if necessary.
	7-3. Blown gasket on either side of orifice plate.	7-3. Replace gasket.
8. Oil spilling out of breather.	8-1. Pump flow output too low.	8-1. Replace pump.
	8-2. Pump suction strainer plugged.	8-2 Remove, clean, inspect and install suction screen.
	8-3. Air leak on suction side of pump.	8-3. Inspect and correct cause of suction leaks.
	8-4. Lube relief valve malfunction.	8-4. Remove and clean or replace parts as necessary.
	8-5. Broken piston rings.	8-5 Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high.	9-1. Adjust oil level.
	9-2. Wrong type of oil.	9-2. Draw and refill with recommended oil.

Troubleshooting of GP Control Valve with Electronic Interface

General

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Electronic Interface LED Indicators

The electronic interface control modules have one green and two red led indicator lights. The green power light is illuminated only when the transmission is in gear.

The following table lists the reasons for the various conditions where lights are illuminated. This should guide in troubleshooting problems. See the wiring schematics in the Installation Section.

Troubleshooting Tables begin on the next page.

Table 16. LED Light Status

Light Status	Profile Generator (Non trolling)	E-troll Module
Green light on	Supply voltage > 9.0 volts.	Supply voltage > 9.0 volts.
Red light on	Valve coil command on.	Valve coil command on.
One red light flashing	All Units: Open circuit in an energized valve coil circuit. MG Units Only: Valve coil leads shorted together or low coil current.	Open circuit in an energized valve coil circuit or valve coil leads shorted together or low coil current.
Both red light flash simultaneously	MG Units: Power is applied to solenoid A and B switch inputs at the same time. MGX Units: Not applicable.	After entering troll from neutral with both voltage and current troll speed signals present, or power is applied to solenoids A and B switch inputs at the same time.
Both red light flash alternately	Not applicable	Either or both speed signals missing.

Table 17. Troubleshooting Chart

1021658 and 1020941 GP Control Valves with Electronic Interface

Symptom	Cause	Remedy
1. Low main oil pressure.	1-1. Partially clogged oil strainer.	1-1. Remove and clean oil strainer.
	1-2. Improper adjustment of main pressure regulating valve.	1-2. Adjust the Main Regulator Valve.
	1-3. Weak or broken springs in the Main Regulator Valve.	1-3. Replace the Main Regulator Valve spring.
	1-4. Broken piston rings on clutch shaft(s).	1-4. Remove the collector and inspect piston rings.
	1-5. Damaged or worn oil pump assembly.	1-5. Replace damaged or worn oil pump assembly (pump is not serviceable).
	1-6. Engine idle speed too low.	1-6. Raise engine speed.
2. No oil pressure, or erratic low pressure at control valve tap.	2-1. Oil pump suction strainer plugged.	2-1. Remove and clean strainer.
	2-2. Oil level low.	2-2. Check oil level and correct.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive on reverse clutch shaft broken.	2-4. Disassemble and repair as required.
	2-5. Main regulating valve stuck in open position.	2-5. Remove, clean, or replace the Main Regulating valve.
	2-6. Oil pump defective.	2-6. Replace oil pump.
	2-7. Leaking heat exchanger has caused oil to be lost over board.	2-7. Replace heat exchanger.

Table 17. Troubleshooting Chart (continued)

1021658 and 1020941 GP Control Valves with Electronic Interface

Symptom	Cause	Remedy
3. High main oil	3-1. Main Regulator Valve is out of adjustment.	3-1. Adjust Main Regulator Valve.
	3-2. Main Regulating Valve orifice and ball check passages blocked.	3-2. Replace orifice valve and ball check cartridge.
4. High temperature.	4-1. Improper oil level.	4-1. Check and fill (or drain) with proper oil to the correct level.
	4-2. Faulty heat exchanger.	4-2. Inspect, repair, or replace heat exchanger.
	4-3. Clutches slipping.	4-3. Check clutch apply oil pressure. If pressure is normal, remove, disassemble, and repair slipping clutch. If pressure is low, replace Proportional Valve, and service transmission oil filter.
	4-4. Bearing failure.	4-4. Overhaul marine transmission.
	4-5. Air leak on suction side of pump.	4-5. Inspect and correct cause of suction leak.
	4-6. Control valve malfunction	4-6. Inspect, repair, or replace control valve.
5. Excessive Noise.	5-1. Bearing failure.	5-1. Overhaul marine transmission.
	5-2. Worn or damaged input coupling.	5-2. Remove marine transmission. Replace a worn or damaged coupling.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional coupling.
	5-4. Worn or damaged gears.	5-4. Overhaul marine transmission.
	5-5. Improper alignment.	5-5. Check alignment of engine and transmission output flange to propeller shaft. Correct as necessary.
	5-6. Damaged propeller.	5-6. Repair propeller.
	5-7. Misfiring engine.	5-7. Repair engine.

Table 17. Troubleshooting Chart (continued)

1021658 and 1020941 GP Control Valves with Electronic Interface

Symptom	Cause	Remedy
6. No neutral.	6-1. Clutch plates warped.	6-1. Remove clutch plates. Overhaul unit.
	6-2. Disengaged clutch has apply pressure.	6-2. Replace Proportional Valve. Service transmission oil filter.
7. Harsh engagement.	7-1. Faulty Proportional Valve.	7-1. Replace Proportional Valve.
	7-2. Faulty Temperature Sensor (if equipped).	7-2. Replace Temperature Sensor.
	7-3. Profile Generator defective or out of adjustment.	7-3. Replace Profile Generator. Adjust if proper equipment is available.
8. Low lube oil pressure.	8-1. Pump flow output too low.	8-1. Replace pump.
	8-2. Pump suction strainer plugged.	8-2. Remove, clean, inspect, and install the suction screen.
	8-3. Air leak on suction side of pump.	8-3. Inspect and correct cause of suction leaks.
	8-4. Lube relief valve malfunction.	8-4. Remove and clean or replace parts as necessary.
	8-5. Broken piston rings.	8-5. Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high.	9-1. Adjust oil level.
	9-2. Wrong type of oil.	9-2. Draw and refill with recommended oil.
10. Low Clutch Apply Pressure.	10-1. Low Main Pressure.	10-1. See Paragraph 1.
	10-2. Defective Proportional Valve.	10-2. Replace Proportional Valve.
	10-3. Low voltage to Profile Generator.	10-3. Verify that green (voltage supply) light and red (clutch energized) lights are bright.

Disassembly

The following procedure is for complete disassembly of the unit. Prior to this procedure, the transmission should be removed from the boat. Qualified personnel should do the work in a fully equipped facility.

The physical size and weight of many of the parts for this transmission assembly are such that adequate lifting devices and procedures are necessary for safety considerations. This requires that the transmission assembly be adequately supported and properly positioned as identified in the following paragraphs.

Note: These transmissions require the use of a SKF THAP 300 Oil Injection Kit, as seen in Special Tools, or similar device to service the output flange and output gear.

Use the following reference: The input side of the transmission is the front and the output side is the rear. Left and right sides are determined by facing the output side of the transmission from the rear.

Note: Photos are intended to illustrate the procedure and may not be consistent with previous disassembly steps.

Prepare Transmission for Disassembly

Note: During service of this unit, all O-rings, gaskets and seals must be replaced. It is good practice to keep the old O-rings, gaskets and seals with the appropriate components being disassembled for future reference during the inspection and assembly process (to make sure you do not forget the quantity, size, etc.).

Drain the oil from the transmission sump by removing the hex plug from the bottom of the rear side of the housing. Drain the water from the heat exchanger by removing the O-ring plug from the bottom of the heat exchanger housing (units with integral heat exchanger only).

⚠ CAUTION

Flat washers are used under all fasteners where the head of the fastener would otherwise contact an aluminum surface.

Pipe threads called out as PT (British Standard Pipe Taper) on drawings and in this text are different from NPT threads. PT threads and NPT threads are NOT interchangeable. Adapters are available from several manufacturers to convert PT threads to NPT threads.

Remove Transmission External Components and Sub-Assemblies

Note: The following steps of disassembly can be accomplished with transmission standing upright.

1. Remove the torsional coupling and hub from the primary shaft spline (if not previously removed). The coupling hub is a slip-fit on the spline. Note the position of the internal retaining ring inside the hub - it must be reinstalled in that position at reassembly.

Note: Some models may have a retaining plate with capscrews to clamp the input coupling adapter to the input shaft.

Figure 26. Removing Torsional Coupling (if equipped)

4. Support front housing with a hoist. Remove M12 x 45 capscrews (20 with SAE #0 housing; 23 with SAE #00 housing), and remove the front housing from the main housing.

5. Remove two M10 x 20 capscrews, and remove output sensor, if equipped. Loosen jam nut and remove input sensor, if equipped.

6. Remove 24 M12 x 45 capscrews and washers, and remove the top cover and gasket.

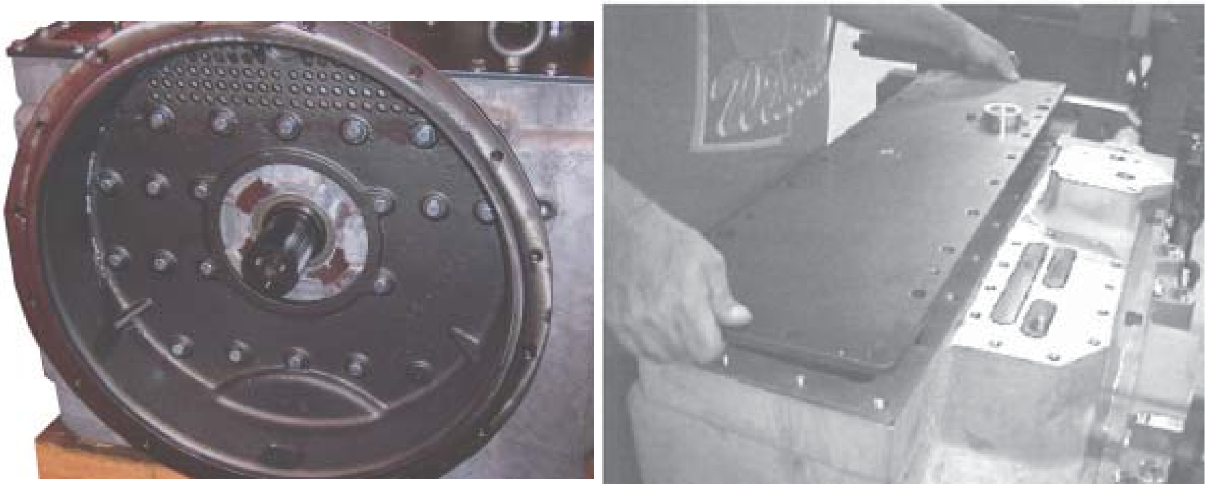


Figure 27. Remove Front Housing (if equipped); Top Cover

7. Remove hose from pump and housing

8. Remove four M12 x 45 capscrews, and remove the oil pump and gasket.

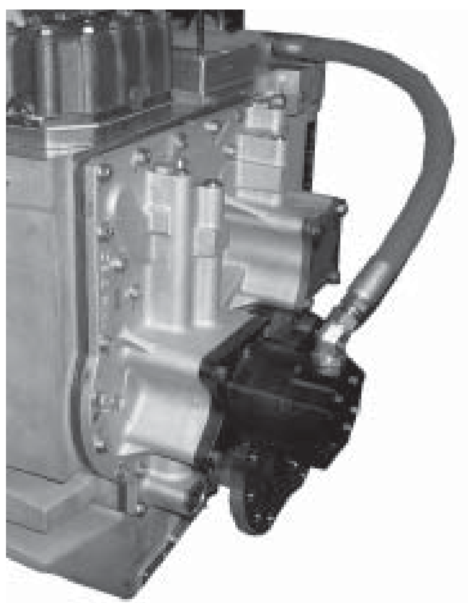


Figure 28. Remove Oil Pump and Related Components

9. Remove the heat exchanger assembly:

Units with standard raw water cooler:

A. Remove 12 M12 x 155 capscrews, and remove the housing with anode.
B. Remove gasket, plate, and remaining gasket.
C. Remove one M8 x 30 capscrew that retains the anode to the housing only if the anode must be replaced.

Units with optional fresh water heat exchanger:

A. Remove 14 M12 x 160 capscrews, and remove housing, heat exchanger, and gasket.
B. Remove 12 M12 x 45 capscrews, and remove ditch plate and gasket. Note that removal of this plate also pertains to units with a customer supplied heat exchanger.

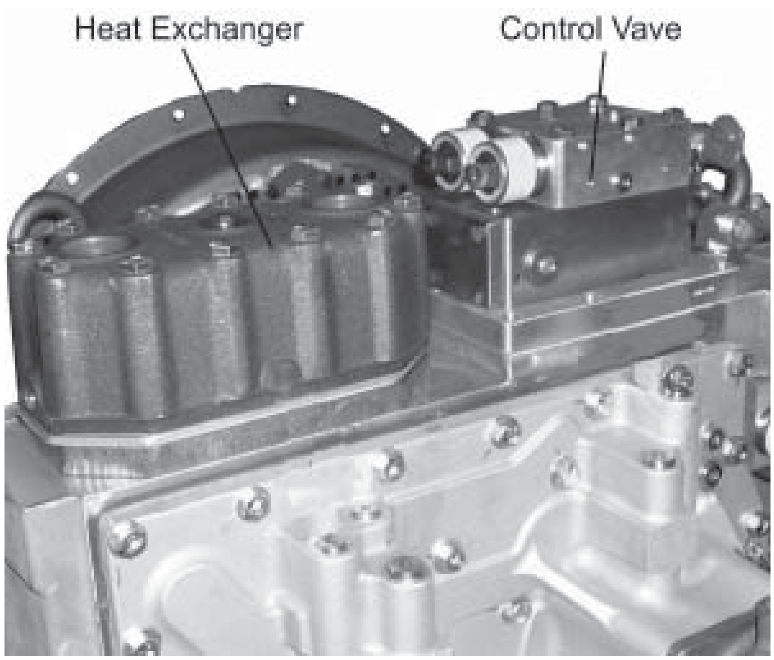


Figure 29. Heat Exchanger and Control Valve

10. Remove control valve assembly:

Remove mechanical valve assembly (1017172):

A. Remove four M10 x 120 sockethead capscrews and remove cover and valve assembly with gaskets.
B. Remove one M10 x 45 sockethead capscrew, and eight M12 x 55 sockethead capscrews.
C. Remove ditch plate and gasket.

Remove electric valve assembly (1018084):

A. Remove four M10 x 150 sockethead capscrews and remove both valve sections with gaskets.
B. Remove one M10 x 45 sockethead capscrew, and eight M12 x 55 sockethead capscrews.
C. Remove ditch plate and gasket.

Remove GP control valve assembly:

A. Loosen four M10 x 10 capscrews, and remove control module (if it was not left with the engine).
B. Remove six M10 x 70 capscrews, and remove top valve section and gasket.
C. Remove four M10 x 35 capscrews, and remove lower valve section and O-rings.
D. Remove eight M12 by 35 capscrews and one M10 x 20 capscrew, and remove ditch plate and gasket.

11. Remove the oil filter assembly:

    A. Remove the oil filter element.
    B. Remove four M12 x 50 capscrews and washers, and remove the filter head.
    C. Remove the filter bypass cartridge valve from the filter head.

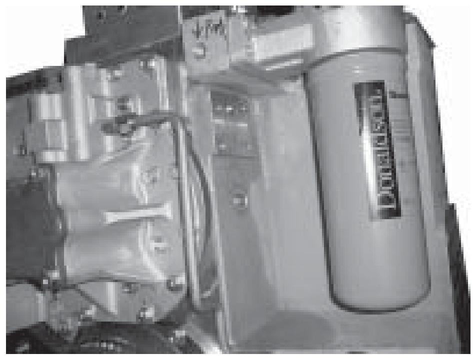


Figure 30. Remove Oil Filter

12. Remove the M12 x 25 capscrew, washer and securing clamp plate for suction strainer cover. Remove suction strainer cover with O-ring, and suction strainer.

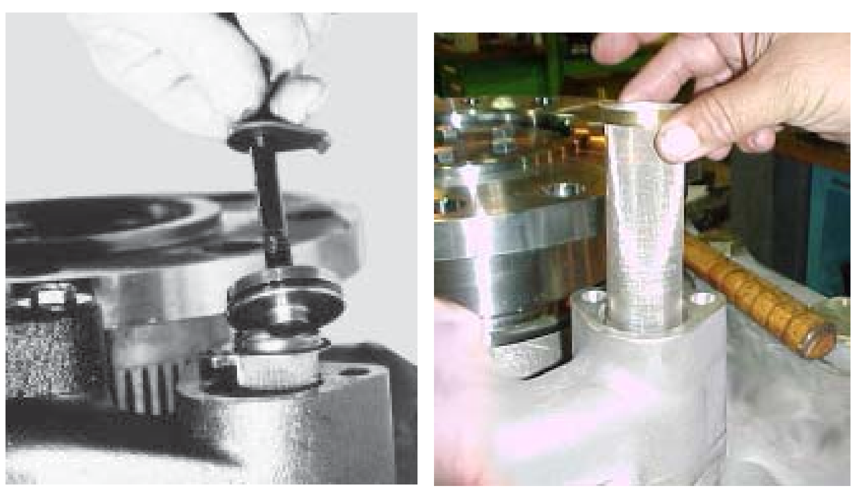


Figure 31. Removing Suction Strainer

13. Remove the oil level gauge and tube assembly from the housing.

14. Rotate the transmission. Block and support the transmission with the output side facing up. Use caution to avoid damaging the primary shaft.

Remove Output Flange

1. Loosen each of the five M12 x 45 output flange retaining washer capscrews approximately six revolutions, resulting in a 9 mm (0.35 inch) gap below each screw head. The capscrews and washers will be used to restrain the output flange when it separates from the output shaft.

⚠ WARNING

Always use retainer bolts or a safety strap to hold parts being separated with oil pressure. Oil pressure applied between the two parts for disassembly can reach 300 Mpa (43500psi). The use of proper safety equipment is mandatory when working with high pressure hydraulic tools. The parts may separate with extreme force.

2. Install the oil injector into the output flange at the O-ring plug location. Note that the threads are 1/4-19 BSP.

Figure 32. Output Flange Oil Injection Plug Location

3. Inject oil with a viscosity of 900 mm^2/S (900 cSt) at room temperature into the flange hub until the flange separates from the output shaft. Remove the oil injection equipment.

   Remove the capscrews, washer, shims, and output flange.

Figure 33. Removing Output Flange Retainer

Note: Use caution to prevent damaging the taper of the output flange or shaft as the torque capacity can be reduced.

4. Remove 15 M16 x 40 capscrews and washers, and remove the output seal carrier.

Figure 34. Removing Seal Carrier and Shims

5. Press the oil seals out of the seal carrier and remove the O-ring from the seal carrier.

6. Remove the output bearing cup and adjustment shims.

Remove and Disassemble Manifold and Bearing Carrier

1. Remove four M12 x 40 capscrews, and remove the primary shaft end cover plate and O-ring.

2. Remove 26 M12 x 60, and four M12 x 75 capscrews with washers that retain the manifold to the main housing. Remove nine M12 x 35 capscrews that secure the manifold to the bearing carrier. Install two of the removed screws into the threaded pusher screw holes of the manifold (near the dowel pins). Tighten the screws alternately and evenly to push the manifold off of the bearing carrier and dowel pins. Remove the manifold and gasket..

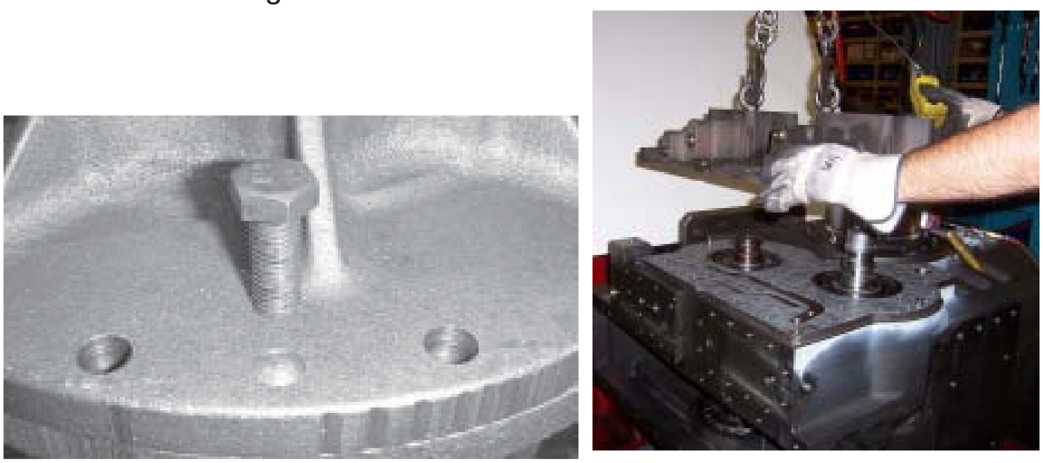


Figure 35. Pusher Screws Installed in Manifold; Removing Manifold

3. Remove the pump drive adapter from the secondary shaft. Remove the shims and bearing spacers from the bearing bores of the bearing carrier. Mark the shims and spacers for location identification.

Figure 36. Remove Adapter, Spacers and Shims

4. Remove the lubrication tube from the bearing carrier.

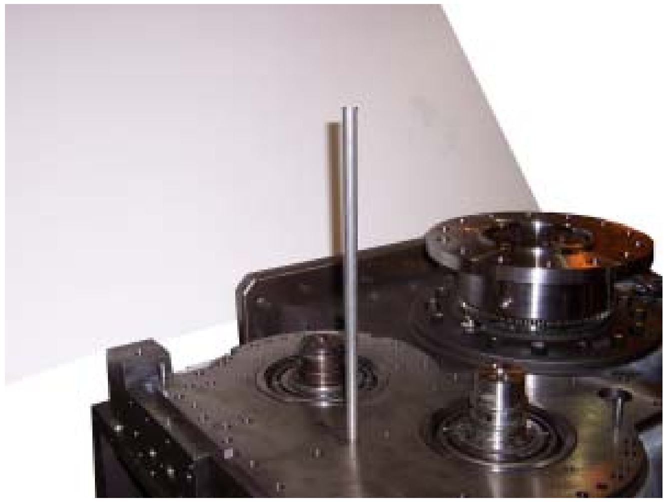


Figure 37. Lube Tube in Bearing Carrier

5. Install two of the removed screws into the threaded pusher screw holes of the bearing carrier (near the dowel pins). Tighten the screws alternately and evenly to push the bearing carrier off the housing and dowel pins. Install an eye bolt in the bearing carrier and lift it from the housing. Take care to prevent the bearing cups from falling out of the bores.

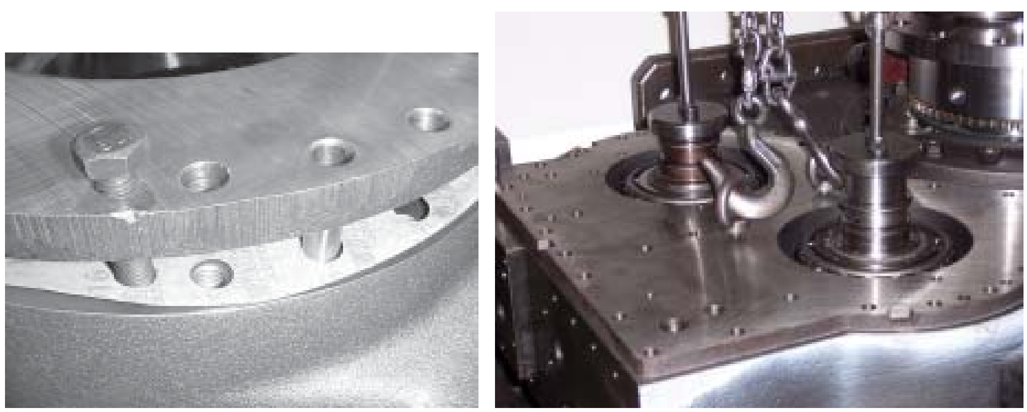


Figure 38. Pusher Screw Installed in Bearing Carrier; Removing Bearing Carrier

6. Remove the bearing cups from the bearing carrier. Mark the bearing cups for location identification.

Remove Primary and Secondary Clutch Shaft Assemblies

1. Lift out primary and secondary shafts. (Disassembly of the primary and secondary shafts are covered later in this section). Use caution with the front pinion bearing cones. They are loose on the pinion diameter, and should remain in the housing. On some ratios, the diameter of the output gear will allow the bearing to come out with the shaft, and it could easily fall off causing damage. Set the shafts aside for further disassembly.

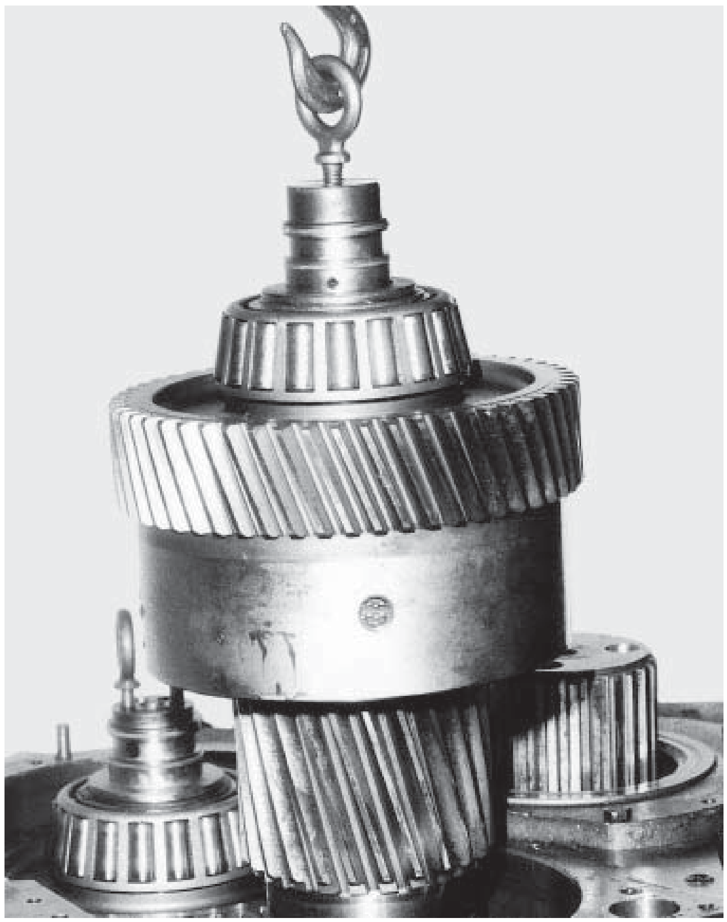


Figure 39. Lifting Out Primary or Secondary Clutch Shaft Assembly

2. Remove front pinion tapered roller bearing cones that were pulled off by output gear as primary and secondary shafts were removed.

   Note: Tapered roller bearing cups of front bearings on the primary and secondary shafts are an interference fit in the housing. Removal of these bearing cups should not be attempted unless replacement of the bearing is necessary.

Remove Output Gear and Shaft

2. Use a hoist to lift the output shaft and gear assembly until the gear contacts the housing. Place blocks under the gear to support the gear and shaft assembly in position.

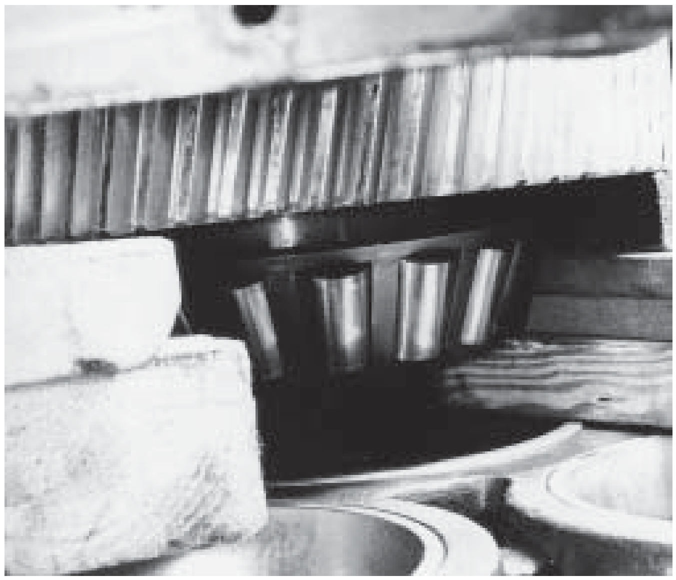


Figure 40. Supported Gear and Shaft Assembly

3. Connect oil injection equipment to the 1/4 - 19 BSP threaded port on the rear end of the output shaft.

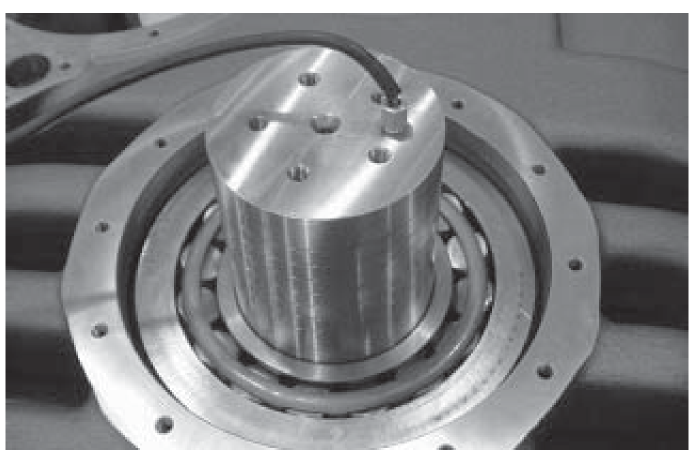


Figure 41. Oil Injection Equipment Connected to Output Shaft

4. Install eyebolts into the end of the output shaft and into the main housing mounting pads.

5. Thread a heavy strap through the eyebolts in the output shaft and the strap to the eyebolts in the main housing. The strap will restrain the output shaft during disassembly.

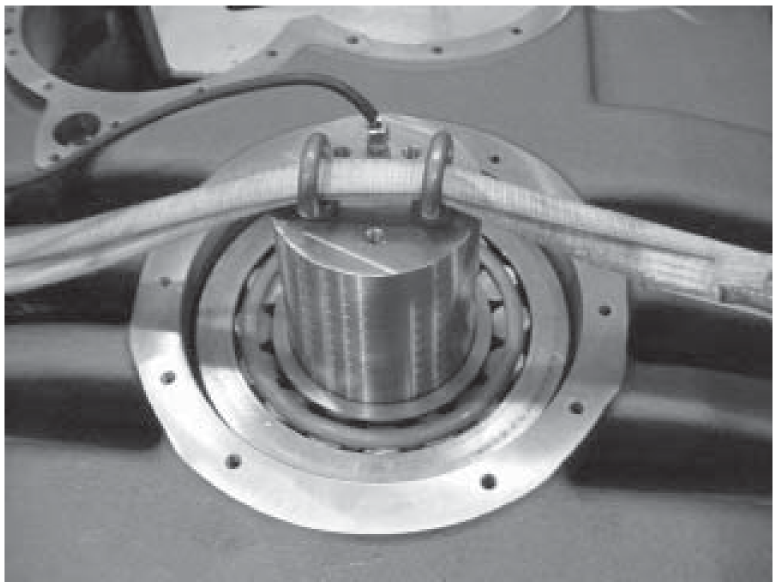


Figure 42. Heavy Strap Restraining Output Shaft

⚠ WARNING

Always use retainer bolts or a safety strap to hold parts being separated with oil pressure. Oil pressure applied between the two parts for disassembly can reach 300 Mpa (43500psi). The use of proper safety equipment is mandatory when working with high pressure hydraulic tools. The parts may separate with extreme force.

6. Inject oil with a viscosity of 900 mm^2/S (900 cSt) at room temperature (dismounting fluid) into the output shaft until the shaft and gear separate.

   Note: Use caution to prevent damaging the taper of the output gear or shaft as the torque capacity can be reduced.

7. Lift the output shaft out of the transmission using tool T-18050-714.

8. Remove four M10 x 25 sockethead capscrews, and remove the trailing pump drive gear from the output gear.

9. Remove output gear assembly from transmission housing. Tool T-19987-2 can be used to ease removal of gear from housing.

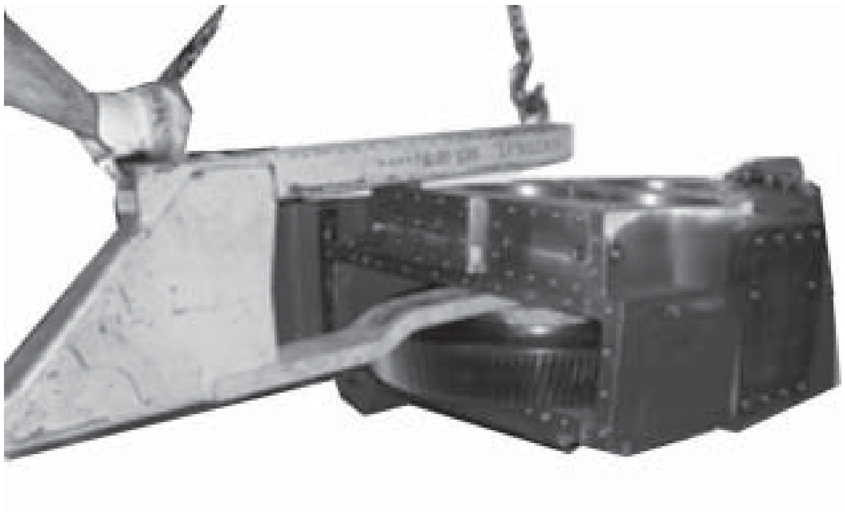


Figure 43. Removing Output Gear Assembly

10. Tapered roller bearing cups for front bearings on primary pinion, secondary pinion, and output shaft are an interference fit in their respective bearing bores of the transmission housing. Remove these parts only if replacement is required. To remove these bearing cups, weld a light bead around the I.D. of the bearing cup with an electric welder. This will shrink the cup and facilitate removal. Bearings removed in this manner must be replaced.

Disassembly of Trailing Pump Drive Components

1. From inside the transmission, remove the M8 x 20 retaining cap screw and washer from the gear end of the trailing pump shaft.

Figure 44. Removing Retaining Cap Screw and Washer

2. Remove the trailing pump driven gear and key from the trailing pump shaft.

3. Remove the trailing pump (or trailing pump cover, if equipped) and gasket from the transmission housing.

4. Remove the internal retaining ring from the bore of the transmission housing.

Figure 45. Removing Internal Retaining Ring

5. Remove the trailing pump shaft assembly.

Figure 46. Removing Shaft Assembly

6. Press the bearings off of the trailing pump shaft only if replacement of parts is necessary.

Disassembly of Primary and Secondary Clutch Shafts

(Primary Shaft Only) Loosen two 10-24 x 3/8 set screws and remove the wear sleeve from the front end of the primary shaft.

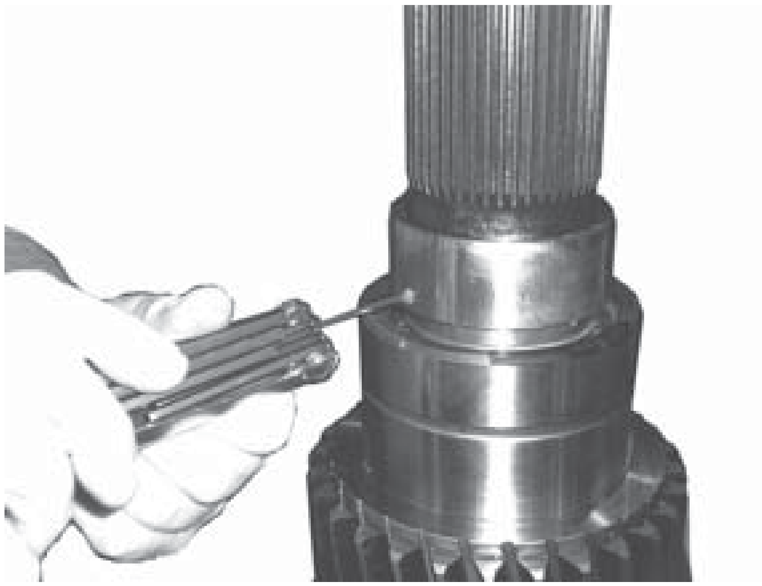


Figure 47. Remove Oil Seal Sleeve with O-Ring from Shaft

1. Remove three piston rings from the rear end of the shaft.

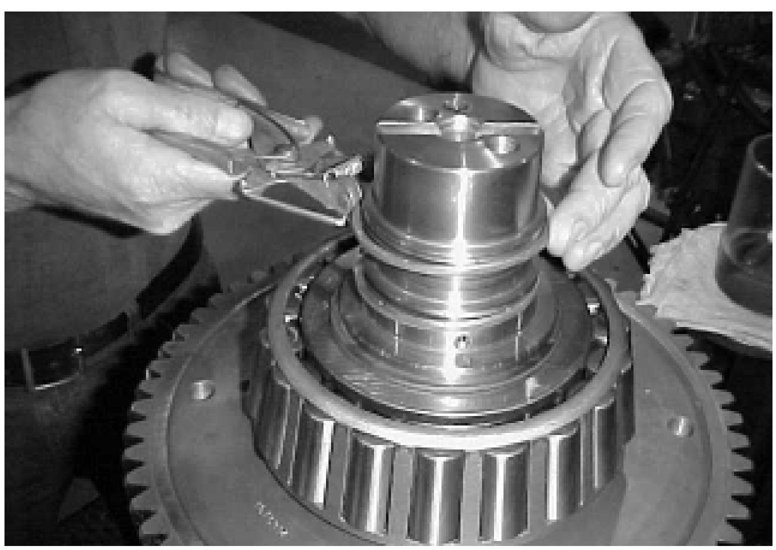


Figure 48. Removing Piston Rings From Shaft

Note: Do not remove the rear bearing unless it must be replaced. The bearing is an interference fit with the shaft, and will be destroyed during removal.

2. If the rear bearing must be removed, do this:

   A. Remove the external retaining ring from the shaft.

   B. With a hammer and chisel, cut the cage off the bearing to remove the cage and rollers.

   C. Use a split-type bearing puller (cheese cutter) to grip the flange at the small end of the tapered inner race.

   D. With a hydraulic jack, push the rear end of the shaft while pulling the inner race of the bearing.

3. Position the shaft upright with the input end up.

4. Remove and disassemble the pinion:

   A. Remove the round retaining ring from the input end of the shaft, and remove the pinion from the shaft.

Figure 49. Removing Round Retaining Ring from Input End of Shaft

B. Remove the internal retaining ring from the front end of the pinion, and remove the straight roller bearing.

Note: The straight roller bearing in the bore of the front end of the pinion is an interference fit, and will likely be destroyed during removal. Remove the straight roller bearing with the use of a puller behind the roller ends.

C. Remove the tapered roller bearing outer race from the bore at the rear of the pinion if bearing requires replacement. This bearing race is an interference fit in the pinion bore. To remove it, use an electric welder to weld a light bead around the I.D. of the bearing race. This will shrink the bearing race to facilitate removal. Bearings removed with this method must be replaced.

5. Remove the internal retaining ring at the front of the clutch housing, and remove the clutch backing plate.

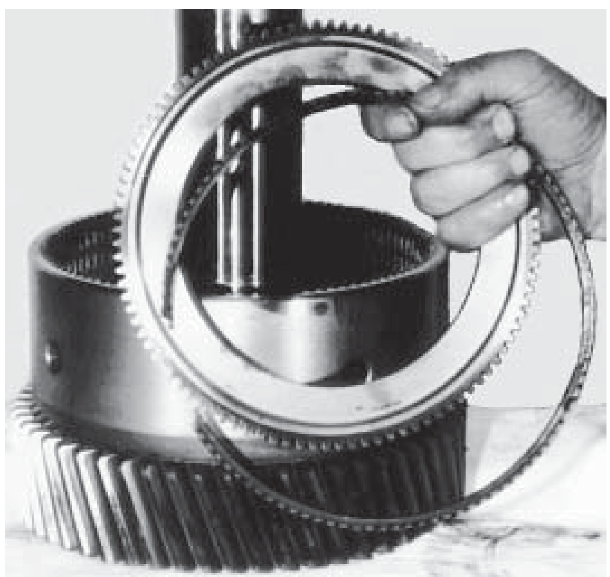


Figure 50. Clutch Backing Plate and Retaining Ring Removed

6. Remove the clutch plates (9 steel, 10 friction), maintaining their respective order for inspection purposes.

7. Remove the tapered roller bearing cone from the shaft. (Bearing supports rear of pinion). This bearing is a slip fit and should remove easily.

8. Remove the clutch apply piston:

A. Place the clutch in a press, input side up. Use special tool T-19330 to compress the clutch release springs and expose the round retaining ring.

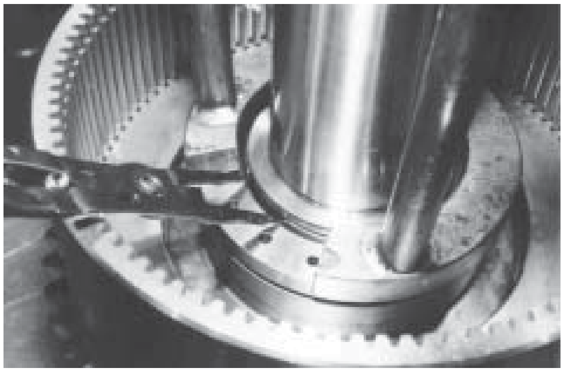


Figure 51. Removing Spring Retainer Retaining Ring

B. Remove the retaining ring. Slowly release the pressure, and remove the shaft from the press. Remove special tool T-19330 and spring retainer. Remove the clutch release springs from the pockets in face of the piston.

C. Remove the clutch piston by applying air to the hydraulic pressure port (between the seal ring grooves), forcing the piston from the bore. Use caution to avoid damaging the piston.

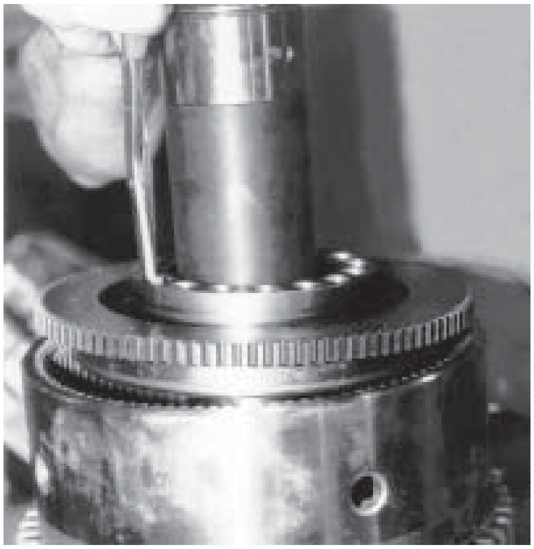


Figure 52. Removing Clutch Piston

D. Remove the piston ring from the ring groove in the shaft (seals I.D. of clutch piston).

Remove the multi-piece piston ring from ring groove outer diameter in O.D. of clutch piston.

Note: Do not separate clutch housing/transfer gear from the secondary shaft unless the shaft or the clutch housing must be replaced, and the mating parts remain serviceable. Use the following procedure to separate the housing/ transfer gear from the shaft.

E. Place a sleeve over the front end of shaft with an I.D. only slightly larger than the O.D. of the large end of the shaft taper (101.6mm [4.00 in.]). Place the shaft and clutch housing on a press, front end down. Rest the end of the sleeve on a heavy wood block while the other end supports the inner face of the clutch housing. Apply press force to rear end of shaft to separate the shaft from the clutch housing. Take care to protect and restrain the shaft to prevent damage as the tapered joint separates.

Disassembly of Control Valve

GP Control Valve with Electronic Interface

The GP Valve is made up of a non-serviceable electronic interface, and two valve body assemblies. The top valve body is made up of plugs and cartridges. O-ring kits are available for servicing the plugs and cartridges, however none of the cartridges are field serviceable beyond replacement of the O-rings. The Lower Valve body contains the pressure regulator valve, an orifice/filter plug, and a ball check valve assembly that are replaceable.

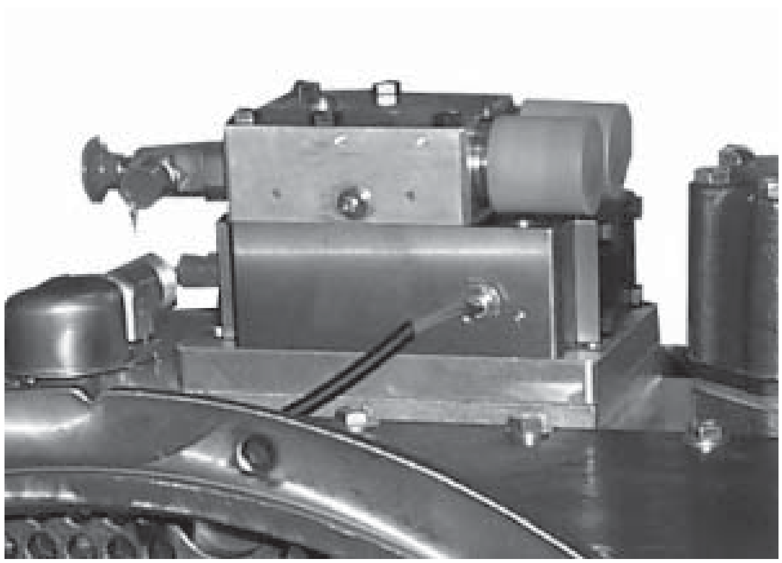


Figure 53. GP Valve Assembly mounted on Marine Transmission.

1. Disconnect the connectors at the proportional valves, the neutral switch, and the temperature sensor (if equipped), and loosen the four M6-1.0 capscrews that retain the Electronic Interface Module to the Hydraulic portion of the valve assembly. If the Electronic Interface is not being replaced, it can be set aside without disconnecting the remaining wires from the installation.

Figure 54. Electronic Profile Module (typical)

2. Remove the six M10-1.50 x 70 capscrews that retain the top valve body assembly to the transmission, and remove the top valve body assembly with gasket (if not previously removed).

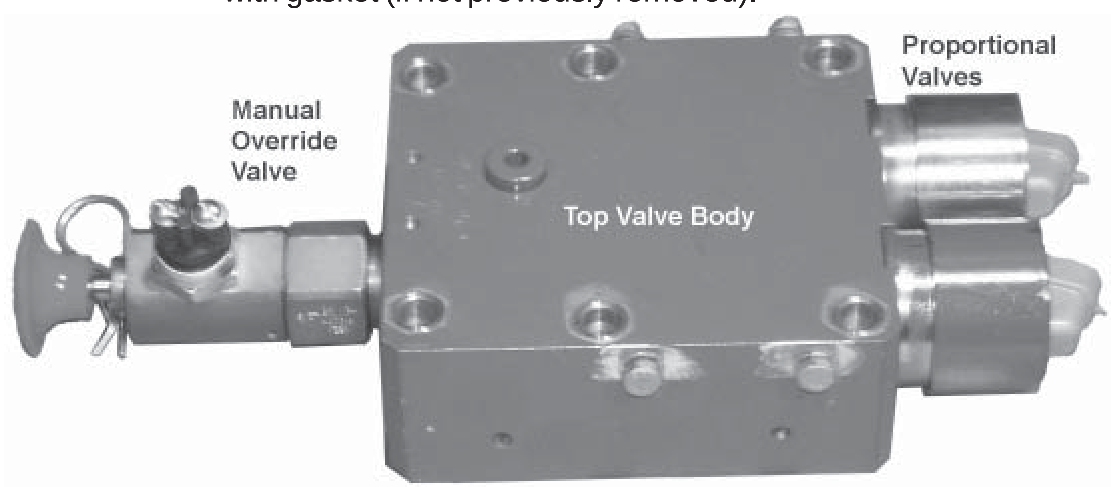


Figure 55. Top Hydraulic Valve Body Assembly

3. Remove the four capscrews that retain the main regulator valve assembly to the transmission housing or ditch plate, and remove the valve assembly and gasket (if not previously removed).

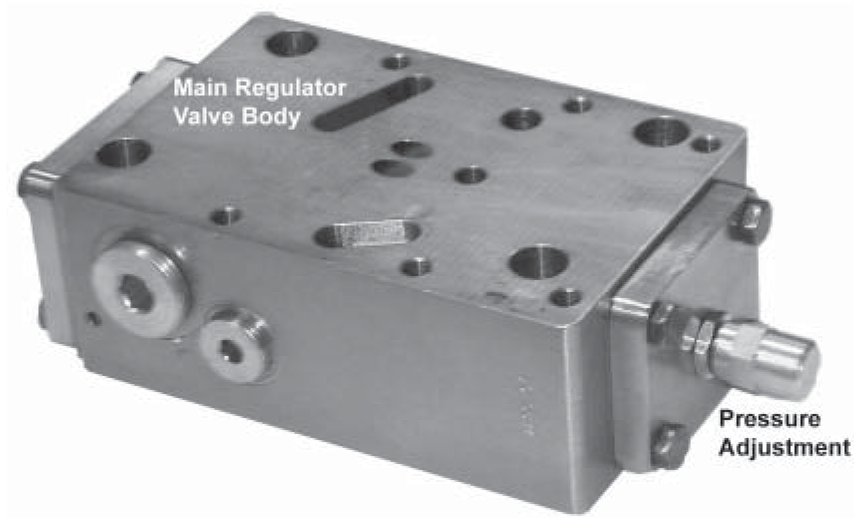


Figure 56. Main Regulator Hydraulic Valve Assembly

4. Remove the Manual Direction Control Valve with switch (if equipped) or the Plug Assembly from the Top Valve Body.

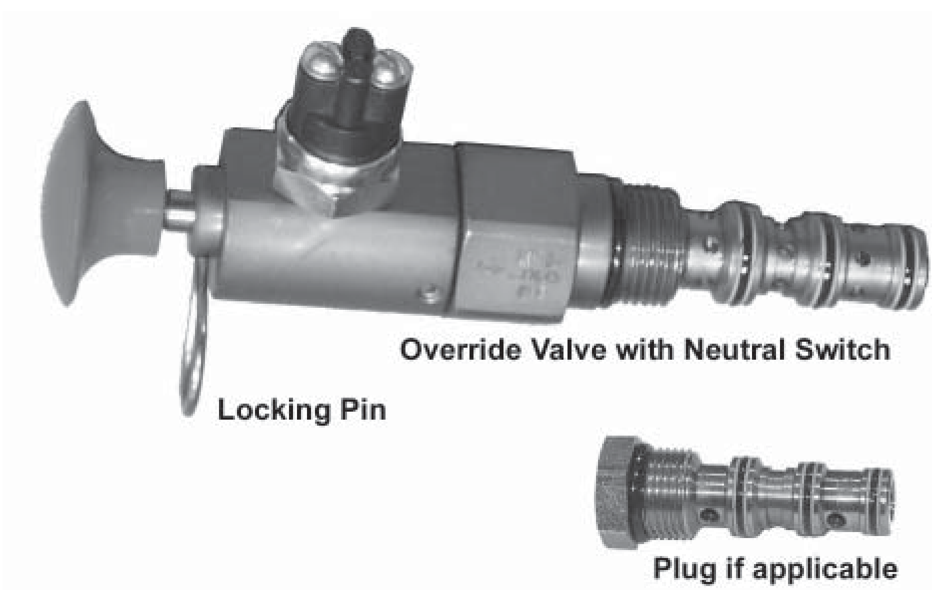


Figure 57. Manual Direction Control Valve or Plug

5. Remove the M6-1.00 x 16 Allen head capscrew, the retaining plate, and the proportional Valve Cartridges from the Top Valve Body. A slight rotating motion while pulling will help to with the removal of the valves.

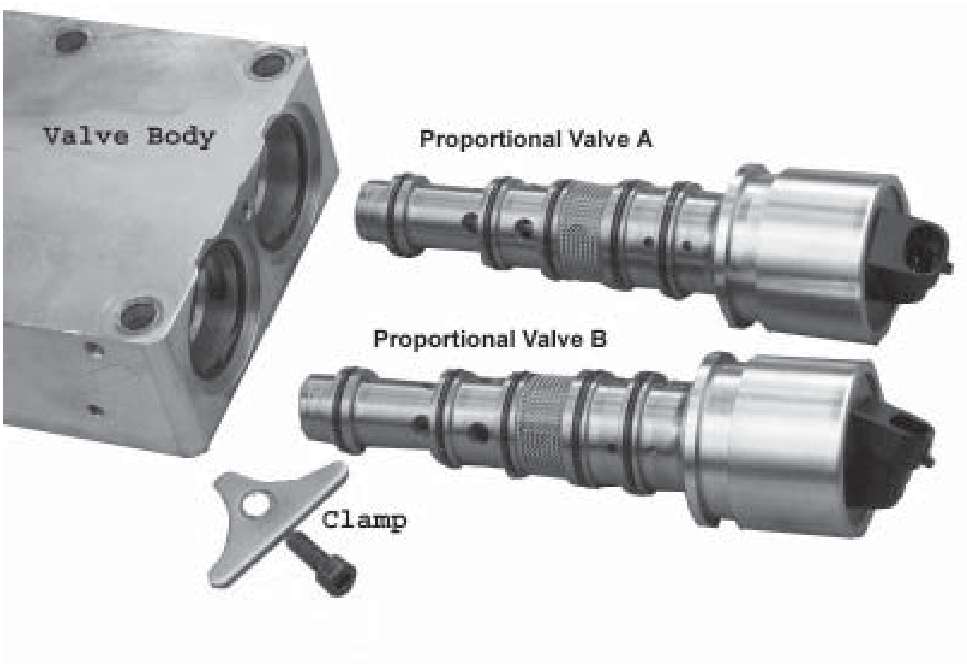


Figure 58. Remove Proportional Valve Cartridges

6. Remove the Main Pressure Regulator from the Main Regulator Valve body.

   A. Remove the regulator adjusting screw cap, and loosen the jam nut.

   B. Turn the adjusting screw counter clockwise to reduce the spring load on the valve.

   C. Evenly loosen the four M8 x 25 capscrews, and remove the cover assembly and gasket, followed by the spring(s) and spool.

   D. Remove the four M-8 x 25 capscrews from the opposite end, and remove the cover and gasket.

   E. Remove the orifice and screen assembly for cleaning.

   F. Remove the ball check assembly only if necessary. Removal will require destruction and replacement of the assembly.

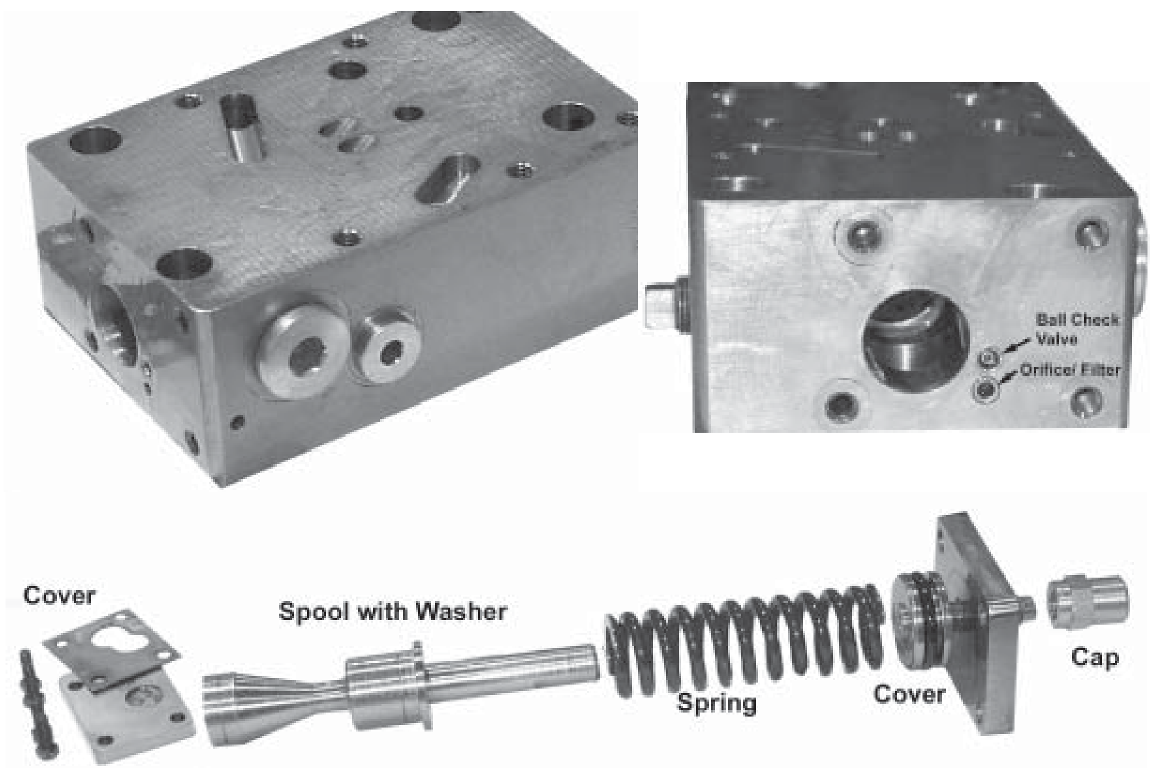


Figure 59. Remove Main Pressure Regulator Valve Components

Electric Selector Valve (1018084) and Mechanical Valve (1017172)

⚠ CAUTION

Steel ball is under pressure from the spring. Care must be taken when removing the cover and orifice plate to prevent loss of steel ball.

1. Loosen and remove four of M8 x 25 socket head capscrews, and remove orifice plate cover and gasket.

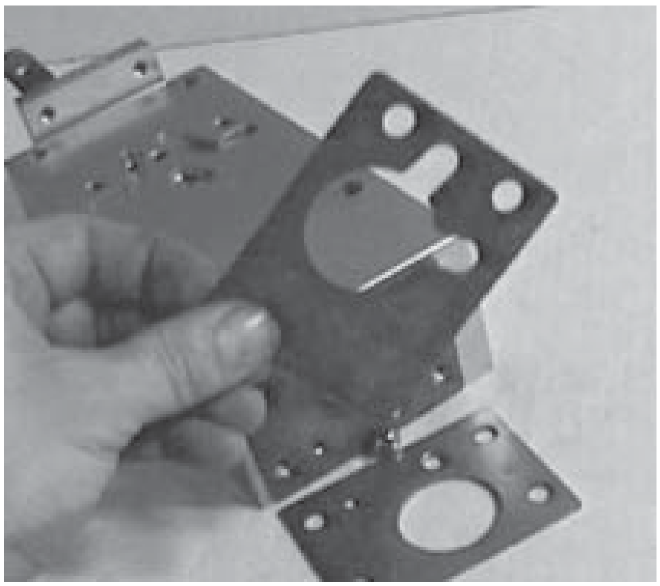


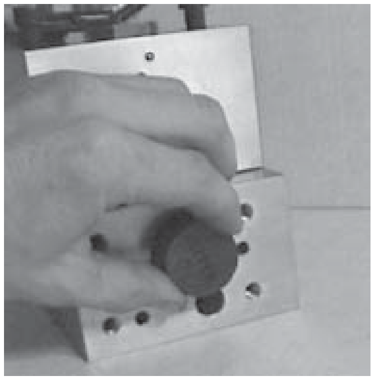
Figure 60. Removing Orifice Plate Cover Gasket

2. Remove orifice plate.

3. Remove steel ball and neutral pressure regulating spring.

4. Remove orifice plate gasket.

5. Remove rate-of-rise piston. Note that shims are located between the piston and springs.



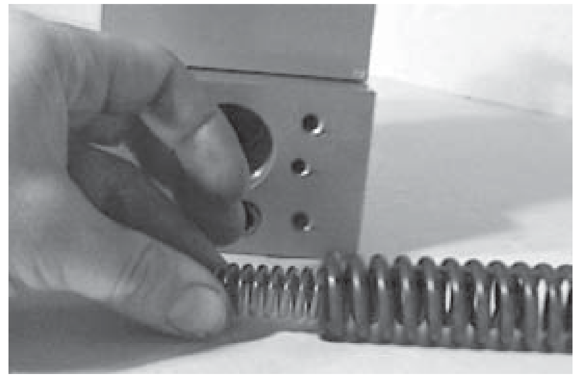


Figure 61. Rate of Rise Piston (left) and Regulator Springs (right)

6. Remove pressure regulating springs.

7. Remove pressure regulating piston with an external retaining ring pliers.

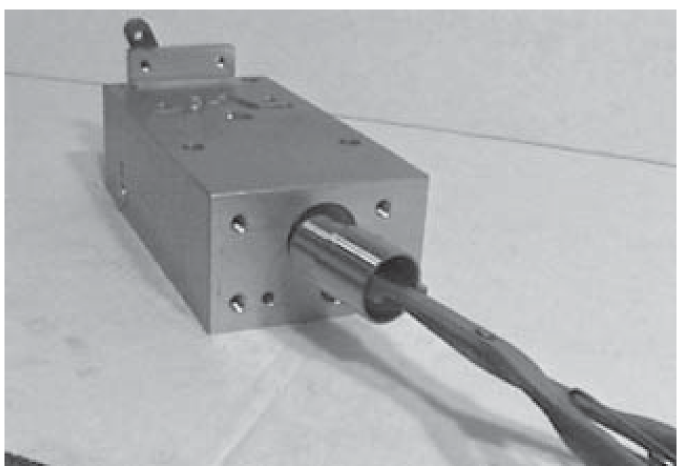


Figure 62. Removing Regulating Piston with Pliers

8. Remove external retaining ring from the lever end of the stem.

9. Loosen the clamping nut and remove the control lever from the stem. It may be necessary to splay the lever to be able to remove it. DO NOT apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

10. Remove the washer and spring from the stem.

11. Remove four of M8 x 25 socket head capscrews.

12. Remove the cover assembly with gasket from the valve body.

13. Remove the O-ring and oil seal from the cover assembly.

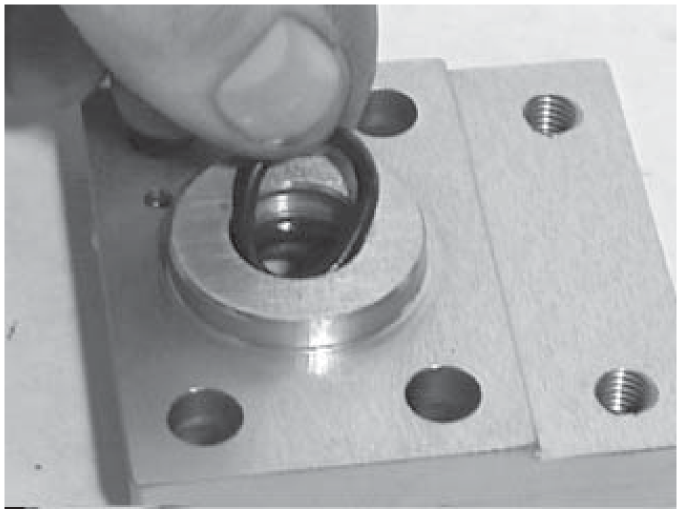


Figure 63. Removing O-ring from Cover

14. Remove the two electrical switches from the sides of the valve body and the two steel balls from each of the switch bores in the valve body (some models).

15. Remove the detent setscrew, spring, and steel ball from the valve body.

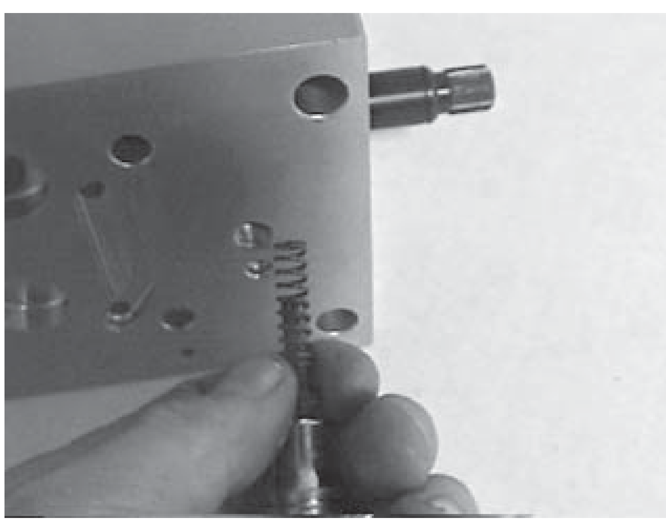


Figure 64. Removing Detent Setscrew and Spring

16. Remove the dog-point setscrew. Note that the setscrew is retained with MA908 threadlocker.

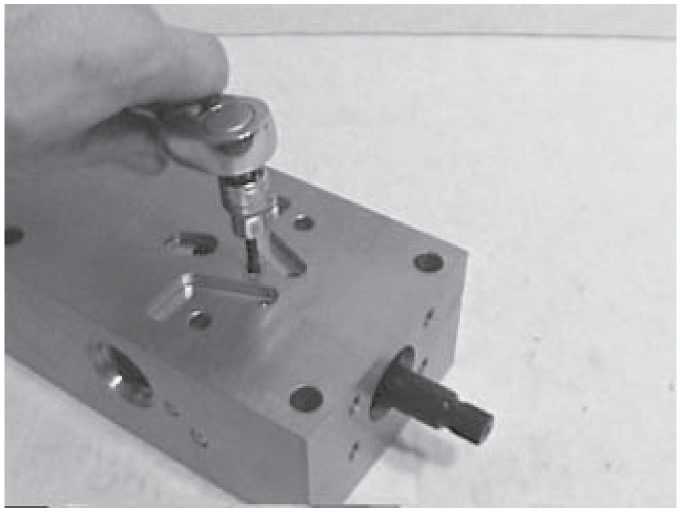


Figure 65. Removing Dogpoint Setscrew

17. Remove the stem from the valve body partially.

18. Remove the thrust washer from the stem.

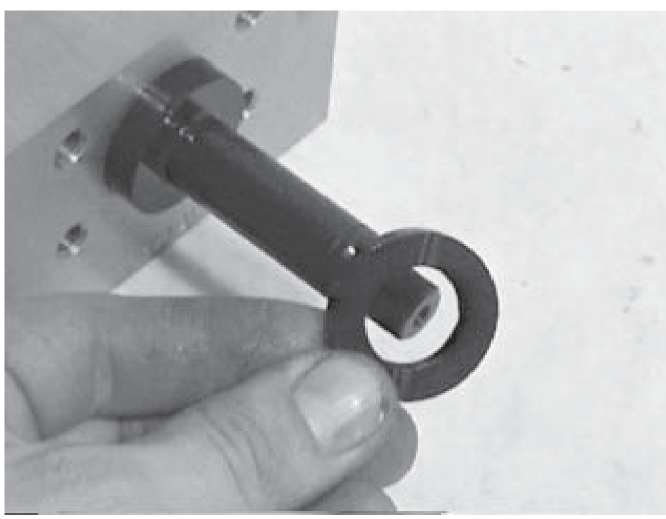


Figure 66. Removing Thrustwasher

19. Remove the stem from the valve body.

20. Remove the roll pin (retains the shuttle ball seat) with a needle-nose pliers.

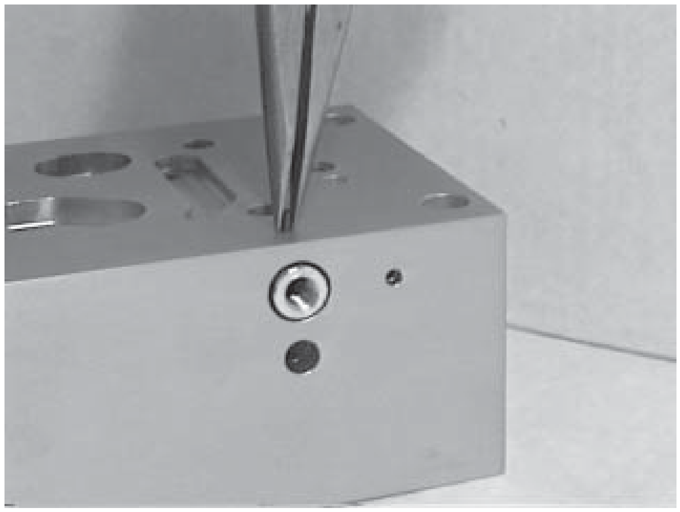


Figure 67. Removing Roll Pin Retaining Shuttle Seat

21. Thread a M8 x 1.25 screw (one of the cover screws works well) into the seat and remove it from the valve body.

22. Remove the shuttle ball from the valve body.

Disassembly of Upper Valve Body Half (electric section)

1. Remove the Weatherpak connector from the valve body by sliding it in the direction of the opening in the shroud.

2. Mark the wires with the location letters that are on the Weatherpak connector. Open the end of the Weatherpak connector to allow removal of the pins and wires.

3. Remove the pins (for the wires of all but one solenoid) from the Weatherpak connector using the extraction tool. Tool is Packard Electric P/N 12014012.

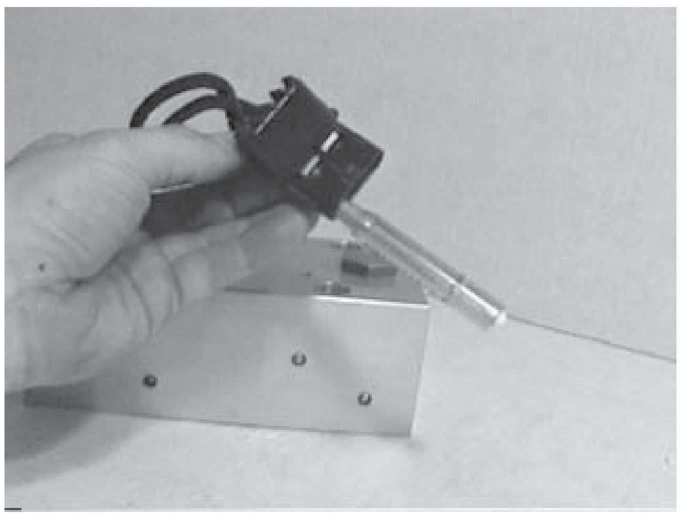


Figure 68. Removing Wires using Extraction Tool

4. Mark the two solenoids for location identification and remove them.

5. Remove the third (Neutral) solenoid (units with hydraulic lock) or plug (units without hydraulic lock).

6. Remove the filter screen from the valve body.

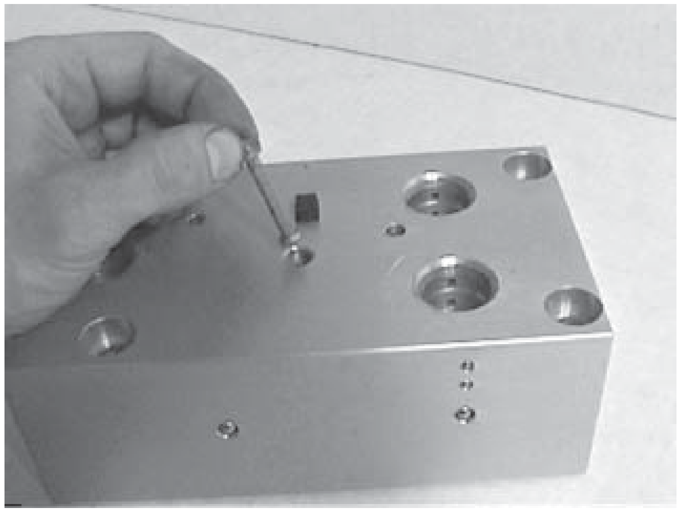


Figure 69. Removing Filter Screen

7. Remove the two socket head O-ring plugs from the bores in the end of the valve body.

8. Remove the two spools from the valve body.

9. Remove one dowel pin and spring from each of the spools (hydraulic lock units only).

10. Remove the spool return spring and dowel pin from the bottom of each of the spool bores in the valve body.

Trolling Valve 1017555 (Optional Equipment)

1. Remove the trolling valve attaching screws.

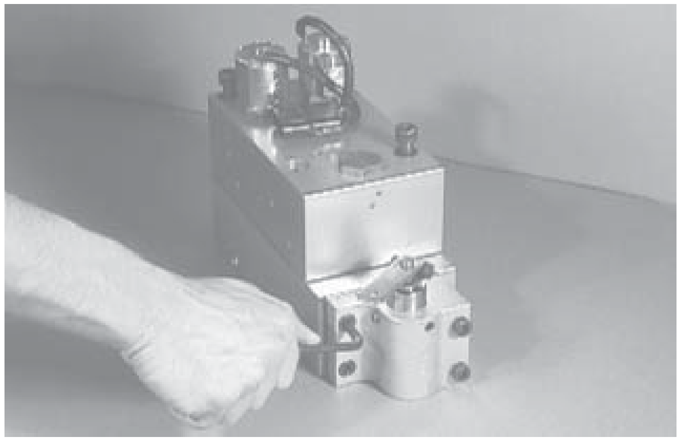


Figure 70. Removing Trolling Valve Attaching Screws

⚠ CAUTION

Steel ball is under pressure from the spring. Care must be taken when removing the trolling valve and orifice plate to prevent loss of steel ball.

2. Remove the trolling valve from control valve.

3. Remove the gaskets, orifice plate, and steel ball from control valve.

4. Remove the screw and nut clamping the lever to the stem.

5. Remove the lever from the stem. It may be necessary to splay the lever to be able to remove it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

6. Remove the detent setscrew, spring, and detent ball.

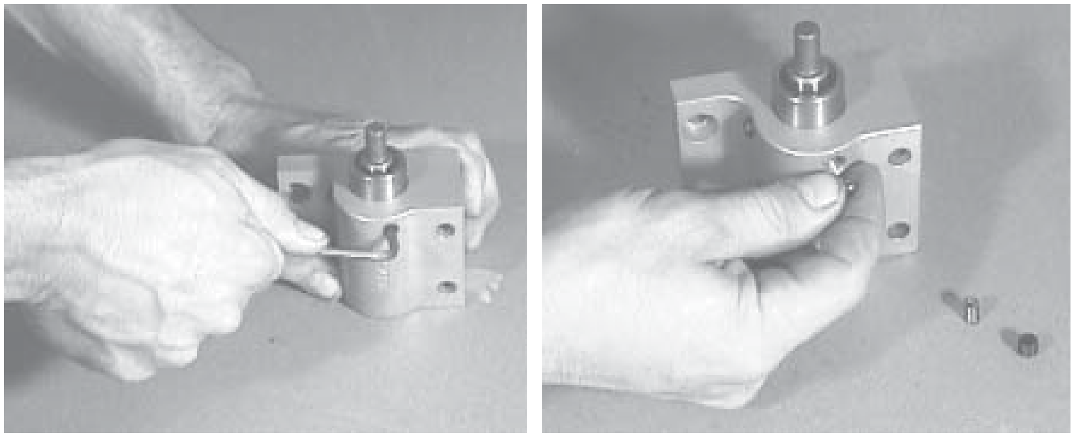


Figure 71. Removing Detent Setscrew (left) and Detent Spring and Ball (right)

7. Remove the dog-point setscrew from the valve body.

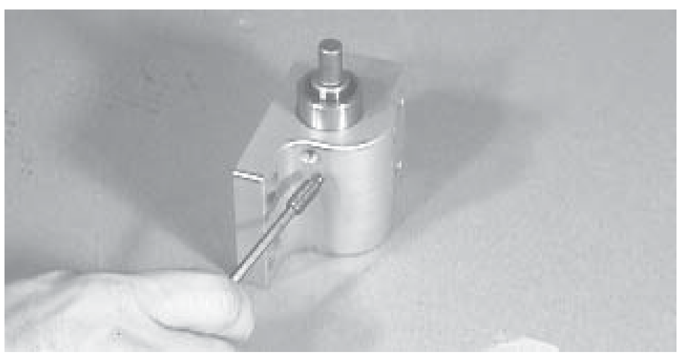


Figure 72. Removing Dogpoint Setscrew

8. Slide the stem and adapter out of the valve body together as one piece. Push the stem out of the adapter such that the spring end of the stem exits the adapter first. Note that the inner spring will come out with the stem.

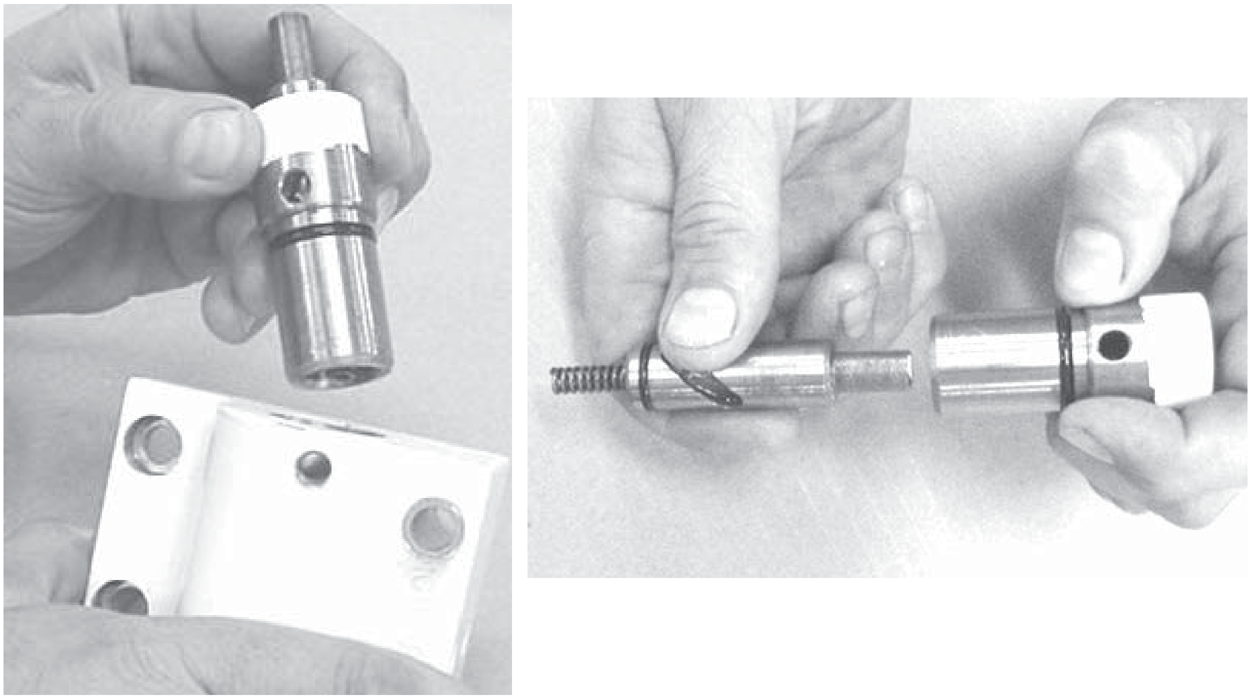


Figure 73. Removing Stem and Adapter from Valve Body (left) and Removing Stem from Adapter (right)

9. Remove the O-ring from the groove in the end of the stem.

Figure 74. Removing O-ring from Stem

10. Remove the inner spring and roll pin from the stem only if replacement of parts is necessary.

11. Remove the washer from the bore of the valve body (some models). Note: the washer may have been removed with the stem.

12. Remove the (outer) spring and piston from the bore of the valve body. Note that there may be washer(s) in the bore of the piston (some models).

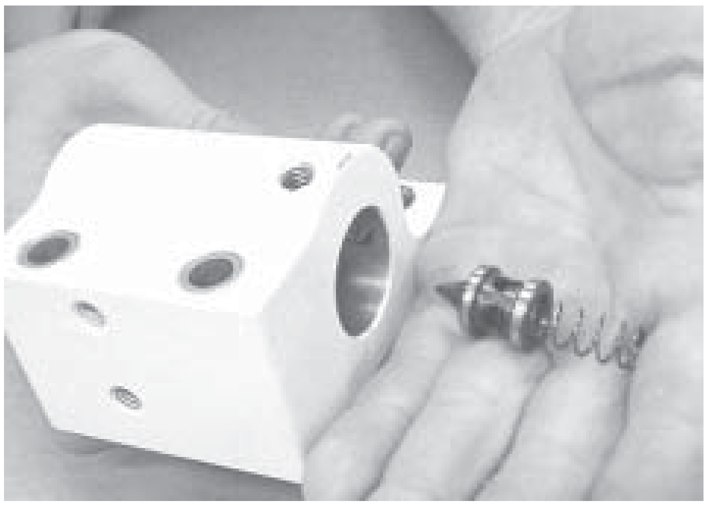


Figure 75. Removing Spring and Piston from Valve Body

13. Remove the O-ring from the groove and the oil seal from the end of the adapter.

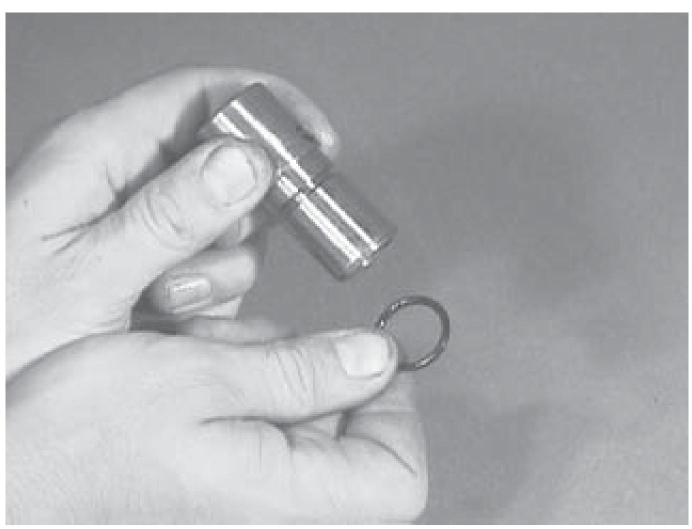


Figure 76. Removing O-ring from Adapter

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings, piston rings, seal rings, 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 be dried and oiled immediately to prevent corrosion.
- ❑ Examine all parts carefully for grit, dirt and abrasives, and reclean them if necessary.
- ❑ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ❑ Use clean solvent to flush oil pumps, valves, etc.
- ❑ Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.
- ❑ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

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

⚠ CAUTION

Never dry bearings with compressed air. Do not spin unlubricated 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

- ❑ For previously sealed joints, scrape surfaces to remove old gasket material or silicone.
- ❑ Clean surfaces with solvent to remove oil and grease residue.
- ❑ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ❑ Replace cast parts or housings that are cracked.
- ❑ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding. This will cause loss of press of bearings or races.
- ❑ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ❑ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ❑ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ❑ Inspect ground tapers for scratches, galling or scoring damage. If any of these the defects, replace the part.
- ❑ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ❑ 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.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

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

Bushings and Sleeves

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

Thrust Washers and Spacers

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

Gears

- ❑ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ❑ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ❑ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

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

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

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

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found. Refer to wear limits in Description and Specifications.

Assembly

The MG-5321DC transmission requires the use of a SKF THAP 300 Oil Injection Kit (See Special Tools) or similar device to install the output gear onto the output shaft.

Unless otherwise specified, all torque values listed are for capscrews that have been lubricated on the threads and contact surfaces.

The following discussion contains frequent reference to the transmissions parts and components. Refer to Engineering Drawings.

Prior to Assembly

Use the following reference: The input side of the transmission is the front and the output side is the rear. Left and right sides are determined by facing the output side of the transmission from the rear.

Identify and place the following bearing components in an oven at 120° C (250° F) for 30 minutes: output shaft rear tapered roller bearing cone and the rear bearing cones for both clutch shafts.

Submerge all new friction clutch plates in transmission oil for a minimum of one hour prior to installation.

Identify and place the following bearing components in a deep freeze -51° C (-60° F) for at least two hours prior to assembly: front output bearing cup, all pinion bearing cups, and both pinion inner needle roller bearings.

Preliminary Assembly

1. Lay the transmission housing on blocking with the rear side up.

2. Install the chilled cups for the primary and secondary front tapered roller bearings into their respective bores in the front inner face of the housing. Use driver T-18050-711 to press/drive cups to the bottom of the bore. It is important to maintain downward force as temperatures equalize to ensure that cup is at bottom of bore.

Figure 77. Front Pinion Bearing Cup Installation

3. Measure and record the distance from the machined surface of the housing to the bottom of the output shaft bearing cup bore where the oil distribution shield contacts (dimension “A”). Measure and record the thickness of the oil distribution shield at the outer edge (dimension “B”). Measure and record the width of the bearing cup (dimension “C”).

4 Install oil distribution shield into output shaft front bearing bore. Be sure shield is properly centered.

5. Install chilled front output tapered roller bearing cup into housing bore. Use driver T-18050-771 to press/drive cup to bottom of its bore.

Note: Care must be taken to ensure that the shield remains centered.

Tighten puller rod to standard torque limit for thread size of puller rod or 275 Nm (200 ft-lb), whichever is less. Maintain this torque until bearing cup and housing temperatures equalize (approx. 10 minutes).

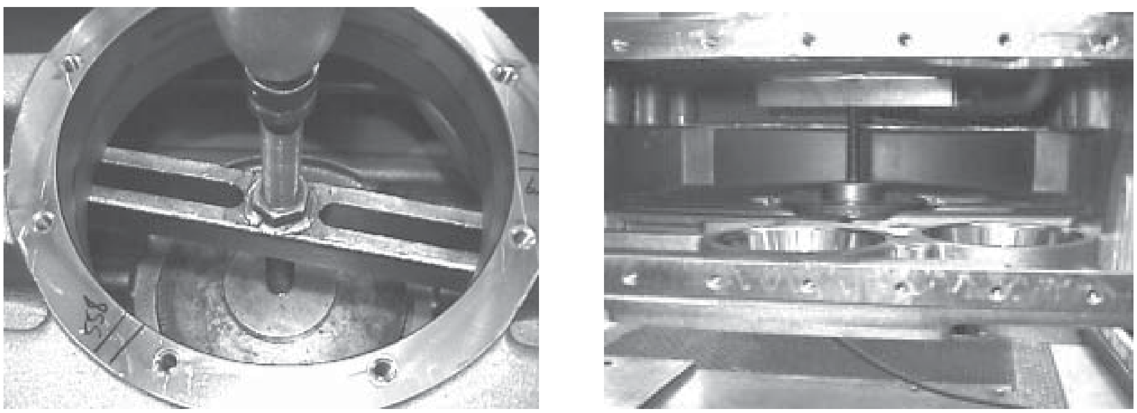


Figure 78. Installing Output Shaft Bearing Cup

Remove T-18050-771. Measure and record the distance from the machined surface of the housing to the top of the bearing cup (dimension "D"). Dimension "D" must equal dimension "A" minus dimension "B" minus dimension "C" within 0.025 mm (0.001 in.).

Installation of Trailing Pump Shaft and Driven Gear

1. Press the bearings onto the trailing pump shaft by pushing on the inner race of the bearing. Use a driver with an inside diameter only slightly larger than the shaft diameter to push bearings on until they are stopped by the shaft shoulder.

Figure 79. Installing Trailing Pump Shaft Bearings

2. Install the trailing pump shaft and bearings into the transmission housing using a soft hammer if necessary.

Figure 80. Installing Trailing Pump Shaft

3. Install internal retaining ring into housing over bearing.

Figure 81. Installing Internal Retaining Ring

4. Install key and trailing pump driven gear onto trailing pump shaft.

5. Install washer and M8 x 20 hex head screw onto trailing pump shaft to retain driven gear. Apply MA908 threadlocker to the threads and torque to 33 Nm (25 ft-lb).

Figure 82. Securing Trailing Pump Gear to Shaft

Installation of Output Shaft and Gear

1. Clean tapered surface of output shaft and tapered bore of output gear. Use OSHA approved cleaning solvent to remove all traces of dirt, grease, oil, etc. Do not touch cleaned surfaces. Loctite® 7070 cleaner is recommended.

2. Before installing the output gear in the transmission housing, confirm the potential advance is in compliance with the specification:

   Place the output shaft into the output gear using T-18050-714. Seat shaft onto the taper of the gear using only the weight of the shaft. Use gauge blocks and a feeler gauge to measure between the output gear and shaft shoulder. This is the potential advance, and it must be 9.45 mm to 11.00 mm (0.372 in. to 0.433 in.).

   Remove the shaft from the bore.

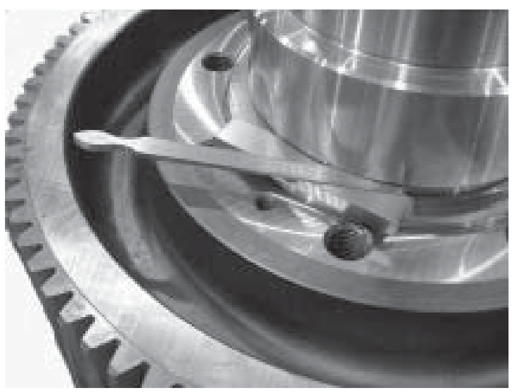


Figure 83. Measuring Output Gear Advance

Note: Should the calculated advance fall outside the range given above, check to assure that all measurements and calculations are correct. If no errors are found and the expected advance is out of tolerance, it will be necessary to change parts. Contact the Product Service Department at Twin Disc, Incorporated for assistance.

⚠ CAUTION

Tapered surface of shaft and matching tapered bore of gear must be completely free of grease, oil, dirt and solvent residue. Failure to properly clean mating parts could prevent proper advance measurement of gear on shaft and adversely effect torque carrying capacity of the assembled joint. Both parts must be at the same temperature.

3. Install the front output bearing cone into the cup in the housing.

   Install the output gear in the housing. Use special tool T-19987-2 to position gear into the correct location. Be sure the gear is centered on the bearing cone.

Figure 84. Installing Output Gear in Housing

4. Working through the output bearing opening in the housing, install the trailing pump drive gear onto the output gear: Insert two M10 x 40 dowel pins in output gear. Place drive gear on dowel pins and attach the gear with four M10 x 25 sockethead screws. Torque the screws to 75 Nm (55 ft-lb).

5. Install the output shaft into the output gear and bearing cone in the transmission housing using T-18050-714. Seat shaft onto the taper of the gear using only the weight of the shaft.

Figure 85. Installing Output Shaft

6. Connect the oil injector to the output shaft.

7. Use portable press with 1340 kN (150 ton) capacity, and fixture T-20023-4 to seat hub using 1340 N (300 lbf) load.

Figure 86. Output Gear Advancing Tools Installed

8. Inject oil with a viscosity of 300 mm^2/S (300cSt) at room temperature (mounting fluid) into the shaft until it leaks out of both ends of the mating surfaces.

9. Advance gear to shaft shoulder stop with the portable press.

10. Release injection oil pressure between the mating surfaces and wait five minutes before lowering the press force and removing the assembly tool.

11. Remove the assembly tools from the output shaft and gear.

12. Install the pinion front bearing cones for primary and secondary shafts onto bearing cups previously installed in transmission housing.

Installation of Output Shaft Rear Bearing

1. Install heated rear output shaft tapered roller bearing cone. Install with small O.D. of bearing to the rear. Press/drive bearing to shaft shoulder using special tool T-21506 to hold bearing in place while temperatures equalize.

Figure 87. Output Bearing Tool T-21506

2. Install output bearing cup into housing bore until it contacts bearing cone.

3. Adjust the output shaft tapered roller bearing. To determine the shim thickness required, proceed as follows:

   A. With a depth micrometer, measure the distance from the housing face (where the seal carrier contacts) down to the tapered roller bearing cup. Record this measurement as dimension “A”.

   B. With a depth micrometer, measure the pilot length of the output seal carrier. Record this measurement as dimension “B”.

   C. Subtract dimension “B” from dimension “A”, and record this as dimension “C”.

   D. Build a trial shim pack having a thickness 0.05 to 0.15 mm (0.002 to 0.006 in.) less than dimension “C”.

   E. Install the trial shim pack over the bearing cup.

4. Install the output seal carrier without output seals or O-ring, and torque the (14) M16 x 40 screws to 192 Nm (203 ft-lb).

Figure 88. Output Bearing Shims Location

5. Install dial indicator onto the housing with finger resting on rear of output shaft or on lifting fixtures. Zero the dial indicator and mark the spot where the reading was taken.

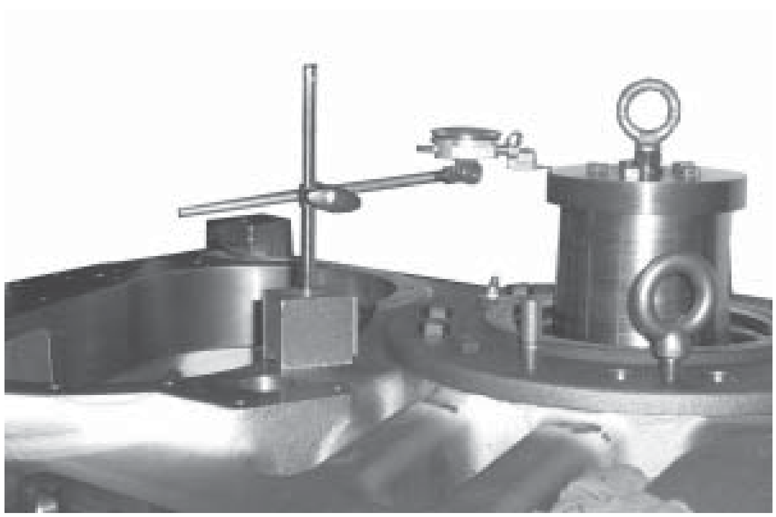


Figure 89. Measuring Output Shaft Endplay

6. Using a hoist and tool T-18050-714, exert 2225 N to 4000 N (500 lbs to 900 lbs) of lifting force onto the shaft. Minimum of 2224 N (500 lbs) lifting force is required to overcome weight of gear and shaft and still exert a minimum of 1334 N (300 lbs) lifting force on bearing. Rotate shaft several revolutions with lifting force applied. Stop rotation with dial indicator finger on mark previously made, continuing to hold lifting force. Read shaft endplay on dial indicator.

7. Add or remove shims as necessary to bring output shaft endplay within the 0.05 to 0.15 mm (0.002 to 0.006 inch) specification. Arrange the shims such that the thinnest shims are in the center of the shim pack.

8. Remove lifting fixture. Remove output seal carrier.

9. Install O-ring in groove in O.D. of output seal carrier.

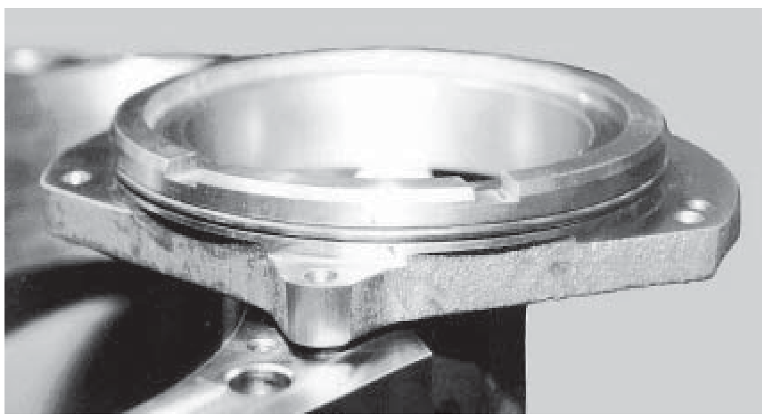


Figure 90. O-ring Installed onto Output Seal Carrier

10. Install oil seals into output seal carrier using driver T-18050-713 per the following description:

    A. Install forward seal with spring-loaded lip toward the inside of the transmission. Start inner seal with flanged side of driver T-18050-713 facing down, and complete its installation with tool inverted as shown below.

    B. Install rear seal with spring-loaded lip of seal toward rear of the transmission. Install flush with outer face of seal carrier with driver T-18050-713.

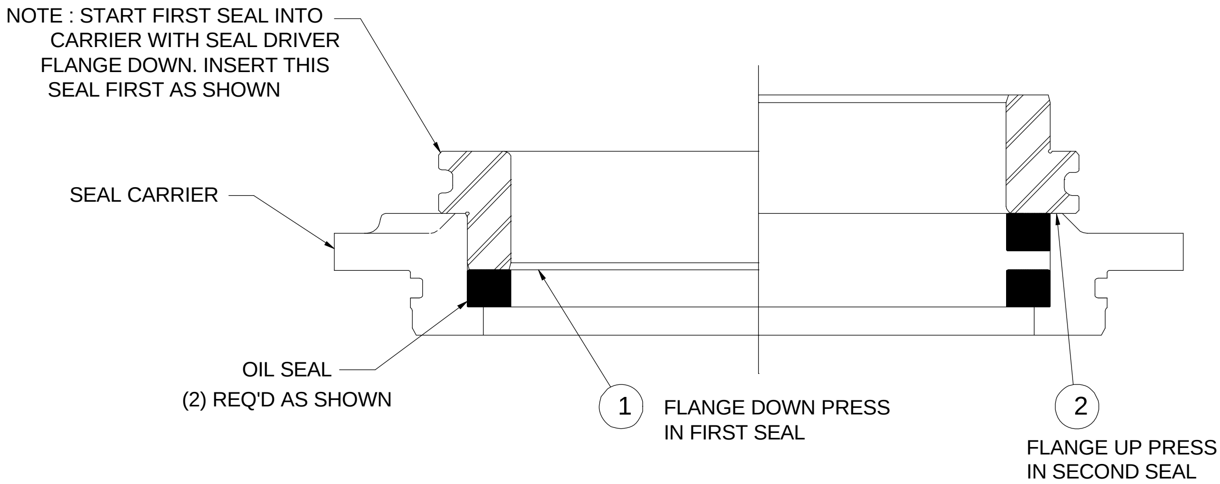


Figure 91. Output Seal Driver T-18050-713

11. Pack area between the seals with NLGI No.2 grease (example Mobilux® EP2).

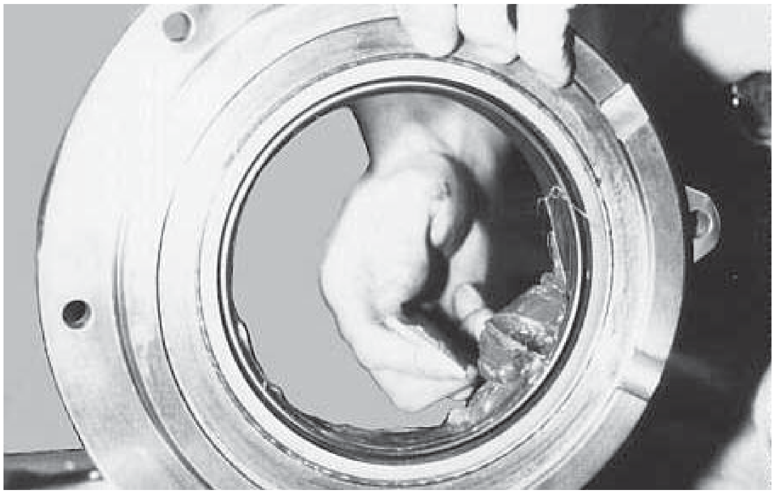


Figure 92. Packing Cavity Between Output Seals With Grease

12. Apply a coat of assembly grease or oil to the O-ring on the seal carrier.

13. Install grease fitting if not previously installed.

14. Install shim pack over bearing cup.

15. Install assembled output seal carrier onto housing. Use caution to avoid damaging the O-ring. Install attaching screws and torque to 112 Nm (83 ft-lb).

16. Remove T-18050-714 from output shaft.

Assembly of Primary and Secondary Shafts

Installation of Transfer Gear, Rear Bearing and Clutch Piston

1. Assemble transfer gear to secondary shaft.

   A. Clean taper on secondary shaft and tapered bore in transfer gear using OSHA approved cleaner. Do not touch cleaned surfaces. Loctite® 7070 cleaner is recommended.

   B. Determine if secondary shaft and transfer gear can be advanced properly:

      a. Hold secondary shaft in a vertical position standing on its front end.

      b. Use a depth micrometer and measure distance from the rear end of the shaft to the shaft shoulder at small end of taper. Record this distance as dimension “A.”

      c. Install secondary transfer gear on secondary shaft taper, small diameter of tapered bore up. Seat gear on shaft taper with 445 N to 890 N (100 lbs to 200 lbs) of force.

      d. Use a depth micrometer and measure distance from rear end of shaft to machined face of transfer gear at small diameter of tapered bore. Record this distance as dimension “B.”

      e. Calculate expected advance: Expected advance = A - B. Calculated advance must be 2.67 mm to 3.71 mm (0.105 in. to 0.146 in.). If calculated advance is not within the range, recheck all measurements and calculations for errors. If no errors are found, contact the Product Service Department at Twin Disc, Incorporated for information.

   C. Set secondary transfer gear on fixture T-18050-723 with large diameter of tapered bore up. Move fixture and transfer gear to a press with at least 667 kN (75 tons) capacity.

   D. Install secondary shaft front end up, into tapered bore of transfer gear. Seat shaft in tapered bore of gear by applying 445 N to 890 N (100 lbs to 200 lbs) downward force on shaft.

E. Center fixture, gear and shaft under ram of press and apply approximately 391 kN to 543 kN (44 tons to 61 tons) of force on front end of secondary shaft. Release pressure and turn fixture, shaft and gear 180°. Reapply pressure to complete advance.

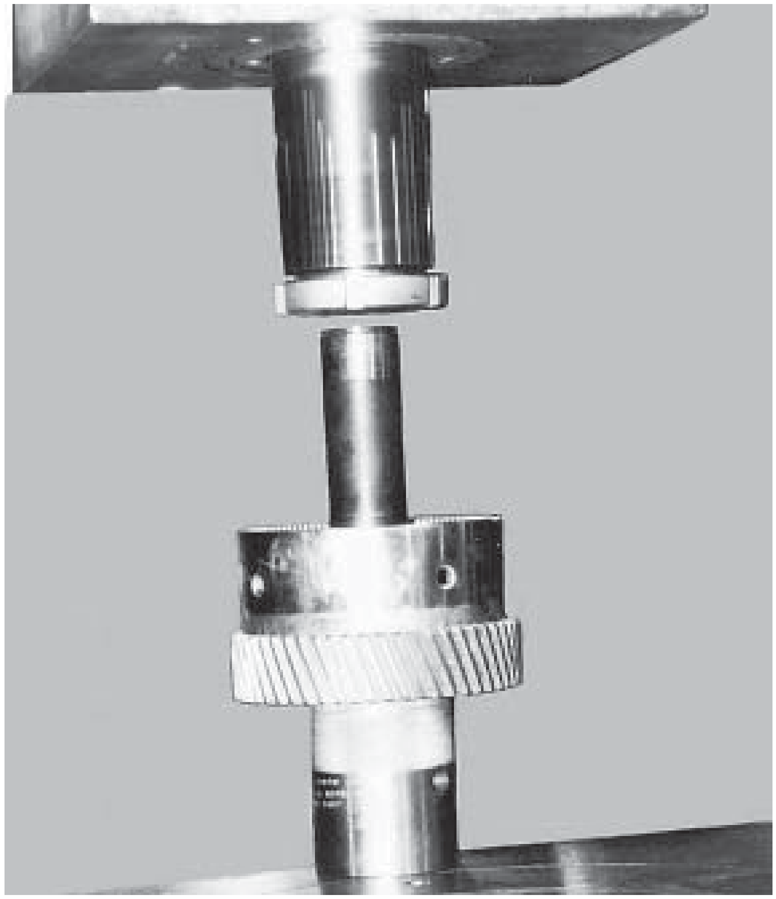


Figure 93. Pressing Clutch Shaft Into Transfer Gear

F. Using a depth micrometer, measure distance from rear end of shaft to face of transfer gear. Record as dimension "C." Transfer gear face should be within 0.05 mm (.002 in.) of the shaft shoulder at the small diameter end of the taper.

Note: Actual advance (C-B) must be 2.67 mm to 3.71 mm (0.105 in. to 0.146 in.). If transfer gear has not been advanced as specified above, contact the Product Service Department at Twin Disc, Incorporated for information.

2. Install heated tapered roller bearing cone onto shaft against clutch housing. Install bearing with large O.D. toward transfer gear. Use driver T-18050-723 and hydraulic press to ensure bearing is fully seated against transfer gear.

3. Install the external retaining ring onto the shaft with the tapered edge side away from the bearing.

4. Install clutch piston inner seal ring into groove in secondary shaft. Apply a coat of assembly grease or oil to seal ring.

5. Install multi-piece seal ring in groove in O.D. of clutch apply piston as follows:

    A. Install the expander into the piston seal ring groove.

    B. Install the first seal ring section into the groove over the expander ring.

    C. Install the second seal ring section into the groove over the expander ring with the ends rotated 180° from the ends of the first seal ring.

    D. Install the third seal ring section into the groove over the expander ring with the ends rotated 90° from the ends of the first seal ring.

    E. Install the fourth seal ring section into the groove over the expander ring with the ends rotated 270° from the ends of the first seal ring.

    F. Apply a coat of assembly grease or oil to the seal ring.

7. Install clutch apply piston into piston bore in transfer gear.

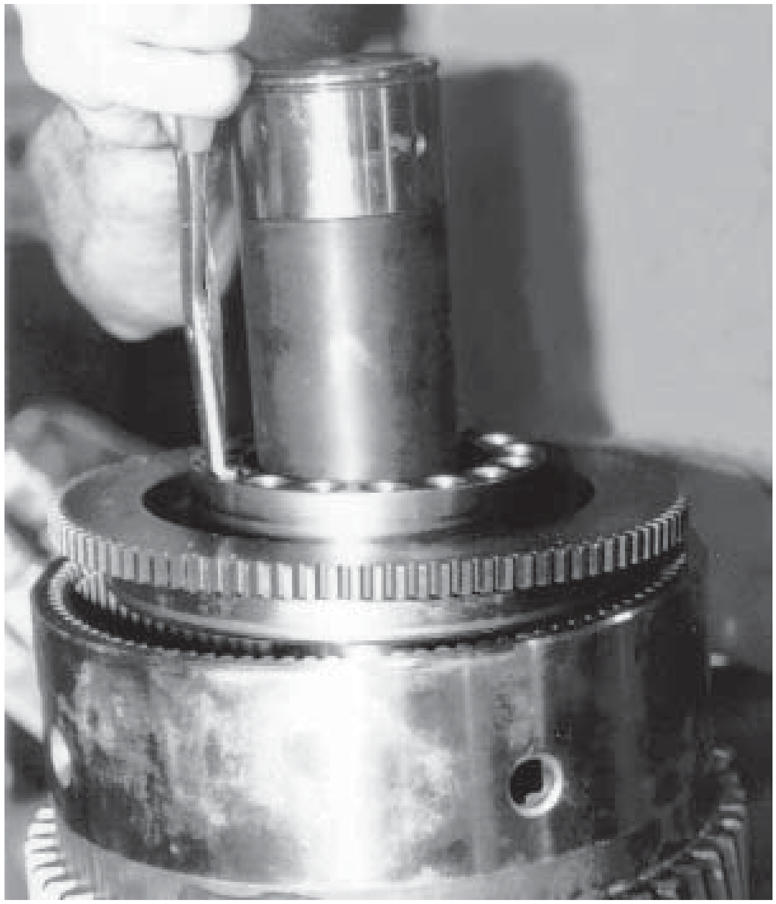


Figure 94. Installing Clutch Piston

Assembly of Clutch

1. Install clutch return springs.

   A. Install 16 clutch return springs into pockets in face of clutch apply piston.

   B. Install spring retainer over springs with groove toward springs. Working through holes in retainer, use a small punch or probe to assure that all springs are in pockets in face of piston and that springs are aligned correctly (stand straight up).

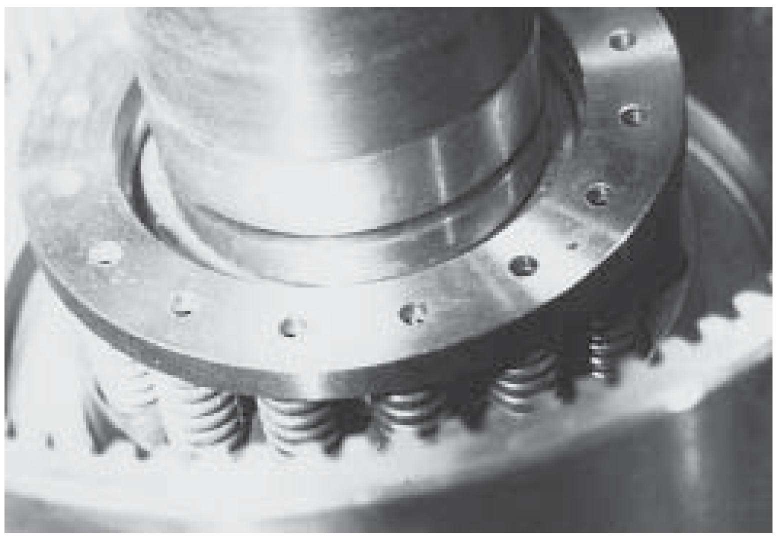


Figure 95. Return Springs and Spring Retainer Ready for Installation

C. Install external retaining ring over shaft to rest against spring retainer. Move shaft assembly to press and install tool T-19330. Press down tool T-19330 to compress springs and expose retaining ring groove of shaft. Keep force on springs and install retaining ring into exposed groove of shaft.

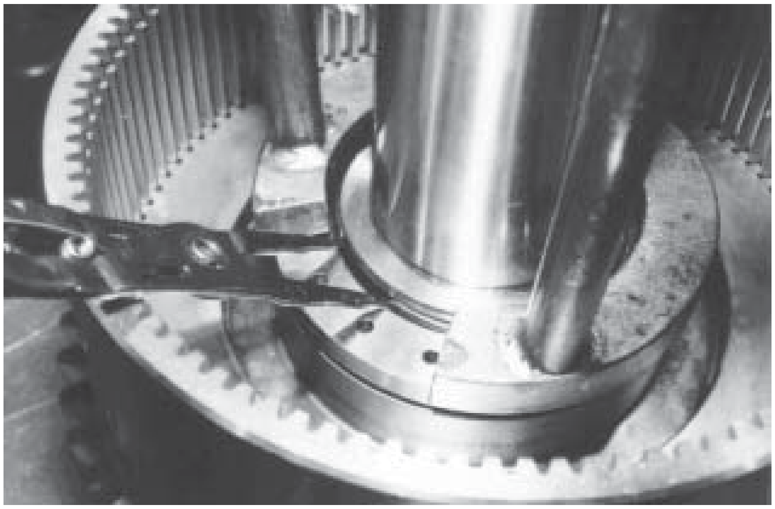


Figure 96. Installing Spring Retainer Retaining Ring

D. Slowly release force on springs assuring that spring retainer counterbore covers retaining ring and prevents retaining ring from coming out of the groove. Remove tool T-19330.

2. Install the pinion rear tapered roller bearing cone onto the shaft.

Note: This bearing is a slip fit and will not require special tools for installation.

3. Beginning with a friction plate, alternately install 10 friction plates and 9 steel plates into clutch housing (transfer gear) against clutch apply piston.

4. Install clutch backplate and internal retaining ring.

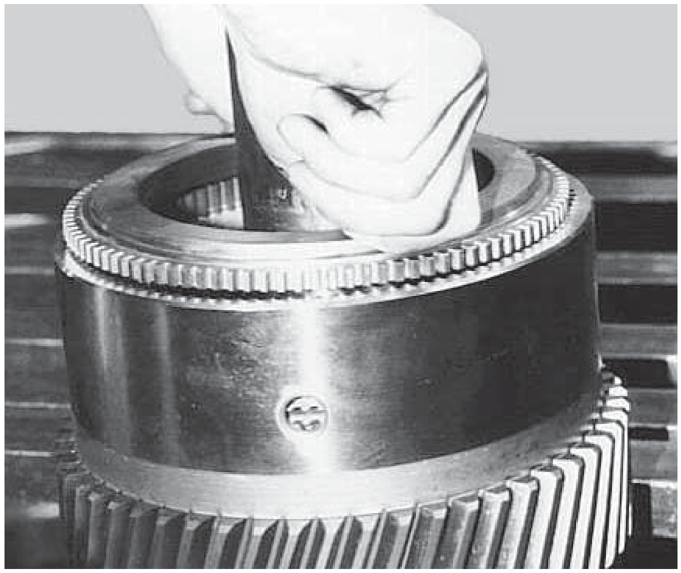


Figure 97. Installing Clutch Backplate

5. Assemble Pinion

   A. Use tool T-18050-708 to install chilled tapered roller bearing cup into rear of pinion for secondary shaft. Bearing cup is installed with small I.D. of taper toward the front and seated against shoulder of bore in clutch hub of pinion.

Figure 98. Installing Tapered Roller Bearing Cup Into Pinion

B. Use tool T-18050-705 to install chilled needle roller bearing into bore at front of pinion with the rounded edge of the outer race entering the pinion first.

Figure 99. Needle Roller Bearing Installed

C. Install internal retaining ring into groove in pinion bore.

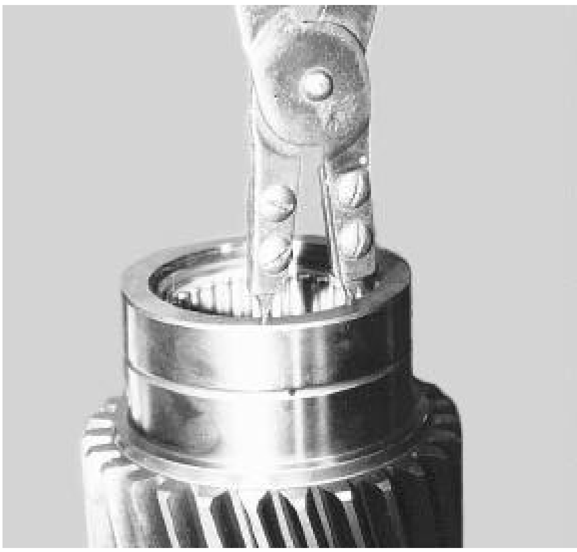


Figure 100. Installing Internal Retaining Ring Into Pinion

6. Align plates in clutch pack and install pinion on secondary shaft so that external teeth on clutch hub mesh with internal teeth of steel plates in clutch pack. Assure that clutch hub is in mesh with all clutch plates.

7. Install external retaining ring to retain pinion on shaft.

Figure 101. Installing External Retaining Ring Onto Clutch Shaft

8. Assemble primary shaft. Repeat previous procedure steps; assembly procedure for primary shaft is the same as for the secondary shaft, and also includes the following:

(Applicable to primary shaft only).

A. Place two spacers (about a half inch thick) on the face of hte pinion.

B. Heat the input oil seal sleeve and place it on the shaft until it rests on the spacers. Note that the groove for the O-ring is over the undercut area of the shaft.

C. Allow the seal sleeve to cool to avoid injury. Install the O-ring over the shaft, and work it into the groove inside the seal sleeve.

D. Remoe the spacers. Use tool T21553-39 and drive the seal onto the shaft, making sure that the O-ring remains in its groove. The setscrew holes will now align with the machined groove in the shaft.

E. Apply MA908 threadlocker to two 10-24 x 3/8 inch setscrews, and secure the sleeve to the shaft. Torque the screws to 18 Nm (13 ft-lb).

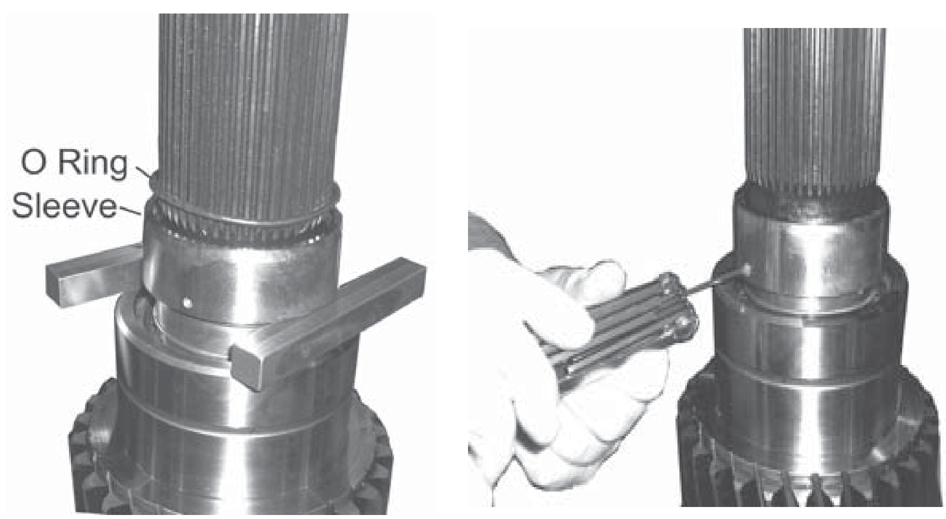


Figure 102. Installing Sleeve on Primary Shaft

Installation of Clutch Shafts, Bearing Carrier, and Manifold

1. Install clutch shaft assemblies into the transmission housing. Use caution to prevent damaging the shafts, gears, and bearings. Use tool T-18050-715 for lifting the primary and secondary shafts.

2. Install bearing carrier gasket over dowels onto rear face of housing.

Figure 103. Installing Clutch Shaft Assembly

3. Install the lube relief valve cartridge into the housing.

Figure 104. Lubrication Oil Pressure Relief Cartridge Installed

4. Install two alignment studs into the face of the transmission housing. Install the bearing carrier over the studs and onto the dowels in the housing face. Use a soft hammer (near the dowels) to seat the carrier against the gasket and over dowels.

Figure 105. Install Bearing Carrier

5. Install the lube tube through the “keyed” hole in the bearing carrier and into the machined pocket in the front inner face of housing. Rotate the tube so the elongated “key” fits into the corresponding “keyway” in the bearing carrier. When properly installed, the lube tube will be flush with the rear face of bearing carrier.

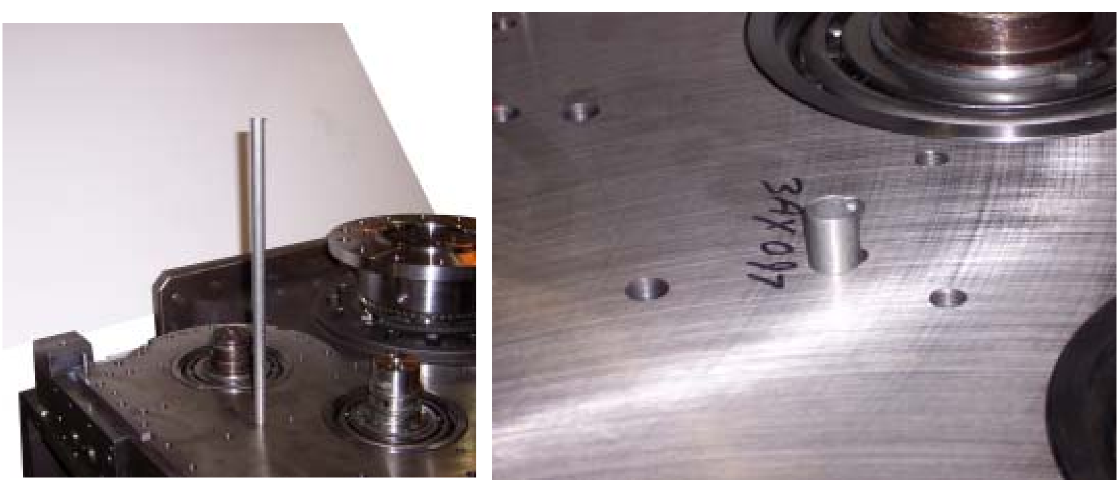


Figure 106. Key Orientation of Lube Tube in Bearing Carrier

6. Install cups for rear tapered roller bearings, on the primary and secondary shafts, into their respective bores in the bearing carrier. Tap the cups down gently with a soft hammer or brass drift to seat them against the bearing cones on the shafts.

7. Install the manifold gasket over the alignment studs and against the bearing carrier.

8. Install the bearing spacers over the bearing cups.

Figure 107. Bearing Cups, Spacers, and Manifold Gasket Installed

9. Rotate the shafts at least three revolutions to seat the bearing rollers while pressing down on both bearing spacers.

10. Push the tapered roller bearing cups, with bearing spacers, firmly against the roller bearing cones. Use a depth micrometer to measure from the top of manifold gasket to the shim retainers. This distance is shaft endplay. Use necessary shims to develop a shim pack for each shaft to reduce the endplay to 0.013 mm to 0.063 mm (0.0005 in. to 0.0025 in.).

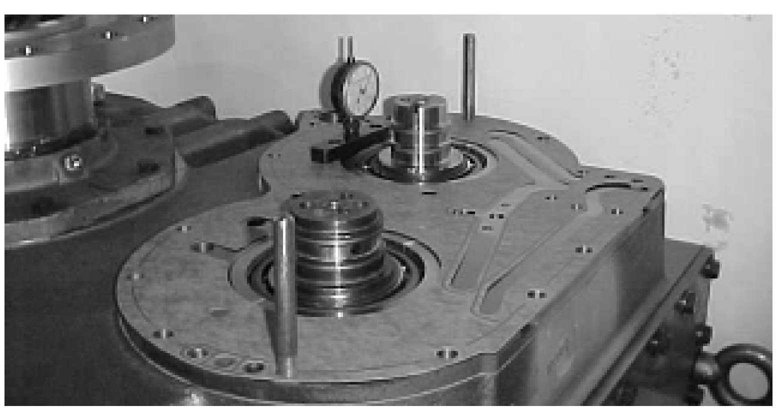


Figure 108. Measuring to Determine Required Shim Pack Thickness

11. Remove one shim retainer and install the shim pack for that shaft directly over the bearing cup. The thinnest of the shims should be in the center of the pack, and the thickest shim should be against the bearing cup. Repeat this process for the other shaft.

12. Install the shaft seal rings into the grooves of both clutch shafts. Center the seal rings in the grooves to prevent seal ring damage during manifold installation.

13. Apply a coat of assembly grease or oil to the seal rings of both clutch shafts.

Figure 109. Install Seal Rings

14. Apply MA908 threadlocker to two M12 x 35 sockethead screws, and attach the pump adapter to end of secondary shaft with them. Torque screws to 130 Nm (95 ft-lb).

Figure 110. Attach Pump Adapter

15. Install the manifold over the bearing carrier and gasket. Use a soft hammer (near the dowels) to seat the manifold against the gasket and over the dowels.

Figure 111. Install Manifold

16. Install (26) M12 x 60 manifold attaching screws and torque to 112 Nm (83 ft-lb).

Figure 112. Manifold Attaching Screws

Installation of Output Flange

1. If removed during disassembly, install the speed pickup gear onto the rear of the output flange with the internal chamfer of the gear towards the flange.

2. Apply MA908 Locktite® to the capscrew threads, and torque the four M8 x 16 socket head capscrews to 37 Nm (27 lb-ft).

3. Clean tapered surface of output shaft and tapered bore of output flange. Use OSHA approved cleaning solvent to remove all traces of dirt, grease, oil, etc. Do not touch cleaned surfaces. Loctite® 7070 cleaner is recommended.

⚠ CAUTION

Tapered surface of shaft and matching tapered bore of flange must be completely free of grease, oil, dirt or solvent residue. Failure to properly clean mating parts could prevent proper advance measurement of flange on shaft and adversely effect torque carrying capacity of the assembled joint. Both parts must be at the same temperature.

4. Measure the length of the tapered bore of the output flange using a depth micrometer. The flange must be placed on a flat surface, and the length being measured is to the inner shoulder of output flange. Record this distance as dimension "A."

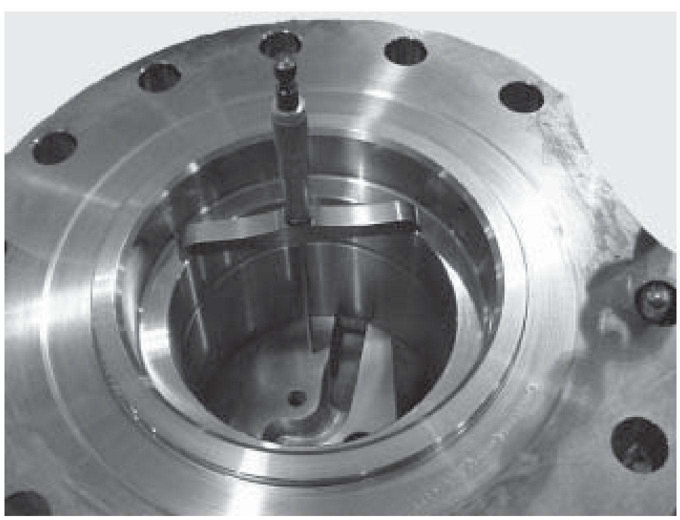


Figure 113. Measuring Output Flange Bore Length

5. With a depth micrometer, measure the output shaft height. This is the distance from the end of the output shaft down to the rear tapered roller bearing cone. Record this distance as dimension “B.”

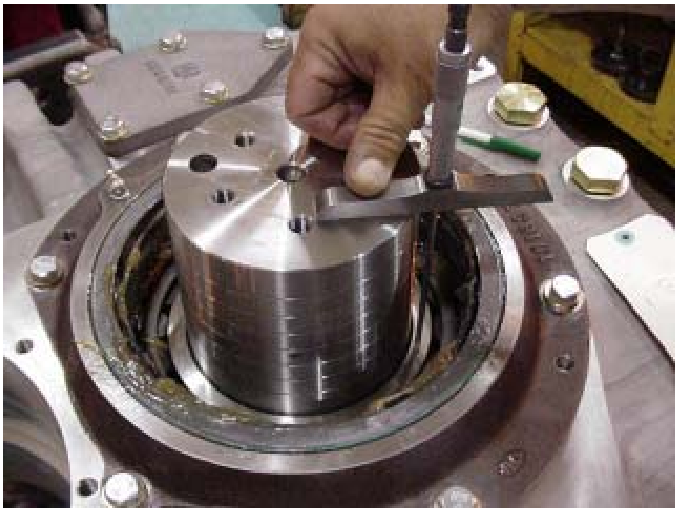


Figure 114. Measuring From Output Shaft Height

6. Seat flange onto the taper of the shaft using only the weight of the flange.

7. With a depth micrometer, measure distance from inner shoulder of output flange to end of output shaft. Record this distance as dimension “C.”

Figure 115. Measuring Output Step Height

8. Calculate the output flange advance, which is dimension “B” plus dimension “C” minus dimension “A.” This is advance must be 4.85 mm to 7.04 mm (0.191 in. to 0.277 in.).

Note: Should the calculated advance fall outside the range given above, check to assure that all measurements and calculations are correct. If no errors are found and the expected advance is out of tolerance, it will be necessary to change parts. Contact the Product Service Department at Twin Disc, Incorporated for assistance.

9. Connect the oil injector to the output flange.

10. Install tool T-21433 onto the output shaft to advance the flange onto the shaft.

11. Inject oil with a viscosity of 300 mm^2/S (300cSt) at room temperature (mounting fluid) into the shaft until it leaks out of both ends of the mating surfaces.

12. Advance flange onto shaft with the portable press.

Figure 116. Advancing Output Flange Onto Output Shaft

13. Release injection oil pressure between the mating surfaces and wait five minutes. Remove T-21433 from the transmission.

Note: It is possible to advance the flange using the retainer washer and its five retaining screws. The screws must be tightened evenly in small increments and in an alternating star pattern to advance the flange squarely onto the shaft. New screws must be installed if the old screws were over-torqued during the advancing process.

14. Measure the distance from the output flange shoulder to the end of the output shaft. Record this as dimension “D.” Dimension “D must be the same as dimension “B” minus dimension ”A” within 0.05 mm (0.002 inch).

15. Create a shim pack that is 0.05 mm to 0.15 mm (0.002 to 0.006 inch) less than dimension “D.” Install the shim pack and retainer washer onto the output shaft. Install the screws and torque them to 112 Nm (83 ft-lb).

Figure 117. Installing Output Flange Retainer Washer and Shims

16. Attach dial indicator to housing with probe resting on face of output flange. Locate indicator probe as close to O.D. of flange as possible. Check flange face runout by rotating flange. Total indicated runout must not exceed 0.10 mm (0.004 in.).

17. Attach dial indicator to housing with probe resting on O.D. of output flange pilot. Check pilot runout by rotating output flange. Total indicated runout must not exceed 0.10 mm (0.004 in.).

    Note: Should total dial indicator runout exceed 0.10 mm (0.004 in.) the flange must be removed and reinstalled on the shaft taper.

18. Install the O-ring plug into the oil injection port of the output flange and torque to 16 Nm (12 ft-lb).

Speed Sensors (if equipped)

1. (On E-Troll units only). Apply anaerobic sealant meeting MA908 specifications (Loctite® 242) to the threads of the output speed sensor pickup. Install the pickup. Turn the speed pickup until it touches the gear tooth O.D.., and back off two complete turns. Tighten the jam nuts to 27 Nm (20 ft-lb).

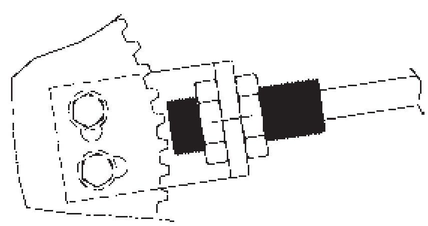


Figure 118. Install Output Speed Sensor Pickup

2. (On E-Troll units only). Apply anaerobic sealant meeting MA908 specifications (Loctite® 242) to the threads of the input speed sensor pickup. Install the pickup. Turn the speed pickup until it touches the gear tooth O.D., and back off one complete turn. Tighten the jam nut to 27 Nm (20 ft-lb).

   If no speed pickup is used, install the plug and O-ring, and torque to 88 Nm (65 ft-lb).

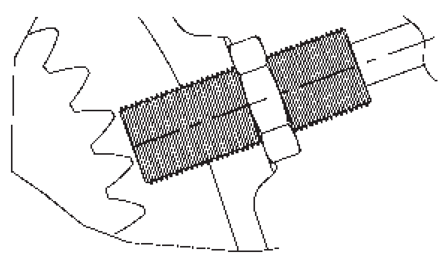


Figure 119. Install Input Speed Sensor Pickup

Installation of Input Oil Seal, Front Housing and Input Coupling

1. Apply a thin coat of M2828 anaerobic sealer to the O. D. of the oil seal and also to the housing input oil seal bore. Install the input oil seal with the driver of tool T-21553-37. Remove any excess M2828 sealant from the seal.

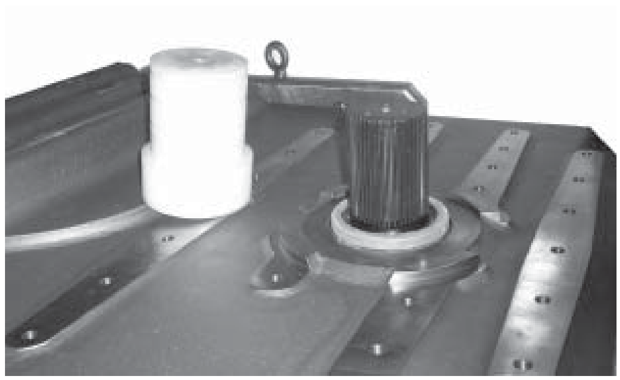


Figure 120. Installing Input Oil Seal

2. Install the front housing onto the transmission. Torque the attaching screws to 112 Nm (83 ft-lb).

3. Check front housing runout.

   A. Mount a dial indicator on the input shaft with the probe on the front housing machined face. Rotate the input shaft and note the total indicator runout. The face runout must not exceed 0.41 mm (0.016 in) for both SAE #0 and #00 housings.

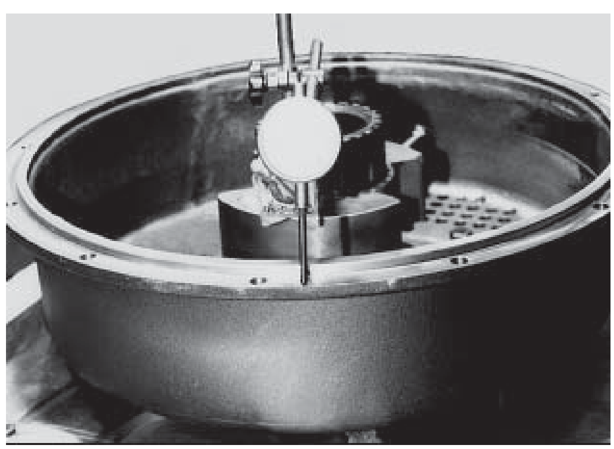


Figure 121. Measuring Front Housing Face Runout

B. Move the dial indicator's probe so it measures the O.D. of the front housing pilot diameter. Rotate the input shaft and note the total indicator runout. The pilot runout must not exceed 0.30 mm (0.012 in) for both SAE #0 and #00 housings. Should total indicator runout exceed the allowable limits, contact the Product Service Department of Twin Disc, Inc. for information and recommendations.

4. On units using Vulkan® or Centa® input couplings, the input shaft splines are a slip fit. If the transmission is to be shipped with the input coupling installed, it must be attached to prevent it from sliding off and causing damage. Be sure the internal retaining ring is installed into the correct groove of the input hub on units using a Vulkan® input coupling (refer to transmission assembly drawing). The torque specification for the M20 screws that attach the coupling element to the coupling hub is 530 Nm (391 ft-lb) with lubricated threads.

5. On free standing units, install the input hub. The spline fit with this hub is a tight fit, therefore it is recommended to heat the coupling to 66° C (150° F) to ease installation. The use of silicone spray lubricant on the shaft is also recommended. Install the retainer washer and capscrews with torque of 112 Nm (83 ft-lb). The torque specification for the M22 x 1.5 screws that attach the coupling element to the coupling hub is 820 Nm (605 ft-lb) with lubricated threads.

Installation of Exterior Components

1. Install new O-rings onto the plugs used for the clutch and lube pressure test ports. Lubricate the O-ring and threads and install the plugs. Torque each plug as indicated below:

Port		Size	Torque Nm (ft-lb)
Main, Pressure	X	M12 x 1.5	16 (9)
Primary Clutch, First Pressure	Z_{pc1}	M14 x 1.5	20 (15)
Primary Clutch, Second Pressure	Z_{pc2}	M12 x 1.5	16 (9)
Primary Clutch, Lube	G	M18 x 1.5	34 (25)
Secondary Clutch, First Pressure	Z_{sc1}	M14 x 1.5	20 (15)
Secondary Clutch, Second Pressure	Z_{sc2}	M12 x 1.5	16 (9)
Secondary Clutch, Lube	G	M18 x 1.5	34 (25)

2. Install suction strainer into bore in manifold.

   Apply assembly grease or oil to the suction screen cover O-ring, and install O-ring into groove in the cover. Install suction screen cover in housing and secure with clamp plate and screw. Torque attaching M12 x 25 screw to 112 Nm (83 ft-lb).

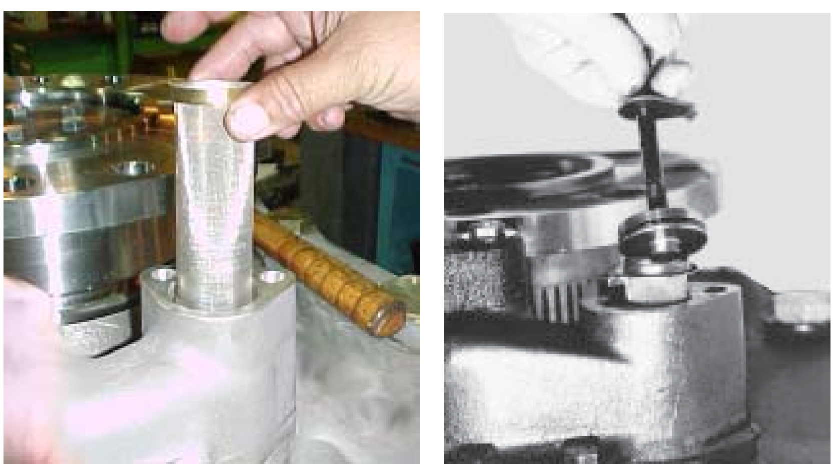


Figure 122. Install Suction Strainer

3. Install O-ring into groove in face of manifold at primary shaft. Install cover onto manifold at primary shaft. Install attaching screws and torque to 112 Nm (83 ft-lb).

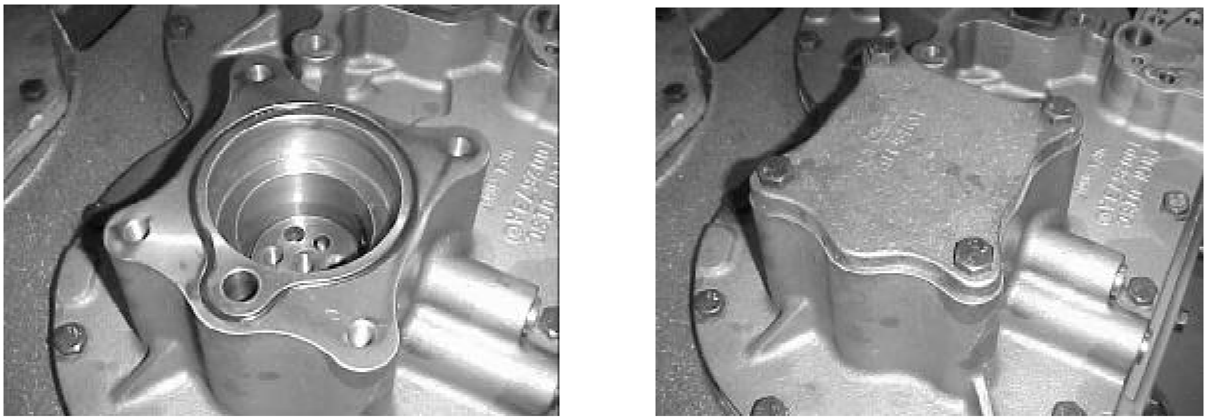


Figure 123. O-ring Installed (left) and Cover Installed (right)

4. Install the oil pump gasket and oil pump. Mesh drive tang on pump shaft with drive slot in secondary shaft drive adapter. Install four M12 x 45 attaching screws and torque to 112 Nm (83 ft-lb).

Figure 124. Oil Pump Installed

5. Assemble oil filter differential bypass valve parts into oil filter head and torque the O-ring plug to 108 Nm (80 ft-lb). Install the oil filter head onto transmission and torque the attaching screws to 80 Nm (59 ft-lb). Install O-ring, filter element, and filter housing onto filter head and torque the bolt to 81 Nm (60 ft-lb) with its threads and washer oiled.

Figure 125. Oil Filter Installed

6. If the transmission is not equipped with an optional trailing pump, install the trailing pump port cover. Insert the cover mounting washers and screws, and torque them to 112 Nm (83 ft-lb).

   Install O-ring on suction screen cavity cover. Install cover and secure it with clamp plate, washer and M12 x 30 hex head screw. Torque to 112 Nm (83 ft-lb).

7. If the transmission is equipped with an optional trailing pump, install the trailing pump, tube, and associated fittings.

Installation of Top Cover Assembly, Heat Exchanger, and Oil Gauge

1. Turn transmission over and block securely in upright position.

2. Attach oil baffle to top cover (if removed). Install the sealing washers onto the screws, apply MA908 threadlocker to the screw threads and grease to the sealing washers, and torque the three M8 x 30 screws to 33 Nm (25 ft-lb).

   Install top cover assembly with its gasket. Install attaching (24) M12 x 45 capscrews and torque them to 112 Nm (83 ft-lb). Install the two lifting eyebolts.

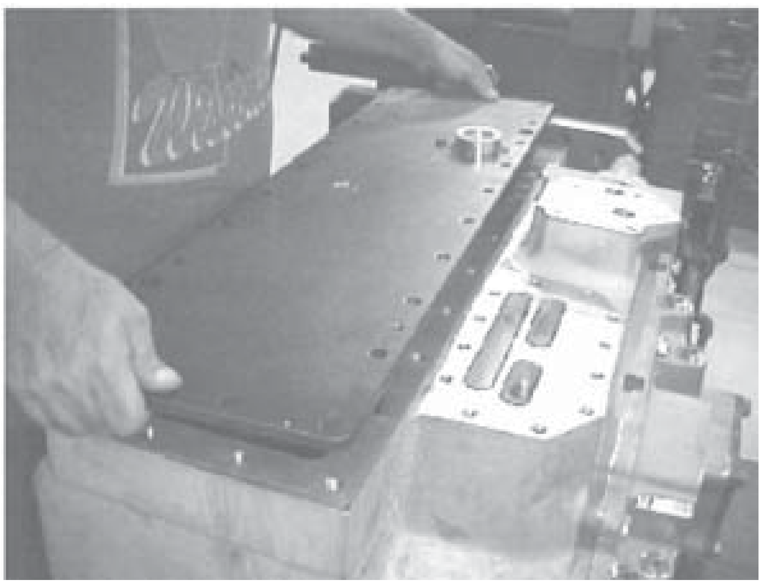


Figure 126. Installing Top Cover

3. Install breather-filler cap.

4. Install oil gauge tube assembly and oil level gauge.

5. Install the heat exchanger. The use of M12 x 1.75 guide studs will ease the installation of the heat exchanger.

Units with Remote Heat Exchanger:

Install the adapter plate and gasket. Torque the attaching sockethead capscrews to 80 Nm (59 ft-lb). Install protective plugs to prevent contaminants from entering into the transmission's lubrication oil circuit.

Units with Integral Fresh Water Heat Exchanger:

Install the adapter plate and gasket. Torque the attaching sockethead capscrews to 80 Nm (59 ft-lb). Install heat exchanger element and gasket over adapter plate. Install heat exchanger cover and gasket and torque the attaching screws to 112 Nm (83 ft-lb). Install protective plugs into cover to prevent the entrance of contaminants into the transmission's water circuit. Install the M10 x 1 O-ring water drain plug and torque to 12 Nm (9 ft-lb).

Units with Integral Raw Water Heat Exchanger:

Install stiffener plate and gasket. Install two O-rings into counterbores of stiffener plate. Install heat exchanger element and cover gasket over adapter plate and O-rings. Install anode into cover with gasket, screw and sealing washer, torquing screw to 18 Nm (13 ft-lb). Fill the remaining threads in the anode below the screw with RTV silicone sealer. Be sure sealer has proper curing time before exposing it to water. Install heat exchanger cover and torque the attaching screws to 80 Nm (59 ft-lb). Install protective plugs into cover to prevent the entrance of contaminants into the transmission's water circuit. Install the M10 x 1 O-ring water drain plug and torque to 12 Nm (9 ft-lb).

Assembly of Control Valve

Assembly of GP Control Valve with Electronic Interface

Prior to assembly, all parts must be properly cleaned. Carefully inspect all o-rings for any damage, and replace as necessary. Lubricate all o-rings, and replace both gaskets.

1. Assemble the Main Regulator Valve body.

   A. Install the filter into the threaded hole of the valve body, and torque to 7.5 Nm (5.5 Ft-lb). If removed, install a new check valve assembly into the bore of the valve body, and drive it with a drift until it is flush with the face of the body. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 Nm (17 Ft-lb).

   B. Install the gasket and cover without the adjustment screw to the valve body with four M8 x 25 capscrews and torque to 23 Nm (17 Ft-lb).

   C. Install the spool with washer, and spring into the bore. Install the gasket, and cover with the adjustment screw, using four M8 x 25 capscrews. Evenly tighten the capscrews, and torque to 23 Nm (17 Ft-lb).

   D. Install the cap onto the adjusting screw finger tight as the main pressure must be set at the time of installation or testing.

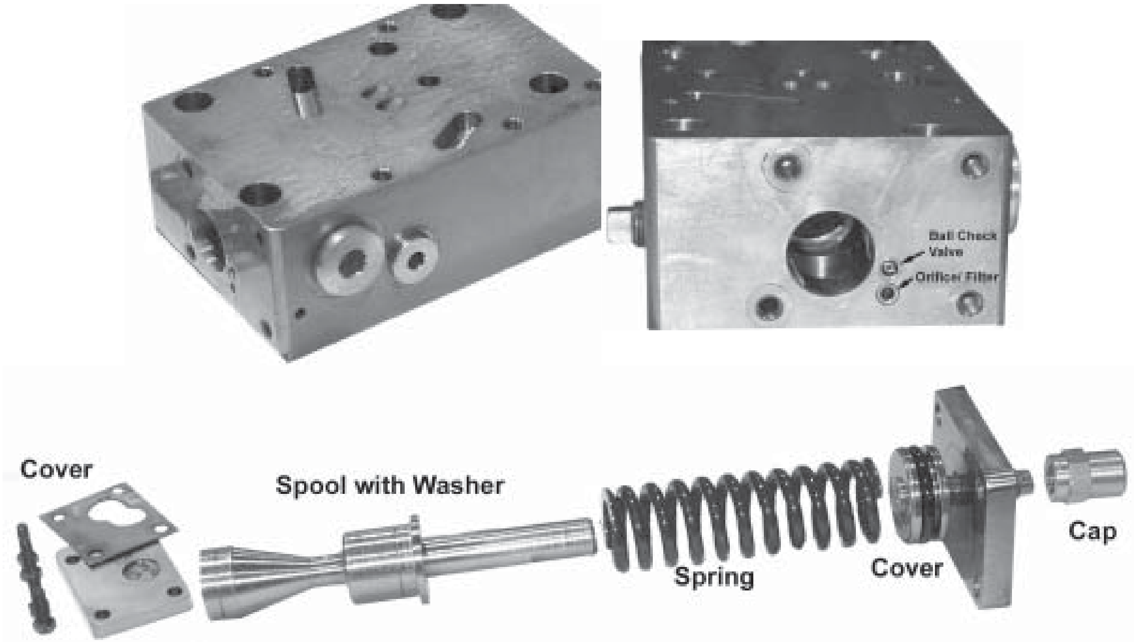


Figure 127. Assemble Main Pressure Regulator Components

2. Assemble the Top Valve Body. Install the two proportional valve assemblies into the valve body, install the retaining plate, and torque the M6-1.00 x 16 socket head capscrew to 9.5 Nm (7 ft-lb). Install the Manual Direction Control Valve into the valve body, and torque to 27 Nm (20 Ft-lb). Install the M12 x 1.50 o-ring plug into the valve body and torque to 16 Nm (12 ft-lb). Connect the wires for the Neutral Switch.

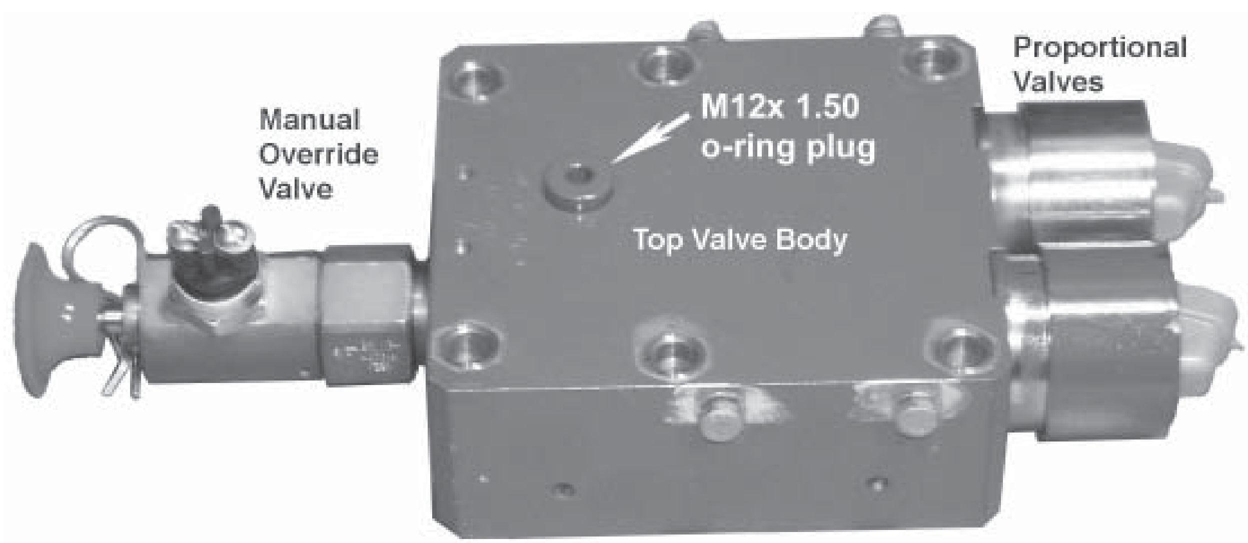


Figure 128. Assemble Top Valve Body Components

3. Install a new gasket, and the Main Regulator Valve Assembly to the transmission or ditch plate, using the four twelve point capscrews. Torque the capscrews to the level specified for the appropriate sized capscrew into aluminum threads. See the torque specifications in Description and Specifications.

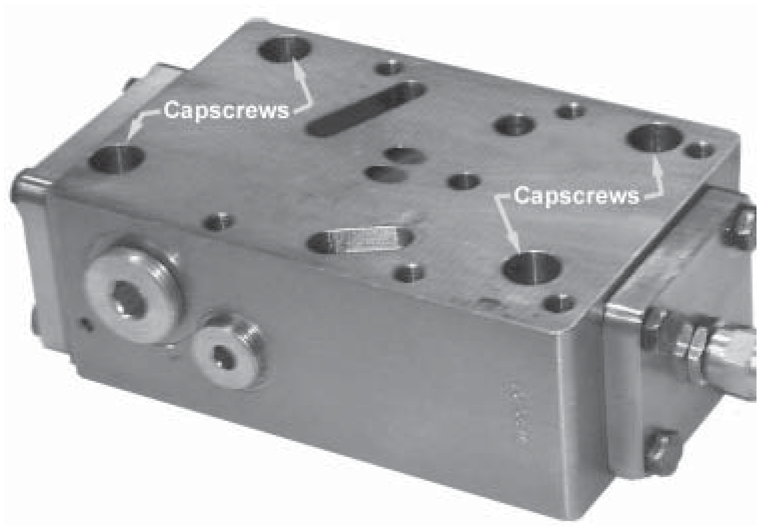


Figure 129. Install Regulator Valve Body to Transmission

4. Install a new gasket, and the Top Valve Body Assembly on the Main Regulator Valve Assembly, using six M10-1.50 x 70 hex head capscrews, and torque to 46 Nm (34 ft-lb).

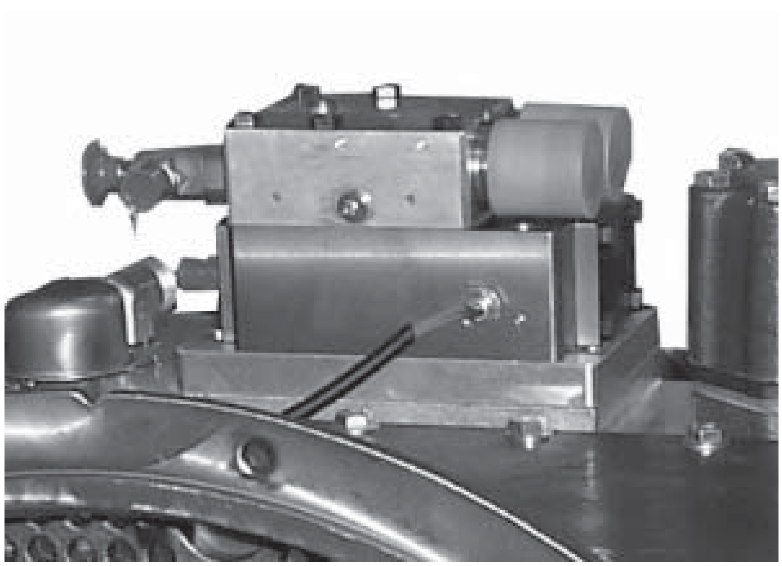


Figure 130. Install Top Valve Body onto Regulator Valve Assembly

5. Install the Electronic Profile or E-Troll Module on the top Valve Body, and torque the four M6-1.0 capscrews to 9.5 Nm (7 ft-lb).

Figure 131. Place Profile or E-Troll Module onto Valve and tighten screws

6. Connect the electrical wires to the proportional valves, and connect any other wires that were removed during disassembly.

Adjustment of Main Pressure

Valve Assembly 1020941:

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the adjusting stem. This will expose a slotted adjustment stem. Loosen the jam nut on the stem.

Figure 132. Main Pressure Regulating Valve Assembly 1020941

3. Start engine with controls in neutral.

   Note: This must be done with the transmission in neutral.

4. Turn the slotted adjustment stem clockwise to achieve the main pressure setting. See the specifications in Description and Specifications.

5. Tighten the jam nut to a torque of 20 Nm (15 ft-lb), install the protective cap, and torque it to 14 Nm (10 ft-lb).

Assembly of Electrical Control Valve (1018084)

Upper Body Half

1. Install one dowel pin (large diameter) into each of the two bores of the valve body.

2. Install one spring into each of the two bores of the valve body.

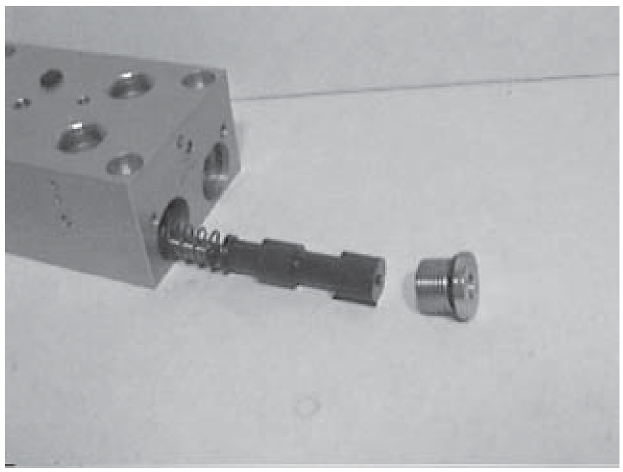


Figure 133. Dowel, Return Spring, Spool, and Plug

3. Install one spool into each of the two bores of the valve body.

4. On units equipped with the hydraulic lock feature, install one spring followed by one pin (small diameter) into each of the spools.

5. Install the two O-ring plugs into the valve body and tighten to 85 Nm (63 ft-lb.)

6. Apply lubricant (such as Dow Corning 200® 30,000cSt fluid) to the O-rings of the solenoids and plug (plug used on units without hydraulic lock). Install solenoids (and plug, if equipped) into the valve body and torque them to 34 Nm (25 ft-lb).

7. Insert the wires (pins) into the Weatherpak connector according to the location markings made at disassembly. Close the end of the Weatherpak connector to lock the wires in position.

8. Install the Weatherpak connector onto its retaining clip on the top of the valve body.

Lower Body Half - Electric Valve (1018084) and Mechanical Valve (1017172)

1. Install the steel shuttle ball into its bore in the valve body.

2. Install the O-ring onto the shuttle ball seat.

3. Apply lubricant such as Dow Corning 200® 30,000cSt fluid to the O-ring, and install the seat into the valve body. Be sure to align the roll pin holes in the seat with the holes in the valve body. One of the valve's M8 x 1.25 cover screws threaded into the seat can be used to adjust the seat location in the valve body.

4. Install the roll pin to retain the shuttle ball seat. Drive the roll pin in until it is flush with the gasket surface of the valve body.

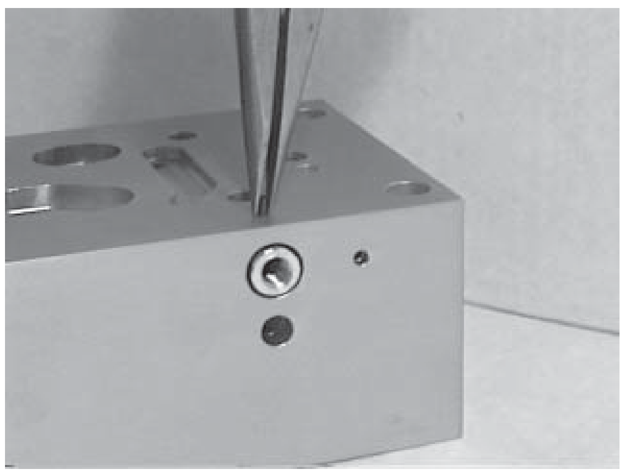


Figure 134. Installing Shuttle Ball Seat Roll Pin

5. Install the stem into the valve body, aligning the slot in the stem with the threaded hole in the valve body for the dog-point setscrew. Be sure the slot in the stem is aligned with the setscrew hole in the valve body to prevent damage to the stem and valve body.

6. Apply MA908 threadlocker to the threads of the dog-point setscrew and install. Tighten the dog-point setscrew until snug, then back off 1/2 turn.

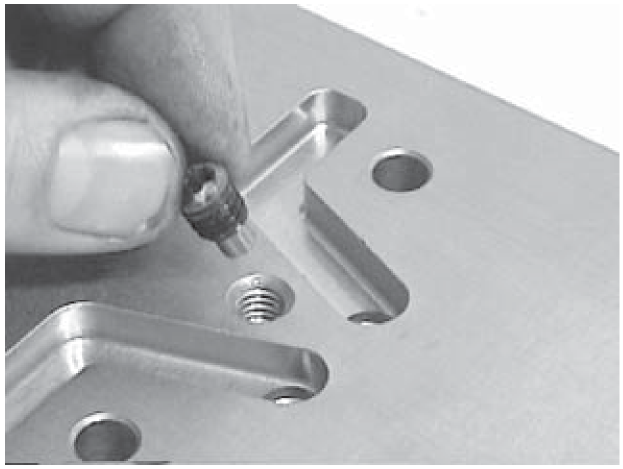


Figure 135. Installing Dogpoint Setscrew

7. Install the steel detent ball into the valve body.

8. Install the detent spring over the detent ball.

9. Apply MA908 threadlocker to the threads of the hollow setscrew and install into the threaded hole. A stepped Allen wrench, or one wrapped with tape will ease the installation of the hollow setscrew. Tighten the setscrew until it is flush with the gasket surface of the valve body. Check the stem rotation and detent action.

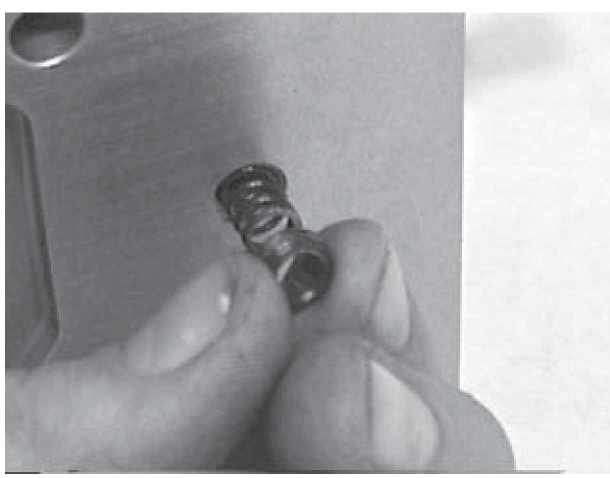


Figure 136. Installing Detent Ball Setscrew

10. Install the thrust washer over the end of the stem.

11. Press the oil seal into the cover assembly until flush with the adjacent cover surface.

12. Install the O-ring into the counterbore in the cover assembly.

13. Apply grease to the stem, O-ring, and oil seal lip.

14. Install cover assembly and gasket onto valve body. Be sure to align the oil drain hole in the gasket with the hole in the valve body.

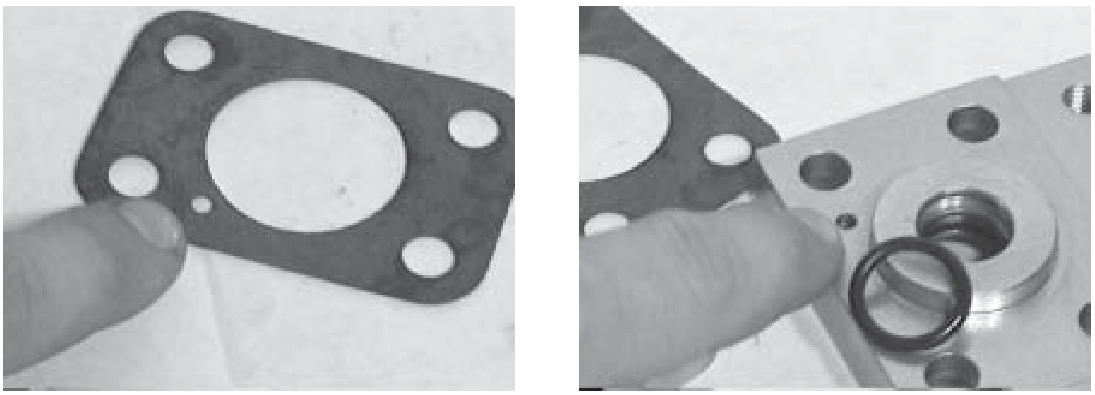


Figure 137. Holes in Gasket and Cover Must be Aligned

15. Install cover capscrews and torque to 23 Nm (17 ft-lb).

16. Install washer over stem and against oil seal.

17. Install spring over stem against washer.

18. Install lever onto the stem. It may be necessary to splay the lever to be able to install it. DO NOT apply any impact force to the lever, as the stem or dog-point setscrew may be damaged. Torque the lever's attaching screw to 9.5 Nm (7 ft-lb).

19. Install external retaining ring onto stem .

20. Install the steel balls and electrical switches into the bores in the sides of the valve body (if equipped). Note that the small diameter ball is inboard of the large diameter ball at each switch location.

21. Install the pressure regulating piston into valve body with spring pocket out.

22. Install pressure regulating springs into valve body and into piston spring pocket.

23. Install the shims that were removed into the bore of the rate-of-rise piston. Install the rate-of-rise piston over the springs and into valve body.

24. Install neutral pressure regulating spring into the pocket of valve body.

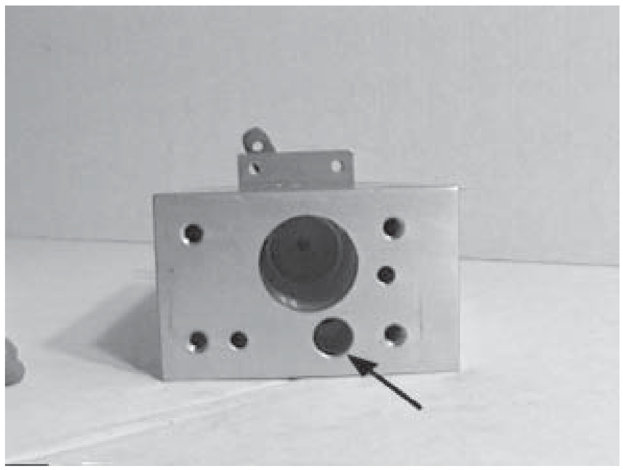


Figure 138. Neutral Pressure Regulating Spring Location

25. Install orifice plate gasket onto valve body.

26. Install orifice plate and steel ball (against spring) onto valve body.

27. Install orifice plate cover and gasket onto valve body. Install cover capscrews and torque to 23 Nm (17 ft-lb).

28. Install gasket over lower valve body half.

29. Set upper valve body half over lower valve body half. Insert the valve attaching screws through valve body halves to keep parts in alignment until installation onto the transmission. When installing the valve onto the transmission, torque the screws to 54 Nm (40 ft-lb).

Assembly of Trolling Valve (optional equipment)

1. Press a new oil seal into the counterbore in the end of the adapter. Install a new O-ring into the groove of the adapter.

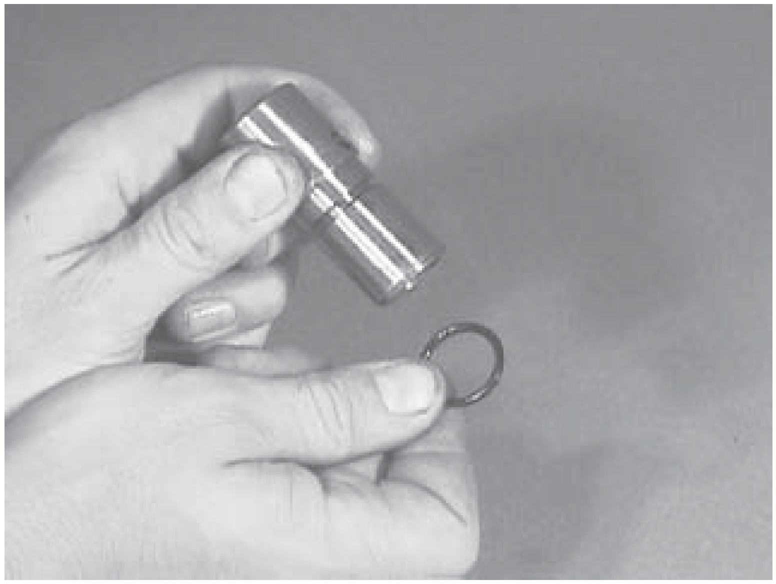


Figure 139. Installing O-ring onto Adapter

2. Install a new O-ring into the groove of the stem.

3. Install the roll pin into the end of the stem (if removed).

4. Install the inner spring onto the roll pin in the stem end with a counterclockwise twisting motion. The spring is to be installed onto the roll pin such that the first coil contacts the end of the stem.

5. Apply assembly grease to the stem, from the O-ring to the reduced diameter end. Install the stem into the adapter, with the reduced diameter end entering the adapter first. Adjust the position of the stem if necessary to bring the helical slot into alignment with the dog-point setscrew hole.

6. Install the large diameter washer (used on some models) inside the bore of the adapter and over the inner spring until it lays flat on the end of the stem.

7. Install the small washer (used on some models) inside the piston. The washer must lie flat at the bottom of the bore in the piston.

8. Apply assembly grease to the adapter (where it contacts the trolling valve body) and install the adapter into the valve body. Be sure to align the setscrew holes in the adapter with those in the valve body.

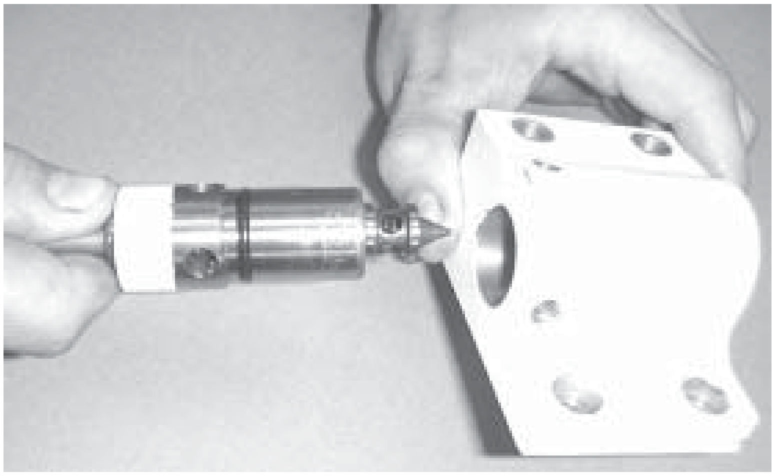


Figure 140. Installing Trolling Valve Parts Into Trolling Valve Body

9. Apply MA908 threadlocker to the threads of the dog-point setscrew and install. Tighten the dog-point setscrew until snug, then back off 1/2 turn. The end of the setscrew should protrude approximately 3 mm from the valve body when the dog point of the setscrew is fully engaged in the helical slot.

Figure 141. Installing Dogpoint Setscrew

10. Check the action of the stem in the trolling valve. If the stem does not rotate 90° smoothly, loosen the dog-point setscrew 1/8 turn and recheck the action of the stem.

11. Install the detent ball and spring into the remaining hole in the valve body. Apply MA908 threadlocker to the threads of the detent setscrew and install until flush with the valve body.

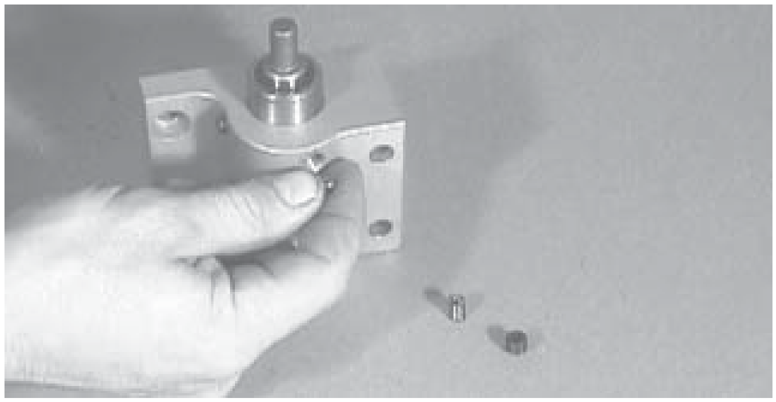


Figure 142. Installing Detent Ball, Spring, and Setscrew

12. Check the torque required to overcome the detent. The torque should be 1.1-1.7 Nm (10-15 in-lb). Adjust the detent setscrew if necessary to achieve the proper torque to rotate the lever out of the detent position.

13. Install the lever onto the stem. It may be necessary to splay the lever to be able to install it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

14. Rotate the lever (if necessary) on the stem to the position shown on the valve installation drawing (see Engineering Drawing Section of this manual). Install the screw and nut to clamp the lever to the stem. Tighten the screw and nut to 9.5 Nm (7 ft-lb).

15. Install the neutral pressure regulating spring into the bore of the control valve (if removed).

16. Install the steel ball onto the neutral pressure regulating spring.

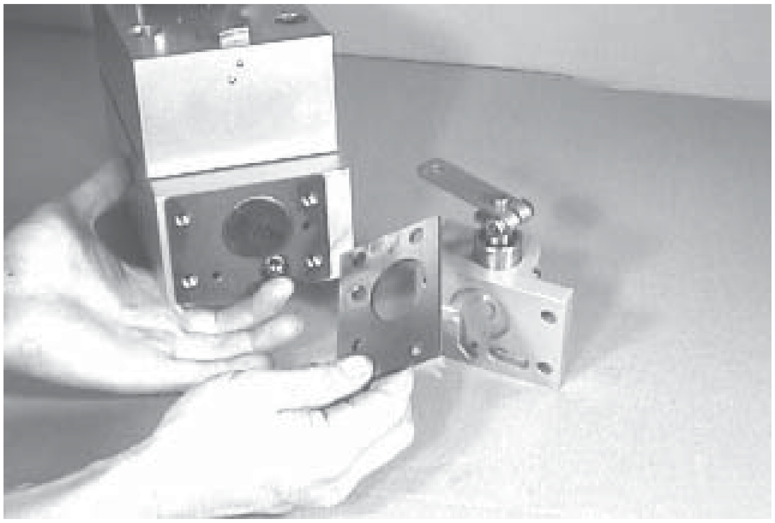


Figure 143. Installing Neutral Pressure Regulating Spring and Ball

17. Install the orifice plate gasket, orifice plate, trolling valve gasket, and trolling valve onto the control valve. Install the attaching screws and torque them to 23 Nm (17 ft-lb).

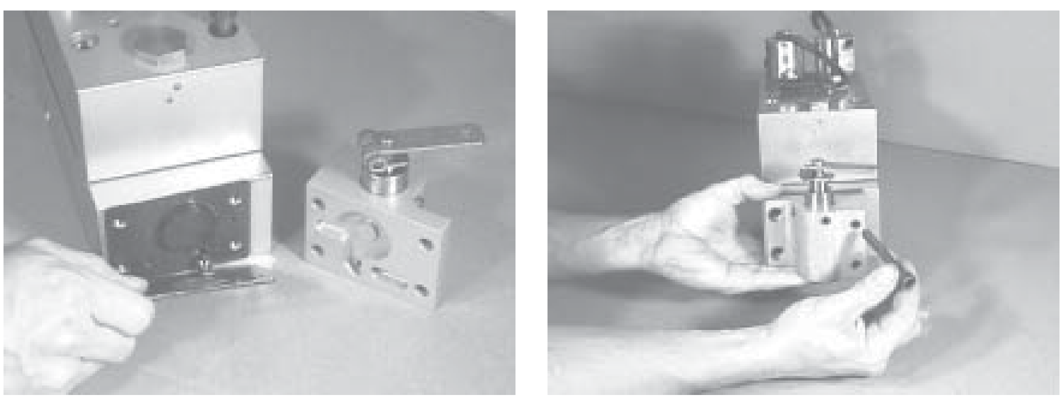


Figure 144. Installing Orifice Plate (left) and Trolling Valve onto Valve Body (right)

Installation of Electric Control Valve

1. Install control valve ditch plate and gasket. Torque the ditch plate attaching capscrews to 112 Nm (83 ft-lb).

2. Install control valve and gasket. Torque the valve attaching capscrews to 54 Nm (40 ft-lb).

Installation

Prior to Installation

⚠ CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine, or are attached to the flywheel through external shafting or adapters. Flywheel-to-driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, the crankshaft endplay should be measured again. The endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin Disc will not be responsible for system damage caused by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

The transmission housing flange and pilot, the engine flywheel and the flywheel housing must be checked for trueness. Clean the engine flywheel and flywheel housing mounting surfaces thoroughly before any measurements are made.

Note: To isolate engine vibration and prevent transferring it to the hull through the propeller shaft, the distance from the marine gear output flange to a fixed stuffing box or the first fixed bearing must be a minimum of 20 times the shaft diameter. If the distance is less than this, a flexible coupling may be necessary to isolate the engine vibration.

Alignment (also reference SAE J-1033 and J-617)

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange.

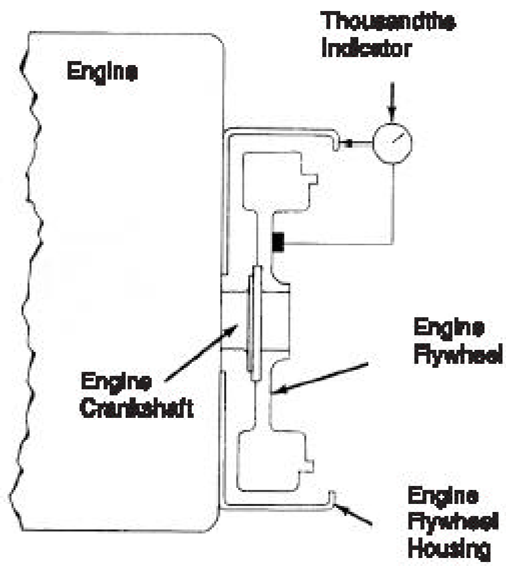


Figure 145. Checking Flywheel Housing Flange for Deviations

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel-housing flange. The face deviation must not exceed the figures given in the table below.

Table 18. Total Indicator Readings for Engine Flywheel Housing Flange

SAE Housing Number	Face Deviations and Bore Eccentricity mm (in.)
00	0.41 (0.016)
0	0.41 (0.016)
1/2	0.36 (0.014)
1	0.30 (0.012)
2	0.28 (0.011)

3. With the indicator mounted as in the previous paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing.

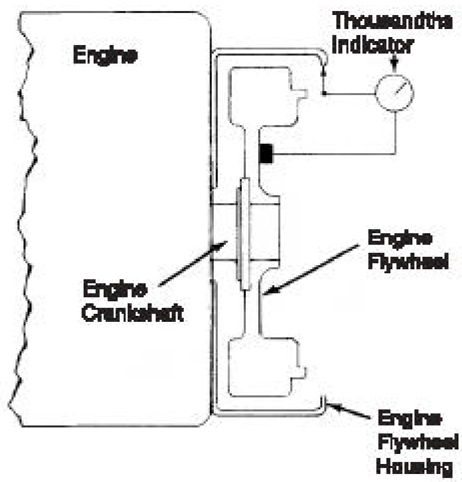


Figure 146. Checking Flywheel Housing Bore Eccentricity

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel-housing bore. See the previous table for allowable tolerances.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator tip is riding on the inner face of the flywheel. Rotate the flywheel. The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.013 mm (0.0005 in) per inch of diameter.

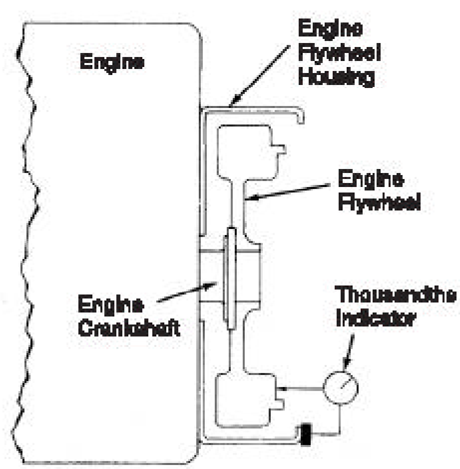


Figure 147. Checking the Flywheel Face Runout

6. With the indicator mounted as in the paragraph above, adjust the indicator tip so that it will ride on the driving ring pilot bore of the engine flywheel. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.13 mm (0.005 in) maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

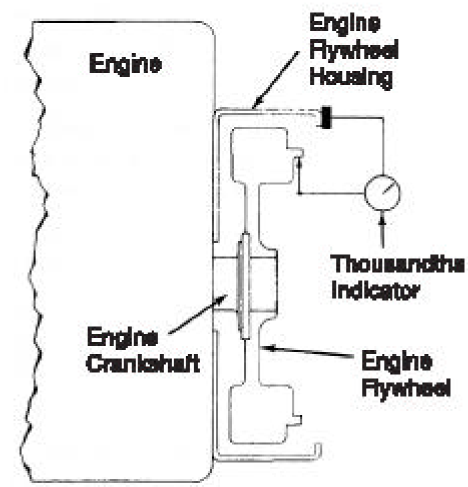


Figure 148. Checking the Flywheel Pilot Ring Bore Eccentricity

Alignment

Propeller Shaft

Before any attempt to align the engine and gearbox to the propeller shaft, proper alignment of the propeller shaft must be determined. This includes alignment of the propeller shaft through all struts and intermediate bearings. Failure to properly align the propeller shaft may result in premature wear on bearings, vibrations, or possible damage to other components.

If the length of the shaft from the last support bearing to the gearbox is excessive or a flexible stuffing box is used, the shaft must be centered prior to engine and gearbox to propeller shaft alignment.

Engine and Marine Transmission

Proper alignment of an engine and marine unit is critical, both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. Engine and shaft alignment can also change on a boat due to varying loads and the boat's age. The following steps may be taken to secure proper marine transmission alignment.

When reinstalling a marine gear after a repair, or when installing a new marine gear to an engine already mounted in the bed rails, the flywheel housing should be checked for deflection using the following procedure:

Install the mounting brackets on the side mounting pads of the marine gear. Install the driving ring on the engine flywheel. Bolt an indicator to the engine block and set the indicator stem on the engine flywheel housing.

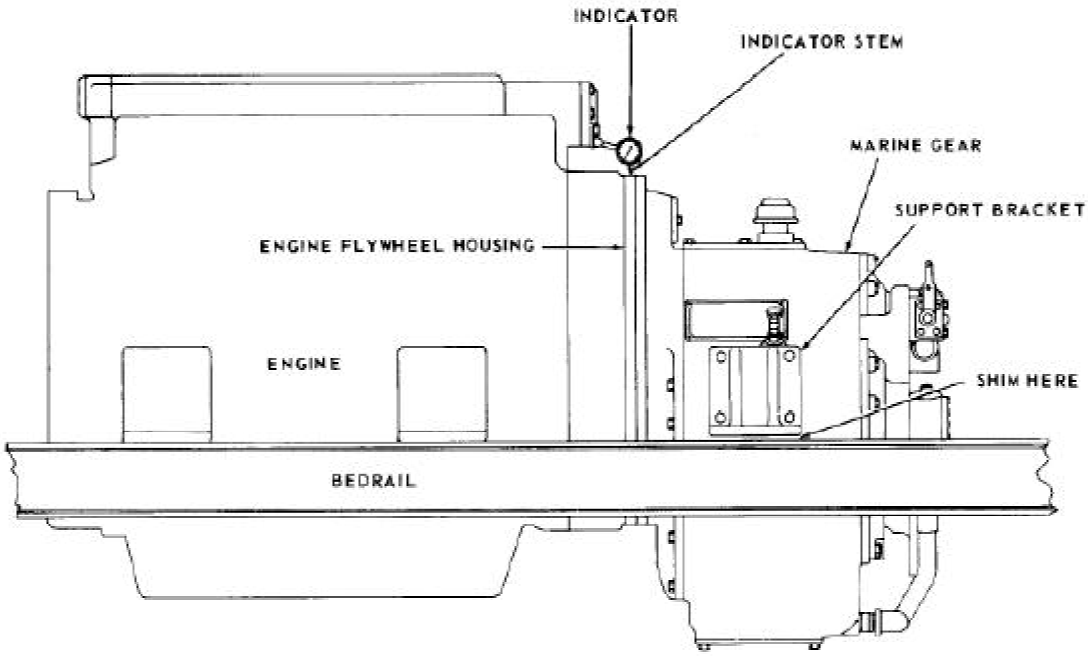


Figure 149. Marine Gear Alignment

Set the indicator gauge at zero (0). Lift the marine gear with a hoist, or other suitable means, and place the unit in position against the engine flywheel housing. Secure the flange of the marine gear main housing to the engine flywheel housing. Use a feeler gauge between each mounting bracket and engine bed rail. Add shims between the brackets and bed rails to equal the feeler gauge readings. Carefully release the lifting force on the marine gear while observing the indicator. The indicator gauge must remain steady at the zero mark. Torque the bed bolts to the proper rating. If the reading moves from zero, lift the marine gear and insert additional shims. Continue this procedure until the marine gear is completely at rest on the bed rails and the gauge maintains a steady zero reading. After obtaining the correct zero reading, indicating no distortion of the engine flywheel housing, secure the mounting brackets to the engine bed rails. Before securing the mounting brackets to the engine bed rails, the propeller shaft should be checked for alignment.

Note: The transmission output flange and companion flange bolts must be torqued to the proper value as identified in Description and Specifications.

Engine and Marine Transmission Alignment

⚠CAUTION

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and transmission must be used. Failure to do so may result in damage to the transmission or the engine flywheel housing.

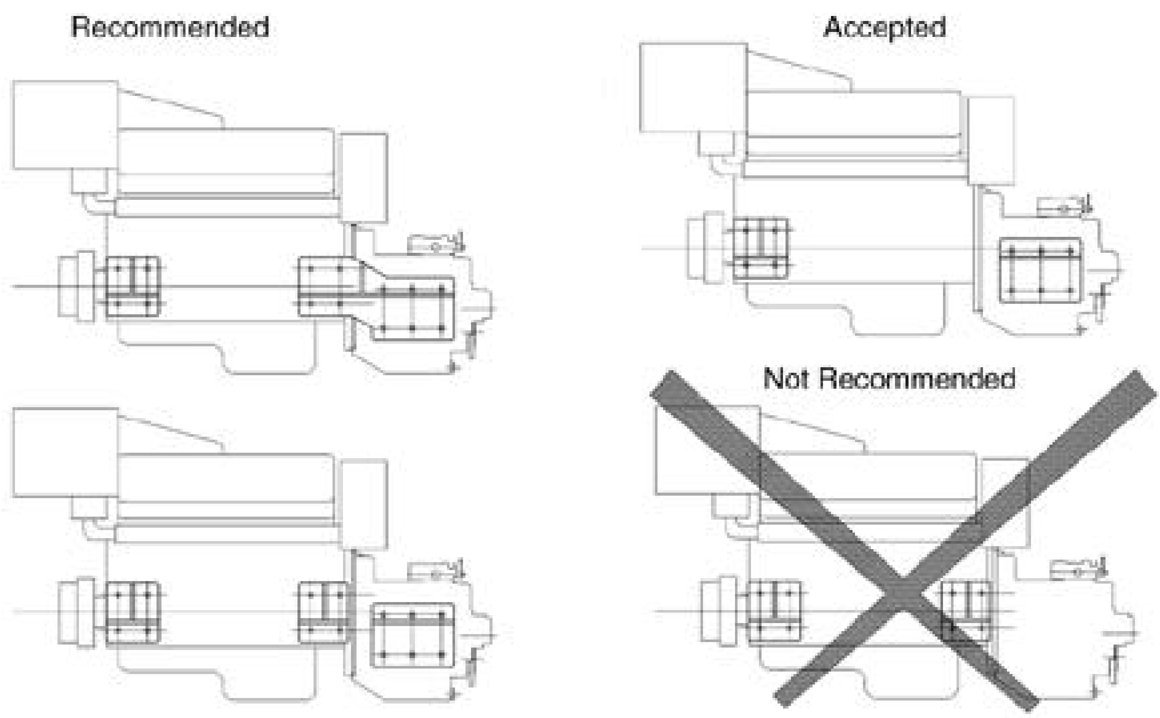


Figure 150. Transmission Mounting Configurations

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and the transmission must be used. Failure to do so may result in damage to the transmission.

It is important to align the engine and transmission only when the boat is afloat, and NOT in dry-dock. During this alignment period, it is also advisable to fill the fuel tanks and load the boat in the typical manner that it is to be used. Some boats are built with flexibility and may change shape as the loading varies. When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission coupling to prevent bending of the shaft.

With the engine and transmission in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off on the jacking screws to obtain the desired adjustment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the engine and transmission to one side or the other on the engine bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

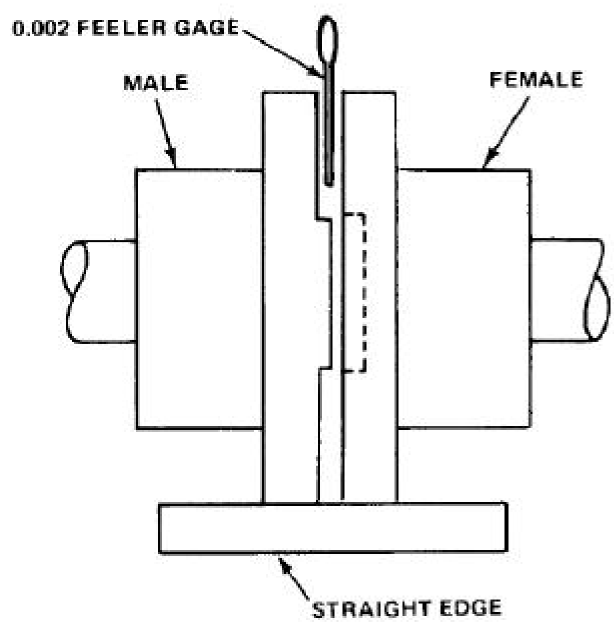


Figure 151. Checking Parallel Alignment of the Coupling

As the engine and marine transmission come into their aligned position, it will be possible to mate the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.05 mm (0.002 in) feeler gauge between the flanges of the coupling. Move (slide) the feeler gauge completely around the coupling. Rotate the marine transmission flange coupling in 90 degree increments, and move the feeler gauge around the flange in each successive position. The feeler gauge will fit snugly, with the same tension, all around the flange coupling in all four positions if the alignment is correct.

If the alignment varies during rotation, additional alignment is necessary, or the marine transmission and shaft couplings should be checked for proper face runout. Runout must not exceed 0.10 mm (0.004 in). Excessive face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline or taper. Excessive shaft coupling runout is usually due to inaccuracy of the taper fit or key to keyway interference. The optimum relative mating location will be where the measured runout dimensions of the transmission flange and the shaft coupling flange compliment each other to result in the least relative out of true parallel measurement.

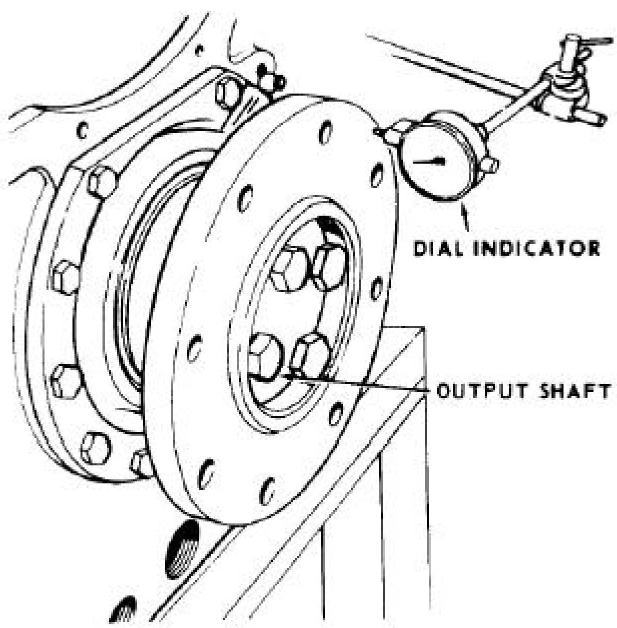


Figure 152. Checking Output Flange Face Runout

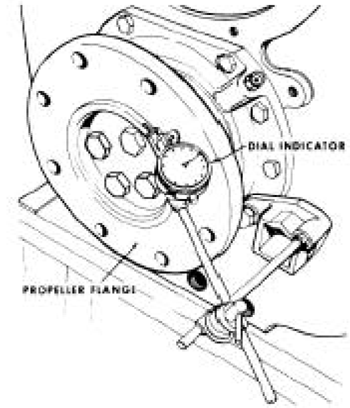


Figure 153. Checking Output Flange Pilot Eccentricity

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. Where this condition exists, it important to apply common sense alignment techniques to minimize the potential damage to any of the components.

During the process of securing final alignment, it may be necessary to shift the engine many times. When the final alignment is accomplished, mark and drill the holes for the lag studs or locating dowel pins. Then with final alignment secured, make up the necessary poured, steel, or hardwood shims, and fasten the engine and transmission in place. Then recheck the alignment, and if satisfactory, bolt the coupling together.

There are many types of flexible couplings in the market today that solve a variety of problems:

- ❑ Couplings to reduce noise and vibration.
- ❑ Couplings to allow a permanent angular misalignment.
- ❑ Couplings that allow engines to be flexibly mounted and take out the momentary misalignment.

In some cases, the proper alignment of these couplings requires an accuracy equal to that of rigid couplings. Always use the alignment procedures recommended by the coupling manufacturer.

Electrical Controls Installation

All electrical wires and connectors must be adequately supported to prevent rubbing, chafing, or distress from relative movement. All electrical connectors must be tight and free from corrosion. It is strongly recommended that the Control Harnesses and Wiring guidelines be followed to ensure proper installation of all wiring.

Control Harnesses and Wiring guidelines

Install all control wires and harnesses as follows:

1. The connector end of each control cable or harness must be secured within twelve inches of control connectors, other connectors, and all other termination points. The cable or harness must be secured to frame supports at sixteen-inch intervals along its entire length unless installed in rigid ducting or conduit.

2. Keep cable or harness away from hot surfaces, moving parts and oil locations.

3. Attach cable or harness to vessel, making the connector the highest point of the wire. If not possible, install cable or harness with drip loop.

4. Protect cable or harness with grommet, loom or flex guard at any “rub” point, particularly when passing a sheet metal hole.

5. Locate cable or harness away from potential hazards. For example, a capscrew cutting through the jacket and shorting a conductor to the chassis, welding, drilling, heat/exhaust, burrs, sharp edges, etc.

6. Prevent the cable from becoming a step or handrail.

7. Make sure connectors will mate properly. Locate and use the connector orientation key.

8. Circular connectors must be hand-tightened and lock wired if possible.

9. Cable or harness bend radius must not be less than eight times the cable diameter.

10. Avoid twisting or winding the cable along its axis during installation or removal.

11. Whenever mating connectors, always inspect each for damage or defects. For example, bent pins, pushed-back sockets, broken keys, etc.

12. Boots must be secured to cable or harness with cable tie to prevent boot from sliding off connector. Cable tie must be installed over cable or harness and butted up against boot where the cable or harness exits the boot.

13. Cables must not be installed in a manner which puts strain on the connector or results in more than twenty-four inches of excess length.

14. Be sure that metal clamps and cable ties do not cut through cable installation.

15. Check that all circular connectors are hand (finger) tight. Check that Sure-Seal connectors have clip/clamps in place. Check that Weather Pack, Metri Pack and Deutsch connectors are snapped together.

16. Check cable or harness tiedowns. Keep cable securely fastened to vessel frame.

17. Check the condition of the cable or harness at any “rub” point and wherever the cable or harness passes through a sheet metal hole and wherever clamps or metal cable ties are used.

18. Check cable or harness for cracks, effects of vibration, abrasion, brittleness or abuse.

19. Visually inspect for evidence of moisture or corrosion.

Wiring Connections

General

The vessel wiring for the Profile or E-Troll Module must be of sufficient size to prevent excessive voltage drop (no greater than 0.5 VDC) between the battery connections (positive voltage and ground) and the Profile or E-Troll Module. The modules operate from nominal 12 VDC or 24 VDC batteries. The battery power connection must be protected by an electrical over-current protection component (fuse or circuit breaker) as required by the vessel's approval agency. The minimum current capacity should be 5 amps.

⚠WARNING

DO NOT connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

The customer supplied selector switches for each of the transmission clutches and for troll (if equipped) must be connected directly to the wires of the Profile or E-Troll Module, and connected to the power source as shown in the table that follows. No other electrical loads should be connected to this circuit.

Wiring Options

The following power connection schematics show the possible configurations for connecting Electronic Profile or E-Troll Module to the power source for the three possible wiring options.

- ❑ Option 1 connections are used when the Profile or E-Troll Module direction control is mechanically switched.
- ❑ Option 2 connections are used when the Profile or E-Troll Module direction control is from an electronic controller that provides switched battery positive direction outputs.
- ❑ Option 3 connections are used if the electronic propulsion controller provides switched battery negative direction outputs. Twin Disc must be consulted for additional information.

Make the following Connections

- ❑ The customer supplied normally closed not in neutral relay must be located in a position to not be affected by vibration. The coil must have a 200 maximum current draw. The coil must be connected to the two “not in neutral” wires of the Profile Generator. When the “not in neutral” circuit is not used, the following wires must be insulated and secured.
  - ❑ MGX Profile Module - Black and White wires
  - ❑ All others - Blue and Black wires
- ❑ EC200/EC250 applications: Remove weather pack connector from the control’s solenoid harness. If EC250, insulate and secure the blue and brown wires of the ASM203452 harness.
- ❑ Plug the appropriate connectors from the Profile Generator into the appropriate Proportional Valves.
- ❑ Plug the appropriate connectors from the Profile Generator into the Engine Speed sensor and the Propeller speed sensor (if equipped).
- ❑ Plug the appropriate connectors from the Profile Generator into the Temperature sensor (if equipped).
- ❑ To initiate troll without the 0.5 volt dead band at minimum troll, add a 100 ohm resistor between the potentiometer and the green wire.
- ❑ When troll speed current input is used to control trolling speed, the orange and green troll speed potentiometer input wires must be electrically connected together with a solder shrink connector. The red wire must be insulated and all three wires secured.
- ❑ When troll speed voltage input is used to control trolling speed, the violet and green wires must be insulated and secured.

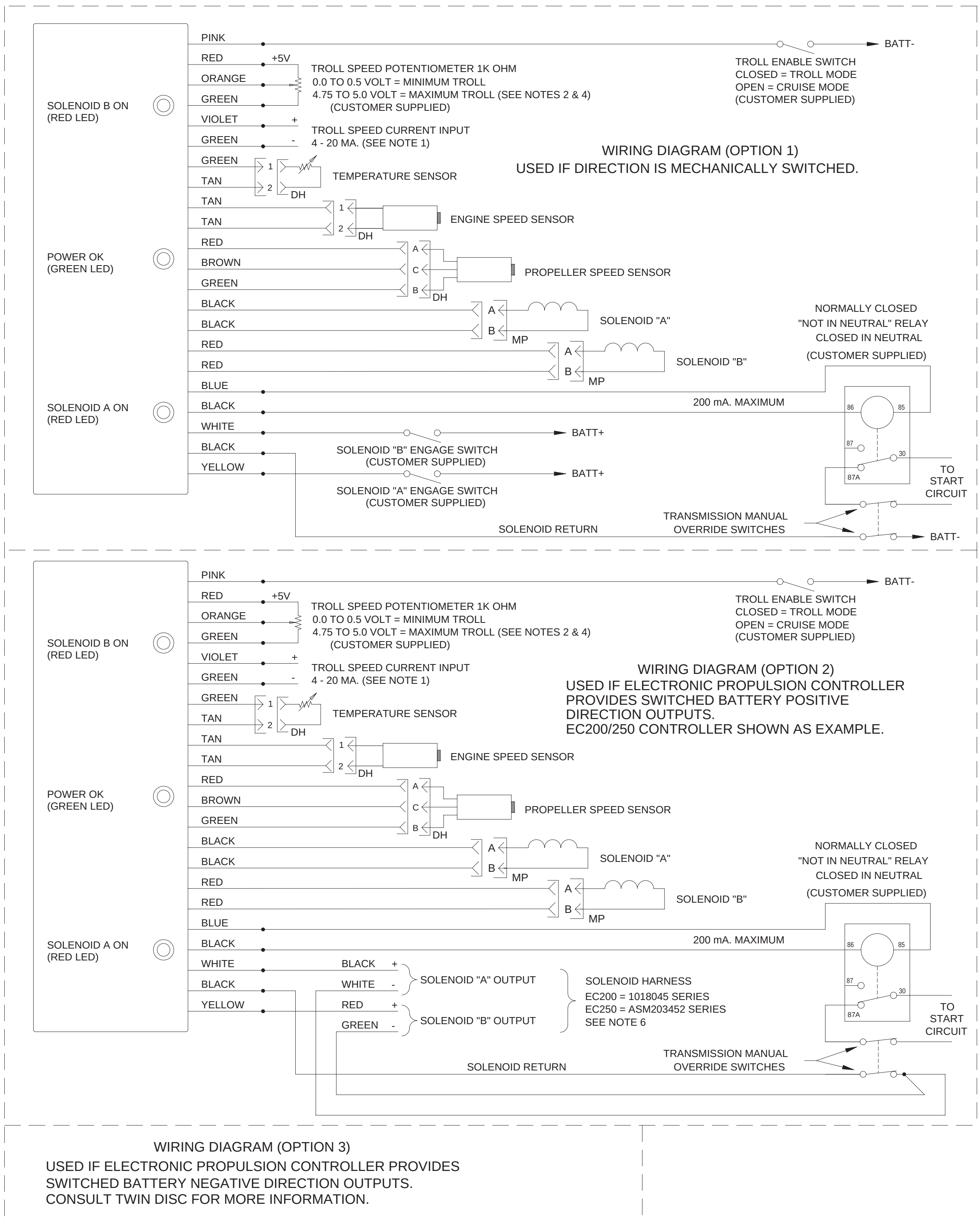


Figure 154. MG E-Troll Wiring Diagram

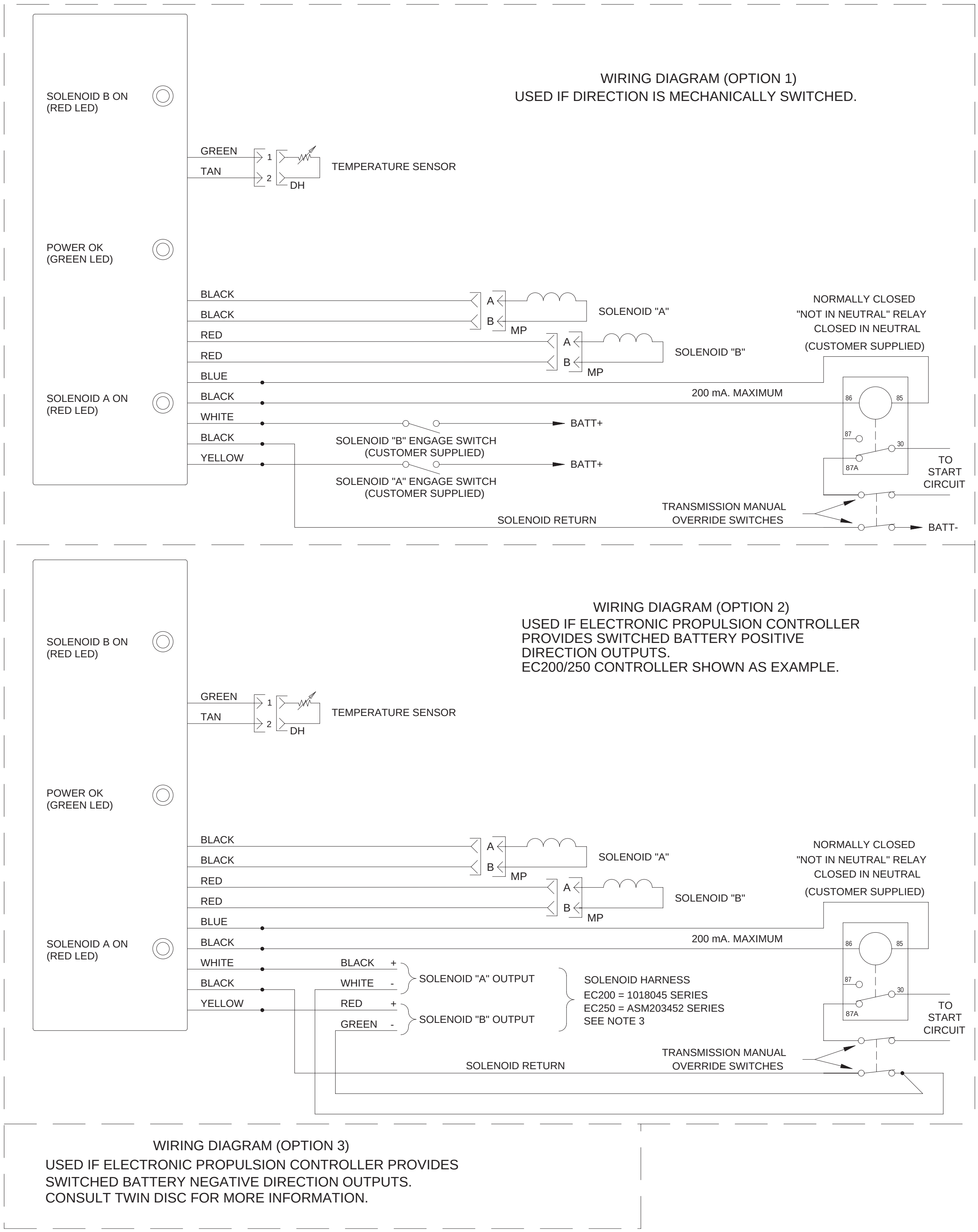


Figure 155. MG Profile Module Wiring Diagram

Final Checks

Be sure the transmission is filled with oil before starting. See Description and Specifications and Preventative Maintenance for proper oil and filling procedure.

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 continued on the following page.

- ❑ Recommended Pump Set and Fluids
- ❑ THAP 300SKF Air-driven Pump Set
- ❑ T-18050-705 Bearing driver for pinion needle roller bearings
- ❑ T-18050-708 Bearing cup driver
- ❑ T-18050-711 Bearing cone driver (primary and secondary shafts)
- ❑ T-18050-713 Output seal driver
- ❑ T-18050-714 Shaft lifting fixture (output shaft)
- ❑ T-18050-715 Shaft lifting fixture (primary and secondary shafts)
- ❑ T-18050-723 Bearing cone and transfer gear driver (primary and secondary shafts)
- ❑ T-18050-771 Front output bearing cup driver
- ❑ T-19330 Spring retainer compressor (coil spring units)
- ❑ T-19987-2 Output gear lifting fixture

- ❑ T-20023-4 Output gear installing fixture (sheet 1 of 3)
- ❑ T-20023-4 Output gear installing fixture (sheet 2 of 3)
- ❑ T-20023-4 Output gear installing fixture (sheet 3 of 3)
- ❑ T-21433 Output flange installing fixture (sheet 1 of 3)
- ❑ T-21433 Output flange installing fixture (sheet 2 of 3)
- ❑ T-21433 Output flange installing fixture (sheet 3 of 3)
- ❑ T-21506 Output shaft bearing driver (sheet 1 of 2)
- ❑ T-21506 Output shaft bearing driver (sheet 2 of 2)
- ❑ T-21533-37 Input seal driver and protection sleeve
- ❑ T-506000 Lifting Bracket for Clutch Removal in Boat
- ❑ SPX Power Team RD1006 100ton x 6.375 inch stroke double acting ram (no drawing)
- ❑ SPX Power Team PE554T electric over hydraulic pump (no drawing)
- ❑ Two SPX #9764 hoses (no drawing)
- ❑ Two SPX #9795 couplers (no drawing)

Recommended Pump Set and Fluids

Twin Disc recommends the following products for use in the assembly and removal of tapered shafts using the oil injection method:

THAP 300 Air-Driven Pump Set

This set consists of the air-driven pump with accessories, such as an adapter block, pressure gauge, high pressure pipe, or pressure hose with quick connection couplings and connection nipples. The set includes one of each: air-driven pump [THAP 300], adapter block [226402], pressure gauge [1077589] and high pressure pipe (2m/6.5 ft.) [227957A].

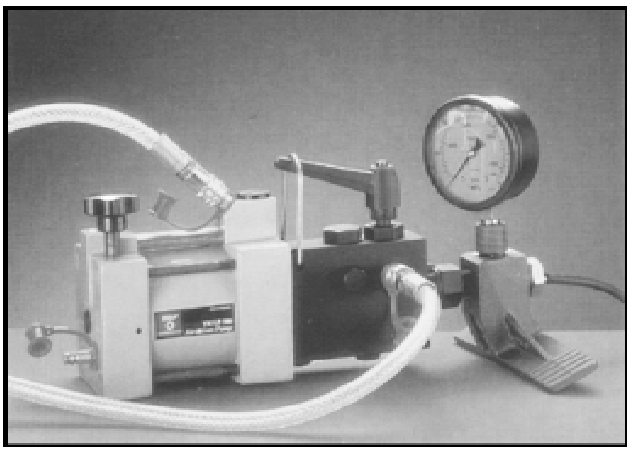


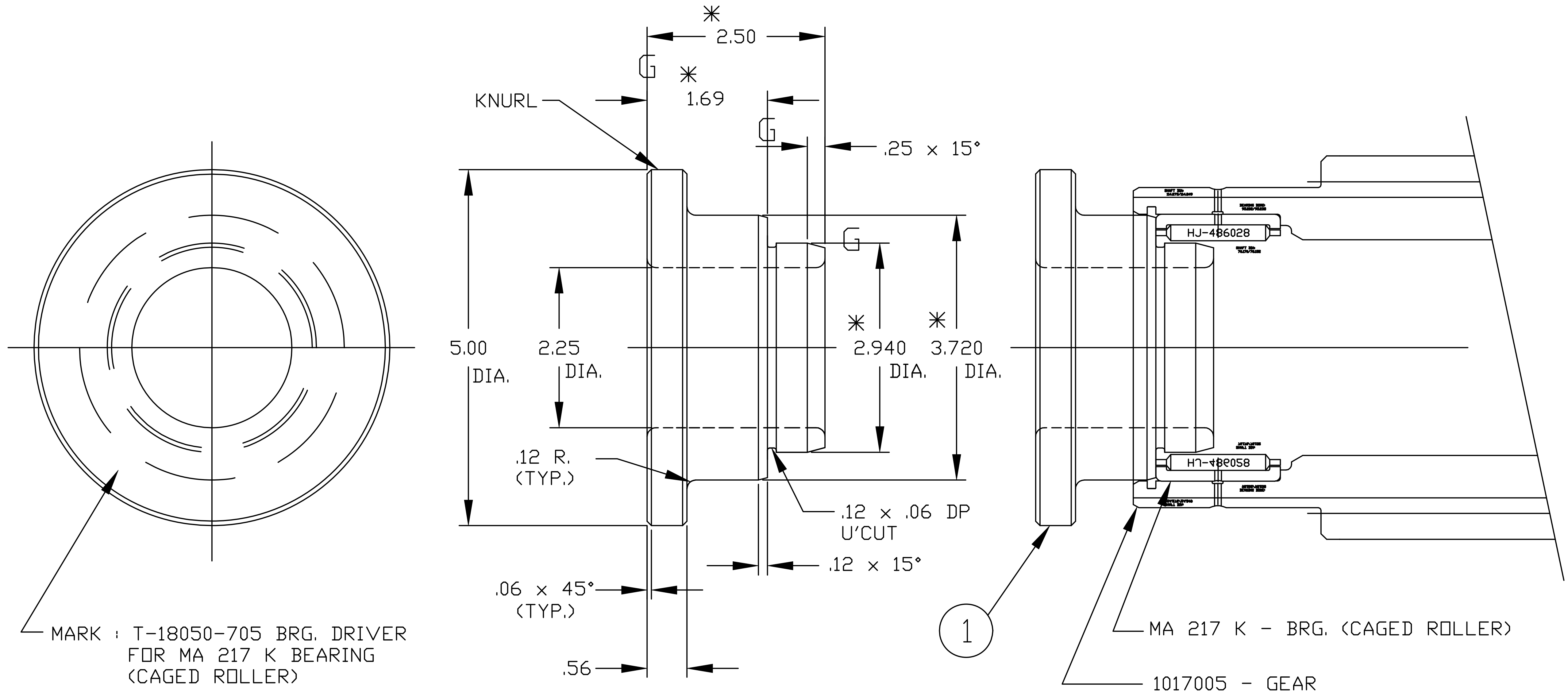
Figure 150. THAP 300 Air-driven Pump Set

Mounting Fluid LHMF 300 and Dismounting Fluid LHDF 900

SKF LHMF 300 and LHDF 900 are recommended when using SKF hydraulic equipment like hydraulic pumps, HMV nuts, oil injection equipment, etc. The fluids contain anticorrosives and are non-aggressive to seal material like nitrile rubber, Buna N (Perbunan), chrome, leather, PTFE, etc. SKF LHMF 300 and LHDF 900 are available in 5 liter (5.3 qt.) cans. Designation: LHMF 300/5 and LHDF 900/6.

Figure 151. SKF LHMF 300 and LHDF 900

Note: Order Through Your Local Authorized SKF Distributor



① BEARING DRIVER (1) REQ'D.
MAT. : M.S. (CARB. HDN.)

*

NOTE : UNLESS OTHERWISE SPECIFIED, BREAK ALL SHARP CORNERS

NOTE : GROUND SURFACES MUST BE PARALLEL WITHIN .0005 OF EACH OTHER

STAMP TOOL NO.: T-18050-705
PART NO.: MG 4406
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : T-18050-705.dwg

(C & H)

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	M.S.	BEARING DRIVER	5.12 DIA. x 2.75 THK.

CHANGE	DESCRIPTION	DATE	BY

Date: 11-16-96 | By: JPL | F.P.N.: | Scale: FULL

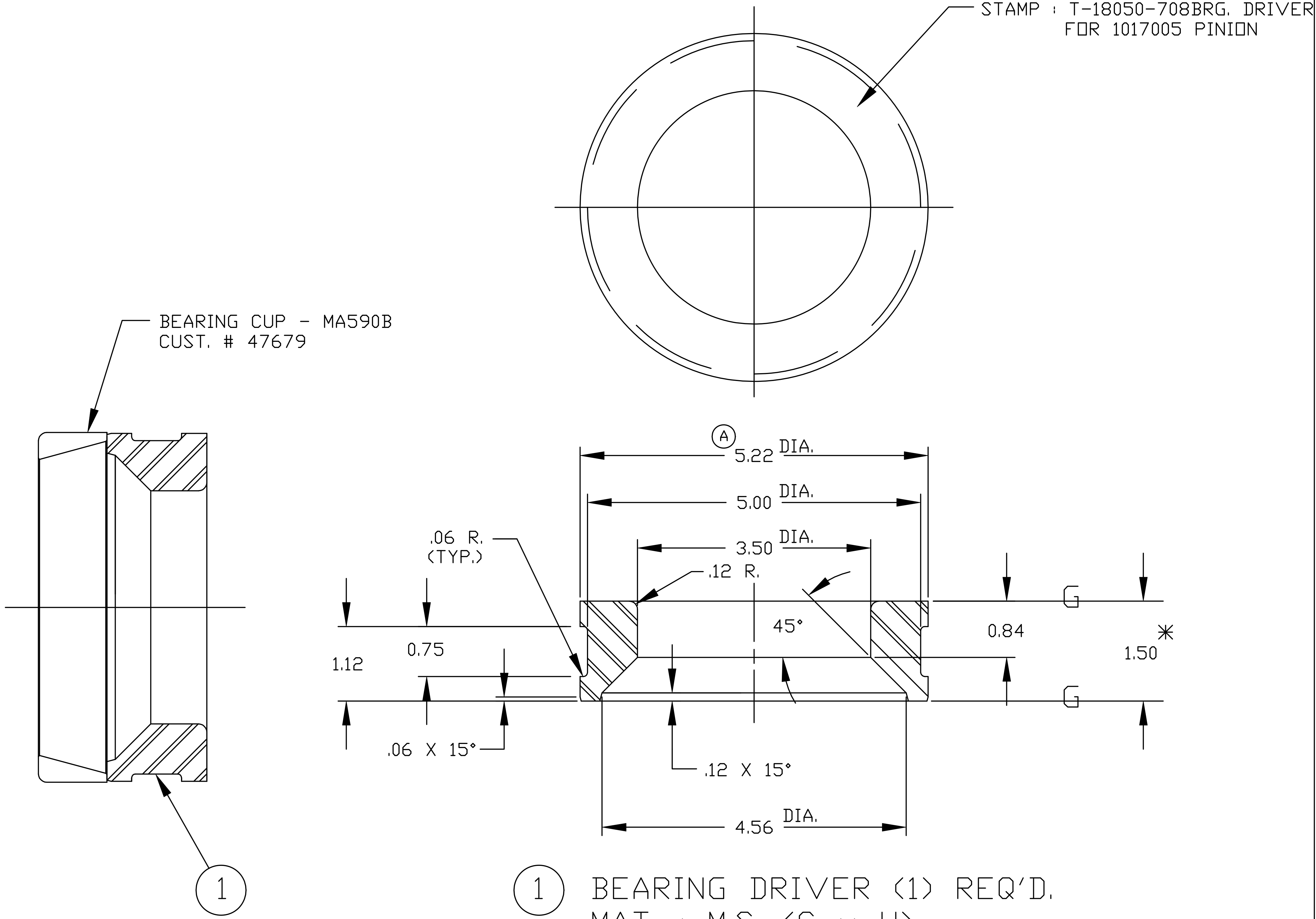
NAME: BEARING DRIVER (CAGED ROLLER)

FOR: MG 4406
MA 217 K - BRG.

SHEET 1 OF 1

T-18050-705

TWIN DISC INC. RACINE, WIS.



1 BEARING DRIVER (1) REQ'D.
MAT. : M.S. (C x H)

*
NOTE : GROUND SURFACES MUST BE PARALLEL
WITHIN .0005 OF EACH OTHER

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

STAMP TOOL NO: T-18050-708
PART NO: MG 4406
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : T-18050-708.dwg

A	WAS 5.50	9-30-97	JPL
CHANGE	DESCRIPTION	DATE	BY

(C x H)

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	M.S.	BEARING DRIVER	5.25 DIA. x 1.62 THK.

Date: 11-20-96 | By: JPL | F.P.N.: | Scale: FULL

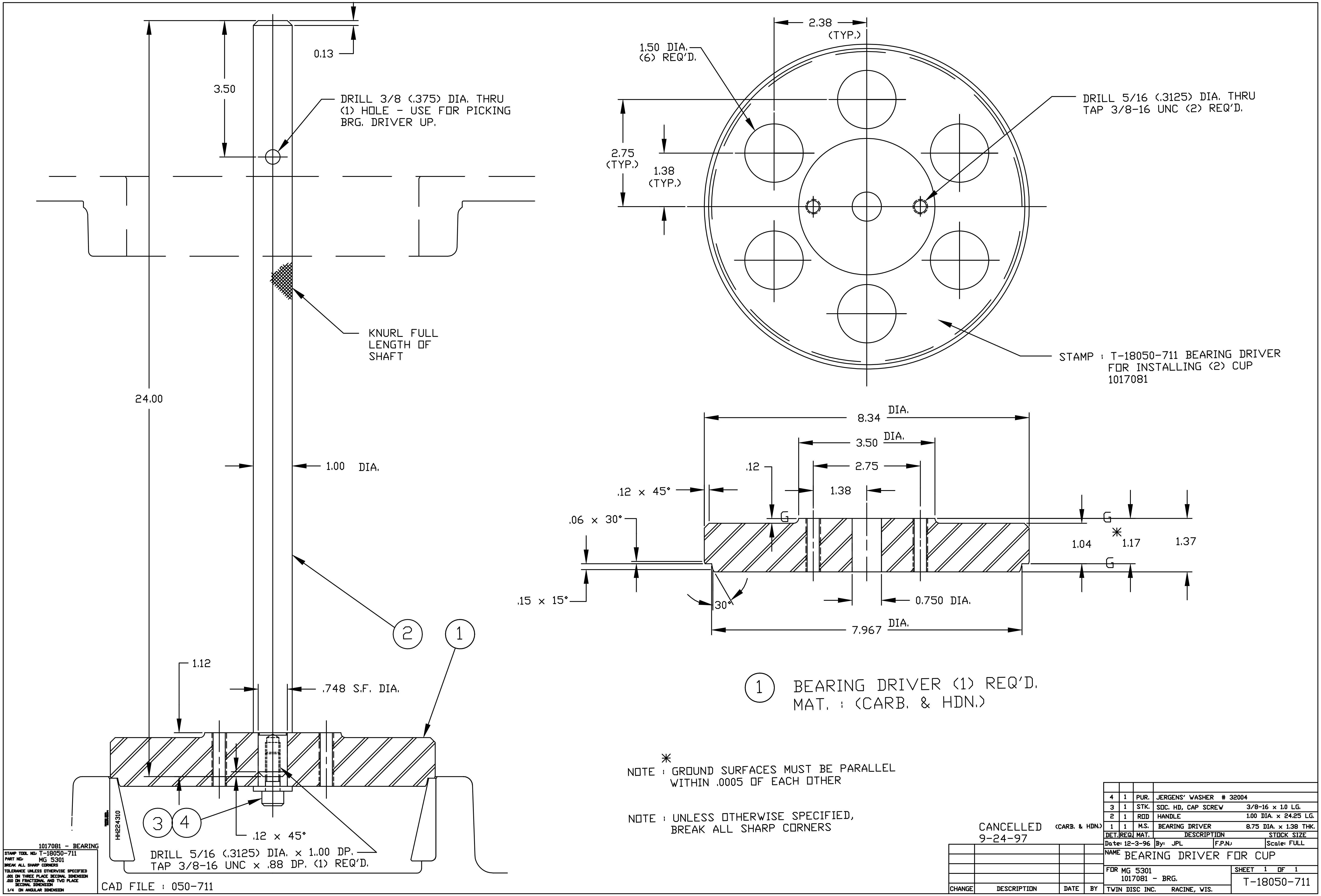
NAME BEARING DRIVER FOR CONE

MG 4406 1017005 - PINION
HH224346 - BRG. CONE

SHEET 1 OF 1

T-18050-708

TWIN DISC INC. RACINE, WIS.



DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
4	1	PUR.	JERGENS' WASHER # 32004	
3	1	STK.	SOC. HD, CAP SCREW	3/8-16 × 1.0 LG.
2	1	ROD	HANDLE	1.00 DIA. × 24.25 LG.
1	1	M.S.	BEARING DRIVER	8.75 DIA. × 1.38 THK.

CHANGE	DESCRIPTION	DATE	BY

Date: 12-3-96 | By: JPL | F.P.N.: | Scale: FULL

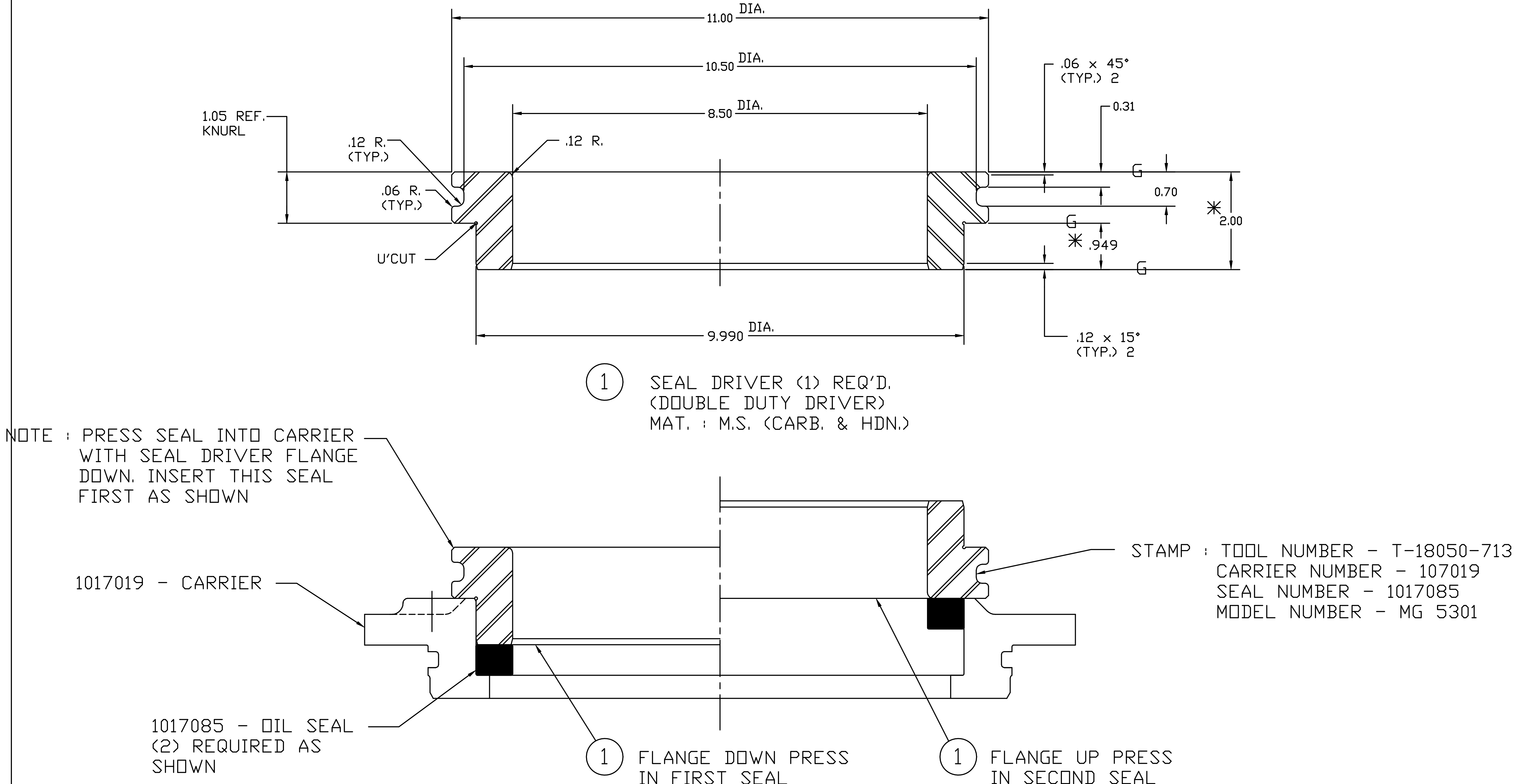
NAME BEARING DRIVER FOR CUP

FOR MG 5301
1017081 - BRG.

SHEET 1 OF 1

T-18050-711

TWIN DISC INC. RACINE, WIS.



NOTE : UNLESS OTHERWISE SPECIFIED, BREAK ALL SHARP CORNERS

*

NOTE : GROUND SURFACES MUST BE PARALLEL WITHIN .005 OF EACH OTHER

1017085 - OIL SEAL
1017019 - CARRIER

STAMP TOOL NO.:	T-18050-713
PART NO.:	MG 5301
BREAK ALL SHARP CORNERS	
TOLERANCE UNLESS OTHERWISE SPECIFIED .001 ON THREE PLACE DECIMAL DIMENSION .010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION 1/4 ON ANGULAR DIMENSION	

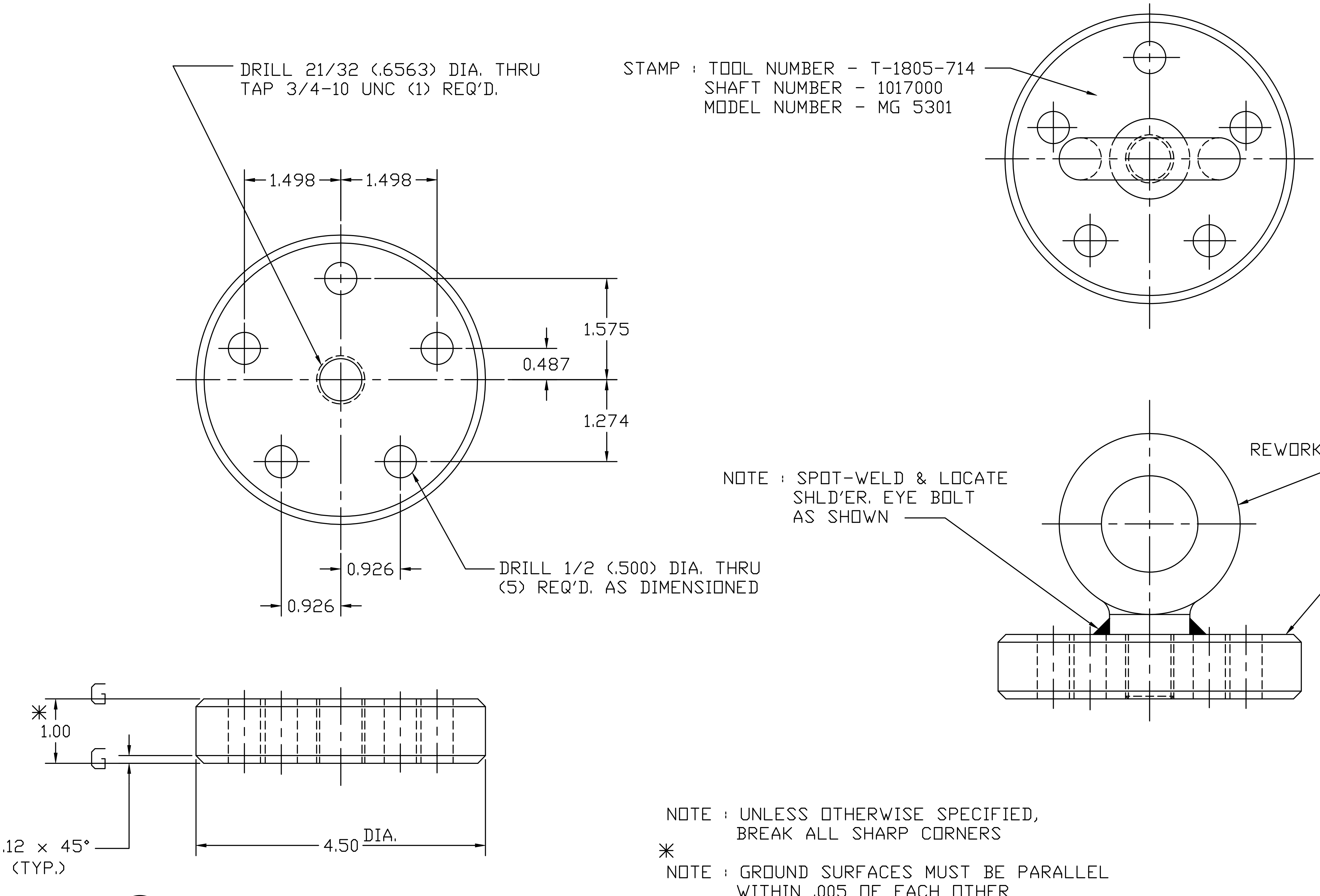
CAD FILE : 050-713

(CARB. & HDN.)

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	M.S.	DRIVER	11.25 DIA. x 1.50 WALL x 2.12 THK.

Date: 12-4-96	By: JPL	F.P.N.:	Scale: FULL
NAME SEAL DRIVER			
FOR MG 5301		SHEET 1 OF	
TWIN DISC INC. RACINE, WIS.		T-18050-713	

CHANGE	DESCRIPTION	DATE	BY



(1) PICK-UP PLATE (1) REQ'D.
MAT. : M.S. (CARB. & HDN.)

STAMP TOOL NO.: T-18050-714
PART NO.: MG 5301
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 050-714

	DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
REWORK JERGENS' # 18506 OR EQUIV.	2	1	PUR.	JERGENS' SHD'ER. EYE BOLT	3/4-10 UNC
(CARB. & HDN.)	1	1	M.S.	PICK-UP PLATE	4.75 DIA. × 1.00 THK.

CHANGE	DESCRIPTION	DATE	BY

Date: 12-5-96 | By: JPL | F.P.N.: | Scale: FULL

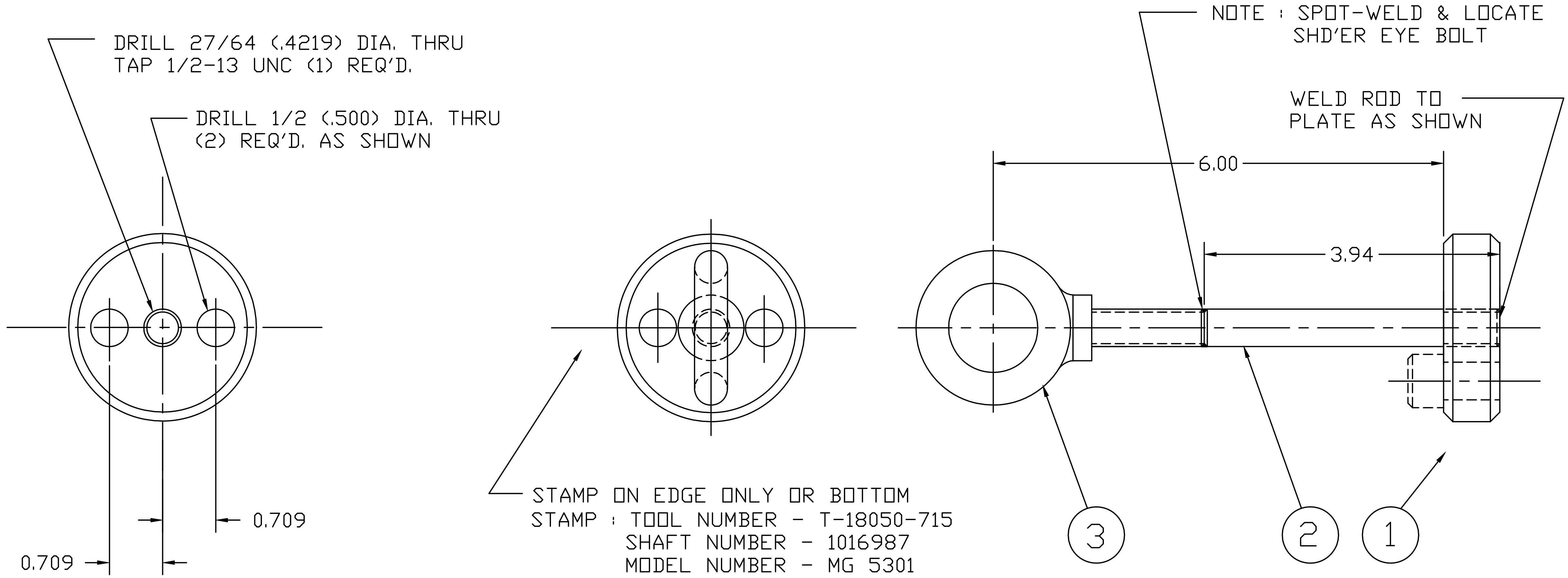
NAME SHAFT PICK-UP FIXTURE

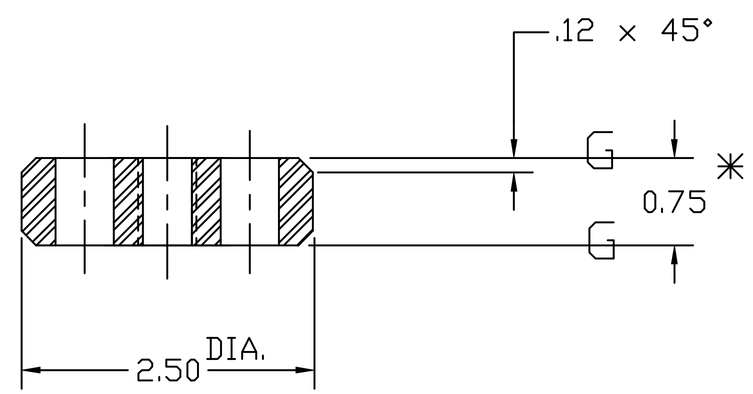
FOR MG 5301
1017000 - SHAFT

SHEET 1 OF 1

T-18050-714

TWIN DISC INC. RACINE, WIS.





1 CLUTCH PICK-UP PLATE (1) REQ'D.
MAT. : M.S. (CARB. & HDN.)

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

* NOTE : GROUND SURFACES MUST BEPARALLEL
WITHIN .005 OF EACH OTHER

JERGENS' # 18504 OR EQUIV.

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
3	1	PUR.	SHLD'ER EYE BOLT	1/2-13 UNC
2	1	D.R.	EXTENSION	.50 DIA. x 4.25 LG.
1	1	M.S.	PICK-UP PLATE	3.62 DIA. x .88 THK.

Date: 12-5-96 | By: JPL | F.P.N.: | Scale: FULL

NAME CLUTCH PICK-UP FIXTURE

FOR MG-5301
1016987 - SHAFT

SHEET 1 OF 1

T-18050-715

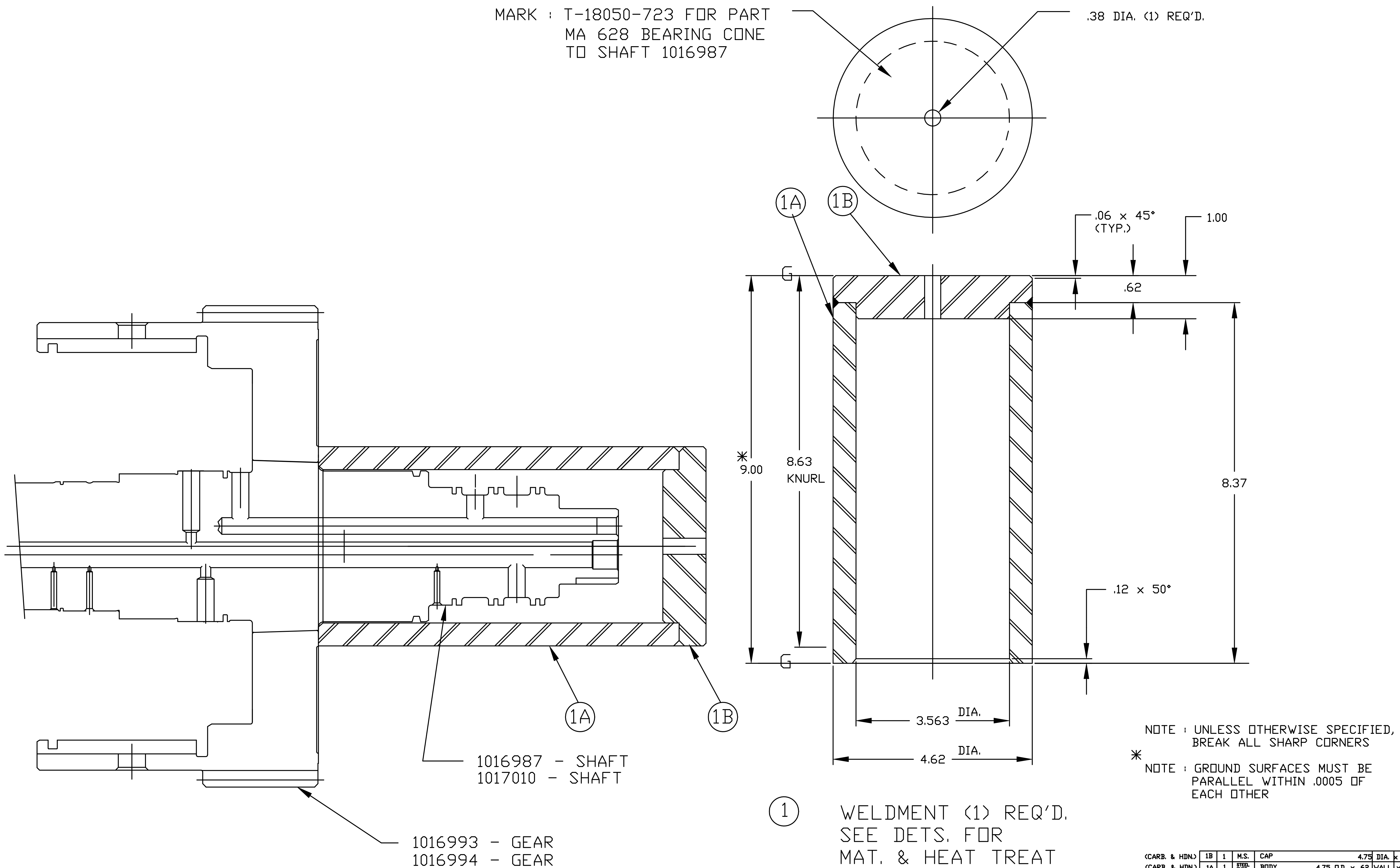
TWIN DISC INC. RACINE, WIS.

CHANGE	DESCRIPTION	DATE	BY
A	OD 3.5" MOD TO 2.5" DET1	6NOV01	RMTR

1016987 - CLUTCH SHAFT

STAMP TOOL NO.: T-18050-715
PART NO.: MG 5301
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : T-18050-715.dwg



	DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE		
(CARB. & HDN.)	1B	1	M.S.	CAP 4.75	DIA.	× 1.00	THK.
(CARB. & HDN.)	1A	1	STEEL TUBE	BODY 4.75 O.D. × .62	WALL	× 8.50	LG.
	1	1		WELDMENT			

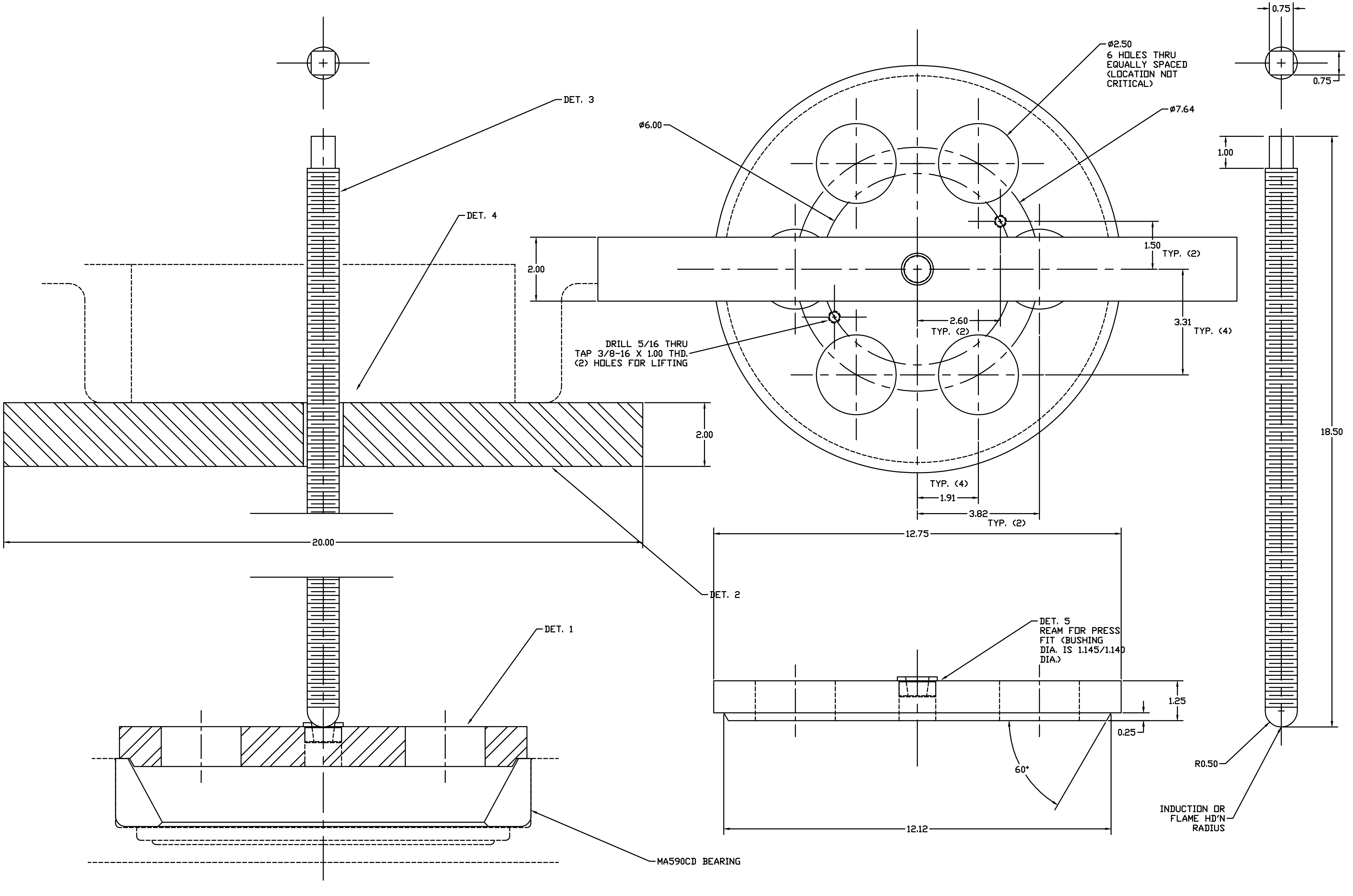
Date: 2-15-97	By: JPL	F.P.N.:	Scale: FULL
NAME BEARING CONE DRIVER			
FOR MG 5301 1016993 1016987,1017010,1016994		SHEET 1 OF 1	
TWIN DISC INC. RACINE, WIS.		T-18050-723	

CHANGE	DESCRIPTION	DATE	BY
	WAS T-18050-719		

1016987 - SHAFT

STAMP TOOL NO: T-18050-723
PART NO: MG 5301
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 050-723



STAMP TOOL NO:
PART NO:
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
ON THREE PLACE DECIMAL DIMENSION
ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
5	1	PUR.	TECO #54973 TAPER INDEX BUSHING	
4	1	PUR.	1-8 STEEL THREADED INSERT	
3	1	PUR.	1-8 DRILL ROD X 18-3/4 LGTH	
2	1	ALUM.	BLOCK 2 X 2 X 20	
1	1	ALUM.	BASE 13 DIA. X 1-1/2	

REV	DESCRIPTION	DATE	BY
A	T# CHGED FROM -762 DUE TO ANOTHER SAME#	4-4-01	TMV

Date: 8/30/99 | By: GDL | F.P.N.: | Scale: FULL

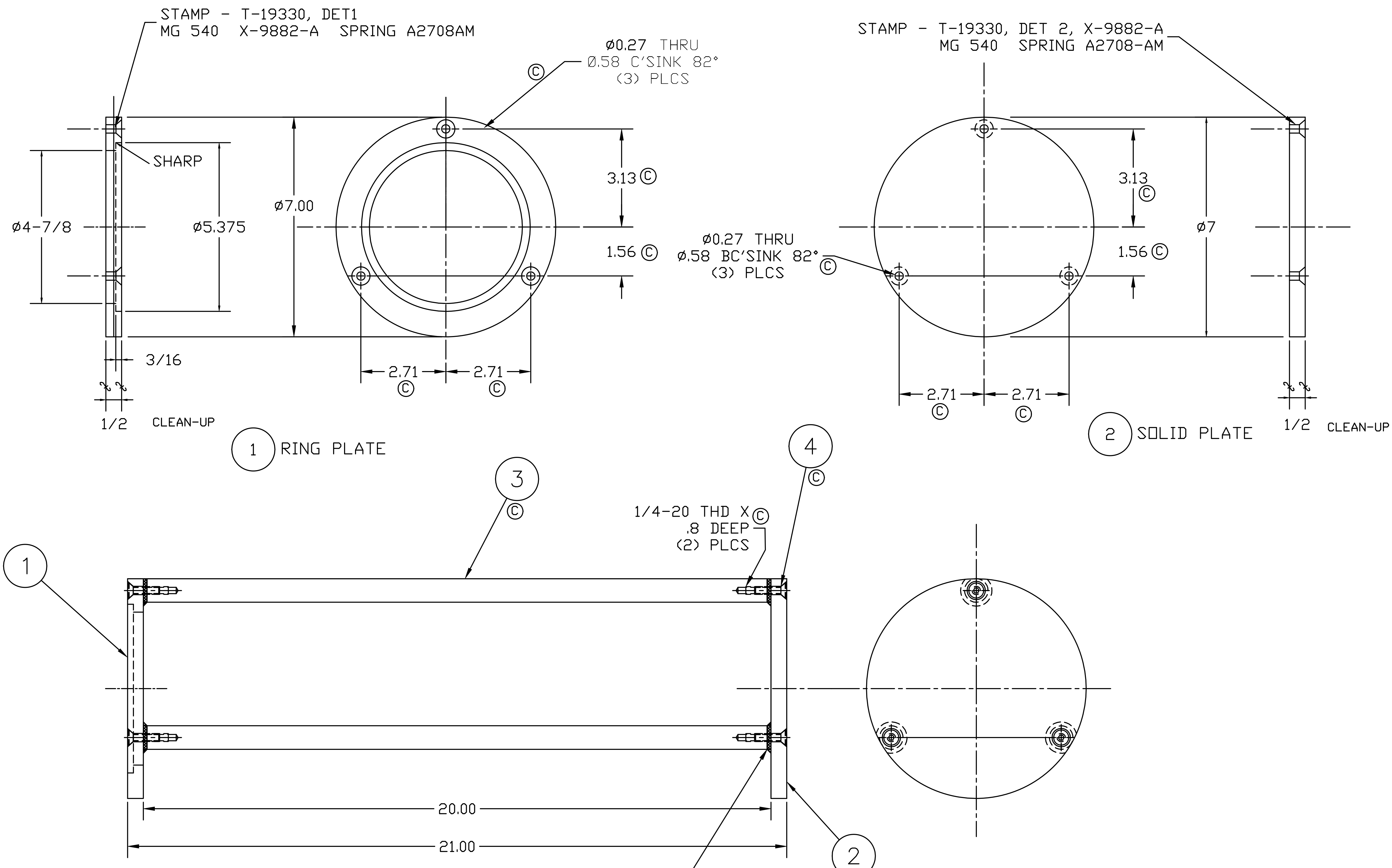
NAME BEARING DRIVER FOR CUP

FOR MG-5301

SHEET 1 OF 1

T-18050-771

TWIN DISC INC. RACINE, WIS.



Ⓒ 4	6	STK	FLAT HD SCR	1/4-20 THD X 1.0
Ⓒ 3	3	MS	SUPPORT BARS	ø3/4 X 20.1
2	1	MS	SOLID END PLATE	ø7.5 X .5
1	1	MS	RING PLATE	ø7.5 X .5

SYMBOL	CHARACTERISTIC
▱	FLATNESS
//	PARALLELISM
⊥	PERPENDICULARITY
◎	CONCENTRICITY
↗	CIRCULAR RUNOUT
⌰	TOTAL RUNOUT
⌖	POSITION

SYMBOL	MODIFIER
Ⓜ	MMC (MAX. MATERIAL CONDITION)
Ⓢ	RFS (REGARDLESS OF FEATURE SIZE)

SYMBOL	NAME
-A-	DATUM FEATURE
ø	DIAMETER

STAMP TOOL NO.: T-17710-38
PART NO.: 1016309
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
±.0002 ON FOUR PLACE DECIMAL DIMENSION
±.001 ON THREE PLACE DECIMAL DIMENSION
±.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

AUTOCAD FILE ~ T-19330

REV	DESCRIPTION	DATE	BY
C	UPDATED PRINT/TOOL (ADD #3 & #4)	4-16-01	TMV
B	CAD DRAWING	3-20-01	RTR
A	5.375 X DIA WAS 5.25	12-6-00	WLR

Date: 10-20-80 | By: W.SCHEEL | F.P.N.: | Scale: HALF

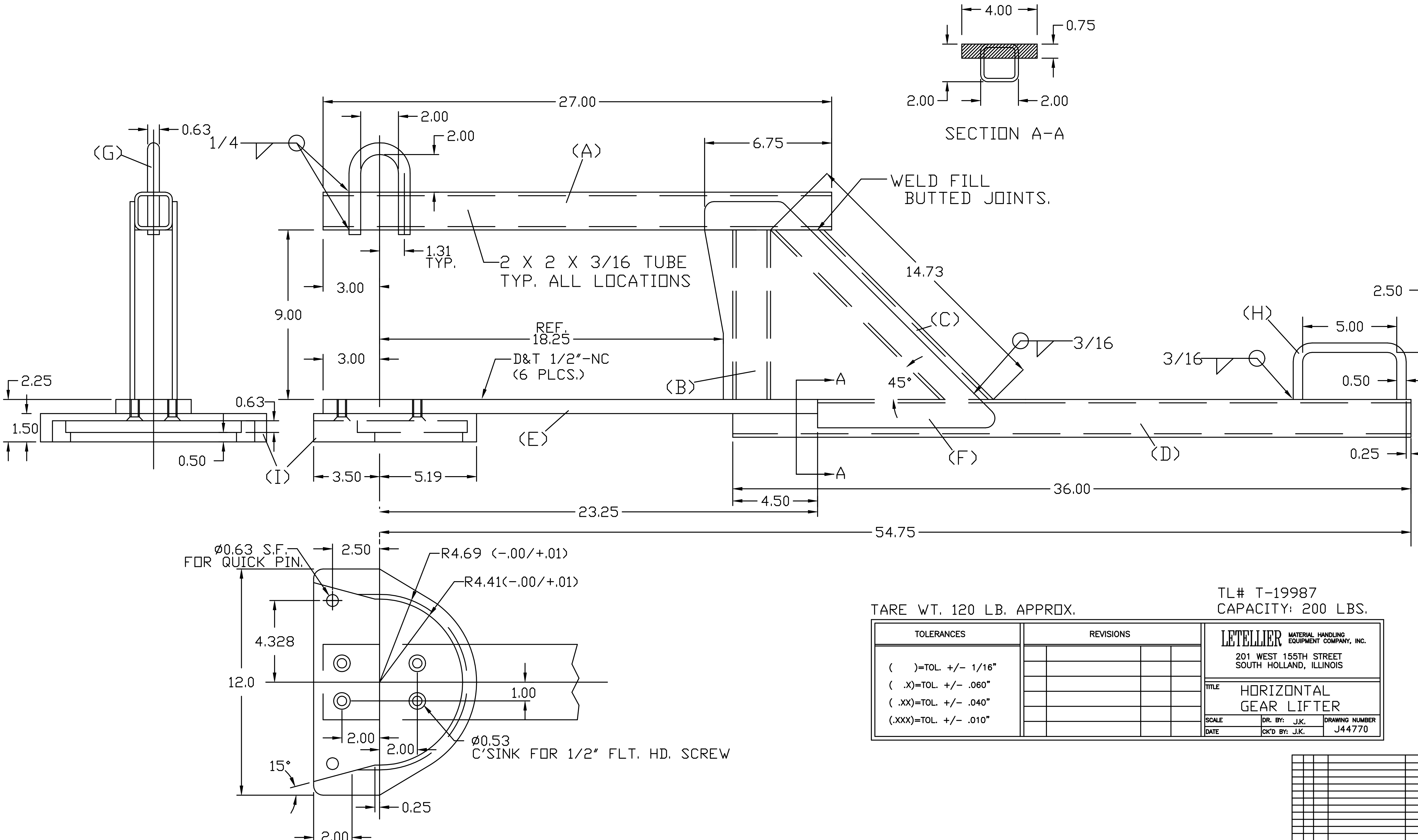
NAME SPRING DE-COMPRESSER

FOR X9882-A (A2708AM SPRING)

SHEET 1 OF 1

T-19330

TWIN DISC INC. RACINE, WIS.



TL# T-19987

CAPACITY: 200 LBS.

TARE WT. 120 LB. APPROX.

TOLERANCES
( )=TOL. +/- 1/16"
(.X)=TOL. +/- .060"
(.XX)=TOL. +/- .040"
(.XXX)=TOL. +/- .010"

REVISIONS

LETELLIER MATERIAL HANDLING EQUIPMENT COMPANY, INC.
201 WEST 155TH STREET
SOUTH HOLLAND, ILLINOIS

TITLE HORIZONTAL GEAR LIFTER

SCALE	DR. BY: J.K.	DRAWING NUMBER
DATE	CK'D BY: J.K.	J44770

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
Date: 7-6-98	By: JPL		F.P.N.:	Scale:

NAME GEAR LIFTING FIXTURE

FOR MG 5301 — SHEET 1 OF 1 — T-19987-2

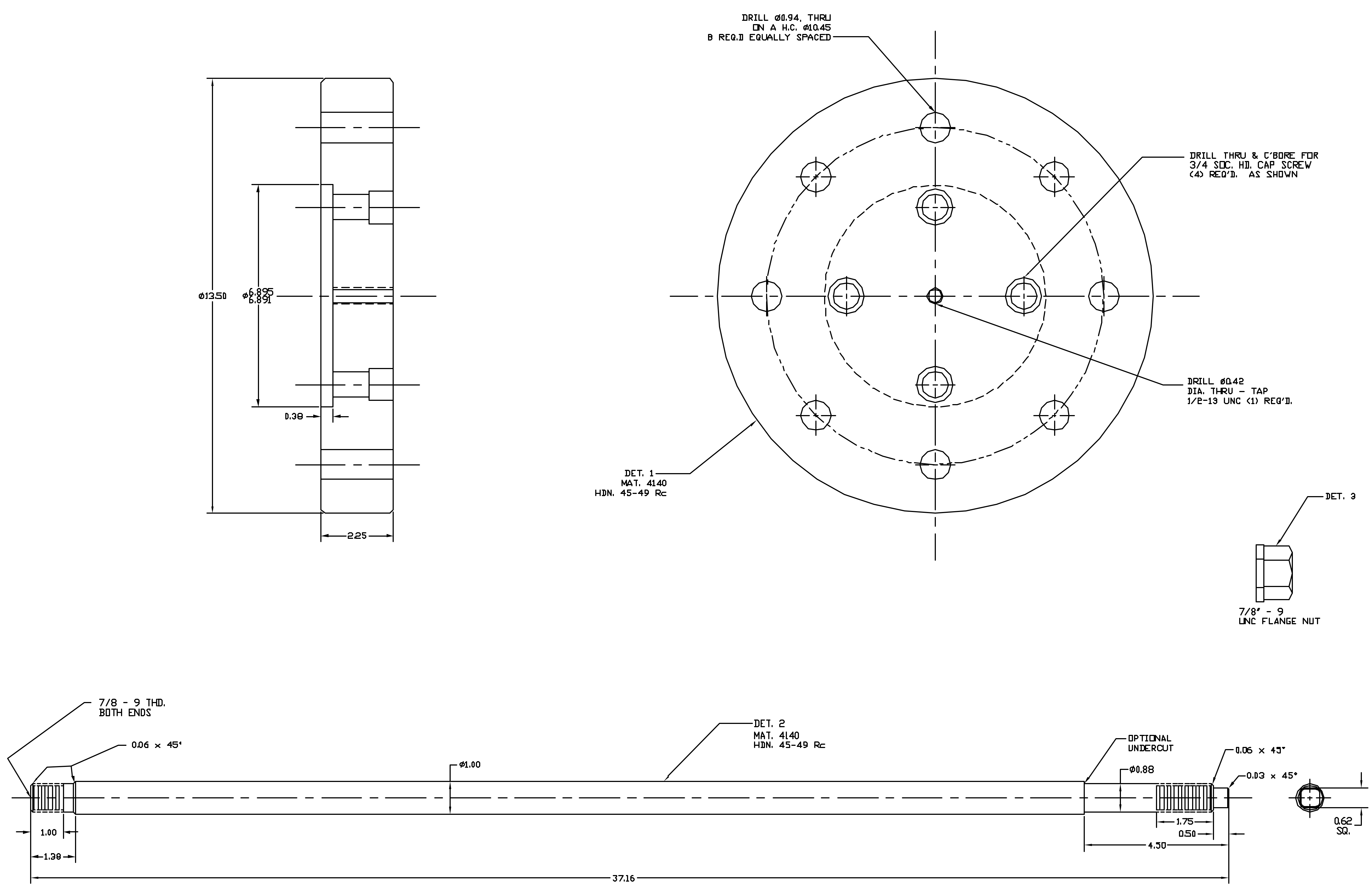
TWIN DISC INC. RACINE, WIS.

CHANGE | DESCRIPTION | DATE | BY

STAMP TOOL NO: T-19987-2
PART NO: MG 5301
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
[illegible] ON THREE PLACE DECIMAL DIMENSION
ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

AUTOCAD FILE14: T-19987-2

OPT.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	4140	TOP PLATE Rc 45-49	ø13.50 x 2.38
2	8	4140	PULLER ROD Rc 45-49	ø1.0 x 38.0
3	8	PURCH.	FLANGE NUT	TECO # 41608
4	1	PURCH.	HYD. CYCLINDER	MOTION IND.



INCH

THIRD ANGLE PROJECTION

NAME: OUTPUT GEAR / PULLER

FOR: MGX-5321DC GEAR # 1022494

DATE: 01-25-06

SCALE: 1=1

DRAWN: R.Lieungh

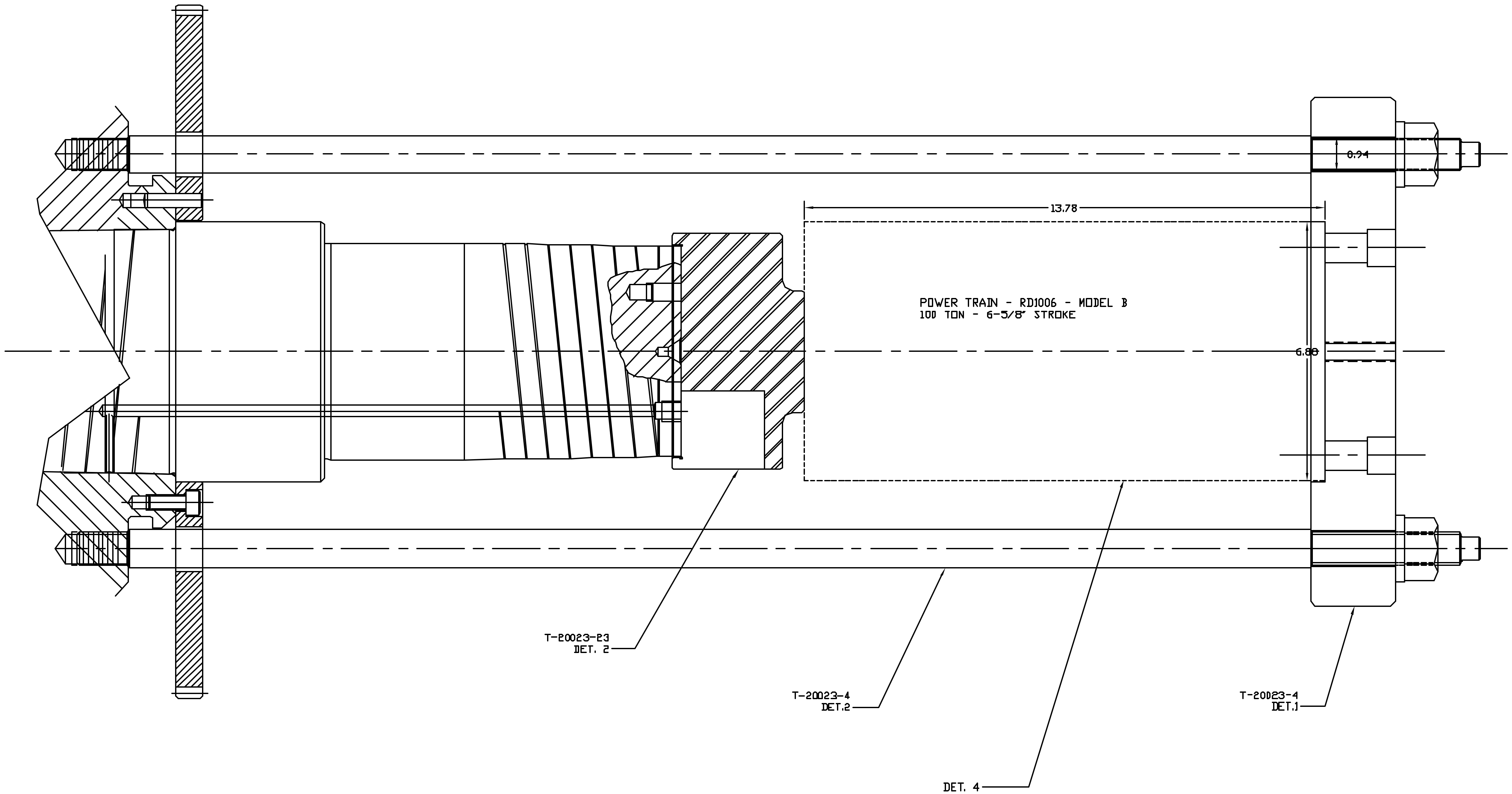
TWIN DISC INCORPORATED

T-20023-4

DWG SIZE: E

SHT. 1 of 2

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	4140	TOP PLATE Rc 45-49	ø13.50 x 2.38
2	8	4140	PULLER ROD Rc 45-49	ø1.0 x 38.0
3	[illegible]	PURCH.	FLANGE NUT	TECO # 41608
4	1	PURCH.	HYD. CYCLINDER	MOTION IND.

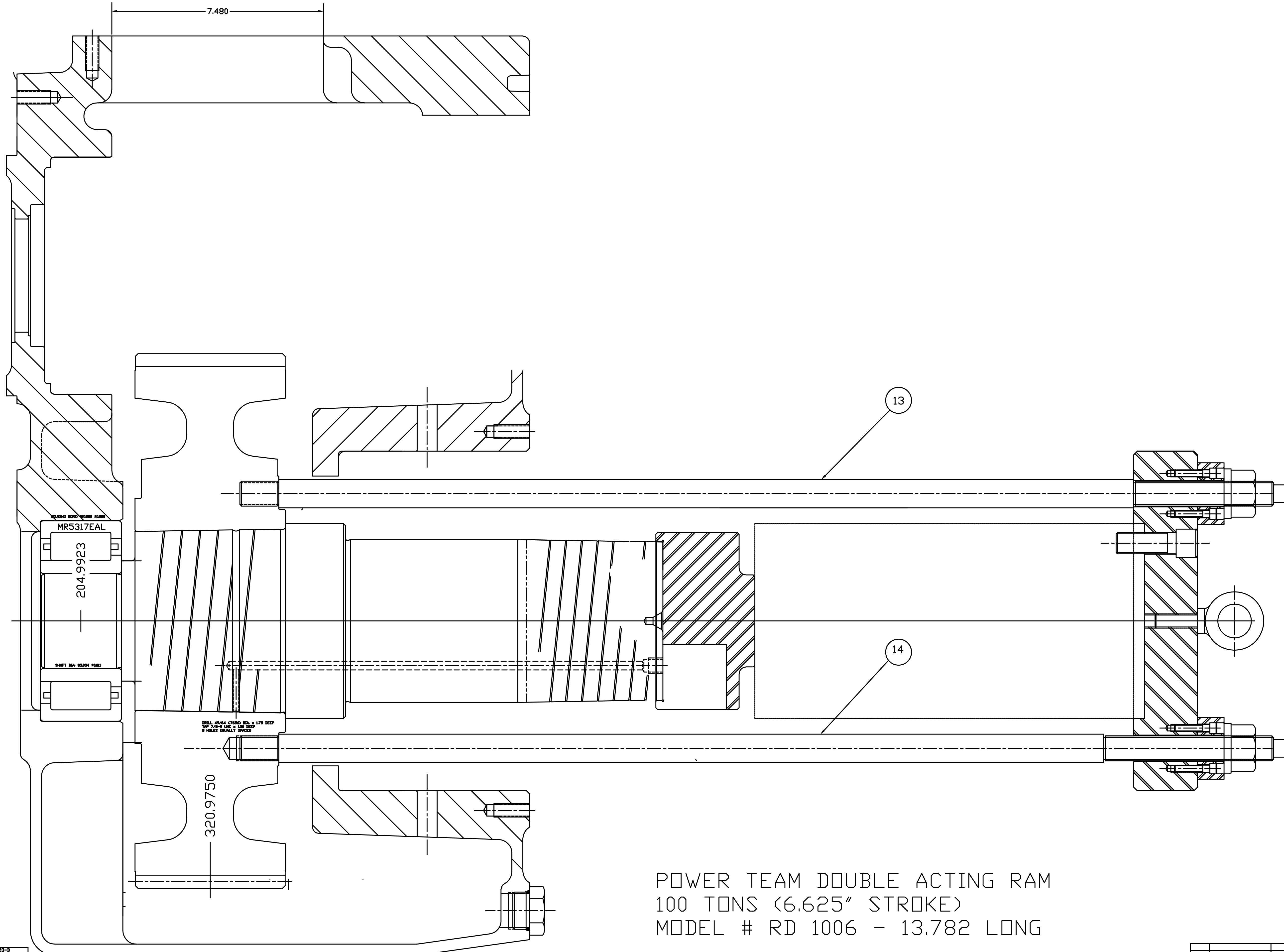


DATE	01-25-06
SCALE	1=1
DRN	R.Lieungh
NAME	OUTPUT GEAR / PULLER
FOR	MGX-5321DC GEAR # 1022494
	INCH
	THIRD ANGLE PROJECTION
MACHINE	CELL
DWG NO.	T-20023-4
DWG SIZE	E
SHT.	2 of 2

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

E D C B A

6 5 4 3 2 1



POWER TEAM DOUBLE ACTING RAM
100 TONS (6.625" STROKE)
MODEL # RD 1006 - 13.782 LONG

NOTE : REF. THIS DRWG. FROM T-20023
FIRST USED ON MG-516

STAMP TOOL NO: T-20023-3
PART NO: MG 6650
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
[illegible] ON THREE PLACE DECIMAL DIMENSION
[illegible] ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 023-3-3

CHANGE	DESCRIPTION	DATE	BY	

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
14	4	4140	ROD SEE SHT. # 2	
13	4	4140	ROD SEE SHT. # 2	

Date: 7-6-98 | By: JPL | F.P.N.: | Scale: FULL

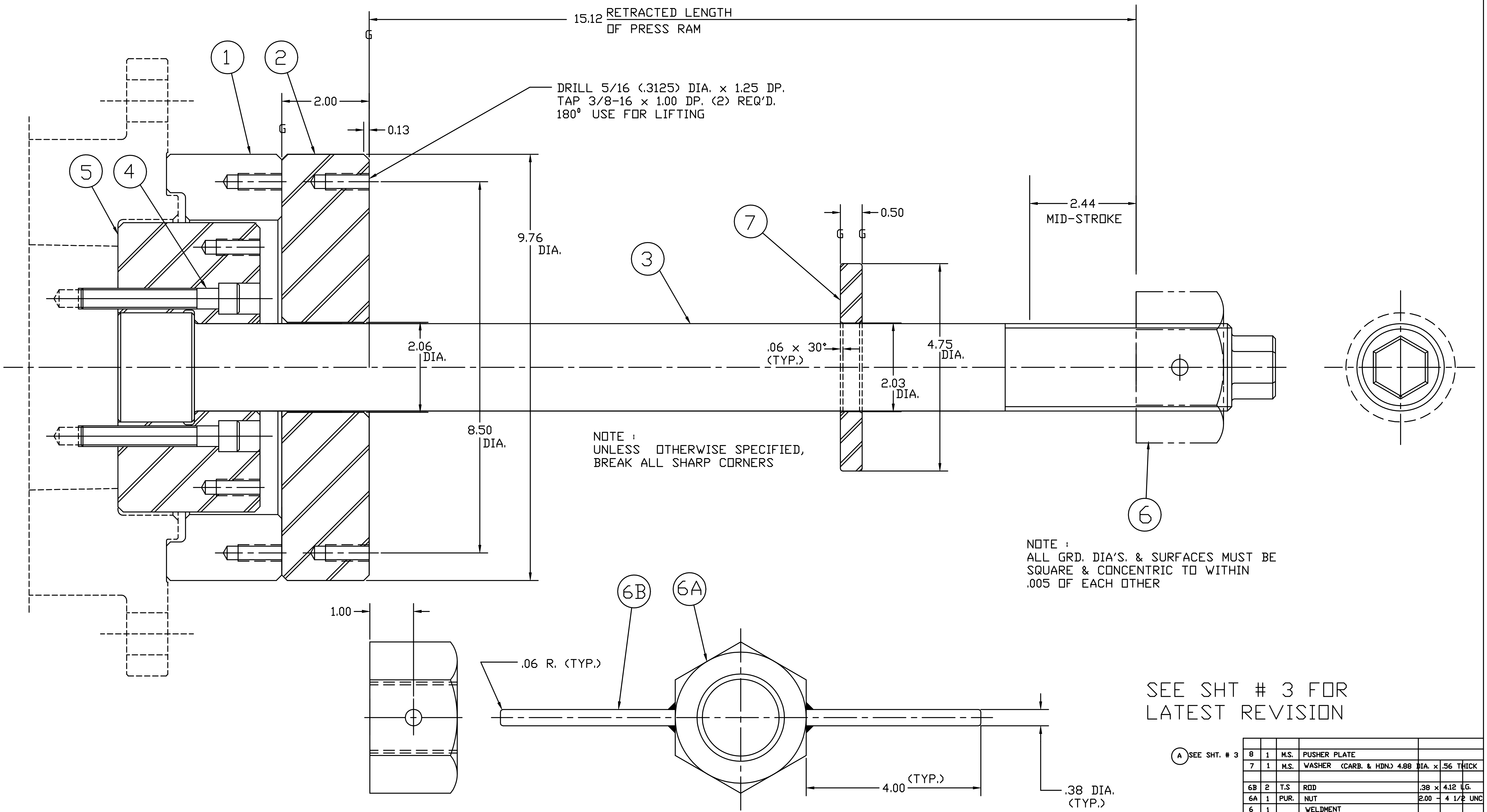
NAME OUTPUT GEAR TO SHAFT PULLER

FOR MG 6650 SC

SHEET 3 OF 3

T-20023-3

TWIN DISC INC. RACINE, WIS.



NOTE :
UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

NOTE :
ALL GRD. DIA'S. & SURFACES MUST BE
SQUARE & CONCENTRIC TO WITHIN
.005 OF EACH OTHER

6 NUT WELDMENT
NUT WITH HANDLES
THREAD SIZE : 2 - 4 1/2 UNC GRADE 8
A 194 GRADE 2H - HEAVY HEX - FULL NUT

SEE SHT # 3 FOR
LATEST REVISION

	DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
(A) SEE SHT. # 3	8	1	M.S.	PUSHER PLATE	
	7	1	M.S.	WASHER (CARB. & HDN.)	4.88 DIA. x .56 THICK
	6B	2	T.S	ROD	.38 x 4.12 LG.
	6A	1	PUR.	NUT	2.00 - 4 1/2 UNC
	6	1		WELDMENT	
(A) SEE SHT. # 3	5	1	M.S.	PULLER BASE	
	4	5	STK.	SOC. HD. CAP SCREW	M12 x 1.75 x 80 MM LG.
SEE SHT.#2	3	1	4340H	PULLER ROD	
	~~2~~	~~1~~	~~M.S.~~	~~PLATE - RAM BASE~~	~~10.00 DIA. x 2.25 THK.~~
~~SEE SHT.#2~~	~~1~~	~~1~~	~~M.S.~~	~~PUSHER PLATE~~	

CHANGE	DESCRIPTION	DATE	BY
A	DET. # 8 REPACES DET. # 1 & # 2 DET. # 5 REWORKED SHT. # 3 ADDED	2-21-97	JPL

Date: 10-4-96 By: JPL F.P.N.: Scale: FULL

NAME OUTPUT FLANGE FIXTURE (A)

FOR MG 5301 SHEET 1 OF 3

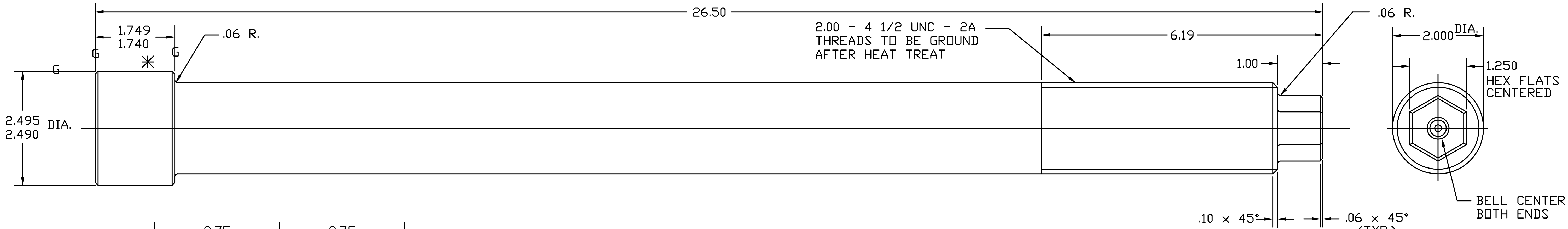
T-21433

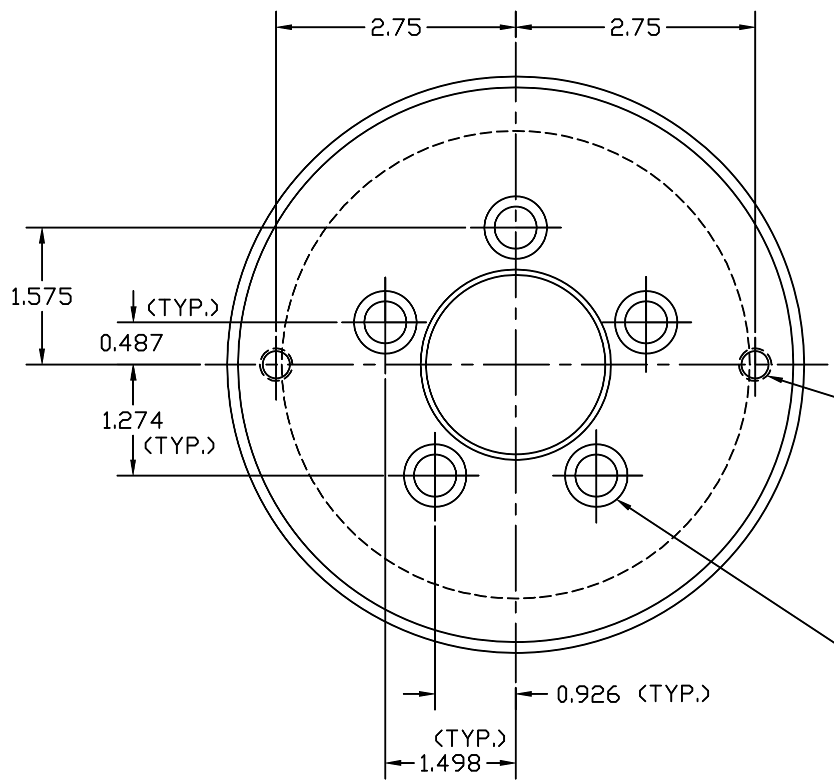
TWIN DISC INC. RACINE, WIS.

PART NO.: 1016523 HSG.
1017000 SHAFT
1017009 FLANGE

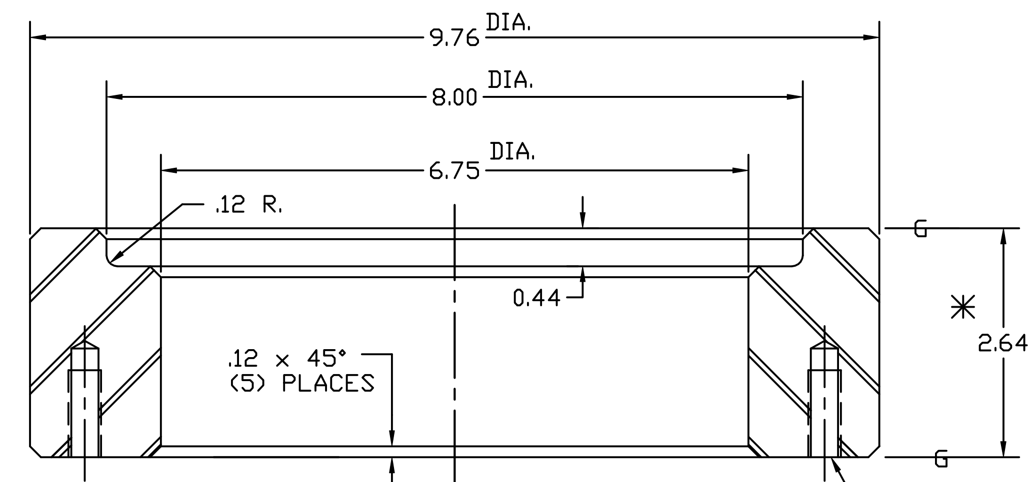
STAMP TOOL NO.: T-21433
PART NO.: MG 4406
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21433

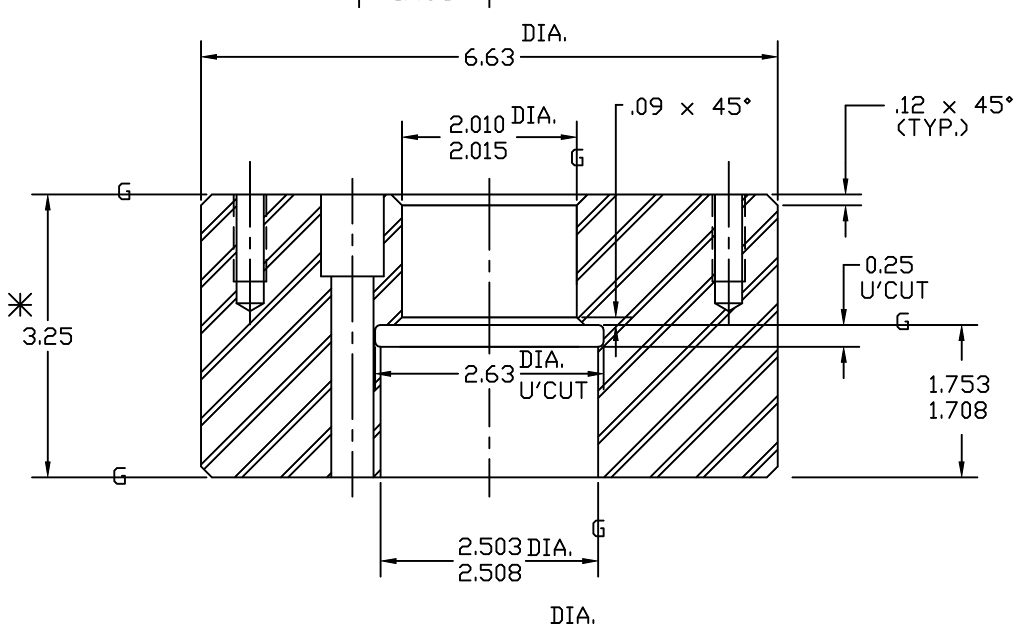




③ PULLER ROD (1) REQ'D.
MAT. : SAE # 4340 H (AIRCRAFT QUILITY)
HEAT TREATMENT :
HARDEN & TEMPER TO Rc 44 - 48
CHECK HARDNESS ON 2.000 DIA. ONLY,
DO NOT TOUCH THREADS
INSPECTION : CHECK ALL SURFACES WITH MAGNIFLO EQUIPMENT



① PUSHER PLATE (1) REQ'D.
MAT. : M.S. (HDN. 45-49 Rc)



1016523 - HSG.
1017000 - SHAFT -OUTPUT
PART NO: 1017009 - FLANGE

STAMP TOOL NO: T-21433
PART NO:
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

⑤ PULLER BASE (1) REQ'D.
MAT. : M.S. (HDN. 45-49 Rc)

CAD FILE : 21433-1

NOTE :
UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

*
NOTE :
ALL GRD. DIA'S. & SURFACES MUST BE
SQUARE & CONCENTRIC TO WITHIN
.005 OF EACH OTHER

Ⓐ (HDN. 45-49 Rc)
SEE DET. # 5 REV'D.
ON SHT. # 3

DET.# 1 NOT USED
Ⓐ (HDN. 45-49 Rc)

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE			
5	1	M.S.	PULLER BASE	6.75	DIA.	× 3.38	THK.
3	1	4340H	PULLER ROD	2.62	DIA.	× 27.00	LG.
1	1	M.S.	PUSHER PLATE	10.00	DIA.	× 2.88	THK.

CHANGE	DESCRIPTION	DATE	BY
A	DET. # 8 ADDED DET. # 5 REV'D. SHT.. #3 ADDED	2-21-97	JPL

Date: 10-12-96 By: JPL F.P.N.: Scale: FULL

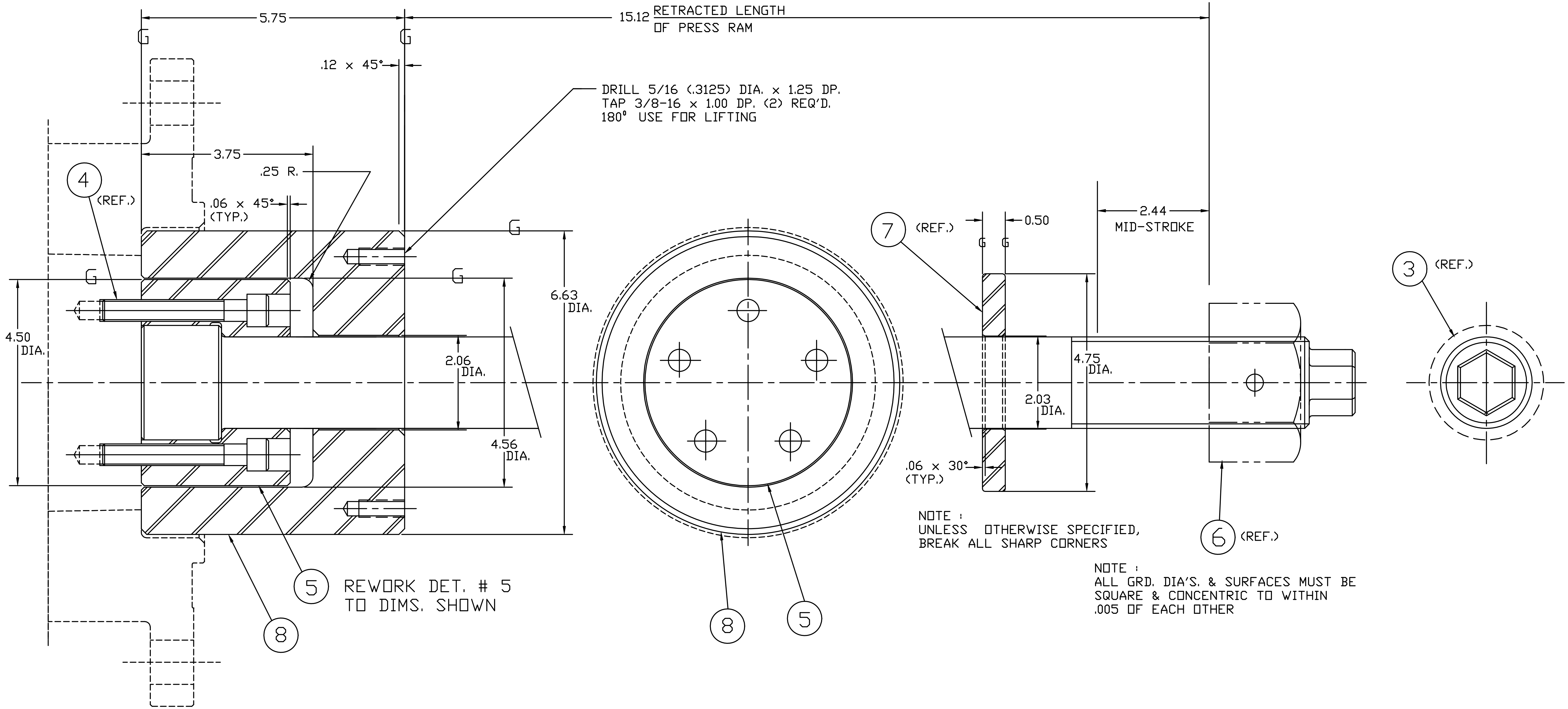
NAME OUTPUT FLANGE FIXTURE Ⓐ

FOR MG 5301

SHEET 2 OF 3

T-21433

TWIN DISC INC. RACINE, WIS.



	DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
(HDN. 45-49 Rc)	8	1	M.S.	PUSHER PLATE	6.75 DIA. × 6.00 LG.
REWORKED TO THIS DRWG. SEE SHT.#2	5	1	M.S.	PULLER BASE	
	4	5	STK.	SOC. HD. CAP SCREW	M12 × 1.75 × 80 MM LG.
SEE SHT.#2	3	1	4340H	PULLER ROD	

Date: 2-21-97 By: JPL F.P.N.: Scale: FULL

NAME OUTPUT FLANGE FIXTURE

FOR MG 5301

SHEET 3 OF 3

T-21433

TWIN DISC INC. RACINE, WIS.

CHANGE	DESCRIPTION	DATE	BY
A	SHT. # 3 ADDED & DET. # 5 REV'D. & DET. # 8 ADDED	2-21-97	JPL

PART NO: 1016523 HSG. 1017000 SHAFT 1017009 FLANGE

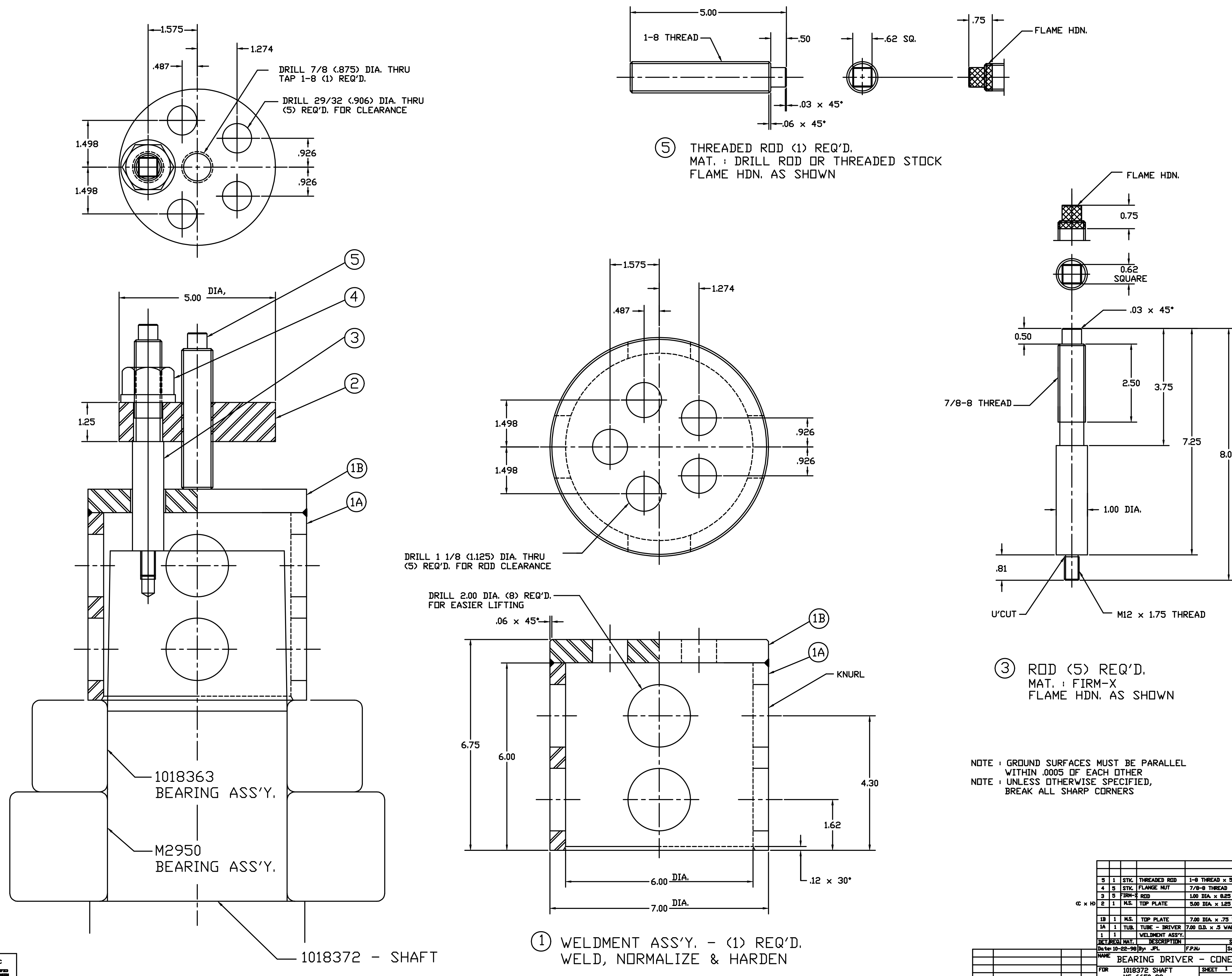
STAMP TOOL NO: T-21433

PART NO: MG 4406

BREAK ALL SHARP CORNERS

TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21433



NOTE : GROUND SURFACES MUST BE PARALLEL
WITHIN .0005 OF EACH OTHER
NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
5	1	STK.	THREADED ROD	1-8 THREAD x 5.25 LG.
4	5	STK.	FLANGE NUT	7/8-8 THREAD
3	5	FIRM-X	ROD	1.00 DIA. x 8.25 LG.
2	1	M.S.	TOP PLATE	5.00 DIA. x 1.25 THK. (C x H)
1B	1	M.S.	TOP PLATE	7.00 DIA. x .75 THK.
1A	1	TUB.	TUBE - DRIVER	7.00 O.D. x .5 WALL x 6.25 LG.
1	1		WELDMENT ASS'Y.	

CHANGE	DESCRIPTION	DATE	BY

Date: 10-22-98 By: JPL F.P.N.: Scale: FULL

NAME BEARING DRIVER - CONE

FOR 1018372 SHAFT
MG 6650 SC

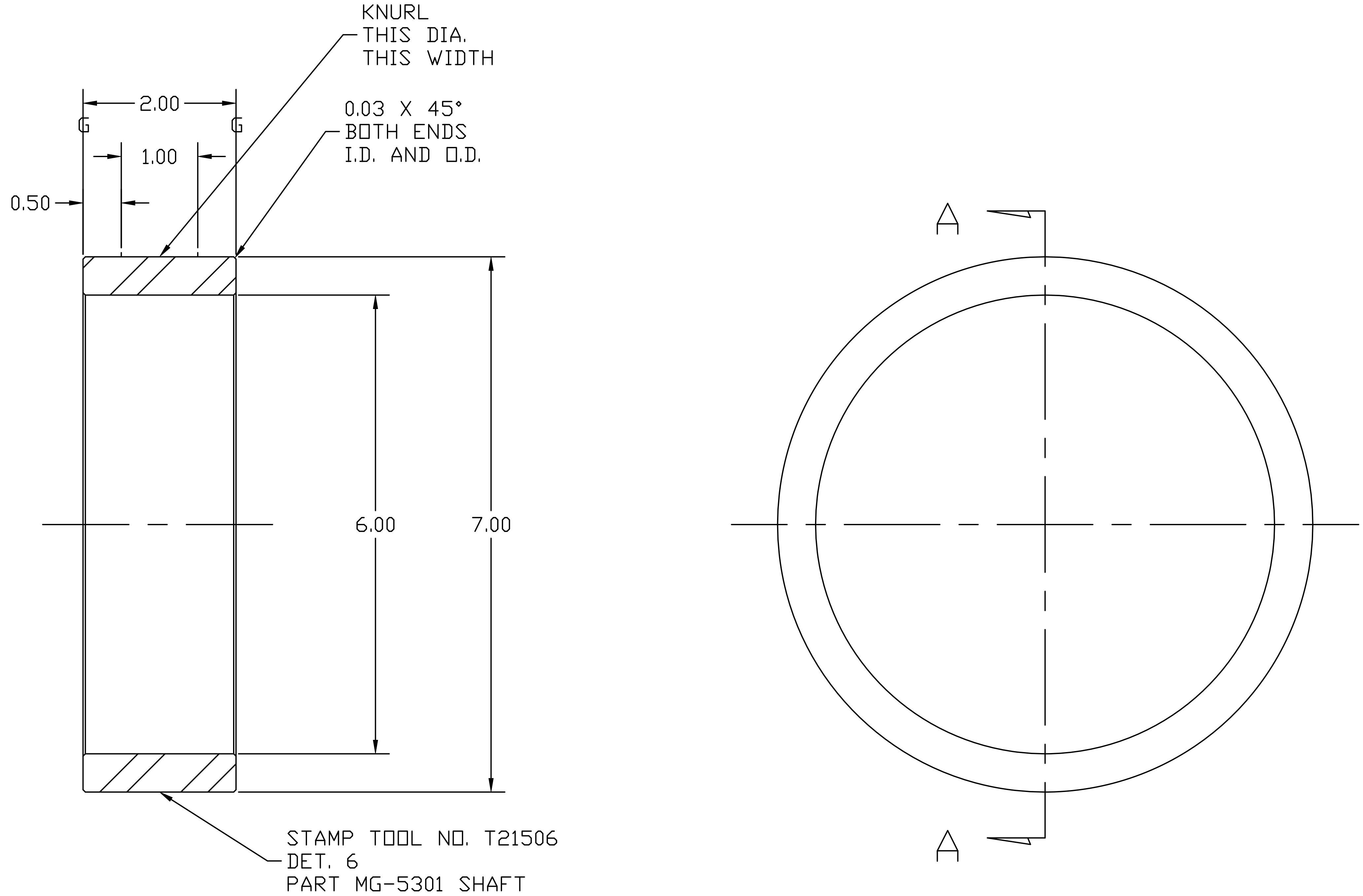
SHEET 1 OF 2

T-21506

TWIN DISC INC. RACINE, WIS.

STAMP TOOL NO: T-21506
PART NO: MG 6650 SC
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE
DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21506



SECTION A-A

STAMP TOOL NO.:
PART NO.:
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CHANGE	DESCRIPTION	DATE	BY

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
6	1	4140	SPACER RING Rc32-36	TUBING 7.25 OD X 2.25

Date: 10/07/99 | By: GDL | F.P.N.: | Scale: FULL

NAME SPACER RING

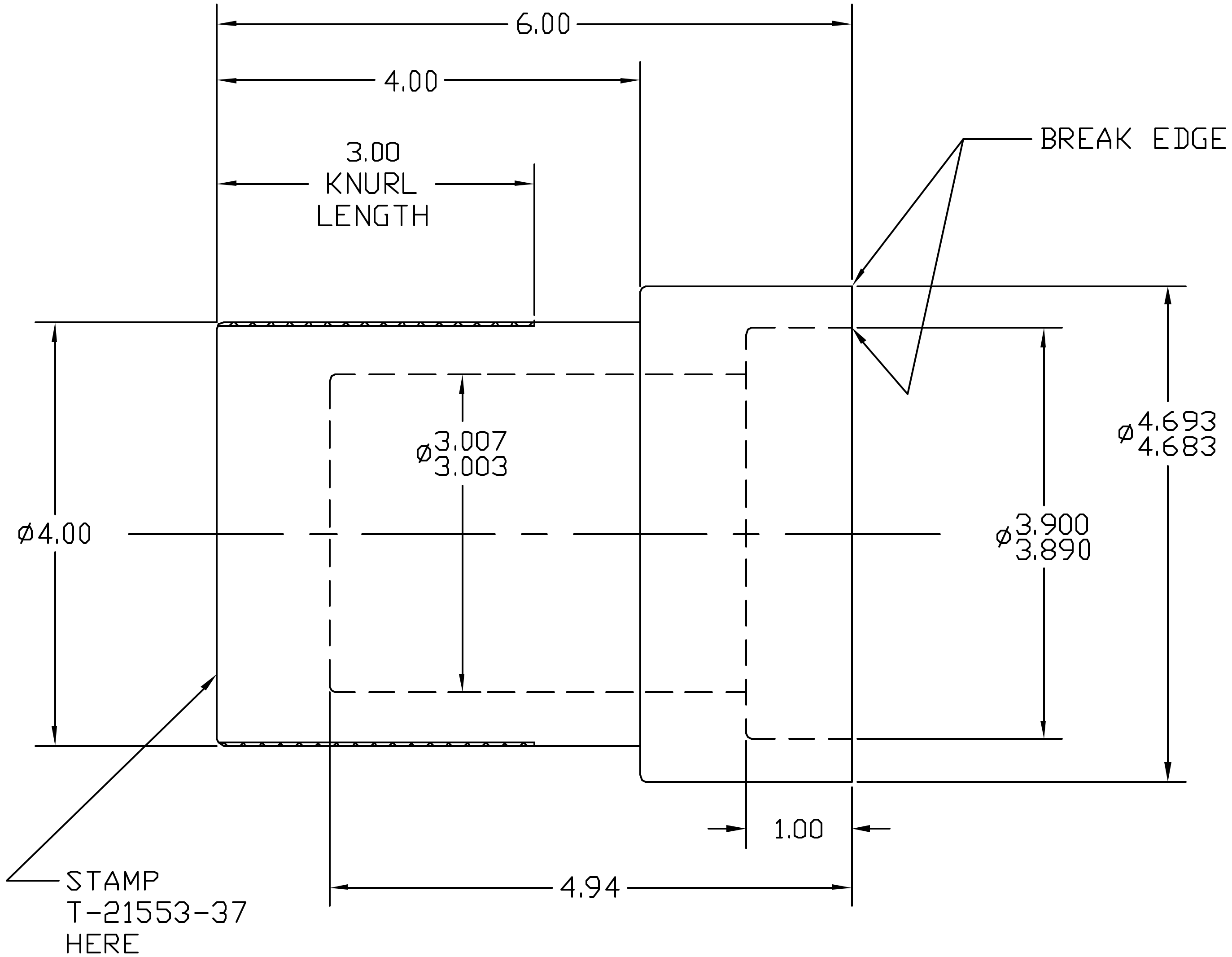
FOR MG-5301 SHAFT

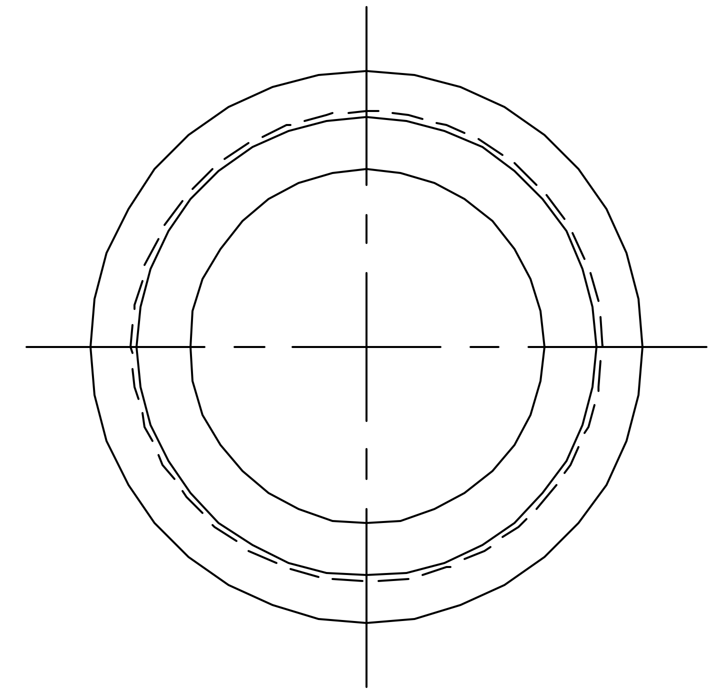
SHEET 2 OF 2

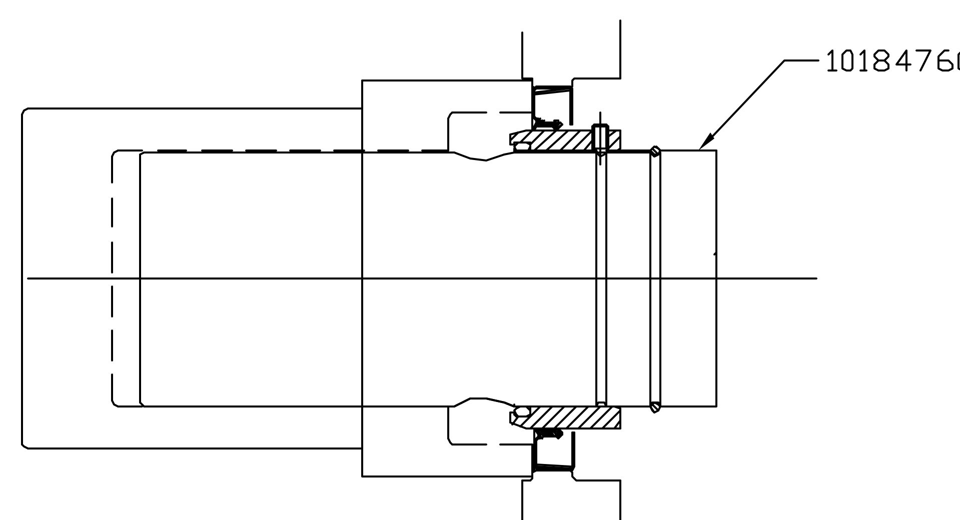
T-21506

TWIN DISC INC. RACINE, WIS.

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
1	1	NYLON	DRIVER, SEAL	Ø5.0 x 6.0







REV	SHEET	ZONE	CH. NO.	DATE

TOLERANCE UNLESS OTHERWISE SPECIFIED
±0.0010 ON FOUR PLACE DECIMAL DIMENSION
±0.005 ON THREE PLACE DECIMAL DIMENSION
±0.01 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
±1/4° ON ANGULAR DIMENSION

STAMP TOOL NO.
PART NO.
MACHINE
CELL

INCH

THIRD ANGLE PROJECTION

OUTSIDE VENDOR DRAWING #

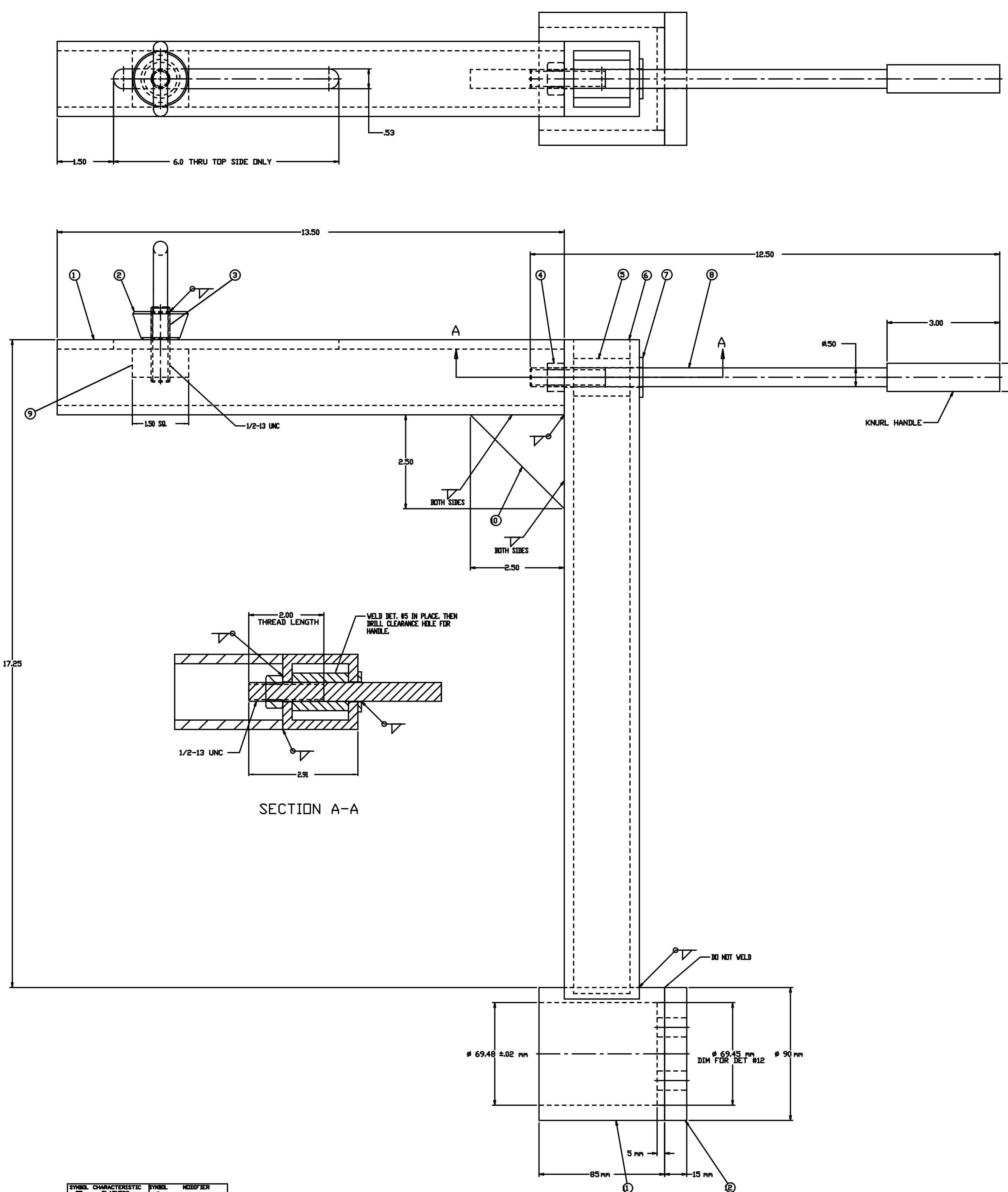
NAME: SEAL DRIVER
FOR: MARINE TRANSMISSION MG-6650

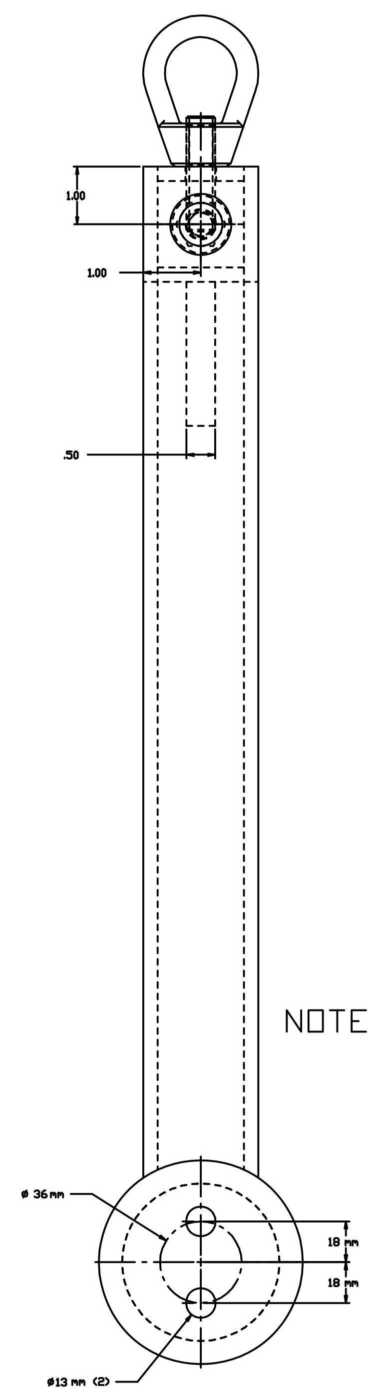
DATE: 12-6-03
SCALE: 1=1
DRN. RSL
CHK.
APPD.

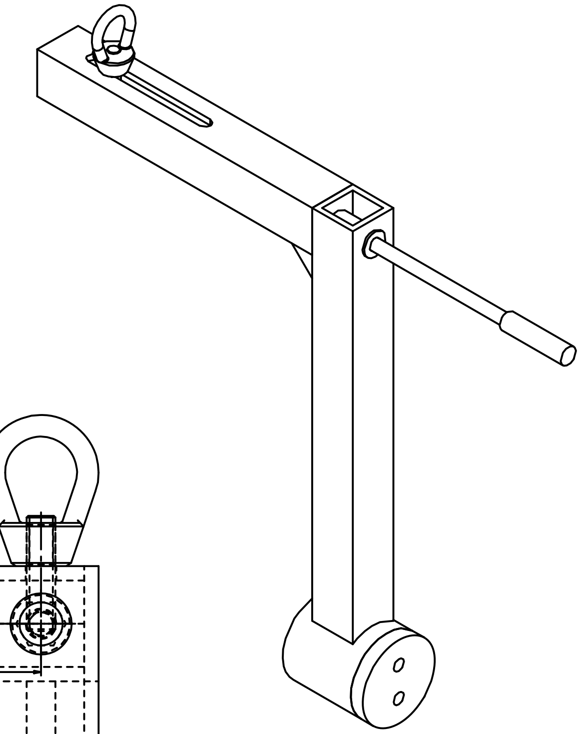
TWIN DISC
INCORPORATED
RACINE, WI 53403 - USA

T-21553-37

DWG SIZE: C | SHT. | REV







NOTE: LIFTING CAPACITY @ 325 POUNDS

NOTE:
HOLD DRILLED, C'BORED AND/OR TAPPED HOLES TO ±.005

AUTOCAD FILE ~T-506000.DWG

STAMP TOOL NO:
PART NO:
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
±.0002 ON FOUR PLACE DECIMAL DIMENSION
±.001 ON THREE PLACE DECIMAL DIMENSION
±.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

SYMBOL	CHARACTERISTIC
⏥	FLATNESS
//	PARALLELISM
⊥	PERPENDICULARITY
◎	CONCENTRICITY
↗	CIRCULAR RUNOUT
⌰	TOTAL RUNOUT
⌖	POSITION

SYMBOL	MODIFIER
Ⓜ	MMC (MAX. MATERIAL CONDITION)
Ⓢ	RFS (REGARDLESS OF FEATURE SIZE)

SYMBOL	NAME
-A-	DATUM FEATURE
?ø?	DIAMETER

DET.	REQ.	DESCRIPTION	MATERIAL
1	1	2.00 SQ X .25 WALL X 13.50	TUBE
2	1	EYE NUT, # 3019T18	McMASTER -CARR
3	1	1/2-13 X 2.00 THREADED ROD	
4	1	1/2-13 NUT	
5	1	1.00 O.D. X .51 I.D. X 1.50	CRS
6	1	2.00 SQ X .25 WALL X 17.56	TUBE
7	1	1/2" I.D. HEAVY WASHER	
8	1	.75 DIA X 12.50	CRS
9	1	1.50 SQ X .75	CRS
10	1	2.50 X 2.50 X .50	CRS
11	1	90MM DIA X 85MM	CRS
12	1	90MM DIA X 20MM	CRS

Date: 10/17/00 By: MDS F.P.N.: Scale: 1/1

NAME P & S SHAFT LIFTING DEVICE TO DO IN-BOAT CLUTCH REPAIR

FOR

SHEET 1 OF 1

T-506000

TWIN DISC INC. RACINE, WIS.

REV	DESCRIPTION	DATE	BY

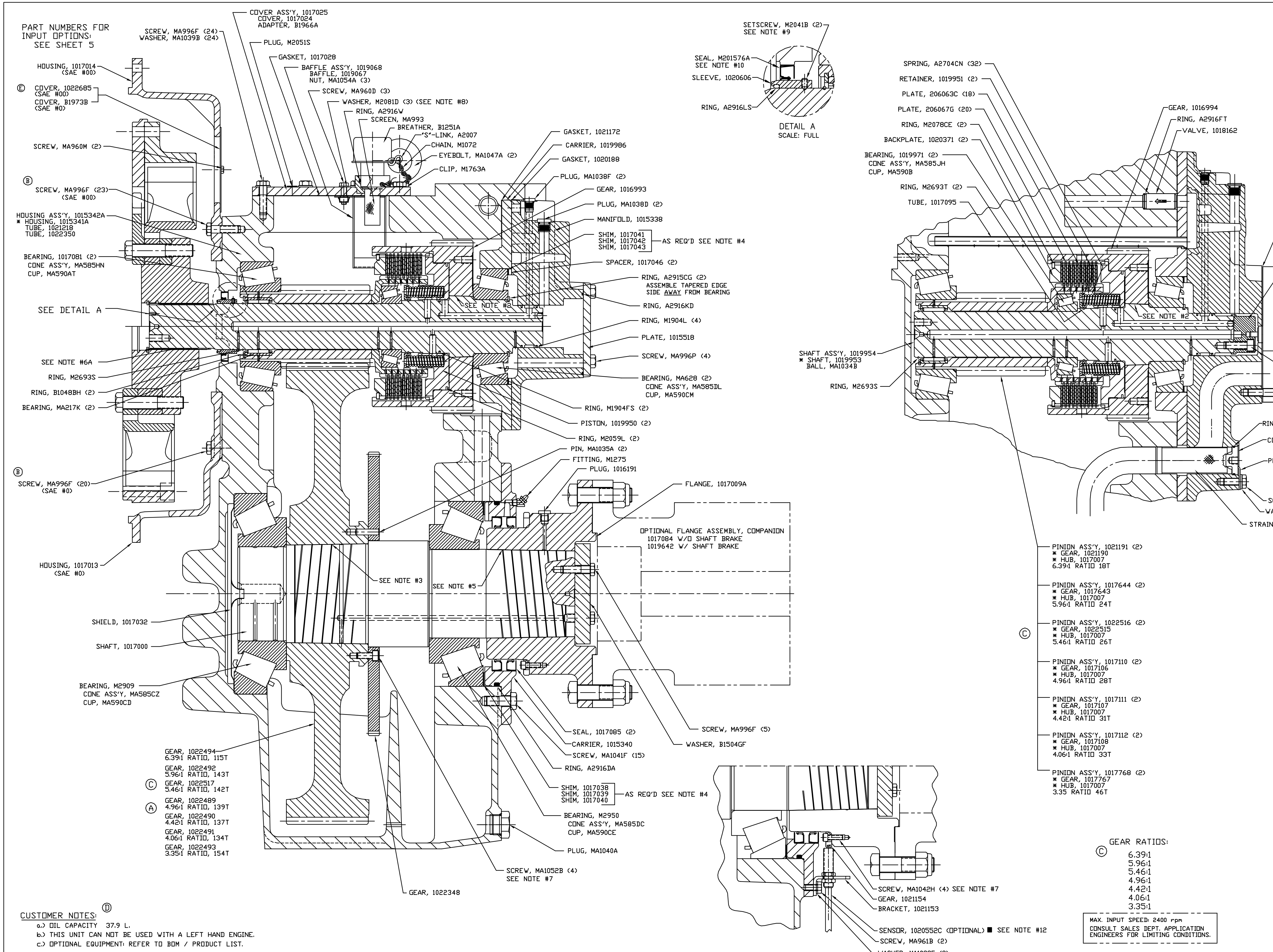
Engineering Drawings

List of Engineering Drawings

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

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.

- ❑ 1015339A (sheet 1 of 6) Marine Transmission
- ❑ 1015339A (sheet 2 of 6) Marine Transmission
- ❑ 1015339A (sheet 3 of 6) Marine Transmission
- ❑ 1015339A (sheet 4 of 6) Marine Transmission
- ❑ A7119AG Hydraulic Diagram
- ❑ 1016473 Trailing Pump Assembly
- ❑ 1017177 Auxiliary Pump Drive Group
- ❑ 1017820E PTO Assembly
- ❑ 1017546 Control Valve (w/trolling valve)
- ❑ 1017172 Control Valve (w/out trolling valve)
- ❑ 1018084 Control Valve (w/out trolling valve)
- ❑ 1020941 Control Valve
- ❑ 1020583 E-Troll Module
- ❑ 1020585 Profile Module



ASSEMBLY INSTRUCTIONS:

ASSEMBLE AND TEST PER S570BQ. NOTES #1 THRU #10 ARE IN S570BQ.

THESE STANDARDS APPLY:

S574 FASTENER TORQUE REQUIREMENTS
S692 BEARING SHIMMING
S765 TAPERED JOINT ASSEMBLY

NOTE #11: APPLY MA908 TO INPUT SENSOR THREADS. ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR ONE FULL TURN.

NOTE #12: ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR TWO FULL TURNS.

NOTE #13: PORT MARKED 'B' TO BE ASSEMBLED CLOSEST TO TRAILING PUMP OUTLET.

NOTE #14: PORT MARKED 'S' TO BE ASSEMBLED CLOSEST TO OUTPUT SHAFT.

GEAR RATIOS:

6.39:1
5.96:1
5.46:1
4.96:1
4.42:1
4.06:1
3.35:1

MAX. INPUT SPEED: 2400 rpm
CONSULT SALES DEPT. APPLICATION ENGINEERS FOR LIMITING CONDITIONS.

CUSTOMER NOTES:

a.) OIL CAPACITY 37.9 L.
b.) THIS UNIT CAN NOT BE USED WITH A LEFT HAND ENGINE.
c.) OPTIONAL EQUIPMENT: REFER TO BOM / PRODUCT LIST.

✱ NOT SERVICEABLE SEPERATELY.
▲ REMOVE BEFORE OPERATING, 2 PLACES, CLOSURES.
■ REQUIRED FOR USE OF 1022307C E-TROLL MODULE.
□ EQUIPPED WITH NEUTRAL SOLENOID.

SHEET 1 OF 6	CROSS SECTION AND PART NUMBERS
SHEET 2 OF 6	CROSS SECTION AND PART NUMBERS
SHEET 3 OF 6	CROSS SECTION AND PART NUMBERS
SHEET 4 OF 6	INSTALLATION DRAWING
SHEET 5 OF 6	FLEXIBLE COUPLING INPUTS
SHEET 6 OF 6	MTU MONITORING
B3504AQ	MASS ELASTIC SYSTEM
B3649M	HEAT EXCHANGER REQUIREMENTS
A7119AG	HYDRAULIC DIAGRAM

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
D	1	I1	ECN13860	1-06-06					
C	1	E2,H2	ECN13694	10-14-05					
B	1 & 4		ECN13653	9-29-05	F	1,2,3,4,6		ECN13992	5-03-06
A	1	H2	ECN13620	9-20-05	E	1 & 5		ECN13873	1-19-06

METRIC — THIRD ANGLE PROJECTION

SIMILAR TO 1015339

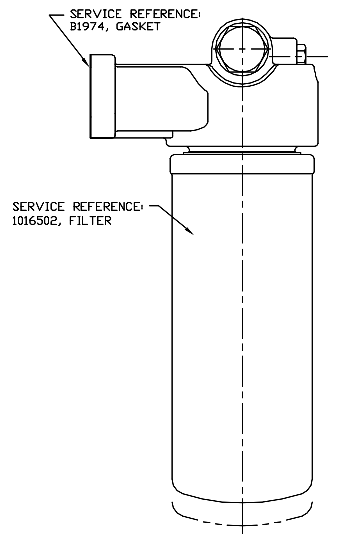
NAME: MG-5321DC MARINE TRANSMISSION

DATE 7-27-05 — SCALE 1/2 — DRN JM — CHK MDL — APPR ALC

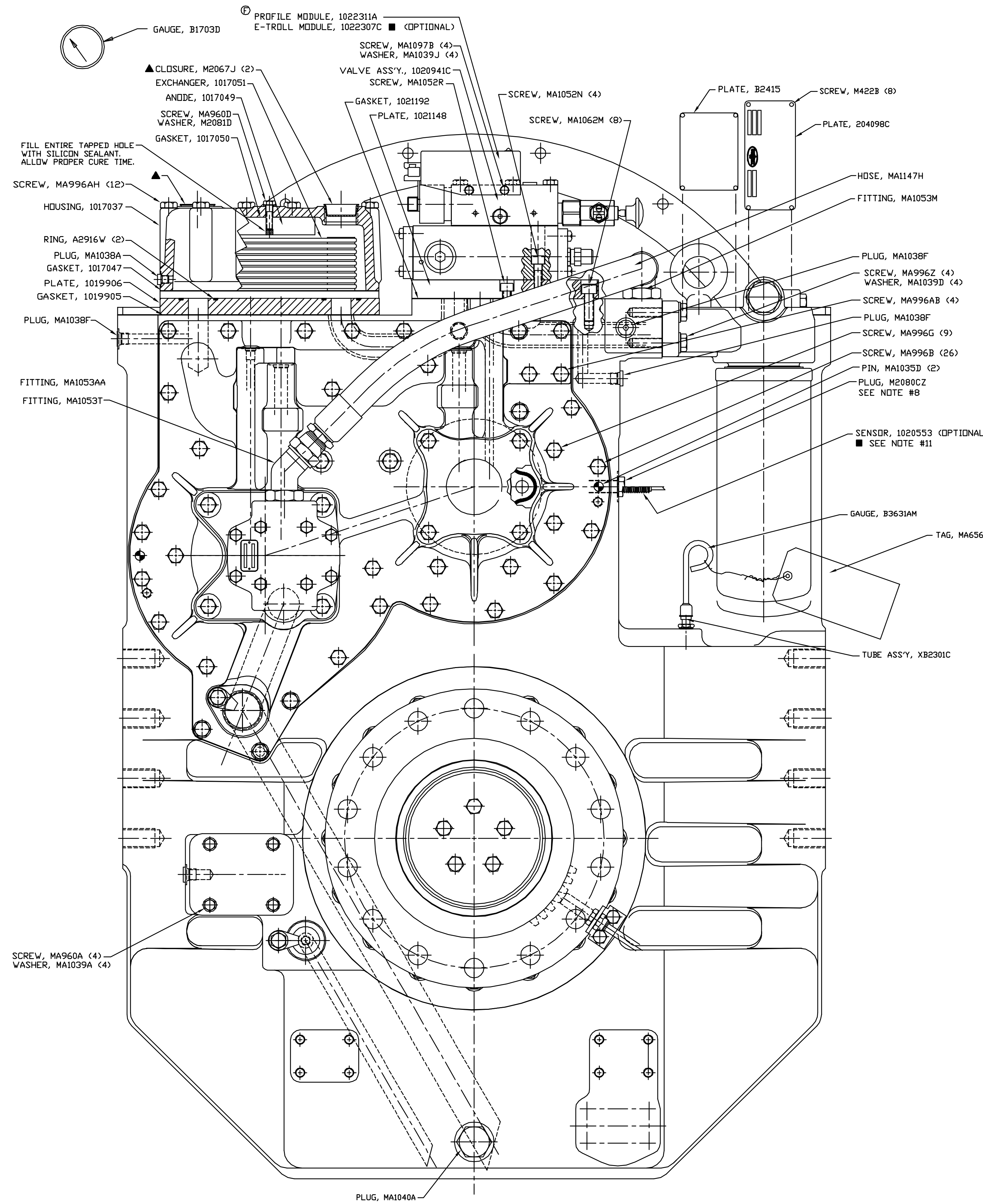
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1015339A — SHT. 1 of 6 — REV F

STANDARD EQUIPMENT



FILTER ASS'Y., 1020872
W/O INDICATOR



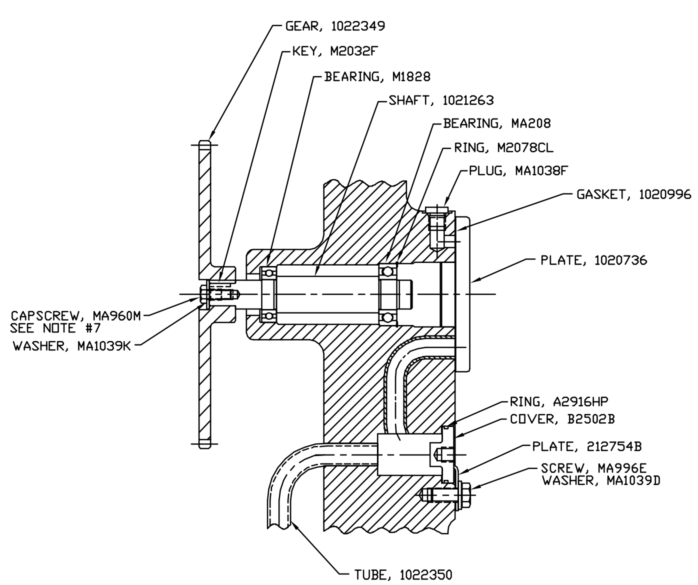
ASSEMBLY INSTRUCTIONS:
ASSEMBLE AND TEST PER S570BQ.
NOTES #1 THRU #10 ARE IN S570BQ.

NOTE #11:
APPLY MA908 TO INPUT SENSOR THREADS.
ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR ONE FULL TURN.

NOTE #12:
ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR TWO FULL TURNS.

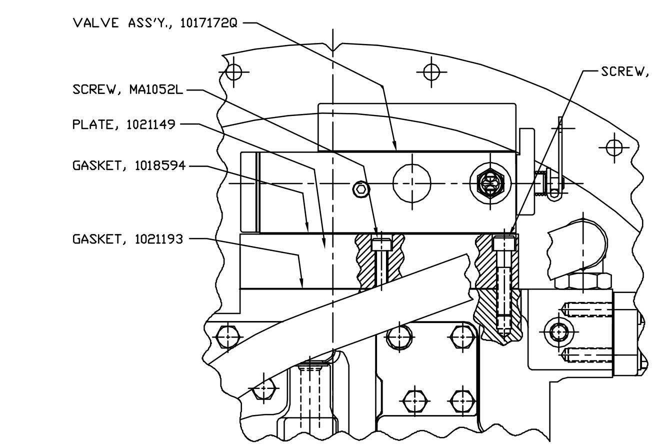
NOTE #13:
PORT MARKED 'B' TO BE ASSEMBLED CLOSEST TO TRAILING PUMP OUTLET.

NOTE #14:
PORT MARKED 'S' TO BE ASSEMBLED CLOSEST TO OUTPUT SHAFT.

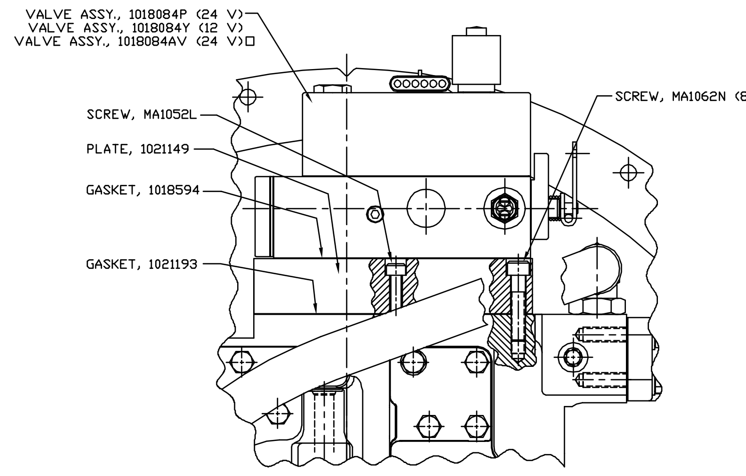


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ASME Y14.5M 1994	WEIGHT kg / WR² N.m² / FIRST USE ASSY. MODEL	METRIC	MATERIAL	HEAT TREAT	DATE 7-27-05 / SCALE 1/2	TWIN DISC INCORPORATED RACINE, WI 53403 - USA
	NOTICE! THIS PRINT CONTAINS PROPIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTEREST OF TWIN DISC, INCORPORATE THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERNMENT OR OTHERS BY CONTRACT.	THIRD ANGLE PROJECTION	SIMILAR TO	NAME MG-5321DC MARINE TRANSMISSION	DRN. JM / CHK. MDL / APPD. ALC	1015339A / DWG SIZE A0 / SHT. 2of6 / REV F

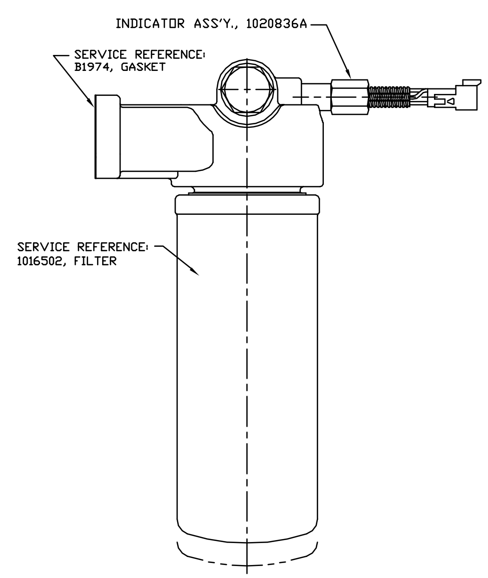
OPTIONAL EQUIPMENT



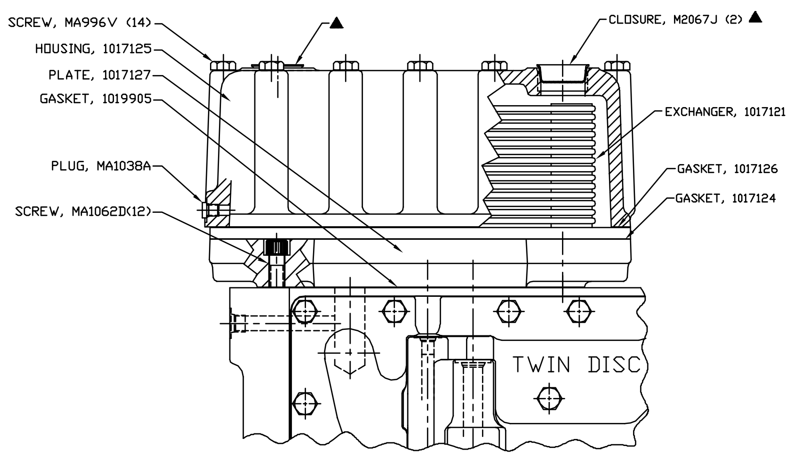
OPTIONAL MANUAL CONTROL VALVE



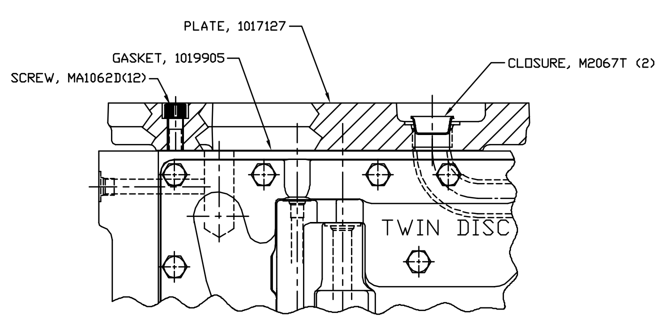
OPTIONAL ELECTRIC CONTROL VALVE



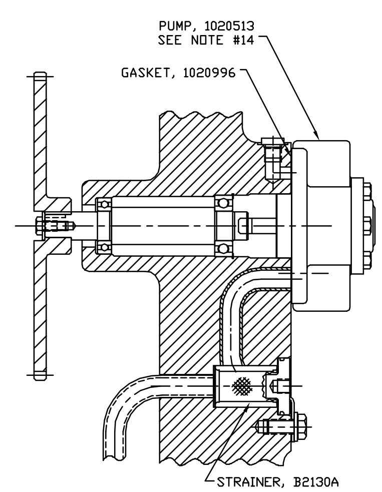
FILTER ASS'Y., 1020872
WITH INDICATOR



OPTIONAL FRESH WATER HEAT EXCHANGER



OPTIONAL DITCH PLATE FOR CUSTOMER SUPPLIED HEAT EXCHANGER



OPTIONAL MOUNTED TRAILING PUMP

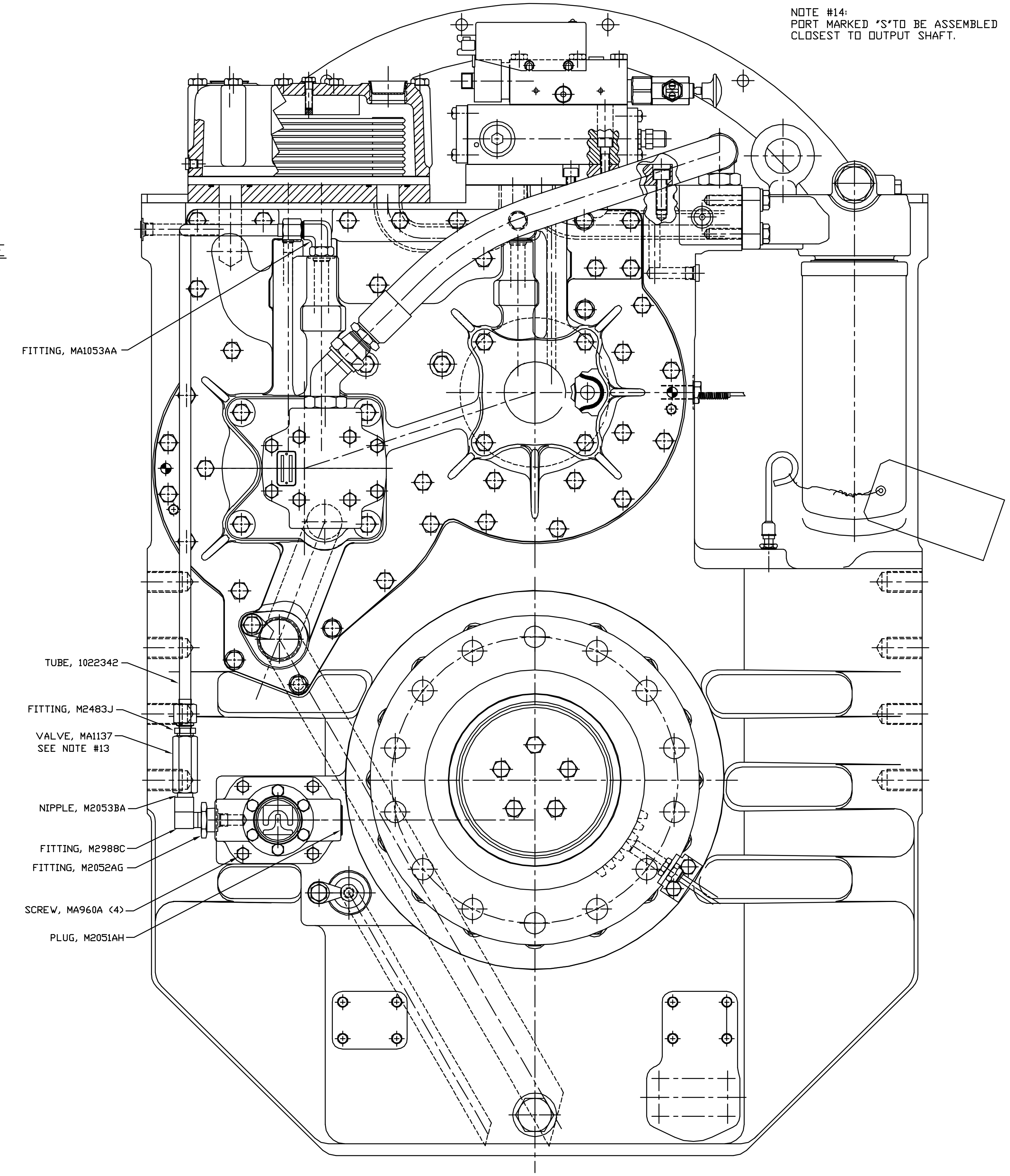
ASSEMBLY INSTRUCTIONS:
ASSEMBLE AND TEST PER S570BQ.
NOTES #1 THRU #10 ARE IN S570BQ.

NOTE #11:
APPLY MA908 TO INPUT SENSOR THREADS.
ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR ONE FULL TURN.

NOTE #12:
ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, THEN BACK OUT SENSOR TWO FULL TURNS.

NOTE #13:
PORT MARKED "B" TO BE ASSEMBLED CLOSEST TO TRAILING PUMP OUTLET.

NOTE #14:
PORT MARKED "S" TO BE ASSEMBLED CLOSEST TO OUTPUT SHAFT.



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

WEIGHT kg | WR² N.m² | FIRST USE | ASSY. | MODEL

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METRIC
THIRD ANGLE PROJECTION

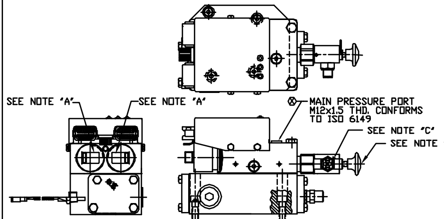
MATERIAL
SIMILAR TO
HEAT TREAT
NAME MG-5321DC MARINE TRANSMISSION

DATE	7-27-05
SCALE	1/2
DRN.	JM
CHK.	MDL
APPD.	ALC

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1015339A

DWG SIZE A0 | SHT. 3of6 | REV F



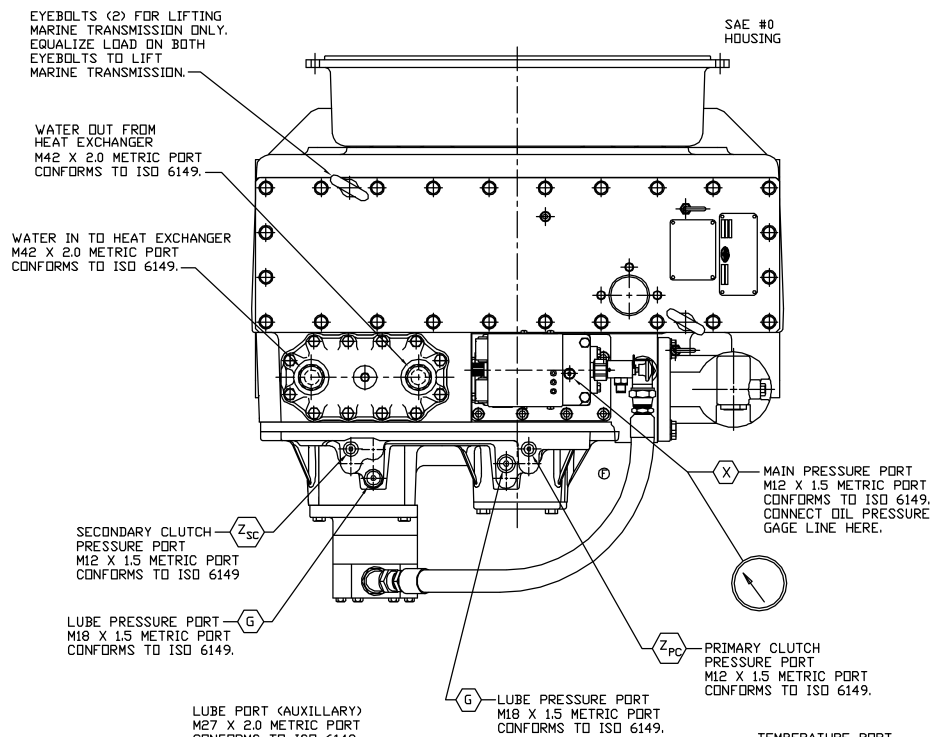
NOTES :

A. PROPORTIONAL CONTROL VALVE OPERATION
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTTERY/POWER SUPPLY VOLATAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PRIMARY CLUTCH.
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE SECONDARY CLUTCH.

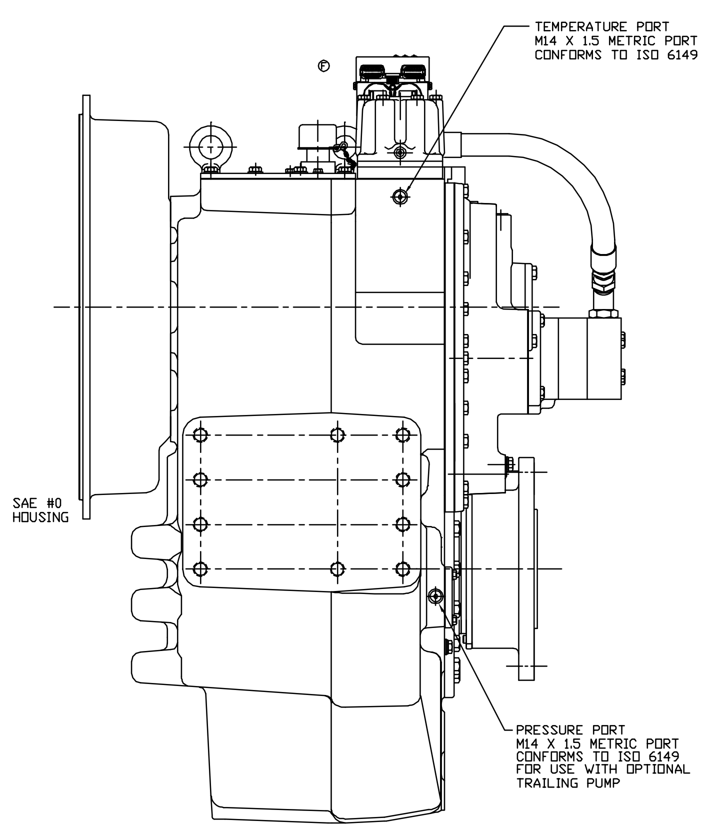
C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH
   1. SWITCH IS NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION.
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

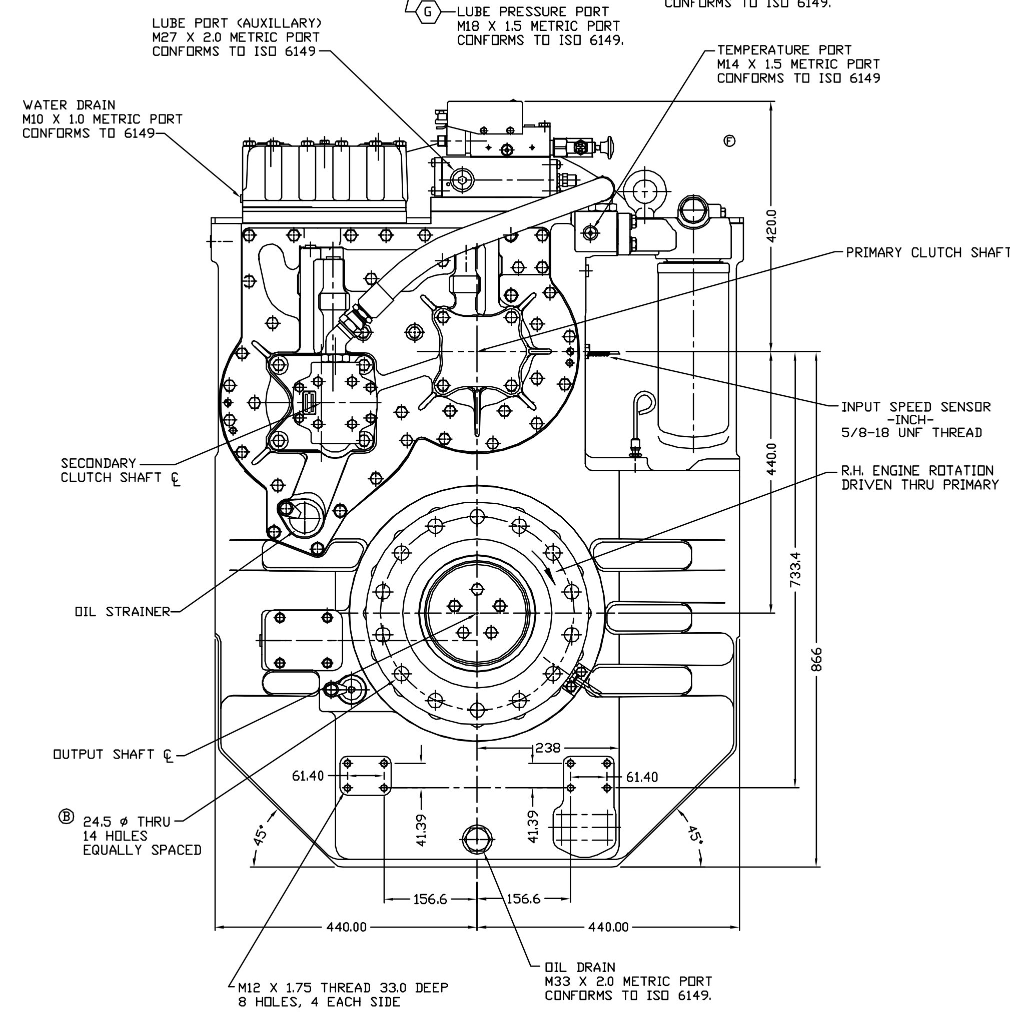
1020941C CONTROL VALVE

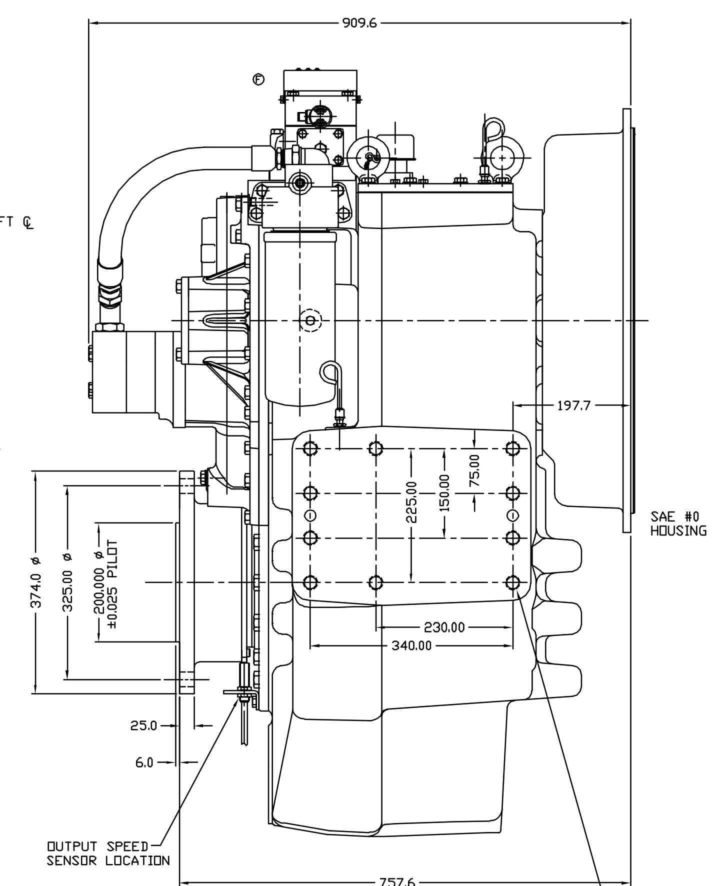


-LAYER DISPLAY OPTIONS-			
OPTION	TO DISPLAY	LAYER TURNED ON	LAYER TURNED OFF
FRONT HOUSING	SAE #0 HOUSING	SAE #0 HSG	SAE #00 HSG & FREE-STANDING
	SAE #00 HOUSING	SAE #00 HSG	SAE #0 HSG & FREE-STANDING
	FREE-STANDING	FREE-STANDING	SAE #0 HSG & SAE #00 HSG.
PTO GROUP	NO PTO	MANIFOLD COVER	LIVE PTO & HYDRAULIC PTO
	LIVE PTO	LIVE PTO	HYDRAULIC PTO & MANIFOLD COVER
	HYDRAULIC PTO	HYDRAULIC PTO	LIVE PTO & MANIFOLD COVER
HEAT EXCHANGER	TWIN DISC SUPPLIED RAW WATER HEAT EXCHANGER	RAW WATER H.E.	FRESH WATER H.E. PLATE CUST H.E.
	TWIN DISC SUPPLIED FRESH WATER HEAT EXCHANGER	FRESH WATER H.E. PLATE CUST H.E.	RAW WATER H.E.
	CUSTOMER SUPPLIED HEAT EXCHANGER	PLATE CUST H.E.	FRESH WATER H.E. RAW WATER H.E.
FILTER	NO CLOGING INDICATOR	NO CLOG INDICATOR	CLOG INDICATOR
	CLOGING INDICATOR	CLOG INDICATOR	NO CLOG INDICATOR
CONTROL VALVE	1020941C	1020941C	1017172Q 1018084
	1017172Q	1017172Q	1020941C 1018084
	1018084P, 1018084Y, & 1018084AV	1018084	1017172Q 1020941C
TRAILING PUMP	NO TRAILING PUMP	NO TRAILING PUMP	TRAILING PUMP
	TRAILING PUMP	TRAILING PUMP	NO TRAILING PUMP

NOTE: FOR CLARITY BEFORE OPTIONAL LAYERS ARE TURNED ON, TURN OFF DIMENSIONS NOTES LAYER.







M24 X 3.0 THREAD 40.0 DEEP
20 HOLES (10 EACH SIDE)
USE ALL 20 HOLES FOR MOUNTING UNIT.
USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898-1 AND TORQUE TO S574 OR SERVICE MANUAL VALUE.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ASME Y14.5M 1994	WEIGHT kg / WR² N.m² / FIRST USE ASSY. MODEL	METRIC	MATERIAL	HEAT TREAT	DATE 7-27-05 SCALE 1/4 DRN. JM CHK. MDL APPD. ALC	TWIN DISC INCORPORATED RACINE, WI 53403 - USA
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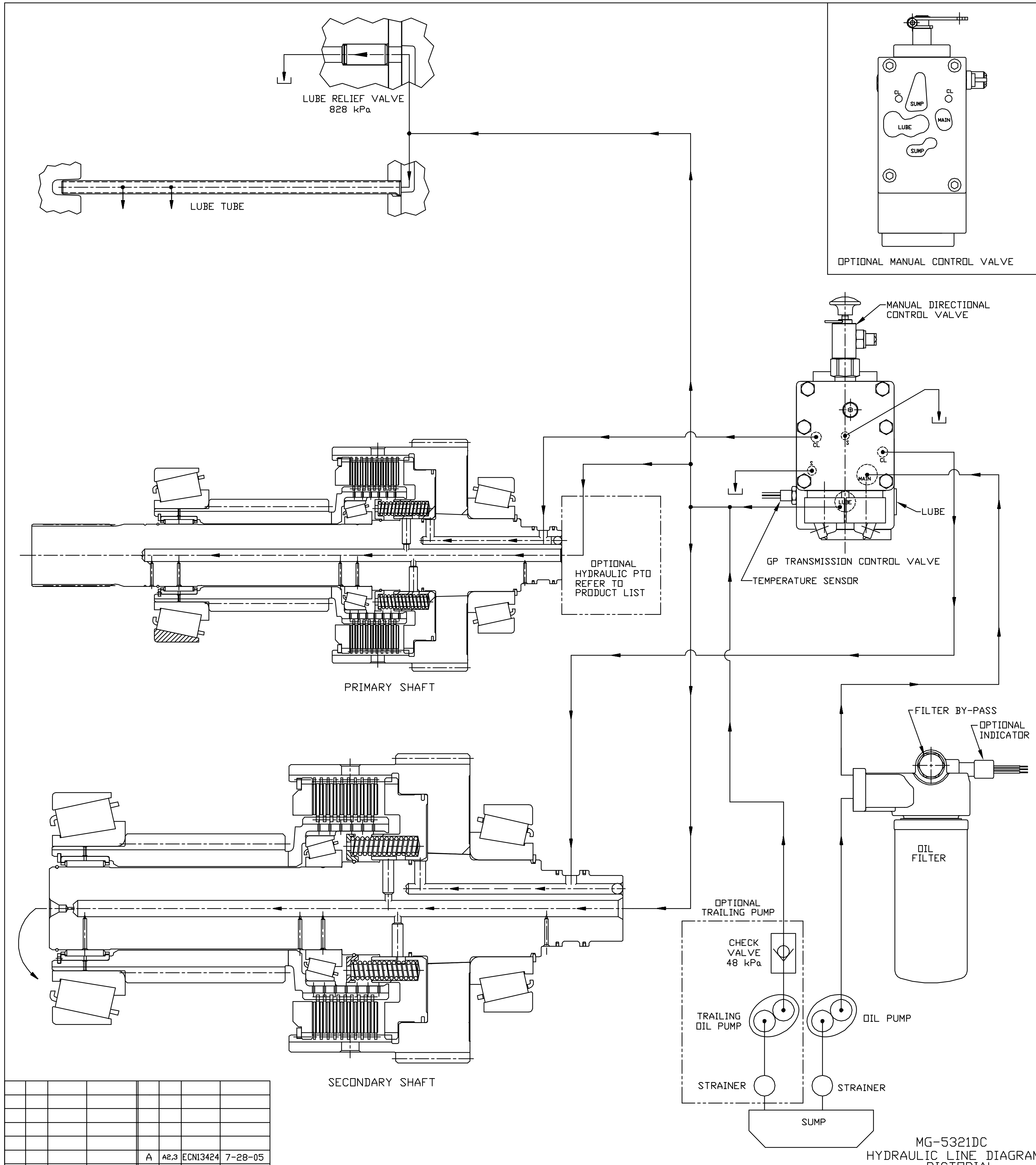
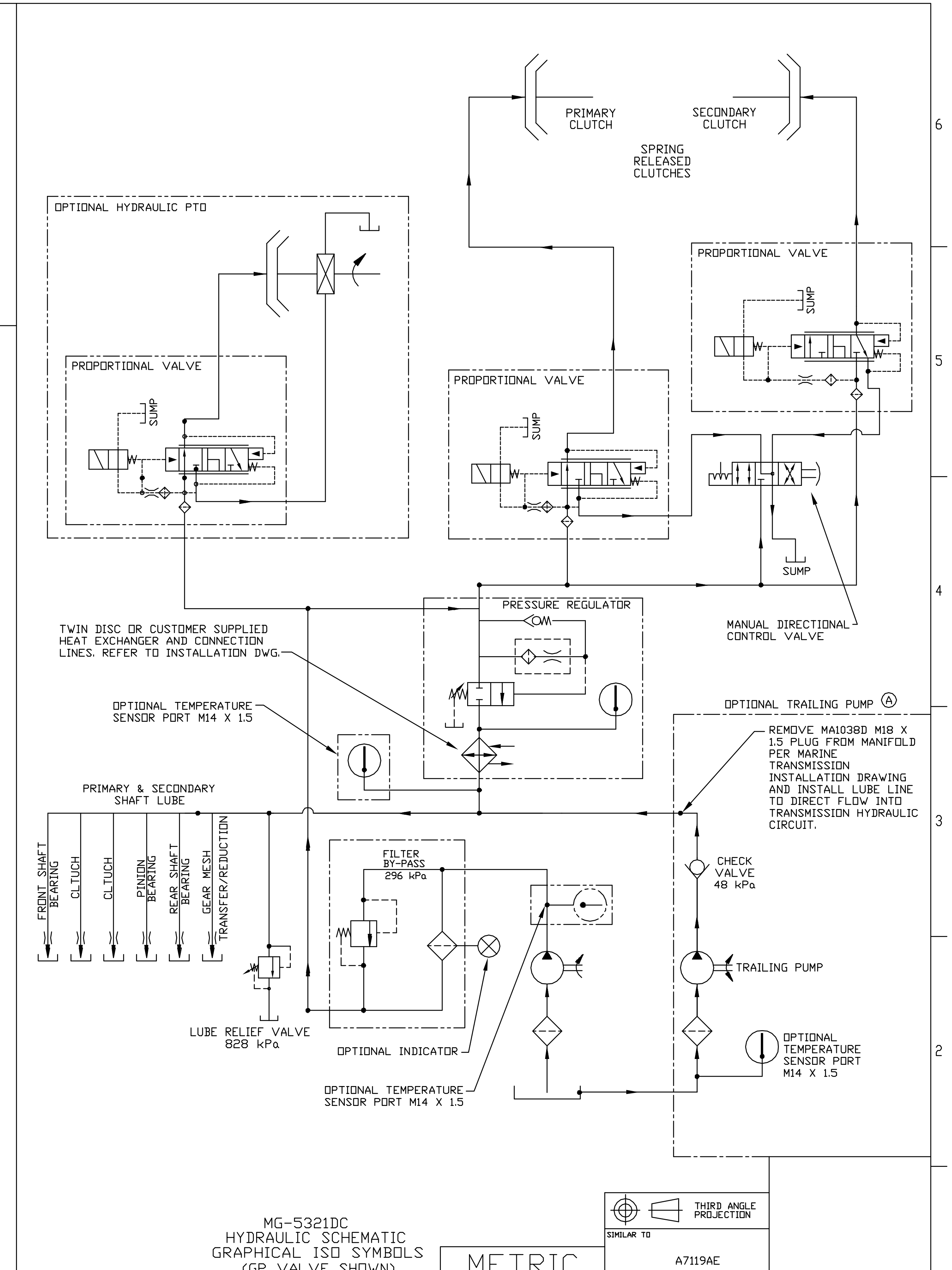




MG-5321DC
HYDRAULIC SCHEMATIC
GRAPHICAL ISO SYMBOLS
(GP VALVE SHOWN)

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO: A7119AE

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
				A	A2,3	ECN13424	7-28-05

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg

FIRST USE
ASSY. 1015339
MODEL MG-5321DC

NAME: SCHEMATIC, HYDRAULIC

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

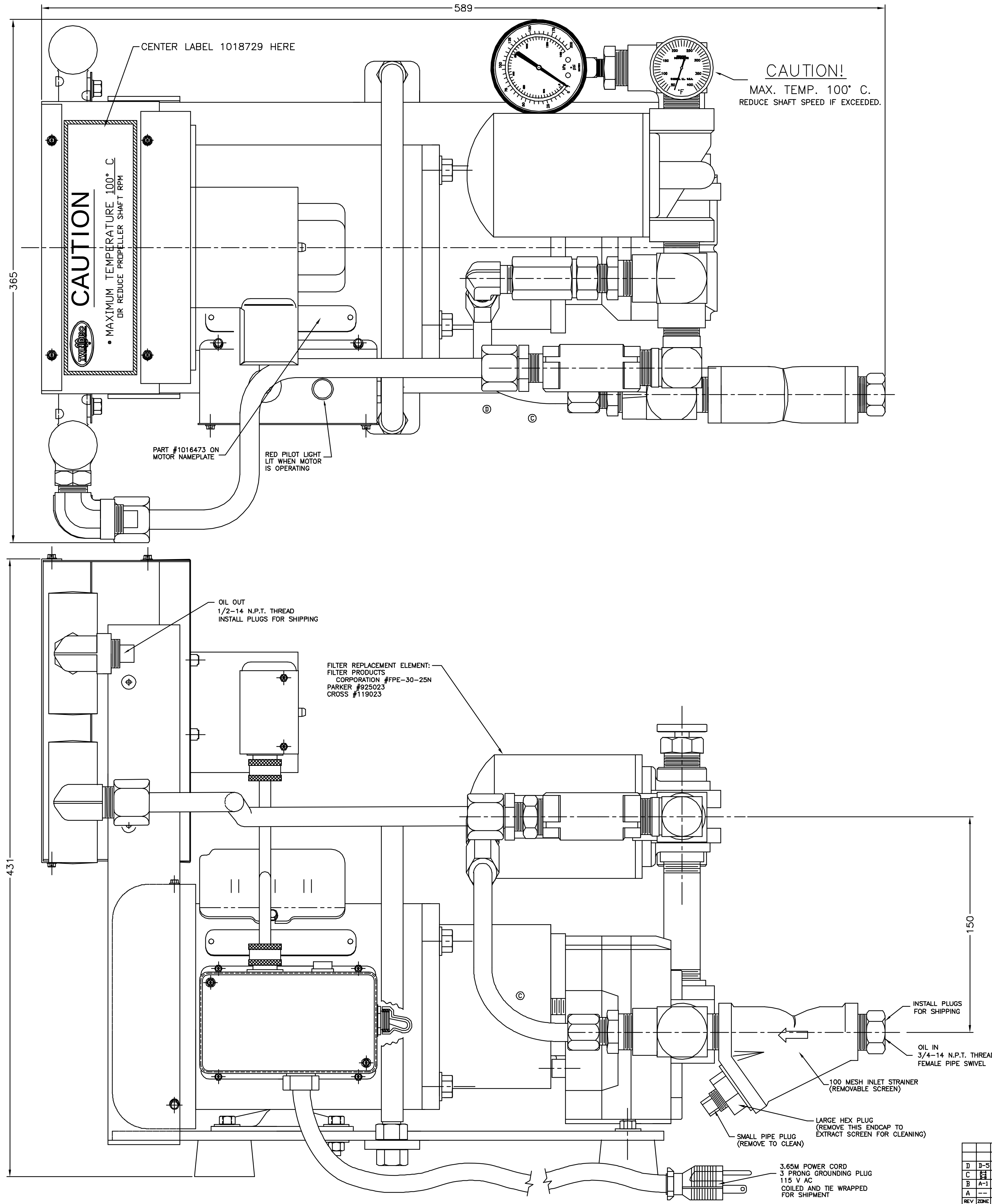
DATE 1-29-04
SCALE NONE
DRN. JM
CHK. GAM
APPD. ALC

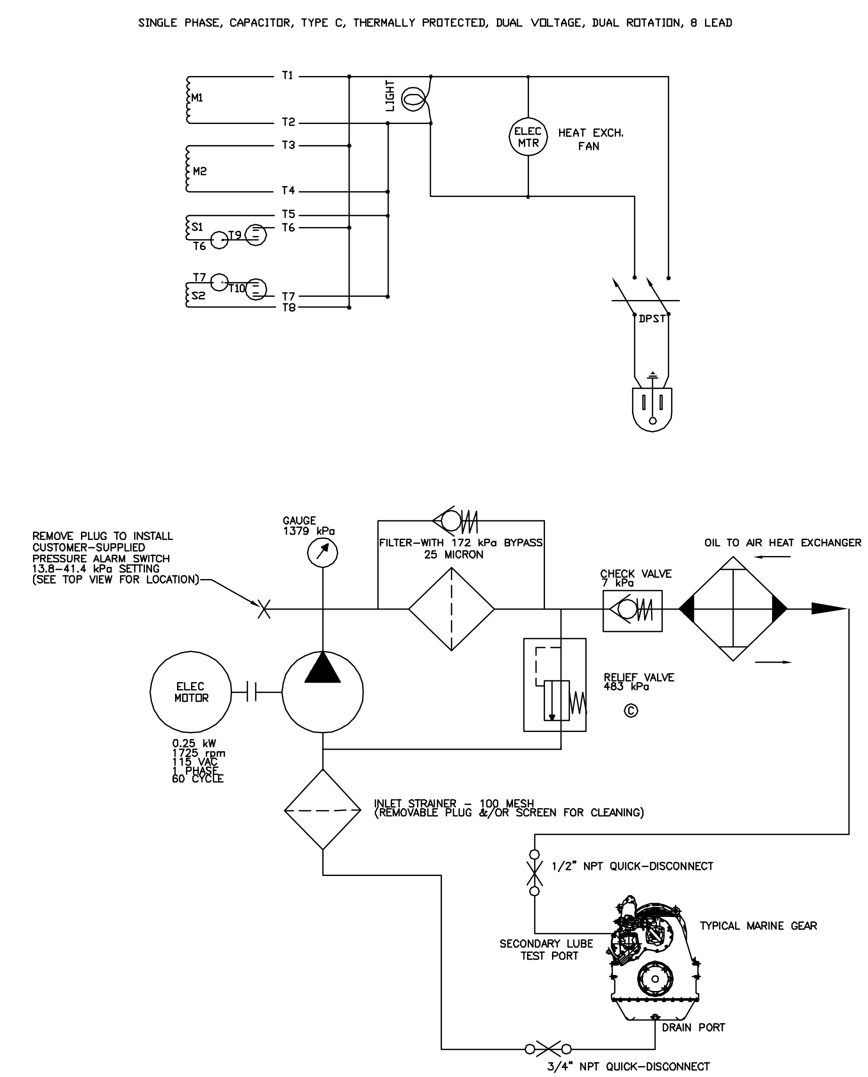
TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

A7119AG

SHEET 1 OF 1 REV A

F E D C B A





PUMP FLOW RATE IS 11.0 l/min. AT 102° C.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	ZONE	CH. NO.	DATE
D	D-5	29860	1-26-00
C	A-4 C-3 D-5	29423	7-6-99
B	A-1	29078	1-19-99
A	--	29003	12-4-98

MATERIAL
HEAT TREAT
SURFACE TREATMENT

WEIGHT 27.0 kg
WR² N·m²
FIRST USE
ASSY.
MODEL
NAME: PUMP ASSEMBLY (TRAILING)

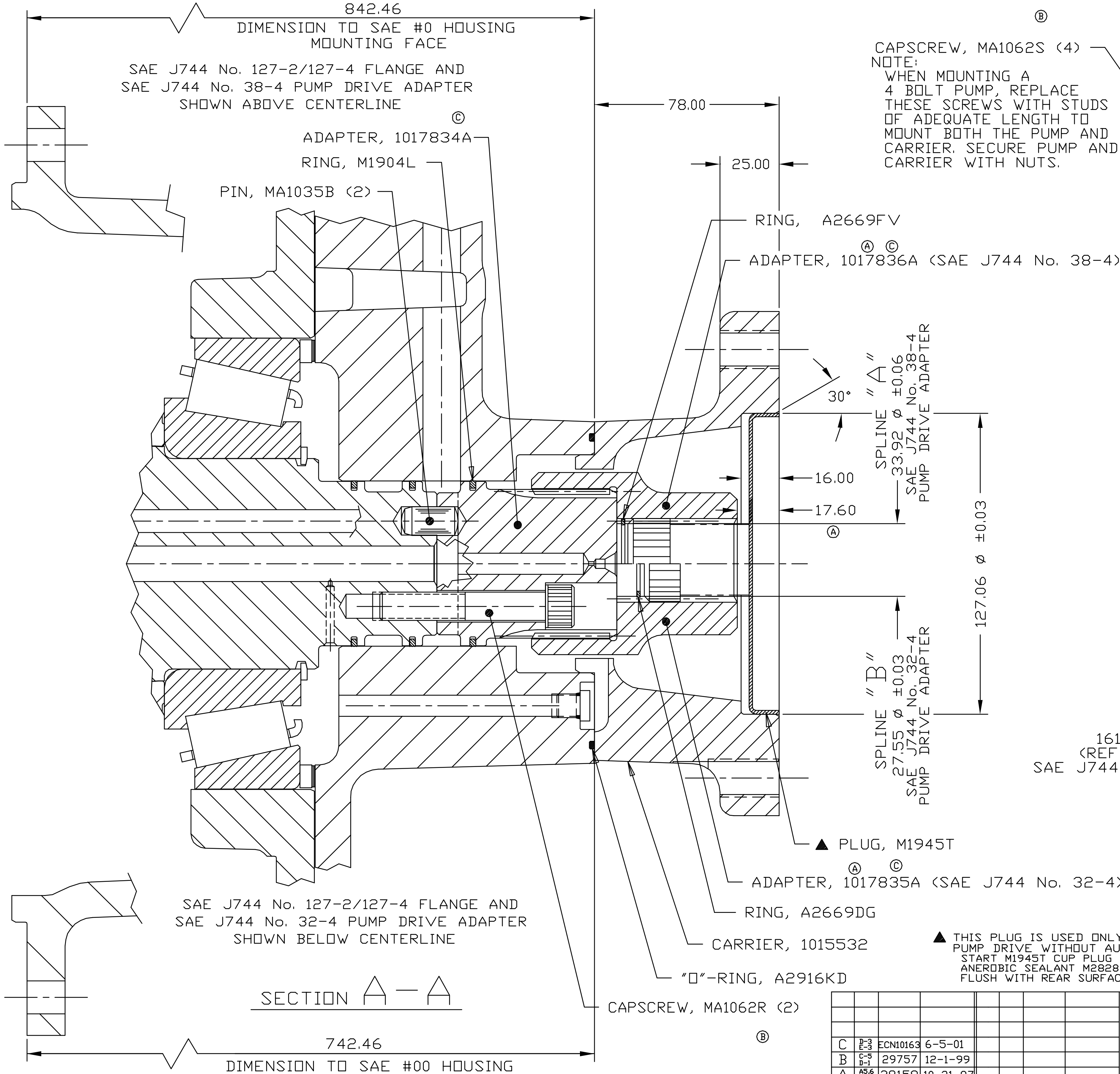
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 4-24-98
SCALE 1:1
DRN. DMB
CHK. PJL
APPD. DAS

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1016473

SHEET 1 OF 1 REV D



SECTION A – A

AUXILIARY PUMP DRIVE AND AUXILIARY PUMP INSTALLATION INSTRUCTIONS:

1.) REMOVE MA1038A PLUG ◉ FROM DRAIN HOLE IN MANIFOLD.

2.) PRESS THE (2) DOWEL PINS IN THE SHAFT UNTILL THE PINS PROTRUDE 9.0 FROM END OF SHAFT.

3.) ASSEMBLE THE PISTON RING INTO THE GROOVE OF THE DRIVE ADAPTER AND AND INSTALL THE ADAPTER OVER THE DOWEL PINS IN THE SHAFT. FASTEN THE ADAPTER TO THE SHAFT WITH (2) CAPSCREWS AND TORQUE PER S574 (OR SERVICE MANUAL) VALUES.

4.) ASSEMBLE THE NEW "O"-RING AND THE AUXILIARY PUMP CARRIER ONTO THE MANIFOLD SO THAT THE "SLOT" IN THE CARRIER BORE ALIGNS WITH THE DRAIN HOLE IN THE MANIFOLD ◉. MAKE SURE THAT THE PLUG IS NOT INSTALLED IN DRAIN HOLE (STEP 1). FASTEN WITH (4) CAPSCREWS AND TORQUE PER S574 (OR SERVICE MANUAL) VALUES.

5.) ASSEMBLE THE SNAP RING INTO SPLINED ADAPTER AND INSTALL THE ADAPTER ONTO THE DRIVE ADAPTER.

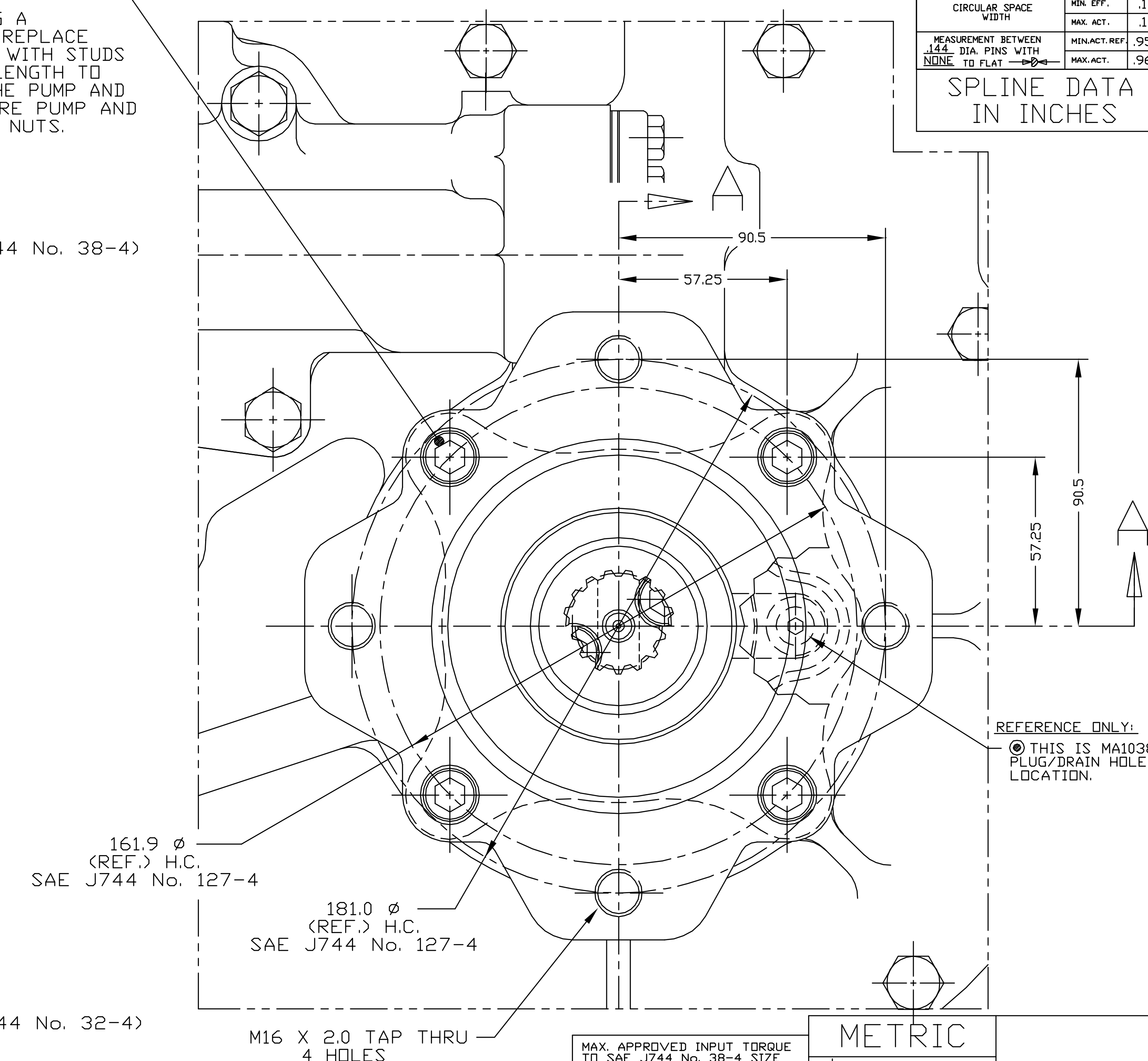
6.) INSTALL APPROPRIATE GASKET AND PUMP ONTO AUXILIARY PUMP CARRIER AND INTO SPLINED ADAPTER. TORQUE FASTENERS PER S574 (OR SERVICE MANUAL) VALUES.

INTERNAL SPLINE DATA (SEE S-435)		A
FLAT ROOT	PRESSURE ANGLE	30°
NUMBER OF TEETH 17	PITCH	12/24
PITCH DIA. (REF) 1.4167	FORM DIA. MIN.	1.504
MAJOR DIAMETER MAX.		1.535
CIRCULAR SPACE WIDTH	MIN. EFF.	.1327
	MAX. ACT.	.1345
MEASUREMENT BETWEEN .144 DIA. PINS WITH NONE TO FLAT	MIN.ACT.REF.	1.2052
	MAX.ACT.	1.2078

Ⓐ

INTERNAL SPLINE DATA (SEE S-435)		B
FLAT ROOT	PRESSURE ANGLE	30°
NUMBER OF TEETH 14	PITCH	12/24
PITCH DIA. (REF) 1.1667	FORM DIA. MIN.	1.254
MAJOR DIAMETER MAX.		1.283
CIRCULAR SPACE WIDTH	MIN. EFF.	.1317
	MAX. ACT.	.1334
MEASUREMENT BETWEEN .144 DIA. PINS WITH NONE TO FLAT	MIN.ACT.REF.	.9574
	MAX.ACT.	.9600

SPLINE DATA IN INCHES



▲ THIS PLUG IS USED ONLY FOR FACTORY INSTALLATIONS OF AN AUXILIARY PUMP DRIVE WITHOUT AUXILIARY PUMP INSTALLED.
START M1945T CUP PLUG INTO CARRIER BORE. APPLY A THIN BEAD OF ANEROBIC SEALANT M2828 TO PLUG O.D. PER S774 AND INSTALL PLUG FLUSH WITH REAR SURFACE OF CARRIER.

MAX. APPROVED INPUT TORQUE TO SAE J744 No. 38-4 SIZE PUMP ADAPTER IS 1,187 N m
MAX. APPROVED INPUT TORQUE TO SAE J744 No. 32-4 SIZE PUMP ADAPTER IS 592 N m
CONSULT SALES DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
C	D-3 E-3	ECN10163	6-5-01				
B	C-5 D-1	29757	12-1-99				
A	A5,6 D2,34	28159	10-21-97				

MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT kg | WR² N m²

FIRST USE
ASSY. 1017020
MODEL TDG-4406

NAME GROUP (AUXILIARY PUMP DRIVE)

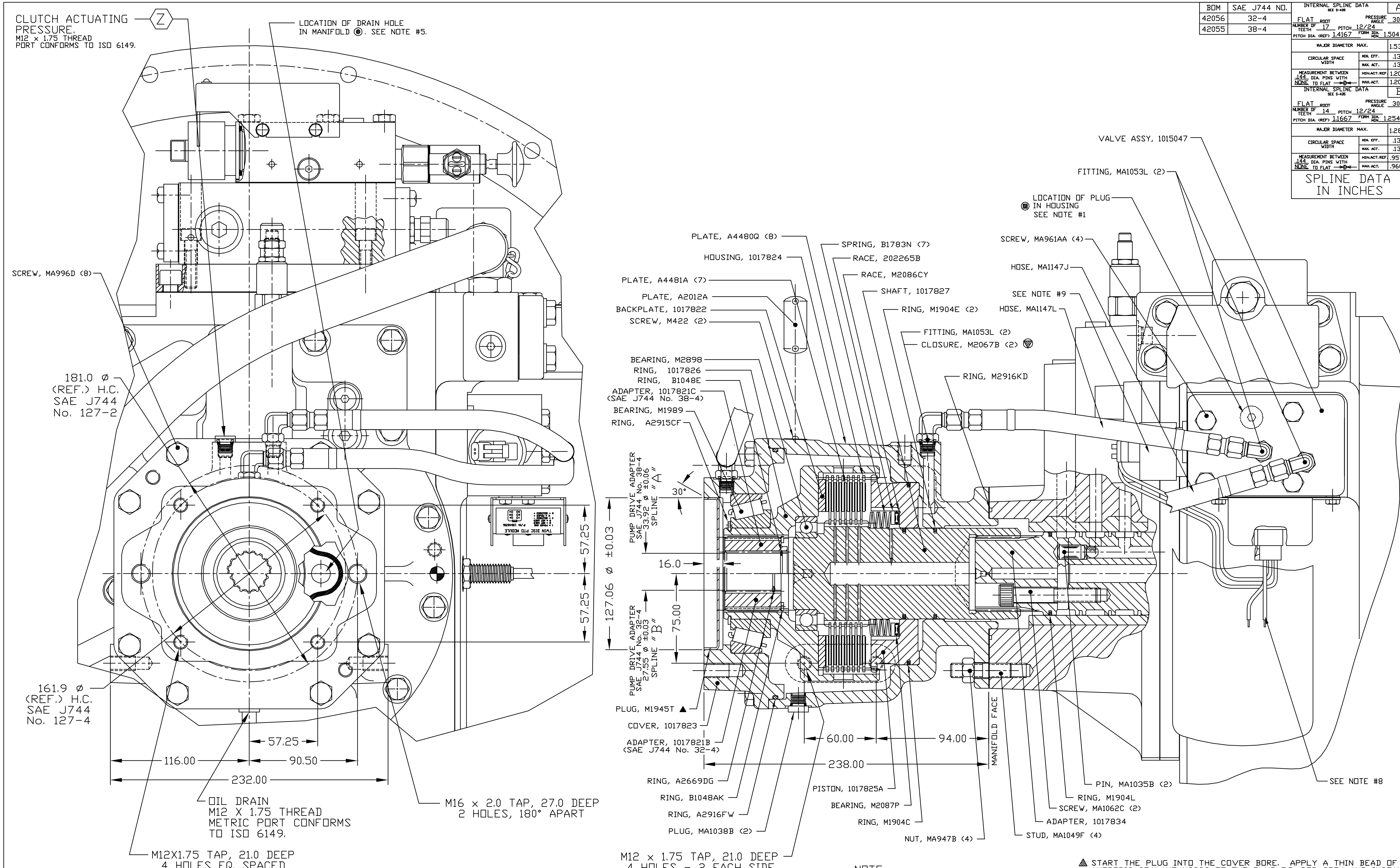
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 11-18-96
SCALE 1.00=1mm
DRN. AZ
CHK. ALC
APPD. DAS

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1017177

SHEET 1 OF 1 REV C



BOM	SAE J744 NO.
42056	32-4
42055	38-4

INTERNAL SPLINE DATA (SEE S-435)		A
FLAT ROOT; NUMBER OF TEETH 17; PITCH 12/24; PITCH DIA. (REF) 1.4167; PRESSURE ANGLE 30°; FORM DIA. MIN. 1.504		
MAJOR DIAMETER MAX.		1.535
CIRCULAR SPACE WIDTH	MIN. EFF.	.1327
	MAX. ACT.	.1345
MEASUREMENT BETWEEN .144 DIA. PINS WITH NONE TO FLAT	MIN.ACT.REF.	1.2052
	MAX.ACT.	1.2078

INTERNAL SPLINE DATA (SEE S-435)		B
FLAT ROOT; NUMBER OF TEETH 14; PITCH 12/24; PITCH DIA. (REF) 1.1667; PRESSURE ANGLE 30°; FORM DIA. MIN. 1.254		
MAJOR DIAMETER MAX.		1.283
CIRCULAR SPACE WIDTH	MIN. EFF.	.1317
	MAX. ACT.	.1334
MEASUREMENT BETWEEN .144 DIA. PINS WITH NONE TO FLAT	MIN.ACT.REF.	.9574
	MAX.ACT.	.9600

SPLINE DATA IN INCHES

P.T.O. INSTALLATION INSTRUCTIONS:

1.) REMOVE PLUG ▣ FROM HOUSING.

2.) PRESS THE (2) DOWEL PINS IN THE SHAFT UNTIL THE PINS PROTRUDE 9.0 FROM END OF SHAFT.

3.) ASSEMBLE THE PISTON RING INTO THE GROOVE OF THE ADAPTER AND INSTALL THE ADAPTER OVER THE DOWEL PINS IN THE SHAFT. FASTEN THE ADAPTER TO THE SHAFT WITH (2) CAPSCREWS AND TORQUE PER S574 (OR SERVICE MANUAL) VALUES.

4.) INSTALL THE (4) STUDS INTO THE MANIFOLD.

5.) INSTALL THE P.T.O. ASSEMBLY ONTO THE MANIFOLD SO THAT THE SLOT IN THE PTO HOUSING ALIGNS WITH THE DRAIN HOLE ◎ IN THE MANIFOLD. FASTEN WITH THE (4) NUTS AND TORQUE PER S574 (OR SERVICE MANUAL) VALUES.

6.) ASSEMBLE O-RINGS AND VALVE TO THE HOUSING WITH THE (4) SCREWS AND TORQUE PER S574 (OR SERVICE MANUAL) VALUES.

7.) REMOVE (2) CLOSURES, ASSEMBLE THE FITTINGS AND HOSES AS SHOWN.

8.) REFERENCE DRAWING 1015047 FOR CONTROL MODULE WIRING SCHEMATIC.

9.) WARNING: DO NOT CONNECT VALVE COIL DIRECTLY TO BATTERY/POWER SUPPLY VOLTAGE. VALVE COIL TO BE OPERATED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

NOTE:

USE ALL 4 HOLES FOR MOUNTING A CUSTOMER SUPPLIED SUPPORT BRACKET TO THE P.T.O. USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898-1 AND TORQUE TO S574 OR SERVICE MANUAL VALUES.

▲ START THE PLUG INTO THE COVER BORE. APPLY A THIN BEAD OF ANEROBIC SEALANT M2828 TO THE PLUG O.D. PER S774 AND INSTALL THE PLUG FLUSH WITH THE REAR SURFACE OF THE COVER.

APPLIES TO MODELS:
MG-5321DC - 1015339
MGX-6650SC - 1002046
MGX-6690SC - 1020674
MGX-6848SC - 1020675

MAX. APPROVED INPUT TORQUE TO SAE J744 No. 38-4 SIZE PUMP ADAPTER IS 1186 N-m

MAX. APPROVED INPUT TORQUE TO SAE J744 No. 32-4 SIZE PUMP ADAPTER IS 592 N-m

CONSULT SALES DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

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

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

WEIGHT 57 kg | WR² N.m² | FIRST USE ASSY. MODEL

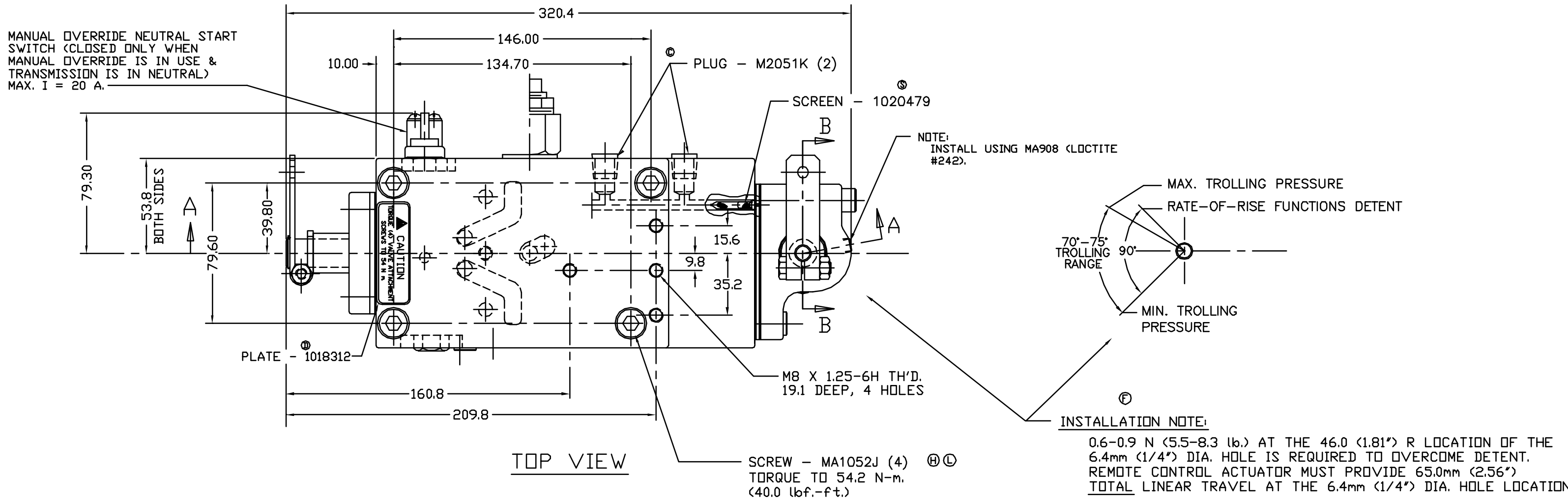
METRIC | THIRD ANGLE PROJECTION | MATERIAL | SIMILAR TO | HEAT TREAT | NAME P.T.O. ASSEMBLY

DATE 7-23-03 | SCALE 1.00=1.00 | DRN. D. MEYERS | CHK. ALC | APPD. ALC

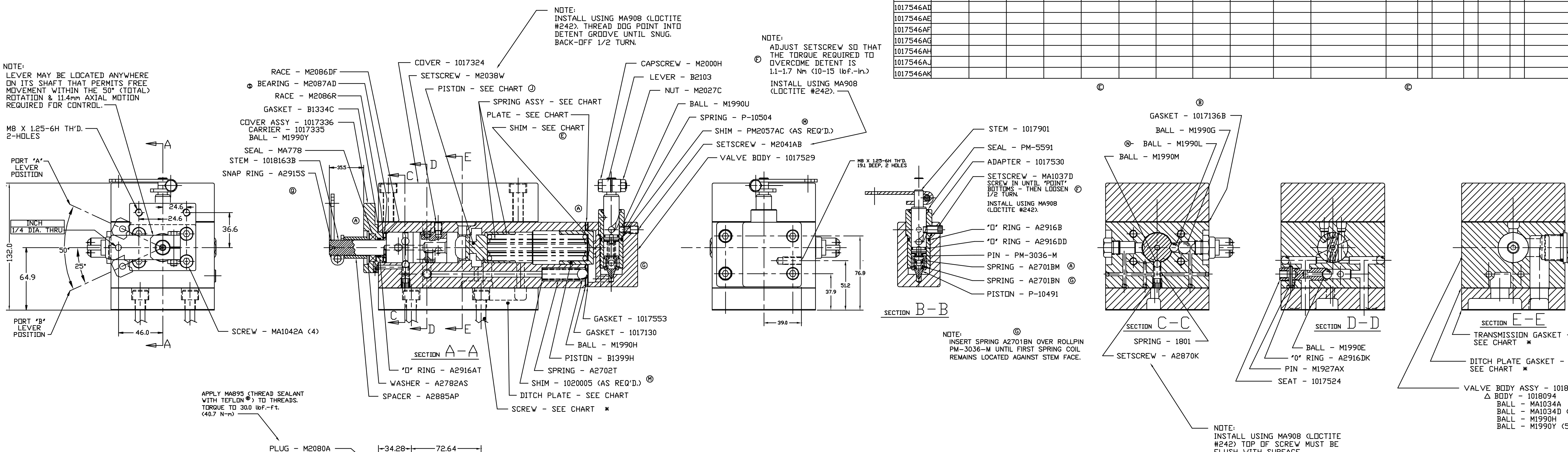
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

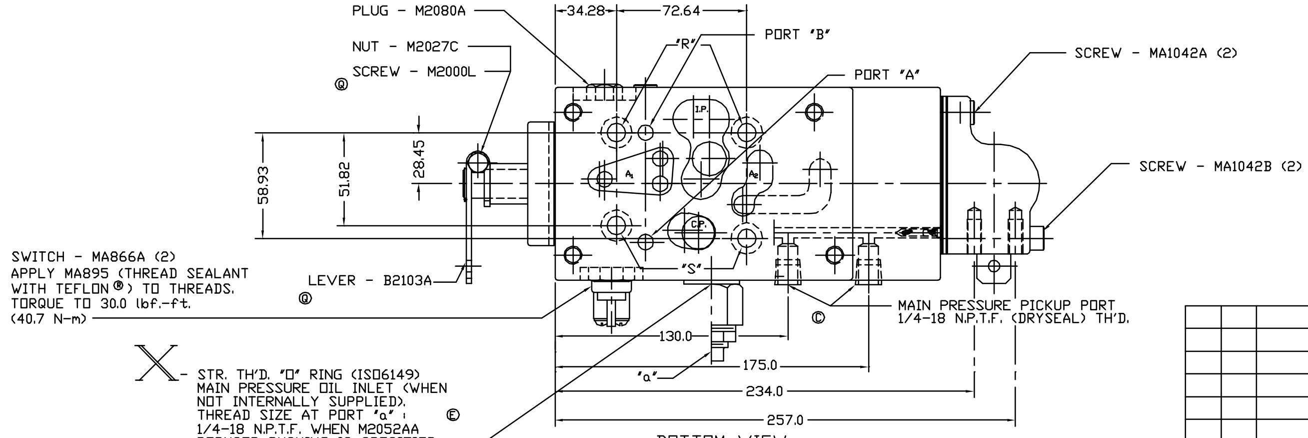
1017820E

DWG SIZE A0 | SHT. | REV



VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	PISTON	VALVE SPRINGS: SPRING ASS'Y	CONSISTS OF: OUTER	CONSISTS OF: INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	X	SHIMS: PART NO.	SHIMS: QTY.	MOUNTING SCREWS: "R" *	QTY.	"S" *	QTY.	FIRST USE	DATE AND APPR.
1017546	40767	------	1017383	------	1017179	------	A2707BD	A2704BU	2415 (350)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	------		------		MG-6619-00-RV	3-31-98 DAS/BJE
Ⓡ Ⓟ 1017546A	40769	1017133	1017134	B1337F	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052A	2	MA1052A	2	MG-5202DC	3-31-98 DAS/BJE
Ⓟ 1017546B		1018584	1018594	B3117A	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	M1732AH	2	M1732AH	2	MG-540	11-6-98 DAS/BJE
1017546C	40962	-------	1017383	-------	1017179	-------	A2707BD A2702BC	A2704BU	2655 (385)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	-----		-----		MG-6449	11-6-98 DAS/BJE
1017546D		-------	1017383	-------	1017179	-------	A2707AX A2702BC	A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	3	-----		-----		MG-6557	11-6-98 DAS/BJE Ⓜ
1017546E		-------	1017383	-------	1017179	-------	A2707AX A2702BC	A2704BU	2450 (355)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-6600 MG-6619	11-6-98 DAS/BJE
1017546F	41242	-------	-------	-------	1018688	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-5301DC	12/16/00 DAS/ALC
Ⓣ Ⓟ 1017546G	41254	-------	-------	-------	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-520-1HP	12/16/00 DAS/ALC
Ⓟ 1017546H	41325	-------	-------	-------	1017179	-------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-5141SC	3/28/00 DAS/ALC
1017546J																			
1017546K																			
1017546L																			
1017546M																			
1017546N																			
1017546P																			
1017546Q																			
1017546R																			
1017546S																			
1017546T																			
1017546U																			
1017546V																			
1017546W																			
1017546X																			
1017546Y																			
1017546Z																			
1017546AA																			
1017546AB																			
1017546AC																			
1017546AD																			
1017546AE																			
1017546AF																			
1017546AG																			
1017546AH																			
1017546AJ																			
1017546AK																			





A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

HYDRAULIC DIAGRAM A7119Y

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	ZONE	CH. NO.	DATE
T		ECN11492	5-28-03
S		ECN10415	1-11-02
R		ECN10465	10-26-01
Q		ECN10249	6-20-01
P		ECN10054	4-18-01
N	B-4 F-6	30462	11-16-00

MATERIAL ---------
HEAT TREAT ----------
SURFACE TREATMENT

WEIGHT kg | WR^2 N·m²

FIRST USE
ASSY. 1015207
MODEL MG-5202DC

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

NAME
VALVE ASS'Y. - CONTROL
(WITH TROLLING VALVE)

DATE 3-31-98
SCALE .50 = 1.00
DRN. RM
CHK. DAS
APPD. BJE

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1017546 SERIES

SHEET 1 OF 1 REV T

	VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	STEM	PISTON	VALVE SPRINGS: SPRING ASS'Y	VALVE SPRINGS: CONSISTS OF: OUTER	VALVE SPRINGS: CONSISTS OF: INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	X	SHIMS: PART NO.	SHIMS: QTY.	MOUNTING SCREWS: "R" *	QTY.	MOUNTING SCREWS: "S" *	QTY.	FIRST USE	DATE AND APPR.	
Ⓣ Ⓡ	1017172	40770	1017133	1017134	B1337F	1018163B	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052A	2	MA1052A	2	MG-5202DC	3-17-98 DAS/BJE	Ⓑ
	1017172A	40772	------	1017383	------	1018163B	1017179	------	A2707BD	A2704BU	2415 (350)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	------		------		MG-6619RV	3-17-98 DAS/BJE	
Ⓡ	1017172B	NOT YET AVAILABLE	1018584	1018594	B3117A	1018163B	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	M1732AH	2	M1732AH	2	MG-540	11-6-98 DAS/BJE	
	1017172C	41183	-------	1017383	-------	1018163B	1017179	-------	A2707BD A2702BC	A2704BU	2655 (385)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	5	-----		-----		MG-6449	11-6-98 DAS/BJE	
Ⓥ Ⓝ	1017172D	41511	-------	1017383	-------	1018163B	1017179	-------	A2707BD A2702BC	A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	4	-----		-----		MG-6557	11-6-98 DAS/BJE	
	1017172E	41866	-------	1017383	-------	1018163B	1017179	-------	A2707AX A2702BC	A2704BU	2450 (355)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-6600 MG-6619	11-6-98 DAS/BJE	
	1017172F	41060	1018885	1018594A	1018884	1018163C	1019791	XA2707AD	A2707AD	A2703AB	2000 (290)	1019786	MA1038E(M27 X 2.0-6H)	B2451B	2	MA1052C	2	MA1052C	2	1017820B HYDRAULIC PTO	3-18-99 BJE/DAS	Ⓚ
Ⓡ	1017172G	41074	1018914	1018594A	1017974	1018163C	1019791	XA2707AD	A2707AD	A2703AB	2000 (290)	1019786	MA1038E(M27 X 2.0-6H)	B2451B	2	MA1062Q	2	MA1062Q	2	1017820C HYDRAULIC PTO	4-15-99 BJE/DAS	Ⓚ
Ⓡ	1017172H	41085	1017133	1017134	B1337F	1018163B	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	M2089F	2	M2089F	2	MG-5112V	5-3-99 BJE/DAS	
	1017172J	41100	1017133	1017134	B1337F	1018163B	1018688	XA2707Z	A2707Z	A2703T	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	2	M2089F	2	M2089F	2	MG-5090A	5-27-99 BJE/DAS	
	1017172K	41136	-------	1018594A	-------	1018163C	1019791	-------	A2707AX A2702BC	A2704BU	2415 (350)	1019786	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		1017820C HYDRAULIC PTO	10-13-99 ALC/DAS	Ⓚ
Ⓤ Ⓡ Ⓛ	1017172L	41226	-------	-------	-------	1018163B	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-516	1-31-00 ALC/DAS	
Ⓦ Ⓡ □	1017172M	41257	-------	-------	-------	1018163B	1018688	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-520-1HP	2/16/00 ALC/DAS	
Ⓡ	1017172N	41306	-------	-------	-------	1018163B	1017179	-------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-5141SC	3/21/00 ALC/DAS	
	1017172P	41331	-------	-------	-------	1018163C	1019791	-------	A2707AD	A2703BA	1860 (270)	1019786	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		X7554B & C HYDRAULIC PTO	4/4/00 AZ/ALC	
	1017172Q	41577	-------	-------	-------	1018163B	1018688	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-6650SC	11/8/00 AZ/ALC	
Ⓣ	1017172R	41725	-------	1017134	-------	1018163B	1018688	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-5205DC	4/26/01 AZ/ALC	
	1017172S	41753	-------	-------	-------	1018163C	1019791	XA2707AD	A2707AD	A2703AB	2000 (290)	1019786	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		X7554B & C HYDRAULIC PTO	5/11/01 JR/ALC	
	1017172T	43678	-------	-------	-------	1018163B	1018688	-------	A2707BD A2702BC	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	-----		-----		MG-6848SC	7/12/05 WR/ALC	
	1017172U																					
	1017172V																					
	1017172W																					
	1017172X																					
	1017172Y																					
	1017172Z																					
	1017172AA																					
	1017172AB																					
	1017172AC																					
	1017172AD																					
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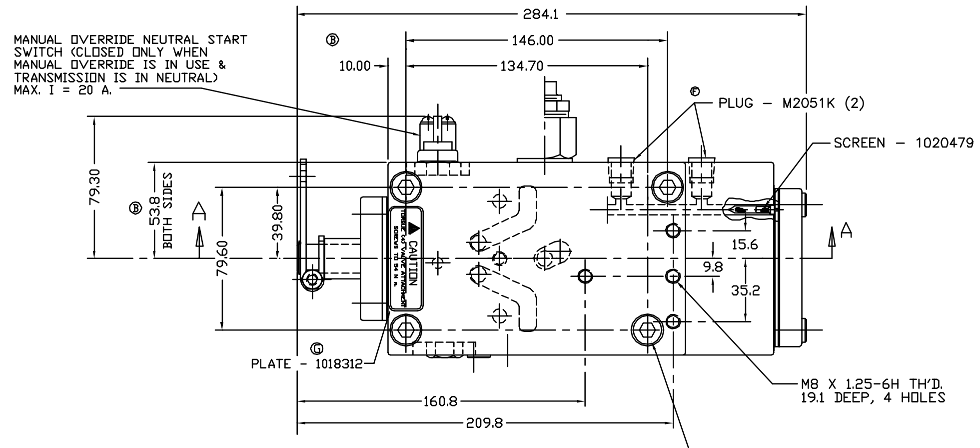
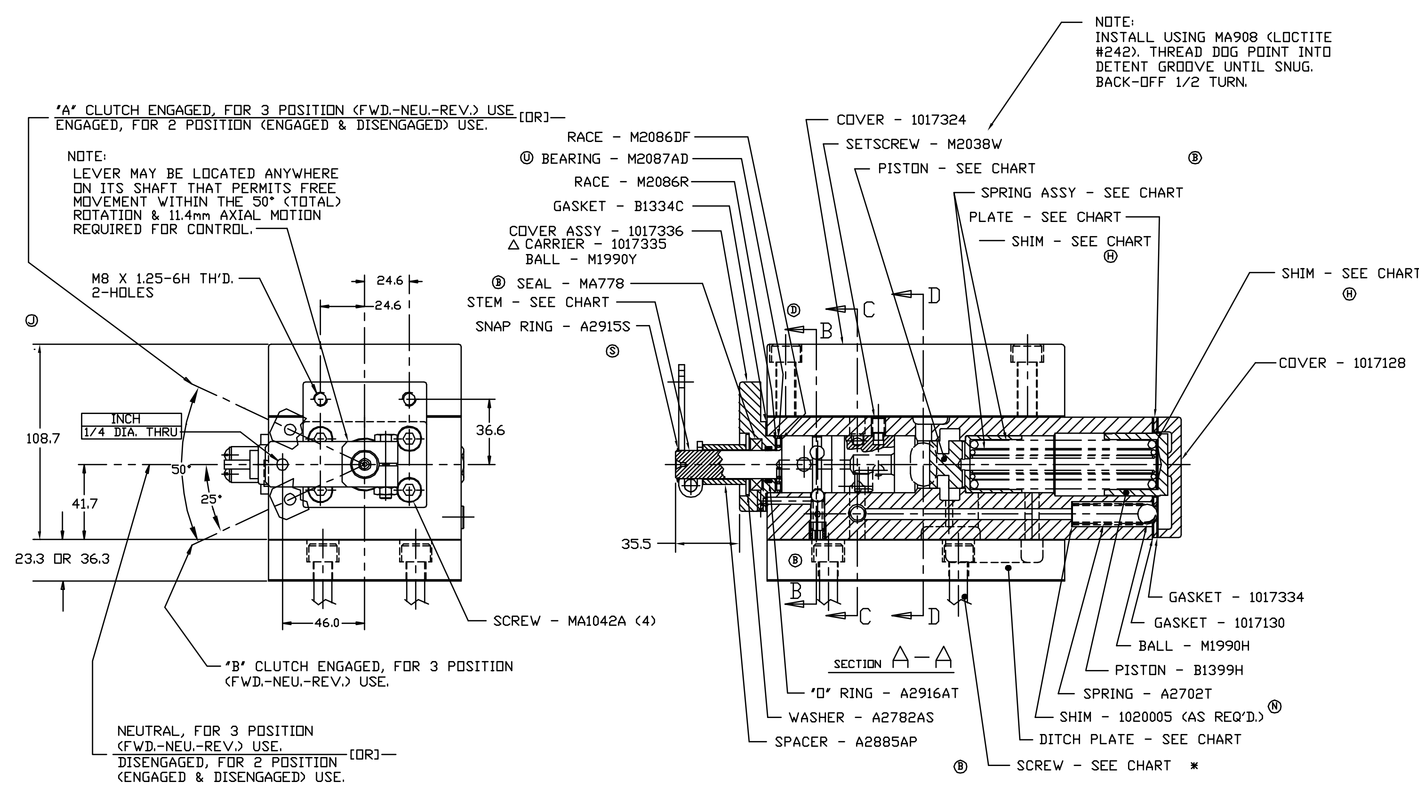
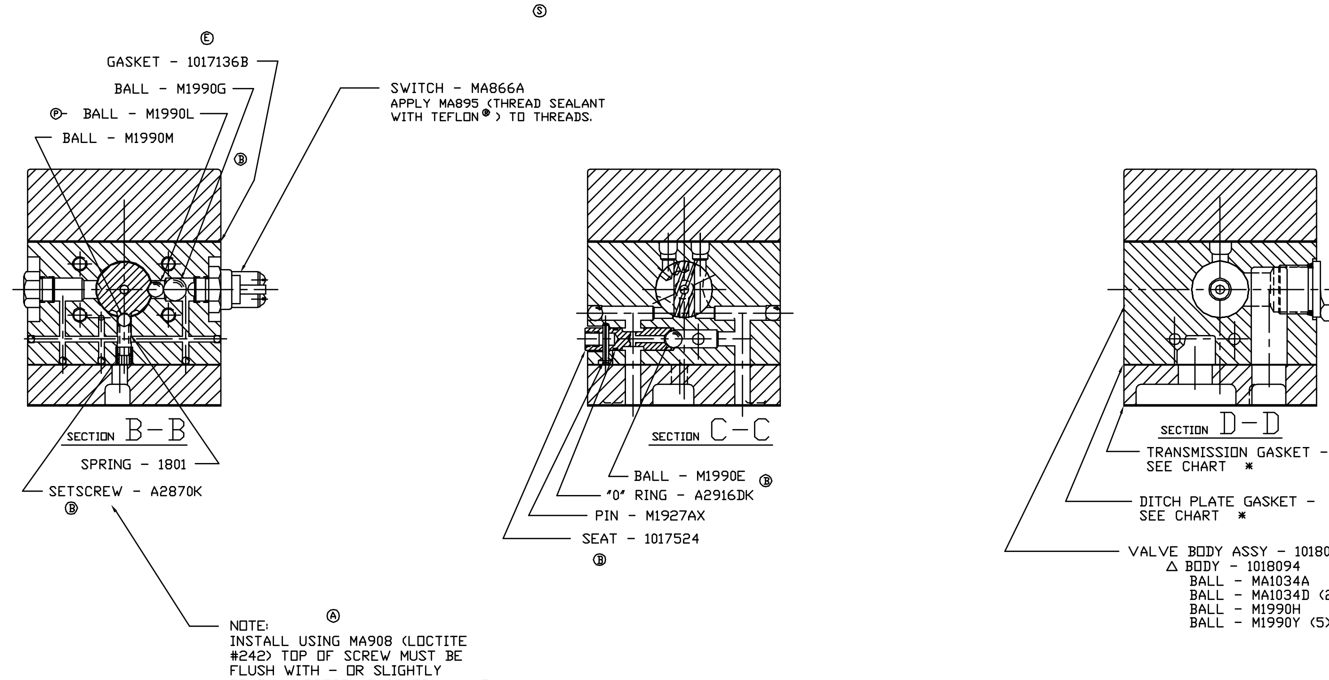
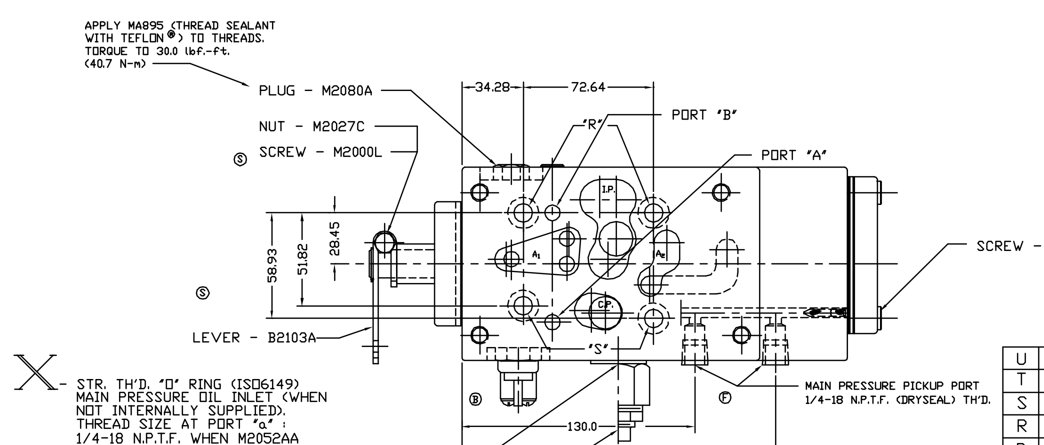
	1017172AJ																					
	1017172AK																					



TOP VIEW







BOTTOM VIEW

X - STR. TH'D. "O" RING (ISO6149) MAIN PRESSURE OIL INLET (WHEN NOT INTERNALLY SUPPLIED). THREAD SIZE AT PORT "a": 1/4-18 N.P.T.F. WHEN M2052AA REDUCER BUSHING IS SPECIFIED.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

Ⓦ □ OBSOLETE FOR PRODUCTION AND SERVICE

△ NOT SERVICEABLE SEPARATELY

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

HYDRAULIC DIAGRAM A7119Y ©

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
U		ECN10415	1-11-02				
T		ECN10465	10-26-01				
S		ECN10249	6-20-01				
R		ECN10054	4-18-01				
P	C-3 F-6	30462	11-16-00	W		ECN11492	5-28-03
N	B-6 D-3	30289	8-30-00	V		ECN10970	8-9-02

MATERIAL ---------
HEAT TREAT ----------
SURFACE TREATMENT

WEIGHT kg | WR^2 N·m²

FIRST USE
ASSY. 1015207
MODEL MG-5202DC

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

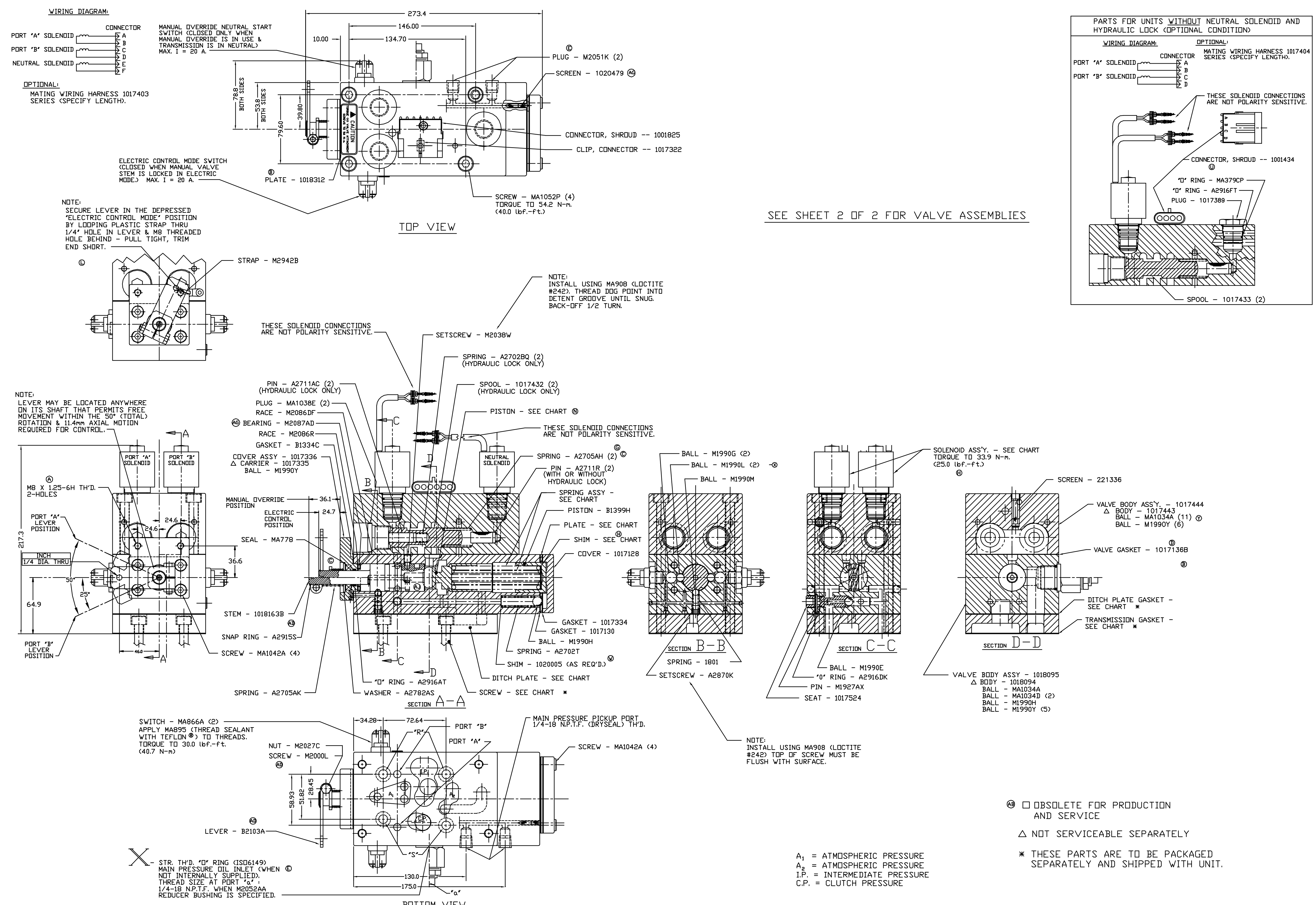
DATE 2-12-97
SCALE .50 = 1.00
DRN. RM
CHK. BE/RM
APPD. TBC

NAME
VALVE ASS'Y. - CONTROL (WITHOUT TROLLING VALVE)

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1017172 SERIES

SHEET 1 OF 1 REV W



OBSOLETE FOR PRODUCTION AND SERVICE

△ NOT SERVICEABLE SEPARATELY

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

HYDRAULIC DIAGRAM A7119W, SHEET 1 OF 2

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
					AJ	1		ECN11238	12-20-02
					AH	2		ECN10970	8-9-02
AL	2		ECN12514	6-23-04	AG	2		ECN10415	1-11-02
AK	2		ECN11492	5-28-03	AF	2		ECN10553	12-3-01

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS X. ±0.75, X.X ±0.25, X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

WEIGHT kg | WR² N.m² | FIRST USE: ASSY. 1015207, MODEL MG-5202DC

METRIC — THIRD ANGLE PROJECTION

MATERIAL: ---------
HEAT TREAT: ----------
SIMILAR TO:

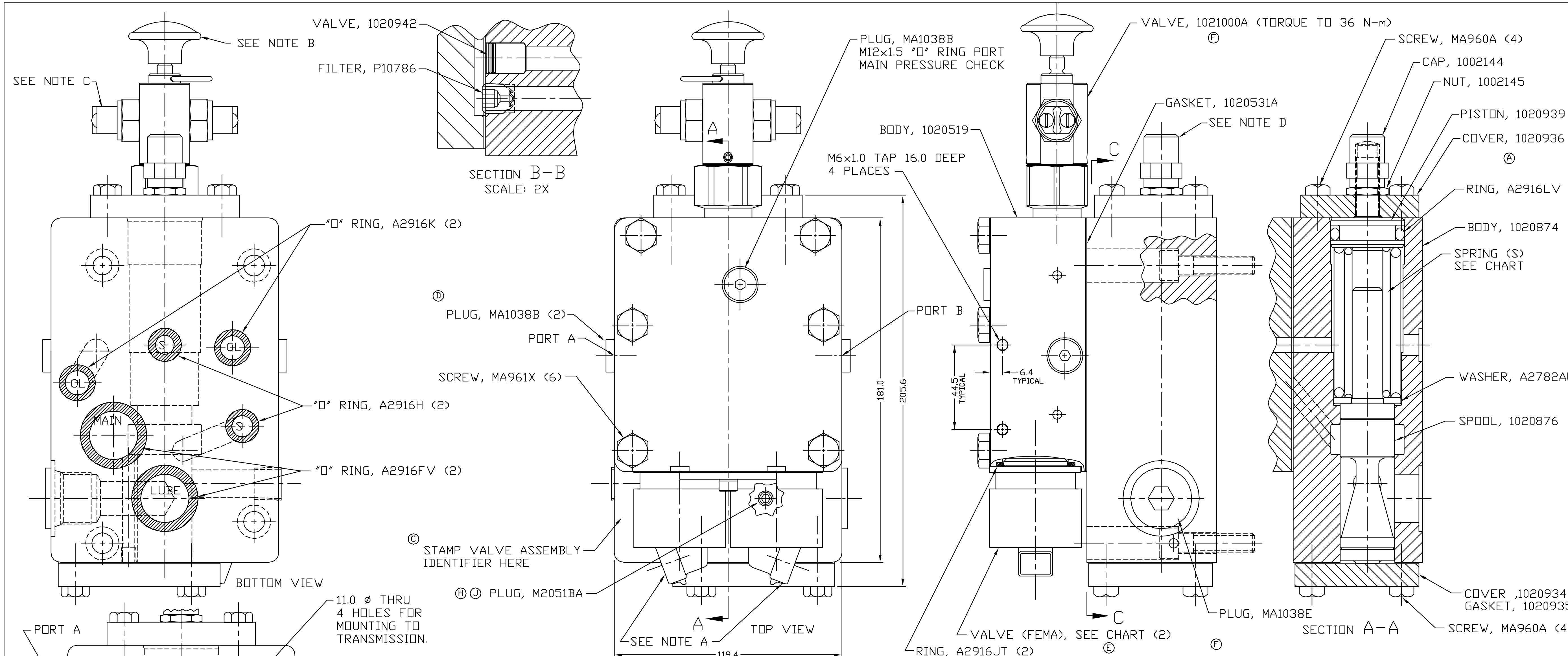
NAME: VALVE ASS'Y. - CONTROL (WITHOUT TROLLING VALVE)

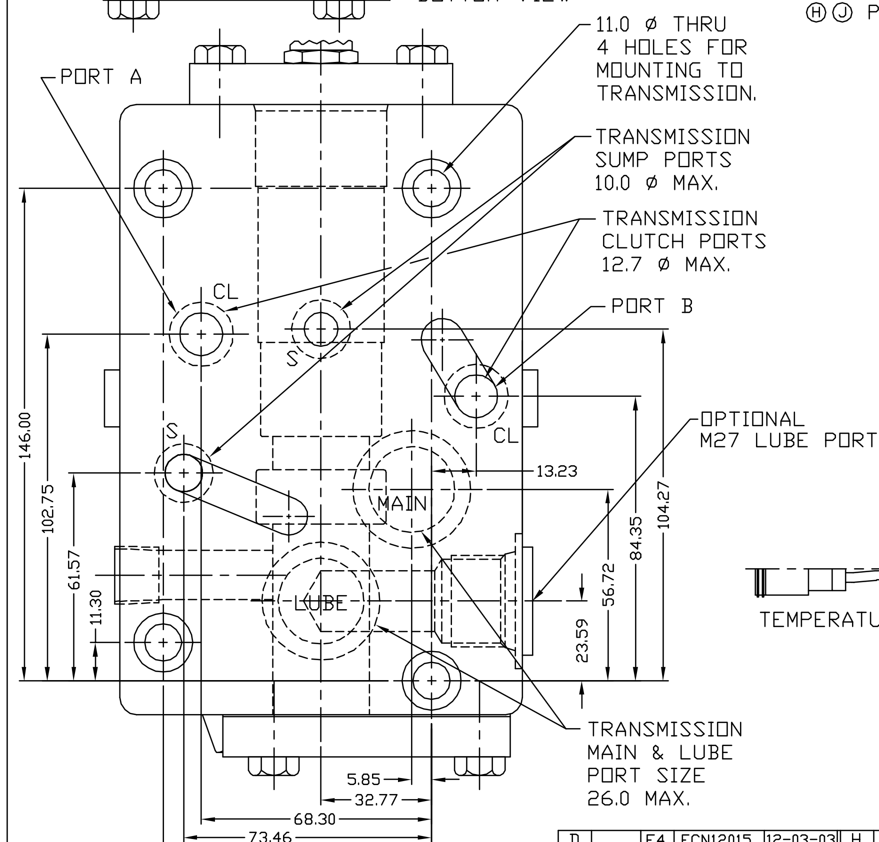
DATE 3-23-98 | SCALE .50 = 1.00 | DRN. RM | CHK. RM/BJE | APPD. DAS

TWIN DISC INCORPORATED, RACINE, WI 53403 - USA

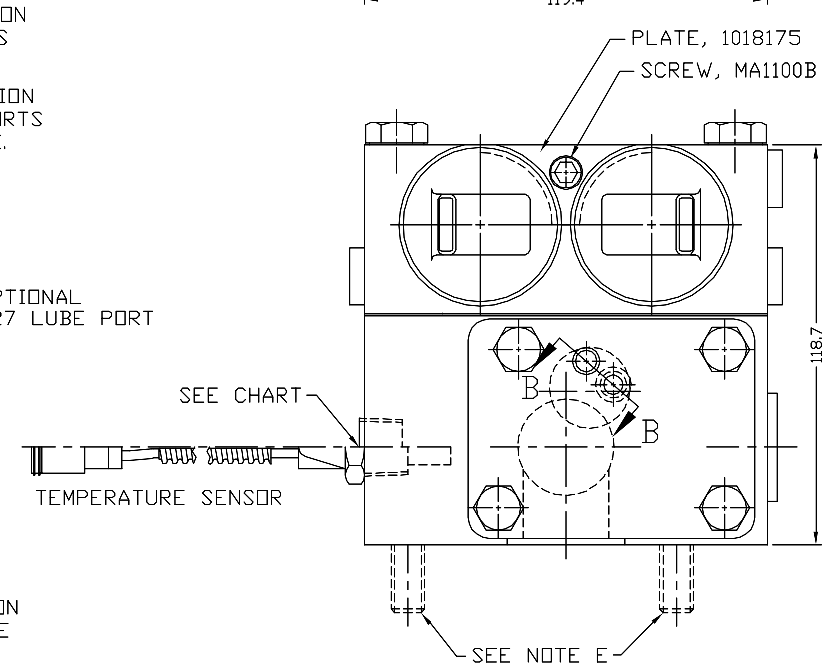
1018084 SERIES

DWG SIZE A1 | SHT. 1 OF 2 | REV AL





VIEW C-C SHOWING MOUNTING CONFIGURATION
MOUNTING SURFACE REQUIRES 0.8 FINISH



NOTES :

A. PROPORTIONAL CONTROL VALVE OPERATION
1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTERY/POWER SUPPLY VOLATAGE.
2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION
1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A"
2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B"

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH
1. SWITCHES ARE NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION.
2. CURRENT = 20 AMPS MAX.
3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR ADJUSTMENT
1. REMOVE 1002144 CAP AND LOOSEN 1002145 NUT.
2. CLOCKWISE ROTATION OF 1020939 PISTON INCREASES PRESSURE. COUNTER CLOCKWISE DECREASES PRESSURE.
3. LOCK PISTON IN PLACE USING JAM NUT AND REPLACE CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING AND SCREWS.

F: SERVICE KIT K1550: UPDATES LOWER VALVE BODY TO INCLUDE M2051BA ORIFICE TO ALLOW PUMP TO PRIME DURING INITIAL START-UP.

VALVE ASSEMBLY PART NO.	BOM	VALVE ASSEMBLY IDENTIFIER	PRESSURE (MPa)	SPRING(S)	TEMP. SENSOR	PLUG	PROPORTIONAL VALVE (PSI)
1020941A	42231	A	2.41 (350 PSI)	201341YX 201341YY	1016122A	——	1020520 (350)
1020941B	42605	B	1.72 (250 PSI)	201341YX	1016122A	——	1018528 (250)
1020941C	42618	C	2.00 (290 PSI)	201341YX 201341ZB	1016122A	——	1020520 (350)
1020941D	44074	D	2.41 (350 PSI)	201341YX 201341YY	——	M2051S	1020520 (350)
1020941E	44079	E	1.72 (250 PSI)	201341YX	——	M2051S	1018528 (250)
1020941F	44080	F	2.00 (290 PSI)	201341YX 201341ZB	——	M2051S	1020520 (350)

ADJUSTMENT TOOL: 1022474

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
D		E4	ECN12015	12-03-03	H		E4	ECN14111	5-2-06					
C		C1	ECN11978	11-18-03	G		C1	ECN14091	4-25-06					
B		C2	ECN11665	7-16-03	F			ECN12457	6-1-04					
A		A5	ECN11639	6-13-03	E			ECN12317	4-15-04	J			ECN14244	6-20-06

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 XX ±0.25 XXX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ASME Y14.5M 1994

FIRST USE 1020608 ASSY. MODEL MGX-6650SC

METRIC
THIRD ANGLE PROJECTION

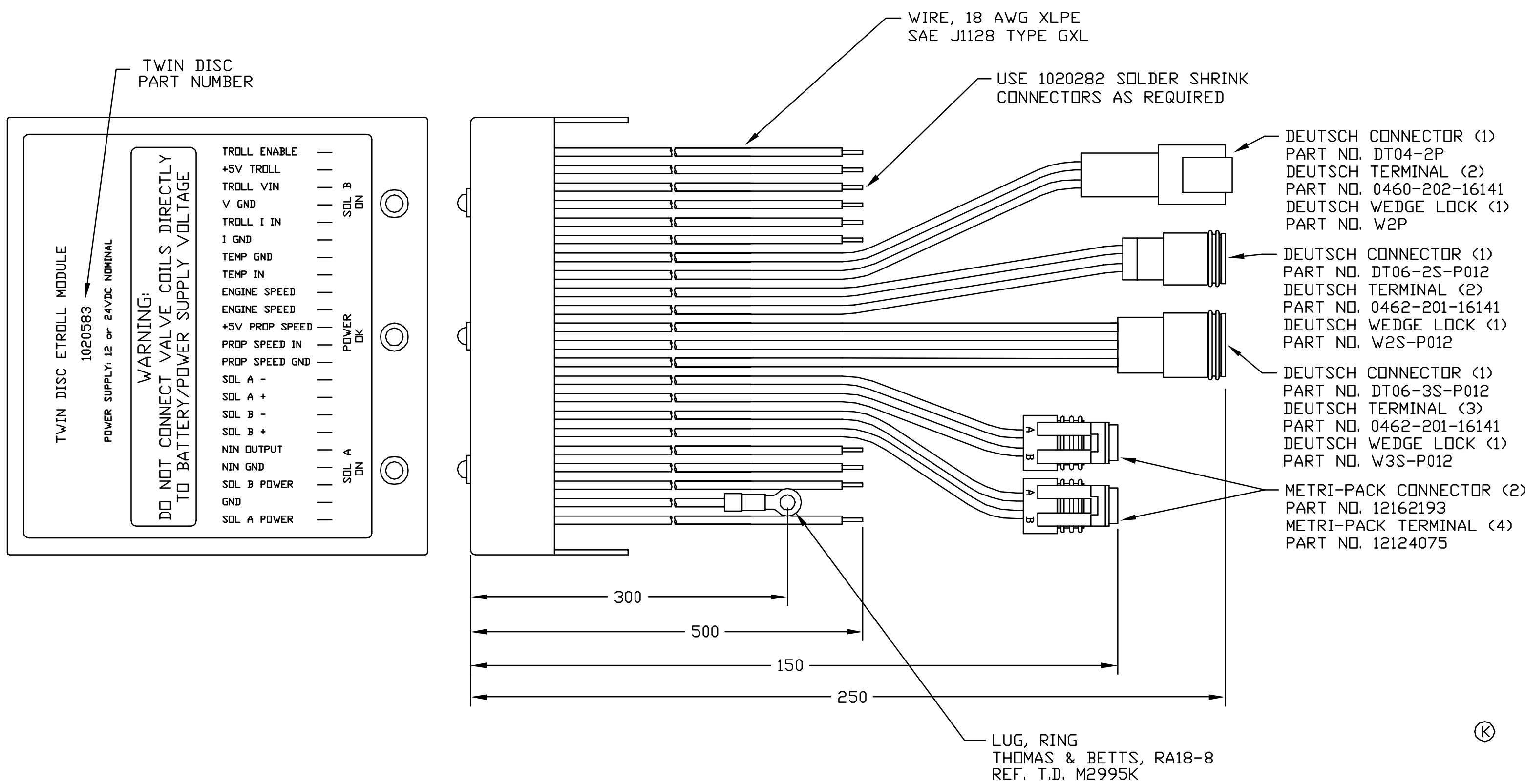
SIMILAR TO 1020526 EX8891-2 & 4

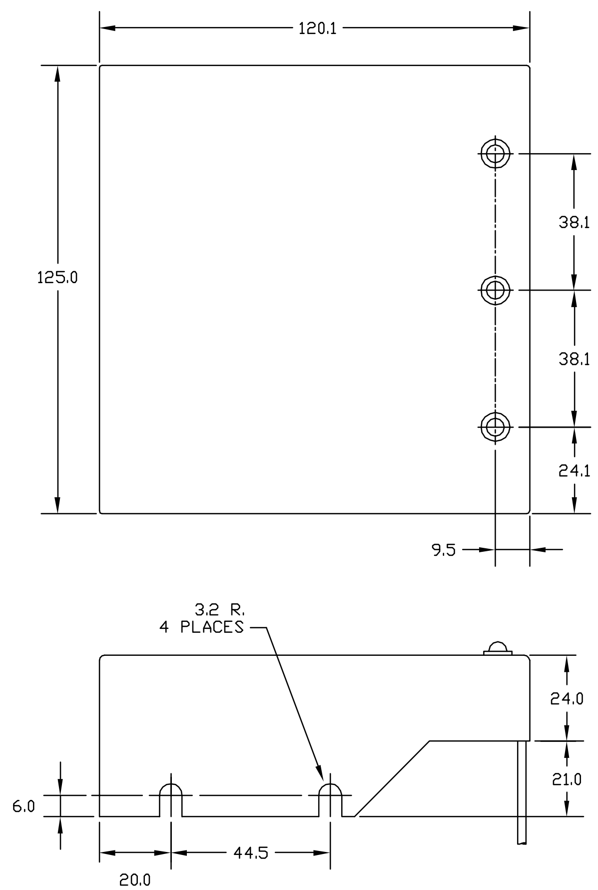
NAME VALVE ASSEMBLY (GP VALVE)

DATE 5-15-03 | SCALE 1=1 | DRN. JM | CHK. GAM/ALC | APPD. GAM

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020941 SERIES
DWG SIZE A1 | SHT. 1 of 1 | REV J





LED INDICATORS

- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT, VALVE COIL LEADS SHORTED TOGETHER, OR LOW COIL CURRENT.
- RED LEDS FLASH SIMULTANEOUSLY AFTER ENTERING TROLL FROM NEUTRAL WITH BOTH VOLTAGE AND CURRENT TROLL SPEED SIGNALS PRESENT OR WHEN POWER IS APPLIED TO SOLENOID "A" AND "B" SWITCH INPUTS AT THE SAME TIME.
- RED ALTERNATELY FLASHING INDICATES EITHER OR BOTH SPEED SIGNALS MISSING

NOTE 1: WHEN TROLL SPEED CURRENT INPUT IS USED TO CONTROL TROLL SPEED, THE ORANGE AND GREEN TROLL SPEED POTENTIOMETER INPUT WIRES MUST BE ELECTRICALLY CONNECTED TOGETHER WITH A SOLDER SHRINK CONNECTOR AND SECURED. THE RED WIRE MUST BE INSULATED AND ALL 3 WIRES SECURED.

NOTE 2: WHEN TROLL SPEED VOLTAGE INPUT IS USED TO CONTROL TROLL SPEED, THE VIOLET AND GREEN WIRES MUST BE INSULATED AND SECURED.

NOTE 3: PROPELLER SPEED SENSOR MUST BE TWIN DISC SUPPLIED PART.

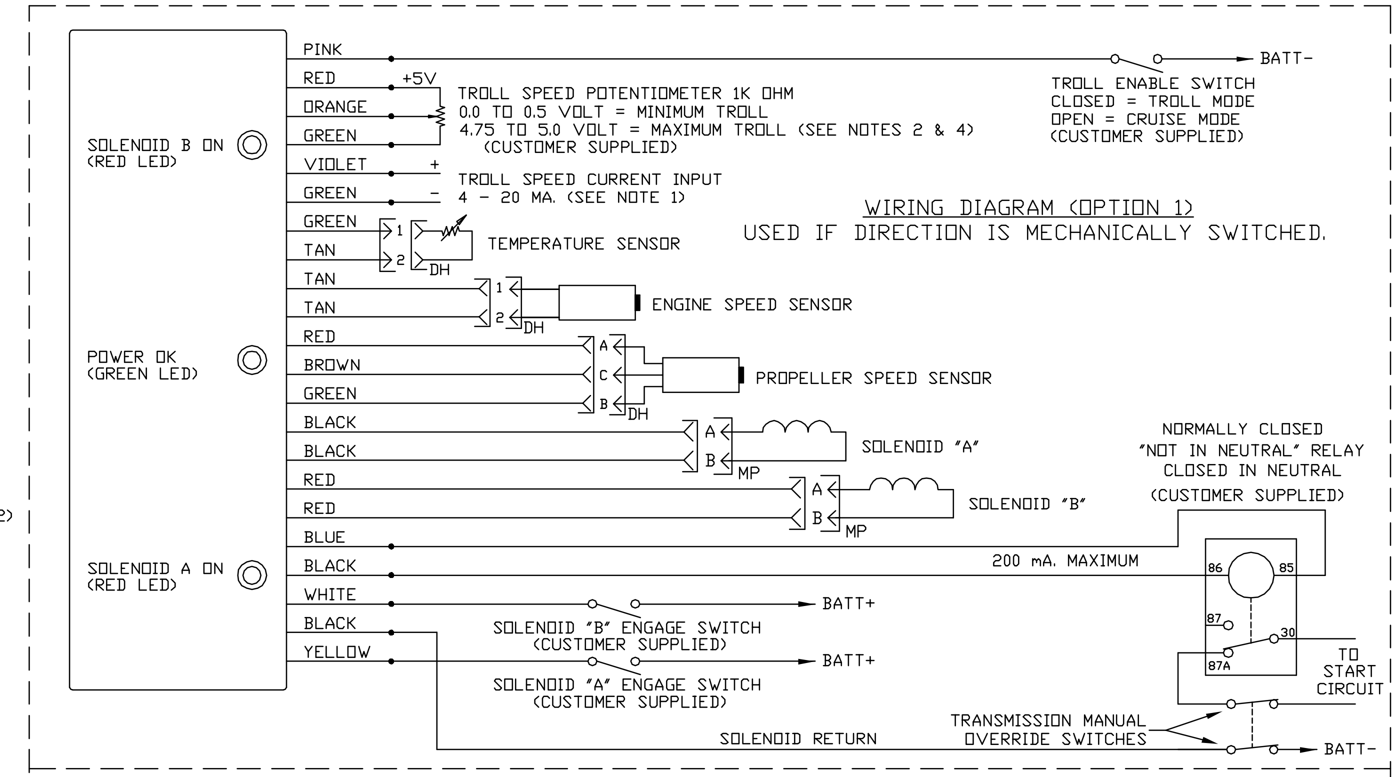
NOTE 4: TO INITIATE TROLL WITHOUT THE 0.5 VOLT DEAD BAND AT MINIMUM TROLL, ADD A 100 OHM RESISTOR BETWEEN THE POTENTIOMETER AND THE GREEN WIRE.

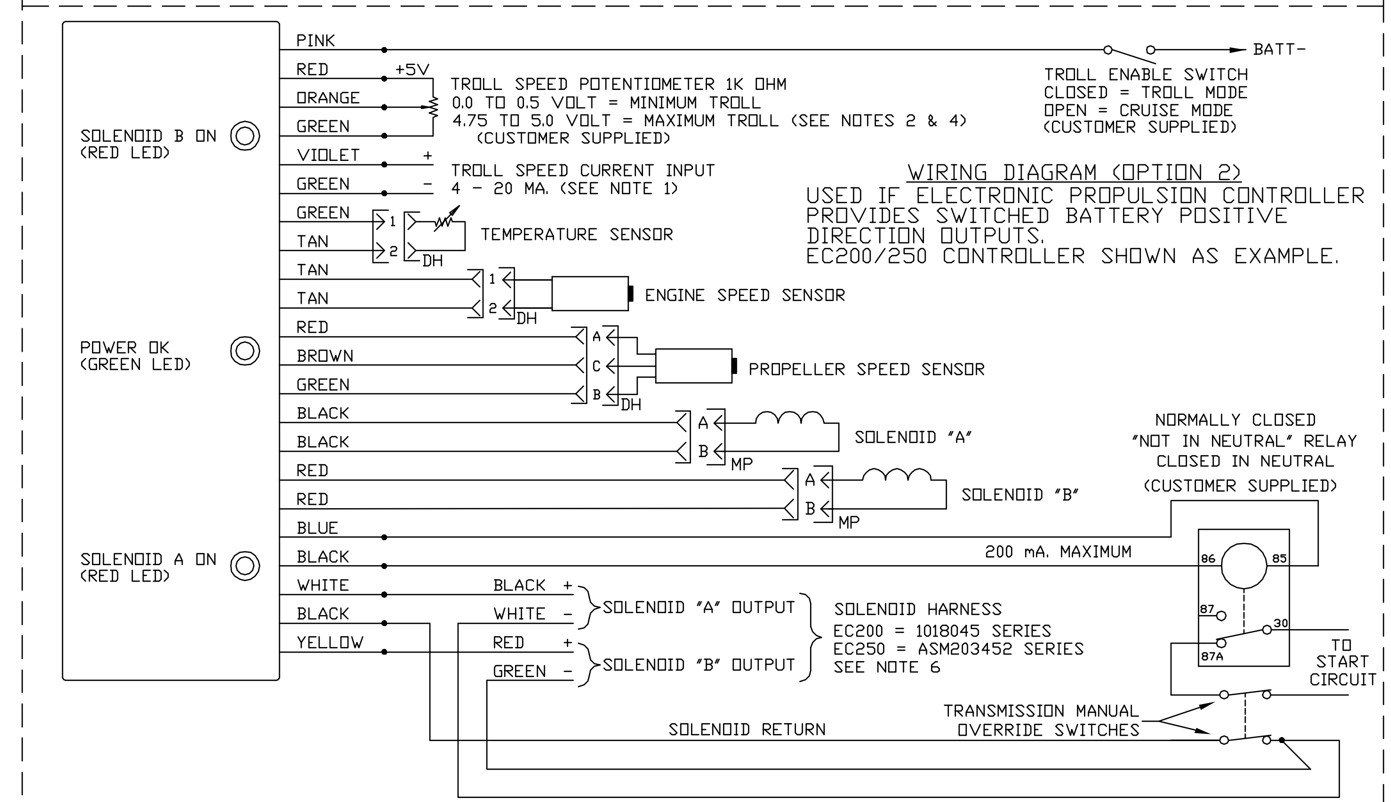
NOTE 5: WHEN THE "NOT IN NEUTRAL" CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLUE AND BLACK WIRES.

NOTE 6: REMOVE WEATHER PACK CONNECTOR FROM EC200/250 SOLENOID HARNESS. IF EC250, INSULATE AND SECURE THE BLUE AND BROWN WIRES OF THE ASM203452 HARNESS.

PART NO.	FACTORY SETTINGS
1020583	SEE PAGE 2
1020583A	
1020583B	
1020583C	
1020583D	

NOTE: FOR USE ON NOMINAL 12/24 VDC SYSTEMS.





WIRING DIAGRAM (OPTION 3)

USED IF ELECTRONIC PROPULSION CONTROLLER PROVIDES SWITCHED BATTERY NEGATIVE DIRECTION OUTPUTS. CONSULT TWIN DISC FOR MORE INFORMATION.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

• = WIRE SPLICE (TWIN DISC P/N 1020282)
DH = DEUTSCH CONNECTOR
MP = METRIPACK CONNECTOR

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
					F	1&2		ECN12521	6-30-04
					E	1&2		ECN11890	10-15-03
K	1		ECN13866	1-09-06	D	1&2		ECN11590	6-03-03
J	1		ECN13667	12-16-05	C	1&2		ECN11452	5-22-03
H	2	F6	ECN13131	3-23-05	B	1		ECN11523	4-29-03
G	2		ECN12835	11-15-04	A	1&2		ECN11418	4-22-03

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MATERIAL: SEE NOTE
HEAT TREAT
SURFACE TREATMENT
WEIGHT
FIRST USE
ASSY.
MODEL
NAME: CONTROL (MG ETROLL MODULE)

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

DATE 7-16-02
SCALE 1 = 1
DRN. W.Russell
CHK. R.N.Schenk
APPD. M.B.Gee

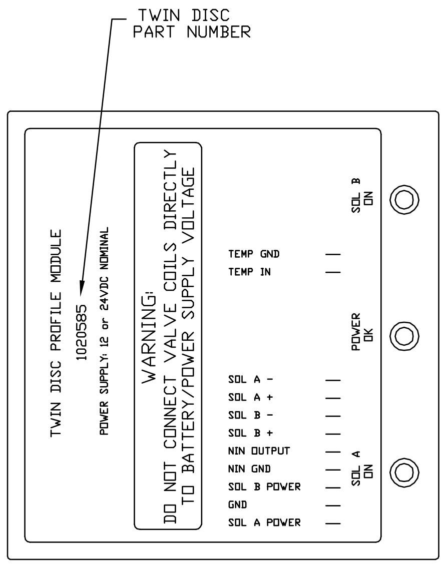
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

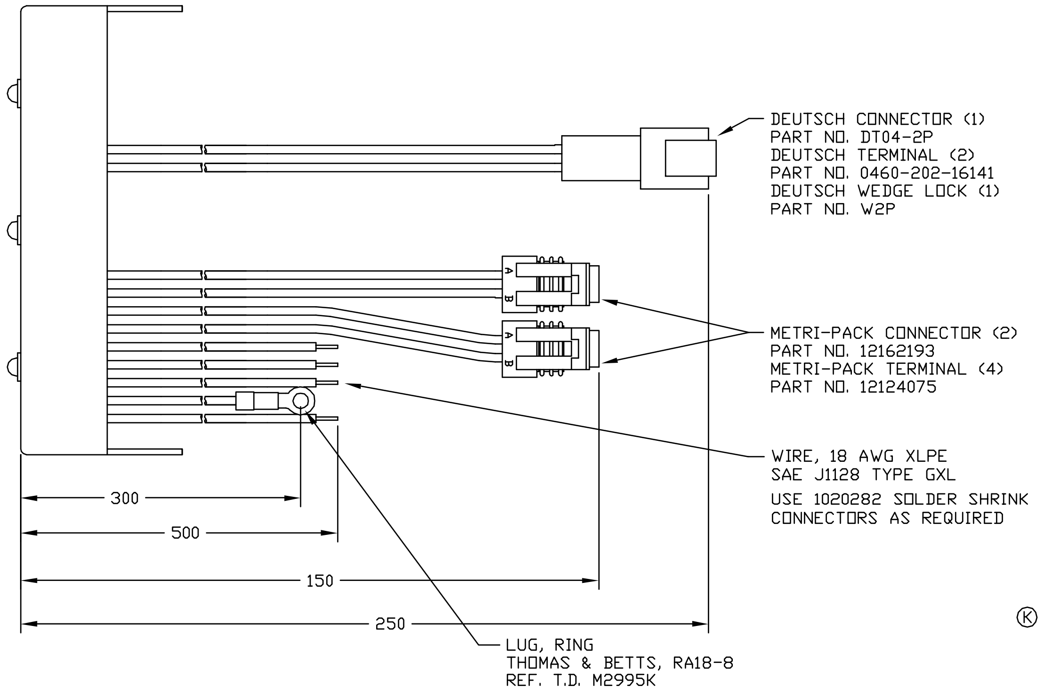
1020583 SERIES

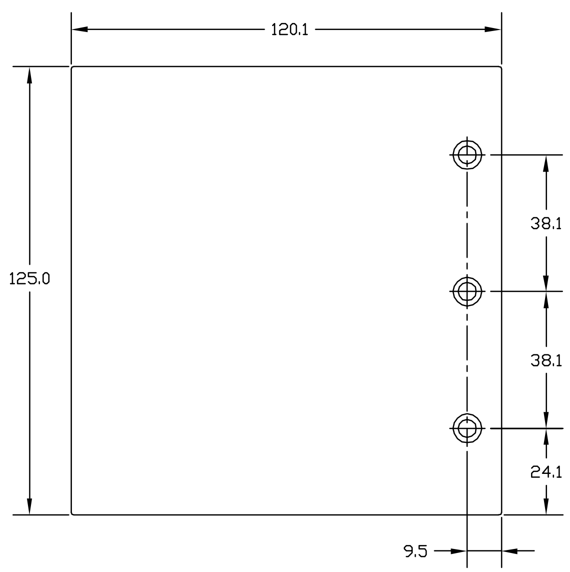
SHEET 1 OF 2 REV K

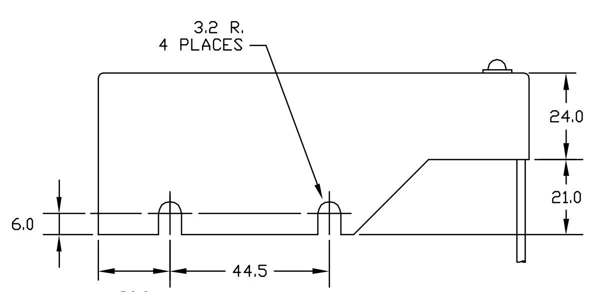
F E D C B A

6 5 4 3 2 1









LED INDICATORS

- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT, VALVE COIL LEADS SHORTED TOGETHER, OR LOW COIL CURRENT.
- RED LEDS FLASH SIMULTANEOUSLY WHEN POWER IS APPLIED TO SOLENOID "A" AND "B" SWITCH INPUTS AT THE SAME TIME.

NOTE 1: TEMPERATURE SENSOR MUST BE A TWIN DISC SUPPLIED PART.

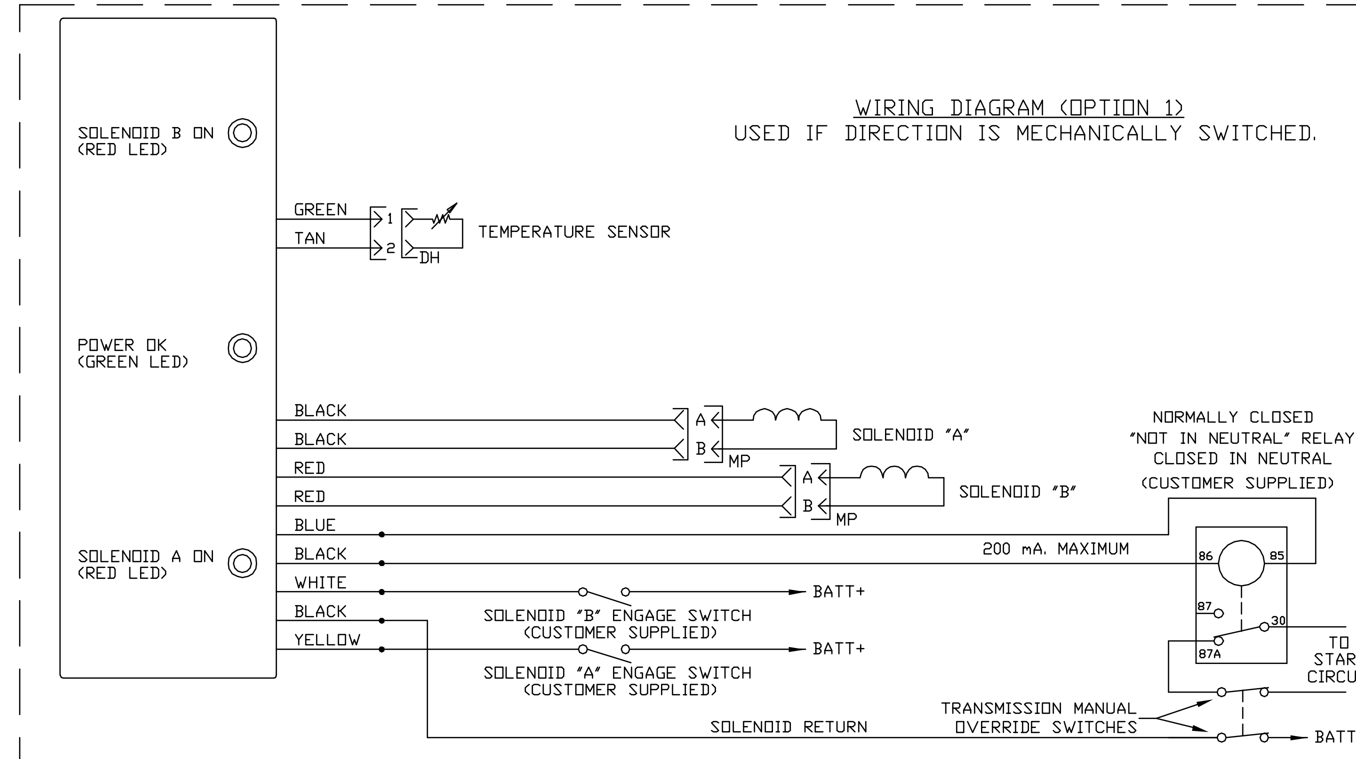
NOTE 2: WHEN THE "NOT IN NEUTRAL" CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLUE AND BLACK WIRES.

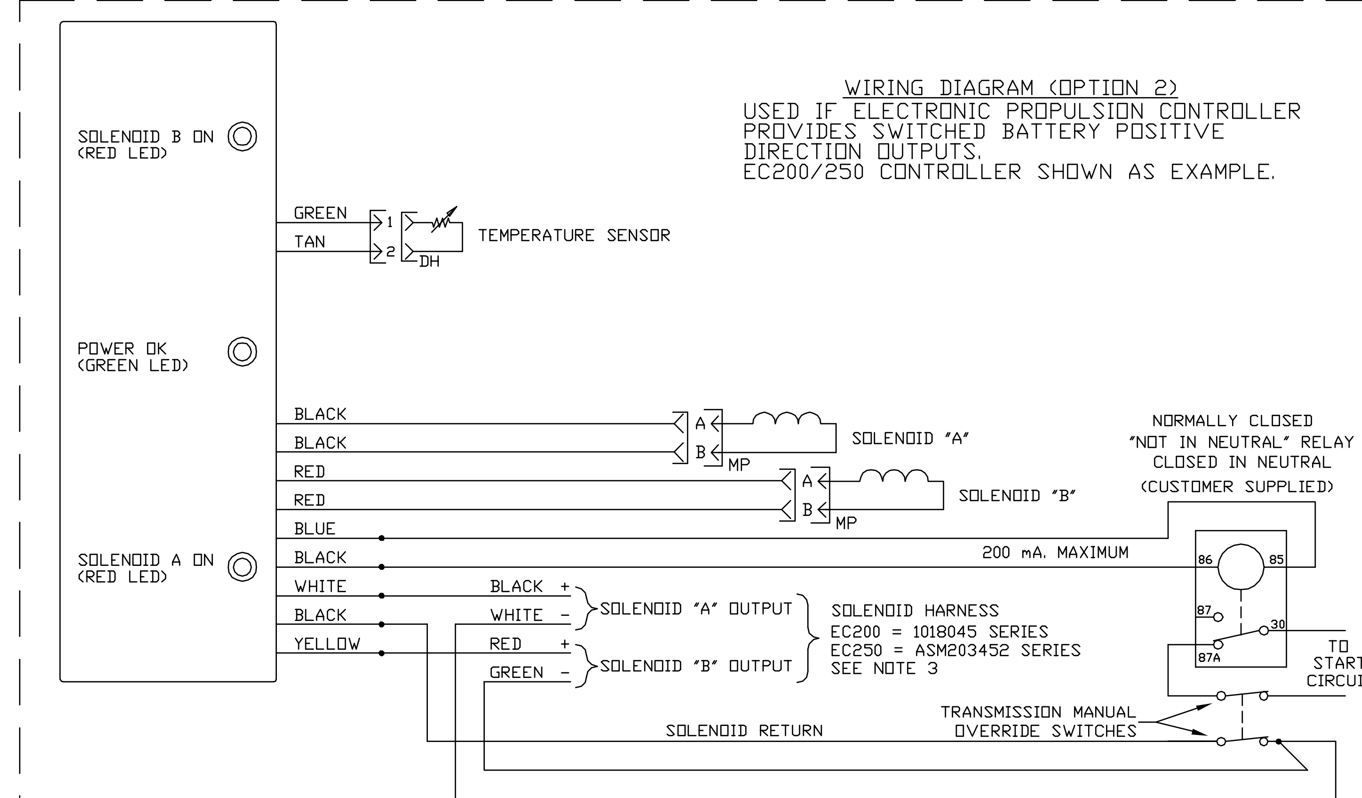
NOTE 3: REMOVE WEATHER PACK CONNECTOR FROM EC200/250 SOLENOID HARNESS. IF EC250, INSULATE AND SECURE THE BLUE AND BROWN WIRES OF THE ASM203452 HARNESS.

PART NO.	FACTORY SETTINGS
1020585	SEE PAGE 2
1020585A	
1020585B	

NOTE: FOR USE ON NOMINAL 12/24 VDC SYSTEMS.

- • = WIRE SPLICE PART # 1020282
- DH = DEUTSCH CONNECTOR
- MP = METRIPACK CONNECTOR





WIRING DIAGRAM (OPTION 3)

USED IF ELECTRONIC PROPULSION CONTROLLER PROVIDES SWITCHED BATTERY NEGATIVE DIRECTION OUTPUTS. CONSULT TWIN DISC FOR MORE INFORMATION.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
					F	2		ECN12835	11-15-04
					E	1 & 2		ECN12521	6-30-04
K	1		ECN13866	1-09-06	D	1 & 2		ECN11890	10-15-03
J	1		ECN13667	12-16-05	C	1 & 2		ECN11590	6-03-03
H	2	F6	ECN13131	3-23-05	B	1	F1	ECN11523	4-29-03
G	1	D5	ECN12974	1-14-05	A	1	F5	ECN11418	4-22-03

MATERIAL: SEE NOTE
HEAT TREAT:
SURFACE TREATMENT:
WEIGHT: kg | WR²: N·m²
FIRST USE / ASSY. / MODEL:
NAME: CONTROL (MG PROFILE MODULE)

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

DATE 2-25-03
SCALE 1 = 1
DRN. W.Russell
CHK. R.N.Schenk
APPD. M.B.Gee

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1020585 SERIES

SHEET 1 OF 2 REV K

#1022294 01/06

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