Service and Maintenance Manual

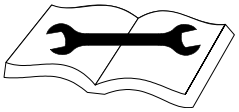
Model
800A
800AJ

Prior to S/N 0300183033

P/N - 3120740

December 18, 2015

ANSI



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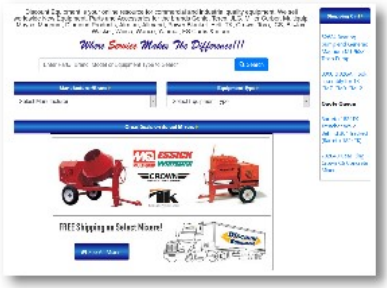

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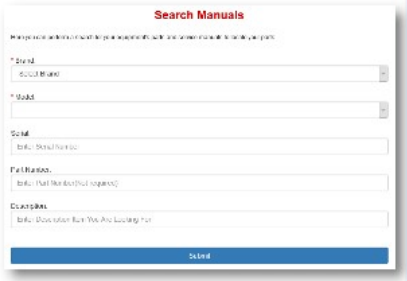

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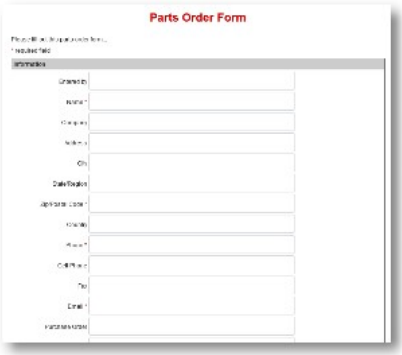

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

This section contains the general safety precautions which must be observed during maintenance of the aerial platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others, or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

⚠ WARNING

MODIFICATION OR ALTERATION OF AN AERIAL WORK PLATFORM SHALL BE MADE ONLY WITH WRITTEN PERMISSION FROM THE MANUFACTURER.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

⚠ WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBILITY OF THE OWNER/OPERATOR.

B HYDRAULIC SYSTEM SAFETY

It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Wear gloves to help protect hands from spraying fluid.

C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION COULD RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- ENSURE REPLACEMENT PARTS OR COMPONENTS ARE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICEMANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTEDDURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

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SECTION NO. TITLE PAGE NO.

SECTION 7 - ELECTRICAL INFORMATION & SCHEMATICS

TABLE NO.	*TITLE*	*PAGE NO.*

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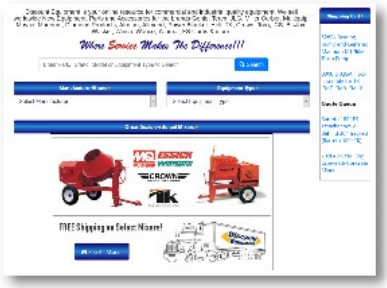

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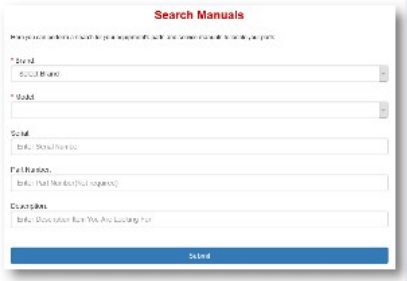

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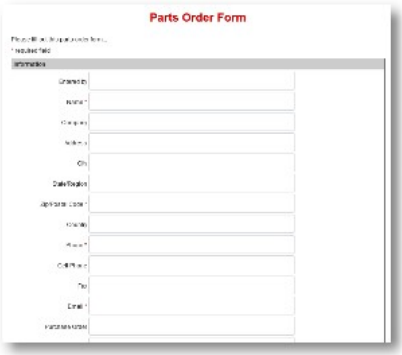

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SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

Travel Speed	
2WD	3.0 MPH (4.83 Km/hr.)
4WD	3.0 MPH (4.83 Km/hr.)
Gradeability	
2WD	30%
4WD	45%
Turning Radius (Outside)	
2WS	22 ft. 6 in. (6.86 m)
4WS	14 ft. 6 in. (4.42 m)
Turning Radius (Inside)	
2WS	12 ft. 0 in. (3.66 m)
4WS	11 ft. 0 in. (2.13 m)
Overall Width	8 ft. 0 in. (2.44 m)
Machine Height Stowed	9 ft. 9.5 in. (2.98 m)
Machine Length (Stowed)	
800A	36 ft. 9 in. (11.25 m)
800AJ	36 ft. 6 in. (11.13 m)
Wheel base	10 ft. 0 in. (3.05 m)
Boom Elevation - 800A	
Above Grade	+80 ft. 3 in. (24.46 m)
Below Grade	-15 ft. 7 in. (4.75 m)
Boom Elevation - 800AJ	
Above Grade	+80 ft. 3 in. (24.46 m)
Below Grade	-13 ft. 1 in. (3.99 m)
Max. Ground Bearing Pressure	84 psi. (5.9 kg/cm^2)
Max. Tire Load	17,755 lbs. (8053.53 kg)
Drive Speed (2WD)	
Forward	42 - 48 seconds for 200 ft
Reverse	42 - 48 seconds for 200 ft
Drive Speed (4WD)	
Forward	42 - 48 seconds for 200 ft
Reverse	42 - 48 seconds for 200 ft
Machine Weight approximately	
IN 385/65D 19.5 Pneumatic	34,200 lbs. (15520 kg)
15 X 19.5 Pneumatic	34,200 lbs. (15520 kg)
IN 445/55D 19.5	34,270 lbs. (15550 kg)
18 X 19.5 Pneumatic Tires	34,270 lbs. (15550 kg)
IN 385/65D 19.5	33,100 lbs. (15020 kg)
15 X 19.5 Foam Filled Tires	33,100 lbs. (15020 kg)
IN 445/55D 19.5	33,550 lbs. (15220 kg)
18 X 19.5 Foam Filled Tires	33,550 lbs. (15220 kg)

Capacities

Table 1-2. Capacities

Fuel Tank	Approx. 40 Gal. (151.4 L)
Hydraulic Tank	Approx. 40 Gal. (151.4 L)
Hydraulic System (Including Tank)	77 Gal. (291.4 L)
Drive Hub* (Prior to S/N 0300083332)	17 ounces (0.5 L)
Drive Hub* (S/N 0300083332 to S/N 0300183033)	44 ounces (1.3 L)
Drive Brake (S/N 0300083332 to S/N 0300183033)	2.7 ounces (79.84 ml)
Engine Oil Capacity	
Ford	4.5 Quarts (4.25 L) w/Filter
Deutz	
Cooling System	5 Quarts (4.73 L)
Crankcase	11 Quarts (10.4 L) w/Filter
Total Capacity	16 Quarts (15.14 L)
Caterpillar	10.6 Quarts (10 L)
Isuzu	8.5 Quarts (8.0 L)
GM	4.5 Quarts (4.25 L) w/Filter

NOTE: *Torque hubs should be one half full of lubricant.*

1.2 COMPONENT DATA

Engine Data

Table 1-3. Ford LRG-425 Specifications

Type	Water-cooled
Fuel	Gasoline
Oil Capacity	4.5 Quarts (4.25 L) w/Filter
Idle RPM	1000
Low RPM	1800
High RPM	2800
Alternator	95 Amp, Belt Drive
Fuel Consumption	
Low RPM	3.45 GPH (13.06 lph)
High RPM	4.60 GPH (17.41 lph)
Battery	1000 Cold Cranking Amps, 210 minute reserve Capacity, 12 VDC
Horsepower	74 @ 3000 RPM, full load
Cooling System	16 Quarts (15.14 L)
Spark Plug	AWSF-52-C
Spark Plug Gap	0.044 in. (1.117 mm)

Table 1-4. Deutz F4M2011F Specifications

Type	Liquid Cooled (Oil)
Fuel	Diesel
Oil Capacity Cooling System Crankcase Total Capacity	 5 Quarts (4.5 L) 11 Quarts (10.5 L) w/Filter 16 Quarts (15 L)
Idle RPM	1000
Low RPM	1800
High RPM	2800
Alternator	55 Amp, belt drive
Fuel Consumption Low RPM High RPM	 1.90 GPH (7.19 lph) 2.50 GPH (9.46 lph)
Battery	1000 Cold Cranking Amps, 210 minutes Reserve Capacity, 12 VDC
Horsepower	65 @ 2800 RPM, full load

Table 1-5. Deutz D2011L04 Specifications

Type	Liquid Cooled (Oil)
Fuel	Diesel
Oil Capacity Cooling System Crankcase Total Capacity	 5 Quarts (4.5 L) 11 Quarts (10.5 L) w/Filter 16 Quarts (15 L)
Idle RPM	1000
Low RPM	1800
High RPM	2600
Alternator	55 Amp, belt drive
Fuel Consumption	0.88 GPH (3.33 lph)
Battery	1000 Cold Cranking Amps, 210 minutes Reserve Capacity, 12 VDC
Horsepower	64 @ 2600 RPM, full load

Table 1-6. Caterpillar 3044C

Type	Four Stroke Cycle
Cylinders	4 in-line
Bore	3.70 inch (94 mm)
Stroke	4.72 inch (120 mm)
Aspiration	turbocharged
Compression ratio	19:1
Displacement	203 in^3 (3.33 L)
Firing Order	1-3-4-2
Rotation (viewed from flywheel)	Counterclockwise
Oil Capacity (w/filter)	10.6 Quarts (10 L)
Cooling System (Engine Only)	5.8 Quarts (5.5 L)
Idle RPM	1000
Low RPM	1800
High RPM	2800
Alternator	60 Amp, belt drive
Fuel Consumption	1.24 GPH (4.69 lph)

Table 1-7. Isuzu 4JB1

Type	Water-cooled
Oil Capacity (w/filter)	8.5 Quarts (8.0 L)
Cooling System (Engine Only)	5.8 Quarts (5.5 L)
Idle RPM	1000
Low RPM	1800
High RPM	2800
Alternator	55 Amp, belt drive
Battery	1000 Cold Cranking Amps, 210 minutes Reserve Capacity, 12 VDC
Horsepower	66 @ 2800 RPM, full load

Table 1-8. GM 3.0L

Fuel	Gasoline or Gasoline/LP Gas
No. of Cylinders	4
BHP Gasoline LP	 83 hp @ 3000 rpm 75 hp @ 3000 rpm
Bore	4.0 in. (101.6 mm)
Stroke	3.6 in. (91.44 mm)
Displacement	181 cu.in. (3.0 L, 2966 cc)
Oil Capacity w/filter	4.5 qts. (4.25 L)
Minimum Oil Pressure at idle Hot	 6 psi (0.4 Bar) @ 1000 rpm 18 psi (1.2 Bar) @ 2000 rpm
Compression Ratio	9.2:1
Firing Order	1-3-4-2
Max. RPM	2800
Fuel Consumption (Gas)	1.23 GPH (4.65 lph)

Tires

Table 1-9. Tire Specifications

Size	Type	Ply Rating	Load Range	Pressure
IN 385/65D 19.5	pneumatic	16	H	95 psi (6.5 bar)
IN 445/55D 19.5	pneumatic	16	H	85 psi (6.0 bar)
15 X 19.5	pneumatic	16	H	95 psi (6.5 bar)
18 X 19.5	pneumatic	16	H	85 psi (6.0 bar)
IN 385/65D 19.5	foam-filled	16	H	N/A
IN 445/55D 19.5	foam-filled	16	H	N/A
15 X 19.5	foam-filled	16	H	N/A
18 X 19.5	foam-filled	16	H	N/A

Drive System (Prior to S/N 0300083332)

Table 1-10. Drive System Specifications

Drive Motor Displacement 2WD 4WD	 2.75 cu. in. max. 1.1 cu. in. min. ($45\ cm^3$ max. $12\ cm^3$ min.) 2.75 cu. in. max. 1.1 cu. in. min. ($46\ cm^3$ max. $12\ cm^3$ min.)
Drive Hub Ratio. 2WD 4WD	 86.7:1 59.3:1
Drive Brake	Automatic spring applied, hydraulically released disc brakes.

Drive System (S/N 0300083332 to S/N 0300183033, S/N B300000100)

Table 1-11. Drive System Specifications

Drive Motor Displacement 2WD 4WD	 2.439 cu. in. max. 1.347 cu. in. min. (40 cc max. 22.09 cc min.) 2.13 cu. in. max. 0.63 cu. in. min. (35 cc max. 10.3 cc min.)
Drive Hub Ratio 2WD 4WD	 87:1 87:1
Drive Brake	Automatic spring applied, hydraulically released disc brakes.

Swing System

Table 1-12. Swing System Specifications

Swing Motor Displacement	4.9 cu. in. ($80\ cm^3$)
Swing Brake	Automatic spring applied hydraulically released disc brakes
Swing Hub Ratio	50:1

Hydraulic Drive Pump

Table 1-13. Hydraulic Drive Pump Specifications

Pump Output	35.5 GPM (134 lpm) @ 2800 RPM
Pump Displacement	2.8 cu. in. ($46\ cm^3$)
Charge Pump Displacement	0.85 cu. in. ($14\ cm^3$)
Charge Pump Output	9.5 GPM (37 ipm) @ 2800 RPM
Charge Pump Pressure	400 PSI. (27.5 Bar)@ 2800 RPM Clockwise Rotation

Variable Displacement Pump

Table 1-14. Variable Displacement Pump Specifications

Type	Variable, swashplate design
Nominal Pressure	3600 psi (248 bar)
Peak Pressure	4600 psi (317 bar)
Pump Circuit	Open
Displacement Vgmax	2.75 in^3 ($45\ cm^3$)
Pressure and Flow Control	DFR1
Rotation	Clockwise
NBR seals	Nitrile rubber to DIN ISO 1629
Shaft	SAE 1.00 in. (2.54 cm) splined

Hydraulic Load Sense Pump

Table 1-15. Hydraulic Load Sense Pump Specifications

Pump Displacement	2.1cu. in. (34.4 cm^3) Max.
Pump Output	15.5 GPM (59 lpm) @ 1800 RPM
Stand By Pressure	400 psi.(27.5 bar) @ 1800 RPM
High Pressure Relief	High Pressure Relief - 2700 PSI.(186 Bar)
Rotation	Clockwise

Auxiliary Power Pump

Table 1-16. Auxiliary Power Pump Specifications

Pump Output	2.1 GPM (9.5 lpm) @ 1400 psi. (69 bar)
Pump Displacement	0.305 cu. in. (5 cm^3)
Valving	Non-Adj. Unloader Preset to 230 psi Adjustable Relief Set at 1800 psi.
Motor	12 V.D.C. 2T Extended EMC Protected Intermittent Duty
Rotation	Counterclockwise

Hydraulic Filter - In-line

Table 1-17. Hydraulic FIlter Specifications

Return Filter	10 Microns Absolute
Charge Filter	10 Microns Absolute
Hydraulic Strainers (In Tank)	30 Microns

1.3 TORQUE REQUIREMENTS

Table 1-18. Torque Requirements

Description	Torque Value (Dry)	Interval Hours
Wheel Bolts	300 ft. lbs. (407 Nm)	150
Support to Rotator Bolts	50 ft. lbs. (68 Nm)	150
Rotator Center Bolt	480 ft.lbs. (651 Nm)	150
Swing Bearing Bolts	190 ft. lbs. (260 Nm)	50/600*
Starter or Aux Pump Solenoid Contacts Coil	 95 in. lbs. (10.5 Nm) 40 in. lbs. (4.5 Nm)	 As required
Oxygen Sensor (Ford Engine)	29.5-40 ft. lbs. (40-54 Nm)	At Installation
Megajector Mounting Bolts (Ford Engine)	60 in. lbs. (7 Nm)	As required
Lockoff Solenoid (Ford Engine)	8-12 ft.lbs. (11-16 Nm)	At Installation

*Check swing bearing bolts for security after first 50 hours of operation and every 600 hours thereafter. (See Swing Bearing in Section 3.)

NOTE: *When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.*

1.4 LUBRICATION

Hydraulic Oil

Table 1-19. Hydraulic Oil

Hydraulic System Operating Temperature Range	S.A.E. Viscosity Grade
+0° to + 180° F (-18° to +83° C)	10W
+0° to + 210° F (-18° to +99° C)	10W-20, 10W-30
+50° to + 210° F (+10° to +99° C	20W-20

NOTE: *Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity index of 152.*

NOTE: *When temperatures remain consistently below 20 degrees F. (-7 degrees C.), JLG Industries recommends the use of Mobil DTE13.*

Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Mobilfluid 424 is desired, contact JLG Industries for proper recommendations.

Table 1-20. Mobilfluid 424 Specs

SAE Grade	10W-30
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min.	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40° C	55 cSt
at 100° C	9.3 cSt
Viscosity Index	152

Table 1-21. Mobil DTE 13M Specs

ISO Viscosity Grade	#32
Specific Gravity	0.877
Pour Point, Max	-40°F (-40°C)
Flash Point, Min.	330°F (166°C)
Viscosity	
at 40° C	33cSt
at 100° C	6.6 cSt
at 100° F	169 SUS
at 210° F	48 SUS
cp at -20° F	6,200
Viscosity Index	140

Table 1-22. Mobil EAL 224H Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32/46
Specific Gravity	.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min.	428°F (220°C)
Operating Temp.	0 to 180°F (-17 to 162°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 40° C	37 cSt
at 100° C	8.4 cSt
Viscosity Index	213
NOTE: *Must be stored above 32°F (14°C)*	

Table 1-23. UCon Hydrolube HP-5046

Type	Synthetic Biodegradable
Specific Gravity	1.082
Pour Point, Max	-58°F (-50°C)
pH	9.1
Viscosity	
at 0° C (32° F)	340 cSt (1600SUS)
at 40° C (104° F)	46 cSt (215SUS)
at 65° C (150° F)	22 cSt (106SUS)
Viscosity Index	170

Table 1-24. Exxon Univis HVI 26 Specs

Specific Gravity	32.1
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40° C	25.8 cSt
at 100° C	9.3 cSt
Viscosity Index	376
NOTE: *Mobil/Exxon recommends that this oil be checked on a yearly basis for viscosity.*	

1.5 CYLINDER SPECIFICATIONS

Table 1-25. Cylinder Specifications - 800A

DESCRIPTION	BORE in.(mm.)	STROKE in.(mm.)	ROD DIA. in.(mm.)
Lower Left	8.00 (203.2)	49.38 (1254.1)	3.00 (76.2)
Tower Telescope	4.00 (101.6)	79.50 (2019.3)	2.50 (63.5)
Upright Level	8.00 (203.6)	42.00 (1066.8)	3.50 (88.9)
Upper Lift	8.00 (203.2	28.75 (730.3)	3.5 (88.9)
Upper Telescope	3.50 (88.9)	244.0 (6197.6)	2.75 (69.9)
Steer	3.00 (76.2)	10.75 (273.1)	1.50 (38.1)
Lockout	4.00 (101.6)	3.88 (98.4)	1.50 (38.1)
Master	2.50 (63.5)	18.50 (469.9)	1.25 (31.8)
Slave	3.50 (88.9)	8.94 (227.1)	1.75 (44.5)

Table 1-26. Cylinder Specifications - 800AJ

DESCRIPTION	BORE in.(mm.)	STROKE in.(mm.)	ROD DIA. in.(mm.)
Lower Left	8.00 (203.2)	49.38 (1254.1)	3.00 (76.2)
Tower Telescope	4.00 (101.6)	79.50 (2019.3)	2.50 (63.5)
Upright Level	8.00 (203.6)	42.00 (1066.8)	3.50 (88.9)
Upper Lift	8.00 (203.2)	28.75 (730.3)	3.5 (88.9)
Upper Telescope	3.50 (88.9)	206.5 (5245.1)	2.75 (69.9)
Steer	3.00 (76.2)	10.75 (273.1)	1.50 (38.1)
Lockout	4.00 (101.6)	3.88 (98.4)	1.50 (38.1)
Master	3.50 (88.9)	18.50 (469.9)	1.50 (38.1)
Slave	3.50 (88.9)	17.50 (444,5)	1.50 (38.1)
Lift (Jib)	3.00 (76.2)	25.50 (647.7)	1.50 (38.1)

1.6 MAJOR COMPONENT WEIGHTS

Table 1-27. Major Component Weights - 800A

MAJOR COMPONENTS	LBS.	KG.
Platform & Control Console	250	113
Upper Boom (Inc. Slave Cylinder Rotator, Support)	3185	1445
Upper Lift Cylinder	444.7	201.7
Main Telescope Cylinder	522	236.7
Upright	1175	535
Upright Level Cylinder	529.5	240.3
Tower Boom Complete	3450	1565
Tower Lift Cylinder	625	283.49
Tower Telescope Cylinder	232.5	105.4
Turntable Counterweight	4805	2180
Turntable Complete (Including Engine)	10625	4820
Chassis Complete (Pneumatic Tires)	13350	6060
Chassis Complete (Foam Filled Tires)	12220	5545
Machine Complete (GVW) w/ Pneumatic Tires	34200	15512.85
Machine Complete (GVW) w/ Foam Filled Tires	33100	15014
NOTE: *The above components are separate assemblies. example: "TURNTABLE COMPLETE" does not include booms, upright, lift cylinders or platform. The weights of these components must be added for the total weight.*		

Table 1-28. Major Component Weights - 800AJ

MAJOR COMPONENTS	LBS.	KG.
Platform & Control Console	250	113
Upper Boom (Inc. Slave Cylinder Rotator, And Support)	3185	1445
Upper Lift Cylinder	444.7	201.7
Main Telescope Cylinder	522	236.7
Upright	1175	535
Upright Level Cylinder	529.5	240.3
Tower Boom Complete	3450	1565
Tower Lift Cylinder	625	283.49
Tower Telescope Cylinder	232.5	105.4
Turntable Counterweight	4805	2180
Turntable Complete (Including Engine)	10625	4820
Chassis Complete (Including Pneumatic Tires)	13350	6060
Chassis Complete (Including Foam Filled Tires)	12220	5545
Machine Complete (GVW) w/ Pneumatic Tires	34200	15512.85
Machine Complete (GVW) w/ Foam Filled Tires	33100	15014

NOTE: *The above components are separate assemblies. example: "TURNTABLE COMPLETE" does not include booms, upright, lift cylinders or platform. The weights of these components must be added for the total weight.*

Critical Stability Weights

⚠ WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION (FOR EXAMPLE: BATTERIES, FILLED TIRES, COUNTER WEIGHT, ENGINE, AND PLATFORM) DO NOT MODIFY UNIT IN ANY WAY TO EFFECT STABILITY.

Table 1-29. Critical Stability Weights - 800A

COMPONENTS		LBS.	KG.
Tire & Wheel Size (Foam Filled Only)	15-625	544	247
	18-625	601	273
Engine	Ford	600	209
	Deutz	534	242
	Isuzu	463	210
	GM w/pumps	1030	468
Counterweight	Turntable	4805	2180
Wheel Hubs	Rear	218	99
	Front 2WD	210	99
	Front 4WD	218	99
Platform	6 FT. (1.83 M)	205	93
	8 FT. (2.44 M)	230	105

Table 1-30. Critical Stability Weights - 800AJ

COMPONENTS		LBS.	KG.
Tire & Wheel Size (Foam Filled Only)	15-625	544	247
	18-625	601	273
Engine	Ford	600	209
	Deutz	534	242
	Isuzu	463	210
	GM w/pumps	1030	468
Counterweight	Turntable	4805	2180
Wheel Hubs	Rear	218	99
	Front 2WD	210	99
	Front 4WD	218	99
Platform	6 FT. (1.83 M)	205	93
	8 FT. (2.44 M)	230	105

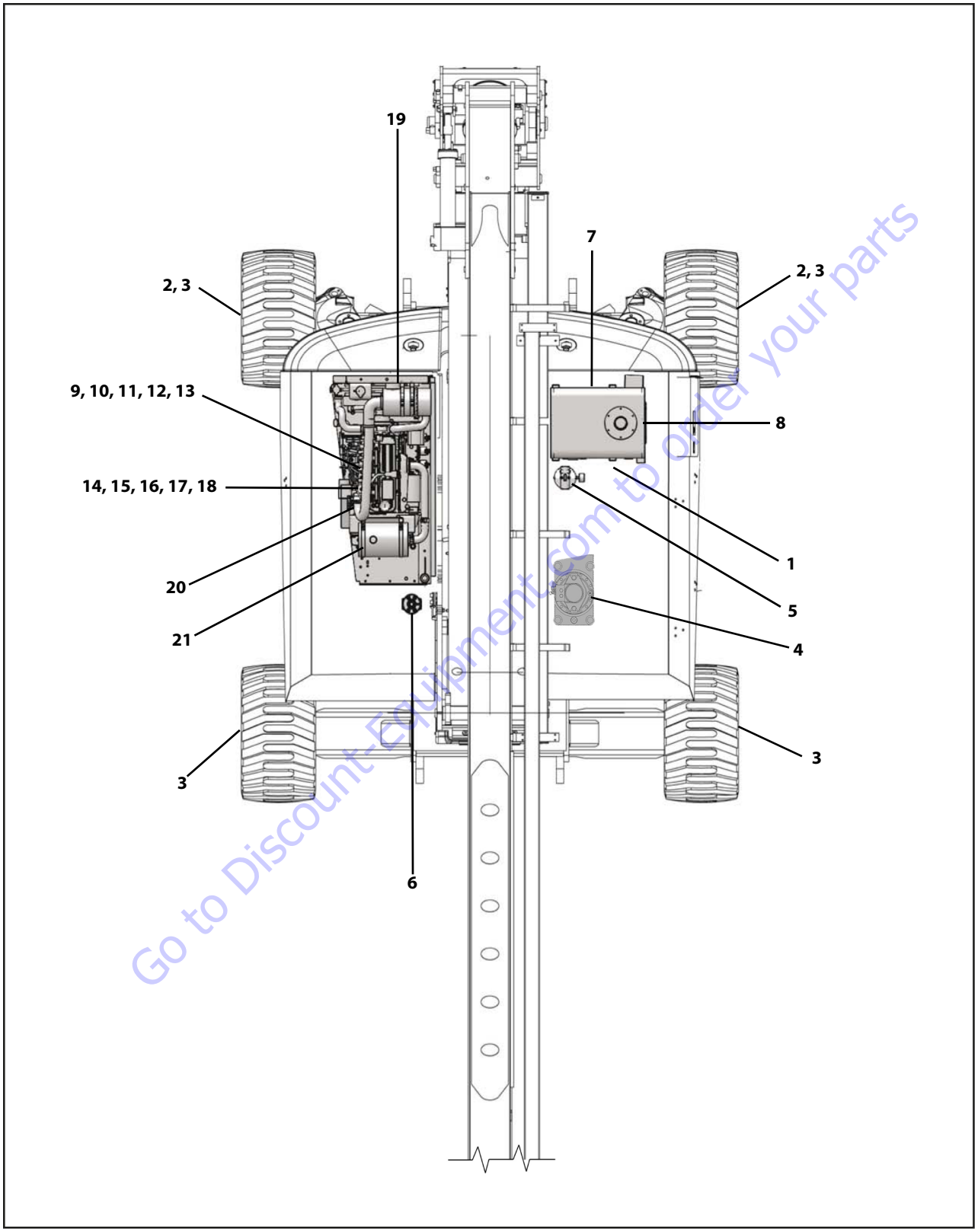


Figure 1-1. Maintenance and Lubrication Diagram

1.7 MAINTENANCE AND LUBRICATION

NOTE: *The following numbers correspond to those in Figure 1-1., Maintenance and Lubrication Diagram.*

Table 1-31. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350°F (177°C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobilfluid 424.
EO	Engine (crankcase) Oil. Gas - API SF, SH, SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

NOTICE

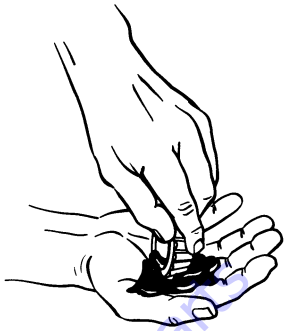
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

NOTE: *It is recommended as a good practice to replace all filters at the same time.*

1. Swing Bearing - Internal Ball Bearing

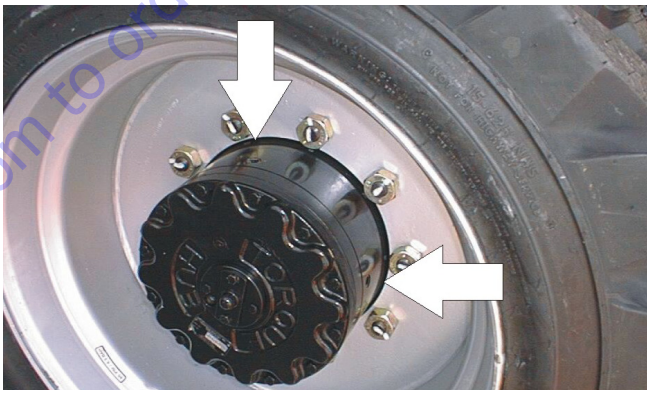
Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Access

2. Wheel Bearings



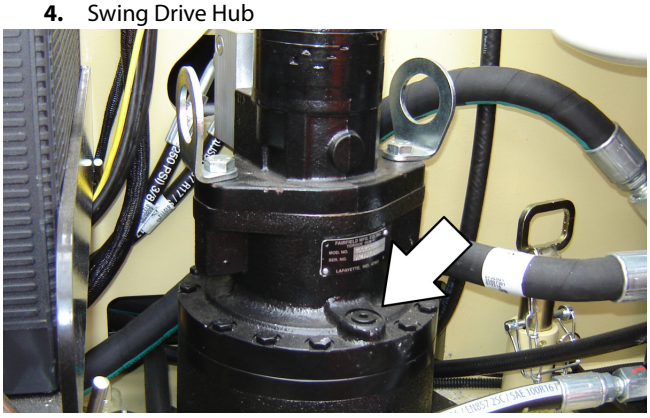
Lube Point(s) - Repack
Capacity - A/R
Lube - MPG
Interval - Every 2 years or 1200 hours of operation

3. Wheel Drive Hub



Lube Point(s) - Level/Fill Plug
Capacity - 17 oz. (0.5 L) - 1/2 Full
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation
Comments - Place Fill port at 12 o'clock position and Check port at 3 o'clock position. Pour lubricant into fill port until it just starts to flow out of check port.

4. Swing Drive Hub

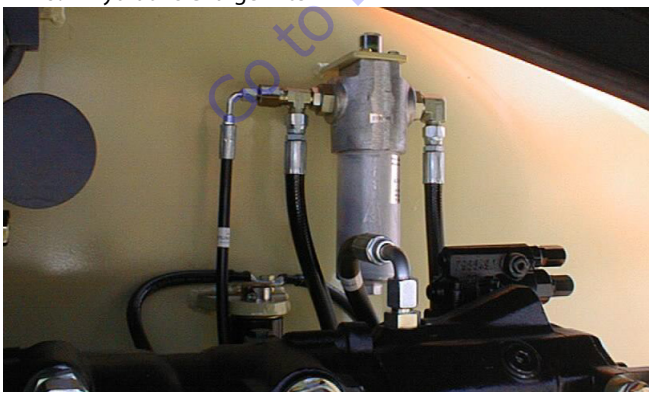


Lube Point(s) - Level/Fill Plug
Capacity - 43 oz. (1.3 L)
Lube - 90w80 Gear oil
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

5. Hydraulic Return Filter

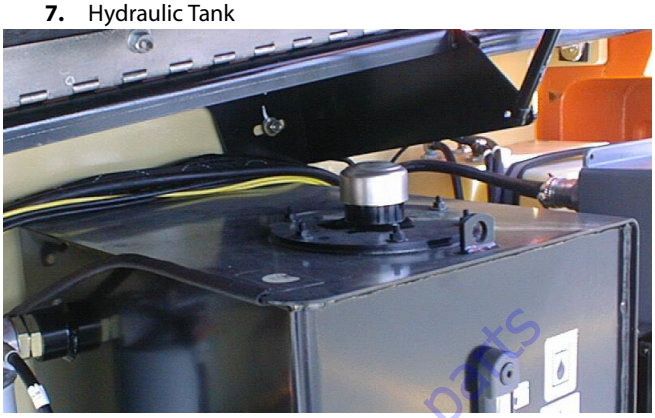
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

6. Hydraulic Charge Filter



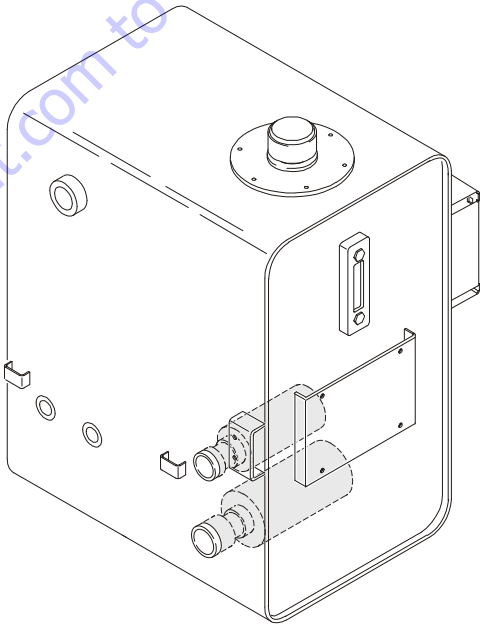
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

7. Hydraulic Tank



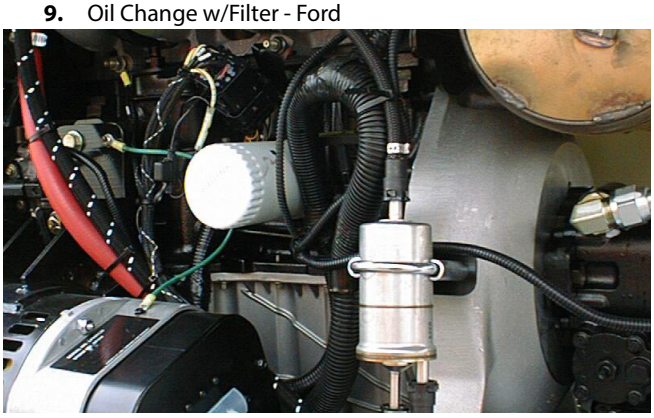
Lube Point(s) - Fill Cap
Capacity - 40 gallons (151 L) Tank; 77 gallons (291.4 L) System
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.

8. Suction Strainers



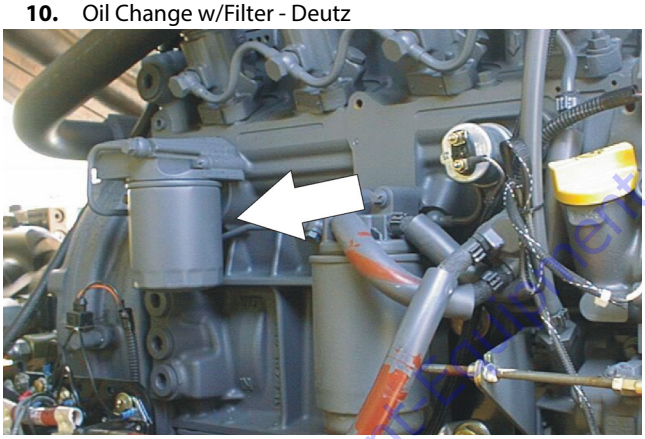
Lube Point(s) - 2
Interval - Every 2 years or 1200 hours of operation, remove and clean at time of hydraulic oil change.

9. Oil Change w/Filter - Ford

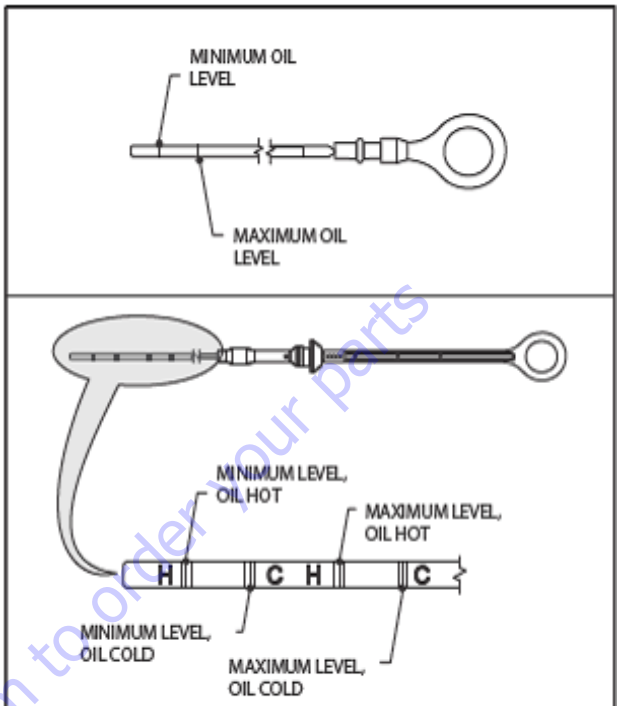


Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 4.5 Quarts
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

10. Oil Change w/Filter - Deutz



Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 11 Quarts(10.5 L) Crankcase
Lube - EO
Interval - Every Year or 1200 hours of operation
Comments - Check level daily/Change in accordance with engine manual. Refer to Figure 1-2., Deutz Engine Dipstick.



NOTE: Hot oil checks should not be made until the engine has been shut down for a period of 5 minutes.

Figure 1-2. Deutz Engine Dipstick

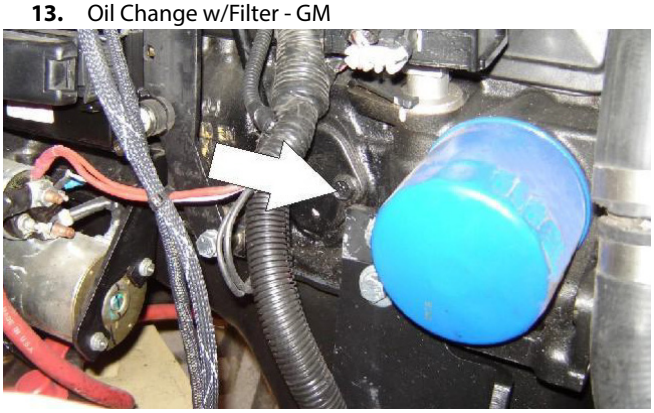
11. Oil Change w/Filter - Isuzu

Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 8.5 qt. (8.0L) engine; 5.3 qt. (5.L) cooler
Lube - EO
Interval - Change oil after first 50 and every 200 hrs. there after. Change oil filter after 50hrs. and every 400 hrs. there after.
Comments - Check level daily/Change in accordance with engine manual.

12. Oil Change w/Filter - Caterpillar

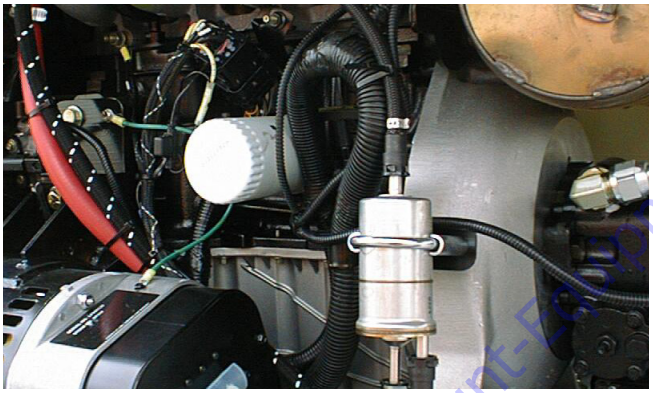
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 10.6 Quarts
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

13. Oil Change w/Filter - GM



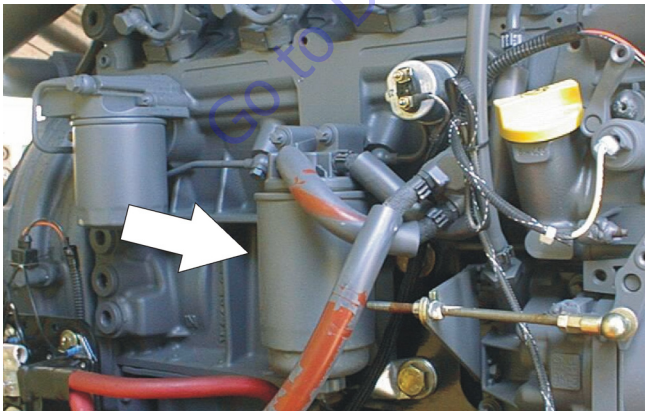
Lube Point(s) - Fill Cap/Spin-on Element (JLG P/N 7027965)
Capacity - 4.5 qt. (4.25 L) w/filter
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

14. Fuel Filter - Ford



Lube Point(s) - Replaceable Element
Interval - Every Year or 1200 hours of operation

15. Fuel Filter - Deutz



Lube Point(s) - Replaceable Element
Interval - Every Year or 600 hours of operation

16. Fuel Filter - Isuzu

Lube Point(s) - Replaceable Element
Interval - Every Year or 600 hours of operation

17. Fuel Filter - Caterpillar

Lube Point(s) - Replaceable Element
Interval - Every Year or 600 hours of operation

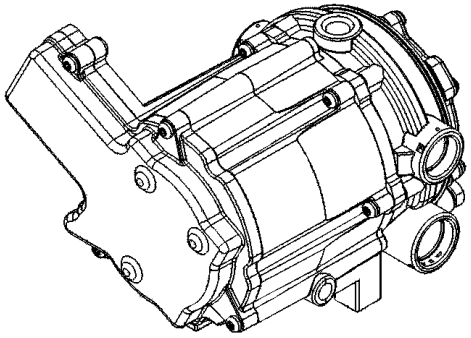
18. Fuel Filter (Gasoline) - GM

Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation

19. Air Filter

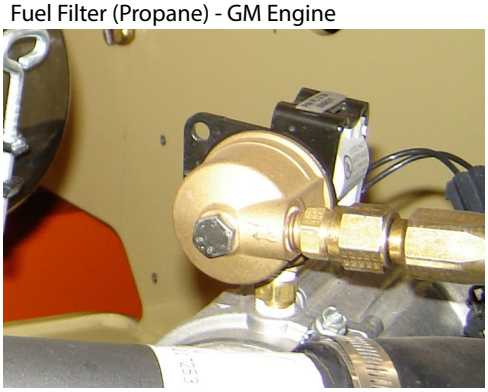
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator

20. Electronic Pressure Regulator (LP only)



Interval - 3 Months or 150 hours of operation
Comments - Drain oil build up. Refer to Draining Oil Build Up From The Propane Regulator

21. Fuel Filter (Propane) - GM Engine



Interval - 3 Months or 150 hours of operation
Comments - Replace filter. Refer to Propane Fuel Filter Replacement

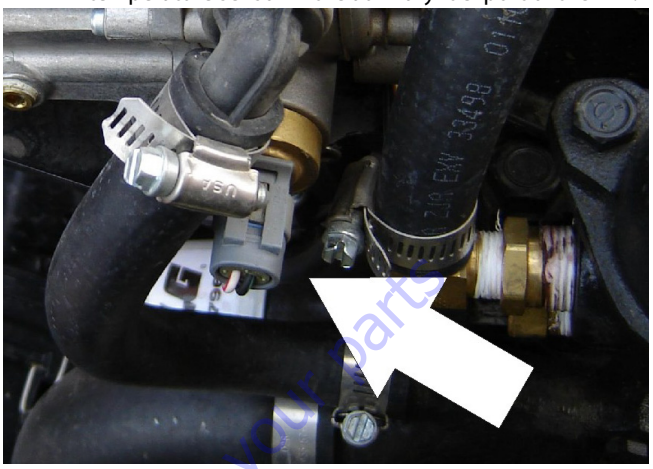
Draining Oil Build Up From The Propane Regulator (Prior to S/N 0300134626)

During the course of normal operation oils may build inside the primary and secondary chambers of the propane pressure regulator. These oils may be a result of poor fuel quality, contamination of the fuel supply chain, or regional variation in the make up of the fuel. If the build up of the oil is significant this can effect the operation of the fuel control system. Refer to Section 1.7, Maintenance and Lubrication for maintenance intervals. More frequent draining may be required if the fuel supply has been contaminated.

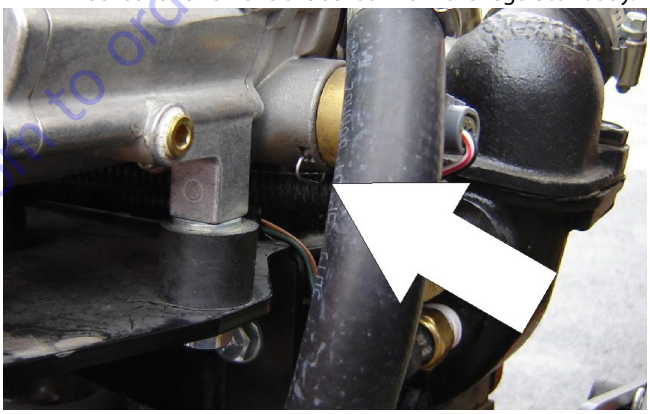
NOTICE

FOR BEST RESULTS WARM THE ENGINE TO OPERATING TEMPERATURE BEFORE DRAINING. THIS WILL ALLOW THE OILS TO BE LIQUID AND FLOW FREELY FROM THE REGULATOR.

1. Move the equipment to a well ventilated area. Ensure there are no external ignition sources.
2. Start the engine and bring to operating temperature.
3. With the engine running, close the manual tank valve and run the engine out of fuel.
4. Push in the Emergency Switch once the engine stops.
5. Disconnect the electrical connection to the LPG fuel temperature sensor in the auxiliary fuel port of the EPR.



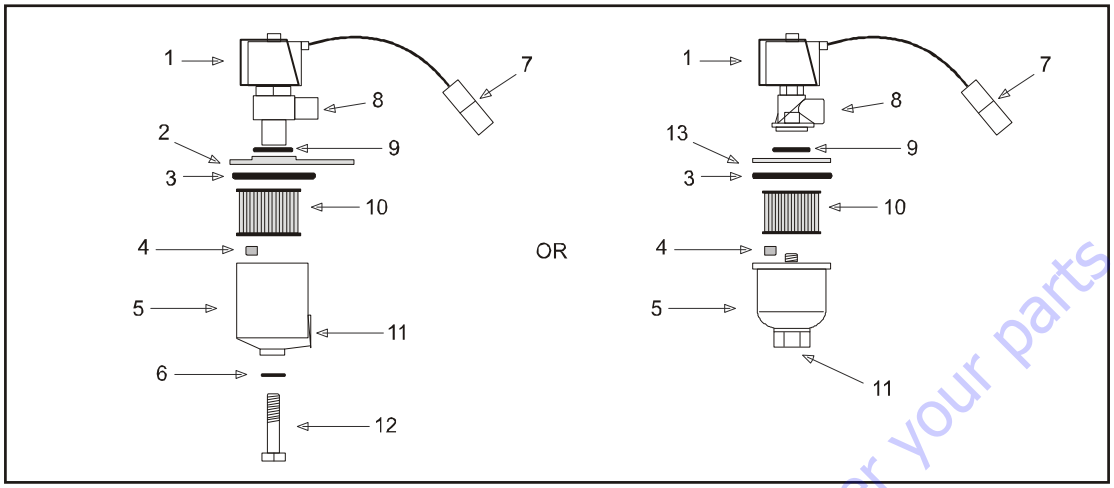
6. Remove the retainer clip for the LPG fuel temperature sensor and remove the sensor from the regulator body.



NOTE: *Have a small container ready to collect oil that will drain freely from the regulator at this point.*

7. Once all of the oil has been drained, reinstall the LPG fuel temperature sensor and reconnect the electrical connector.
8. Open the fuel tank manual valve.
9. Start the engine and verify all connections are secure.
10. Dispose of any drained oil in a safe and proper fashion.

Propane Fuel Filter Replacement



1. Electric Lock Off Solenoid
2. Mounting Plate
3. Housing Seal
4. Filter Magnet
5. Filter Housing
6. Seal
7. Electrical Connector
8. Fuel Outlet
9. O-ring
10. Filter
11. Fuel Inlet
12. Retaining Bolt
13. Ring

Figure 1-3. Filter Lock Assembly

REMOVAL

1. Relieve the propane fuel system pressure. Refer to Propane Fuel System Pressure Relief.
2. Disconnect the negative battery cable.
3. Slowly loosen the Filter housing retaining bolt and remove it.
4. Pull the filter housing from the Electric lock off assembly.
5. Locate Filter magnet and remove it.
6. Remove the filter from the housing.
7. Remove and discard the housing seal.
8. Remove and discard the retaining bolt seal.
9. Remove and discard mounting plate to lock off O-ring seal.

INSTALLATION

NOTICE

BE SURE TO REINSTALL THE FILTER MAGNET INTO THE HOUSING BEFORE INSTALLING NEW SEAL

1. Install the mounting plate to lock off O-ring seal.
2. Install the retaining bolt seal.
3. Install the housing seal.
4. Drop the magnet into the bottom of the filter housing.
5. Install the filter into the housing.
6. Install the retaining bolt into the filter housing.
7. Install the filter up to the bottom of the electric lock off.
8. Tighten the filter retaining bolt to 106 in lbs (12 Nm).
9. Open manual shut-off valve. Start the vehicle and leak check the propane fuel system at each serviced fitting. Refer to Propane Fuel System Leak Test.

Propane Fuel System Pressure Relief

⚠ CAUTION

THE PROPANE FUEL SYSTEM OPERATES AT PRESSURES UP TO 312 PSI (21.5 BAR). TO MINIMIZE THE RISK OF FIRE AND PERSONAL INJURY, RELIEVE THE PROPANE FUEL SYSTEM PRESSURE (WHERE APPLICABLE) BEFORE SERVICING THE PROPANE FUEL SYSTEM COMPONENTS.

To relieve propane fuel system pressure:

1. Close the manual shut-off valve on the propane fuel tank.
2. Start and run the vehicle until the engine stalls.
3. Turn the ignition switch OFF.

⚠ CAUTION

RESIDUAL VAPOR PRESSURE WILL BE PRESENT IN THE FUEL SYSTEM. ENSURE THE WORK AREA IS WELL VENTILATED BEFORE DISCONNECTING ANY FUEL LINE.

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)																		
SAE GRADE 5 BOLTS & GRADE 2 NUTS													SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*					
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)		Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7											
	48	0.1120	0.00661	420	9	1.0	7	0.8											
6	32	0.1380	0.00909	580	16	1.8	12	1.4											
	40	0.1380	0.01015	610	18	2.0	13	1.5											
8	32	0.1640	0.01400	900	30	3.4	22	2.5											
	36	0.1640	0.01474	940	31	3.5	23	2.6					1320	43	5				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5					1580	60	7				
	32	0.1900	0.02000	1285	49	5.5	36	4					1800	68	8				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12			2860	143	16	129	15		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22	4720	25	35	20	25	20	25
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38	7000	45	60	40	55	35	50
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61	9550	70	95	65	90	50	70
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92	12750	105	145	95	130	80	110
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133	16400	155	210	140	190	115	155
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183	20350	210	285	190	260	160	220
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	21300	260	353	200		285	388	240	325	30100	375	510	340	460	280	380
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523	41600	605	825	545	740	455	620
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

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Figure 1-4. Torque Chart - Sheet 1 of 5 (SAE Fasteners)

REFERENCE JLG THREAD LOCKING COMPOUND			
JLG P/N	Loctite® P/N	ND Industries P/N	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

Values for Magni Coating Fasteners (Ref 4150701)																		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS							SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load	Torque (Dry or Loctite® 263) K= 0.17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8											
	48	0.1120	0.00661	420	8	0.9											
6	32	0.1380	0.00909	580	14	1.5											
	40	0.1380	0.01015	610	14	1.6											
8	32	0.1640	0.01400	900	25	2.8											
	36	0.1640	0.01474	940	26	2.9					1320	37	4				
10	24	0.1900	0.01750	1120	36	4.1					1580	51	6				
	32	0.1900	0.02000	1285	42	4.7					1800	58	7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9			2860	122	14	114	13		
	28	0.2500	0.0364	2320	99	11.1	95	11			3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20	4720	20	25	20	25	20	25
	24	0.3125	0.0580	3700	15	20	15	21	15	20	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34	7000	35	50	35	50	35	50
	24	0.3750	0.0878	5600	30	40	28	38	25	34	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48	9550	60	80	55	75	50	70
	20	0.4375	0.1187	7550	45	60	44	60	40	54	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75	12750	90	120	85	115	80	110
	20	0.5000	0.1599	10700	75	100	71	97	65	88	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109	16400	130	175	125	170	115	155
	18	0.5625	0.2030	12950	105	145	97	132	90	122	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156	20350	180	245	170	230	160	220
	18	0.6250	0.2560	16300	145	195	136	185	125	170	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272	30100	320	435	300	410	280	380
	16	0.7500	0.3730	23800	255	345	238	324	225	306	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435	41600	515	700	485	660	455	620
	14	0.8750	0.5090	32400	400	545	378	514	355	483	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	38600	545	740	515	700	480	653	51500	730	995	685	930	645	875
	12	1.0000	0.6630	42200	600	815	563	765	530	721	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	47500	755	1025	713	969	670	911	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

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Figure 1-5. Torque Chart - Sheet 2 of 5 (SAE Fasteners)

				SOCKET HEAD CAP SCREWS													
				Magni Coating (Ref 4150701)*							Zinc Yellow Chromate Fasteners (Ref 4150707)*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15		Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85®) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604														
	48	0.1120	0.00661														
6	32	0.1380	0.00909														
	40	0.1380	0.01015														
8	32	0.1640	0.01400														
	36	0.1640	0.01474														
10	24	0.1900	0.01750														
	32	0.1900	0.02000														
1/4	20	0.2500	0.0318	2860	122	14	114	13			2860	143	16	129	15		
	28	0.2500	0.0364	3280	139	16	131	15			3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	320	435	300		280	380	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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Figure 1-6. Torque Chart - Sheet 3 of 5 (SAE Fasteners)

			Values for Zinc Yellow Chromate Fasteners (Ref 4150707)								
			CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS					CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ OR Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.20	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.18	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13			
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22			
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47			
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8	8.85			
6	1	20.10	8.74	11	7.9	9.4	12	12.5			
7	1	28.90	12.6	18	13	16	19	18.0	25	23	19
8	1.25	36.60	15.9	26	19	23	28	22.8	37	33	27
10	1.5	58.00	25.2	50	38	45	55	36.1	70	65	55
12	1.75	84.30	36.7	88	66	79	97	52.5	125	115	95
14	2	115	50.0	140	105	126	154	71.6	200	180	150
16	2	157	68.3	219	164	197	241	97.8	315	280	235
18	2.5	192	83.5	301	226	271	331	119.5	430	385	325
20	2.5	245	106.5	426	320	383	469	152.5	610	550	460
22	2.5	303	132.0	581	436	523	639	189.0	830	750	625
24	3	353	153.5	737	553	663	811	222.0	1065	960	800
27	3	459	199.5	1080	810	970	1130	286.0	1545	1390	1160
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2095	1885	1575
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2855	2570	2140
36	4	817	355.5	2560	1920	2300	2690	509.0	3665	3300	2750
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5865	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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Figure 1-7. Torque Chart - Sheet 4 of 5 (Metric fasteners)

Values for Magni Coated Fasteners (Ref 4150701)										
			CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS				CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K=0.17	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.16	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=0.15	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0	3.13			
3.5	0.6	6.78	2.95	1.8	1.7	1.5	4.22			
4	0.7	8.78	3.82	2.6	2.4	2.3	5.47			
5	0.8	14.20	6.18	5.3	4.9	4.6	8.85			
6	1	20.10	8.74	9	8.4	7.9	12.5	13	12	11
7	1	28.90	12.6	15	14	13	18.0	21	20	19
8	1.25	36.60	15.9	22	20	19	22.8	31	29	27
10	1.5	58.00	25.2	43	40	38	36.1	61	58	55
12	1.75	84.30	36.7	75	70	66	52.5	105	100	95
14	2	115	50.0	119	110	105	71.6	170	160	150
16	2	157	68.3	186	175	165	97.8	265	250	235
18	2.5	192	83.5	256	240	225	119.5	365	345	325
20	2.5	245	106.5	362	340	320	152.5	520	490	460
22	2.5	303	132.0	494	465	435	189.0	705	665	625
24	3	353	153.5	627	590	555	222.0	905	850	800
27	3	459	199.5	916	860	810	286.0	1315	1235	1160
30	3.5	561	244.0	1245	1170	1100	349.5	1780	1680	1575
33	3.5	694	302.0	1694	1595	1495	432.5	2425	2285	2140
36	4	817	355.5	2176	2050	1920	509.0	3115	2930	2750
42	4.5	1120	487.0	3477	3275	3070	698.0	4985	4690	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

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Figure 1-8. Torque Chart - Sheet 5 of 5 (METRIC Fasteners)

PARTS FINDER

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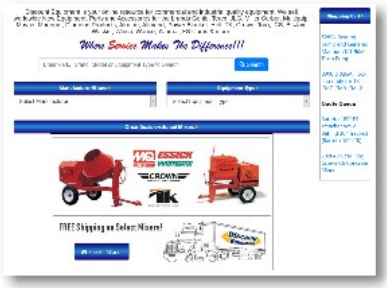

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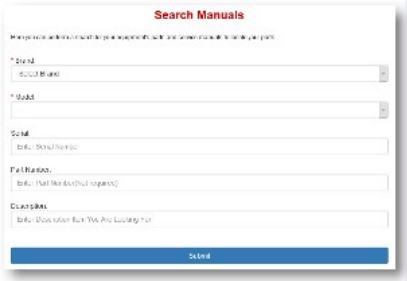

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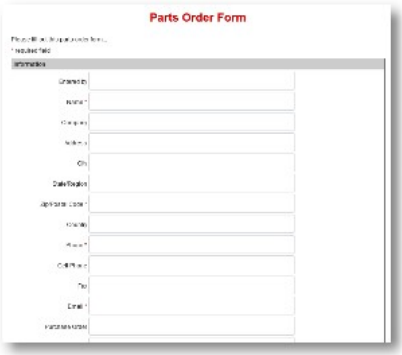

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service.

Preparation, Inspection, and Maintenance

It is important to establish and conform to a comprehensive inspection and preventive maintenance program. The following table outlines the periodic machine inspections and maintenance recommended by JLG Industries, Inc. Consult your national, regional, or local regulations for further requirements for aerial work platforms. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the Operator's and Safety Manual for completion procedures for the Pre-Start Inspection. The Operator and Safety Manual must be read in its entirety and understood prior to performing the Pre-Start Inspection.

Pre-Delivery Inspection and Frequent Inspection

The Pre-Delivery Inspection and Frequent Inspection shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

The Pre-Delivery Inspection and Frequent Inspection procedures are performed in the same manner, but at different times. The Pre-Delivery Inspection shall be performed prior to each sale, lease, or rental delivery. The Frequent Inspection shall be accomplished for each machine in service for 3 months or 150 hours (whichever comes first); out of service for a period of more than 3 months; or when purchased used. The frequency of this inspection must be increased as environment, severity and frequency of usage requires.

Reference the JLG Pre-Delivery and Frequent Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of these inspections. Reference the appropriate areas of this manual for servicing and maintenance procedures.

Annual Machine Inspection

The Annual Machine Inspection must be performed by a Factory-Certified Service Technician on an annual basis, no later than thirteen (13) months from the date of the prior Annual Machine Inspection. JLG Industries, Inc. recognizes a Factory-Certified Service Technician as a person who has successfully completed the JLG Service Training School for the subject JLG product model. Reference the machine Service and Maintenance Manual and appropriate JLG inspection form for performance of this inspection.

Reference the JLG Annual Machine Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of this inspection. Reference the appropriate areas of this manual for servicing and maintenance procedures.

For the purpose of receiving safety-related bulletins, it is important that JLG Industries, Inc. has updated ownership information for each machine. When performing each Annual Machine Inspection, notify JLG Industries, Inc. of the current machine ownership.

Preventative Maintenance

In conjunction with the specified inspections, maintenance shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

Reference the Preventative Maintenance Schedule and the appropriate areas of this manual for servicing and maintenance procedures. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

Table 2-1. Inspection and Maintenance

Type	Frequency	Primary Responsibility	Service Qualification	Reference
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operator and Safety Manual
Pre-Delivery Inspection	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, whichever comes first; or Out of service for a period of more than 3 months; or Purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory-Certified Service Technician	Service and Maintenance Manual and applicable JLG inspection form.
Preventative Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

2.2 SERVICE AND GUIDELINES

General

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this book.

Safety and Workmanship

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.
2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.
3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

Components Removal and Installation

1. Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
2. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90 degrees.
3. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

Pressure-Fit Parts

When assembling pressure-fit parts, use an anti-seize or molybdenum disulfide base compound to lubricate the mating surface.

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
3. If bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.
4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

Gaskets

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will assure that they are correctly reinstalled.

Hydraulic System

1. Keep the system clean. If evidence of metal or rubber particles are found in the hydraulic system, drain and flush the entire system.
2. Disassemble and reassemble parts on clean work surface. Clean all metal parts with non-flammable cleaning solvent. Lubricate components, as required, to aid assembly.

Lubrication

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

Battery

Clean battery, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry battery and coat terminals with an anti corrosion compound.

Lubrication and Servicing

Components and assemblies requiring lubrication and servicing are shown in the Lubrication Chart in Section 1.

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.
2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.
3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.
4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

NOTE: *Metal particles may appear in the oil or filters of new machines due to the wear-in of meshing components.*

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.

2. JLG recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: *Start-up of hydraulic system with oil temperatures below -15 degrees F (-26 degrees C) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -15 degrees F (-26 degrees C).*

3. The only exception to the above is to drain and fill the system with Mobil DTE 13 oil or its equivalent. This will allow start up at temperatures down to -20 degrees F (-29 degrees C). However, use of this oil will give poor performance at temperatures above 120 degrees F (49 degrees C). Systems using DTE 13 oil should not be operated at temperatures above 200 degrees F (94 degrees C) under any condition.

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.

2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.

3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise, regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Section 1 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDER DRIFT TEST

Maximum acceptable cylinder drift is to be measured using the following methods.

Platform Drift

Measure the drift of the platform to the ground. Lower booms (if equipped) slightly elevated, main boom fully extended with the rated load in the platform and power off. Maximum allowable drift is 2 inches (5 cm) in 10 minutes. If the machine does not pass this test, proceed with the following.

Cylinder Drift

Table 2-2. Cylinder Drift

Cylinder Bore Diameter		Max. Acceptable Drift in 10 Minutes	
inches	mm	inches	mm
3	76.2	0.026	0.66
3.5	89	0.019	0.48
4	101.6	0.015	0.38
5	127	0.009	0.22
6	152.4	0.006	0.15
7	177.8	0.005	0.13
8	203.2	0.0038	0.10
9	228.6	0.0030	0.08

Drift is to be measured at the cylinder rod with a calibrated dial indicator. The cylinder oil must be at ambient temperature and temperature stabilized.

The cylinder must have the normal load, which is the normal platform load applied.

If the cylinder passes this test, it is acceptable.

NOTE: *This information is based on 6 drops per minute cylinder leakage.*

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   a. Excessive sloppiness in joints.
   b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
   a. Frayed or separated fibers on the liner surface.

b. Cracked or damaged liner backing.

c. Bearings that have moved or spun in their housing.

d. Debris embedded in liner surface.

3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):

a. Detectable wear in the bearing area.

b. Flaking, pealing, scoring, or scratches on the pin surface.

c. Rusting of the pin in the bearing area.

4. Re-assembly of pinned joints using filament wound bearings.

a. Housing should be blown out to remove all dirt and debris...bearings and bearing housings must be free of all contamination.

b. Bearing / pins should be cleaned with a solvent to remove all grease and oil...filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).

c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

NOTE: *This instruction applies to repairs, or modifications to the machine and to welding performed from the machine on an external structure, or component,*

Do the Following When Welding on JLG Equipment

- Disconnect the battery.
- Disconnect the moment pin connection (where fitted)
- Ground only to structure being welded.

Do NOT Do the Following When Welding on JLG Equipment

- Ground on frame and weld on any other area than the chassis.
- Ground on turntable and weld on any other area than the turntable.
- Ground on the platform/support and weld on any other area than the platform/support.
- Ground on a specific boom section and weld on any other area than that specific boom section.
- Allow pins, wear pads, wire ropes, bearings, gearing, seals, valves, electrical wiring, or hoses to be between the grounding position and the welded area.

NOTICE

FAILURE TO COMPLY WITH THE ABOVE REQUIREMENTS MAY RESULT IN COMPONENT DAMAGE (I.E. ELECTRONIC MODULES, SWING BEARING, COLLECTOR RING, BOOM WIRE ROPES ETC.)

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Boom Assembly	9					
Boom Weldments				1,2,4	1,2,4	
Hose/Cable Carrier Installations				1,2,9,12	1,2,9,12	
Pivot Pins and Pin Retainers				1,2	1,2	
Sheaves, Sheave Pins				1,2	1,2	
Bearings				1,2	1,2	
Wear Pads				1,2	1,2	
Covers or Shields				1,2	1,2	
Extend/Retract Chain or Cable Systems				1,3,5,22		
UMS System Functional Check				1,2,3		
Platform Assembly	9					
Platform	1,2				1,2	
Railing	1,2			1	1,2	
Gate			5	1	1,5	
Floor	1,2			1	1,2	
Rotator		9,5		15		
Lanyard Anchorage Point	2			1,2,10	1,2,10	
Turntable Assembly	9					
Swing Bearing or Worm Gear				1,2,14	1,2,3,13,14	
Oil Coupling		9				
Swing Drive System				11	11	
Turntable Lock				1,2,5	1,2,5	
Hood, Hood Props, Hood Latches				5	1,2,5	
Chassis Assembly	9					
Tires	1	16,17		16,17,18	16,17,18	
Wheel Nuts/Bolts	1	15		15	15	
Wheel Bearings						14,24
Oscillating Axle/Lockout Cylinder Systems					5,8	
Outrigger or Extendable Axle Systems				5,8	5,8	
Steer Components						
Drive Motors						
Drive Hubs				11	11	
Functions/Controls	9					

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Platform Controls	5	5		6	6	
Ground Controls	5	5		6	6	
Function Control Locks, Guards, or Detents	1,5	1,5		5	5	
Footswitch	1,5			5	5	
Emergency Stop Switches (Ground & Platform)	5			5	5	
Function Limit or Cutout Switch Systems	5			5	5	
Capacity Indicator					5	
Drive Brakes				5		
Swing Brakes				5		
Boom Synchronization/Sequencing Systems					5	
Manual Descent or Auxiliary Power				5	5	
Power System	9					
Engine Idle, Throttle, and RPM				3	3	
Engine Fluids (Oil, Coolant, Fuel)	11	9,11		11	11	
Air/Fuel Filter		1,7		7	7	
Exhaust System			1,9	9	9	
Batteries	5	1,9			19	
Battery Fluid		11		11	11	
Battery Charger		5			5	
Fuel Reservoir, Cap, and Breather	11,9		2	1,5	1,5	
Hydraulic/Electric System	9					
Hydraulic Pumps		1,9		1,2,9		
Hydraulic Cylinders		1,9,7	2	1,2,9	1,2,9	
Cylinder Attachment Pins and Pin Retainers		1,9		1,2	1,2	
Hydraulic Hoses, Lines, and Fittings		1,9	12	1,2,9,12	1,2,9,12	
Hydraulic Reservoir, Cap, and Breather	11	1,9	2	1,5	1,5	24
Hydraulic Filter		1,9		7	7	
Hydraulic Fluid	11			7,11	7,11	
Electrical Connections		1		20	20	
Instruments, Gauges, Switches, Lights, Horn		1			5,23	
Holding Valve Checks				1,5,9,22		
General						
Operation and Safety Manuals in Storage Box	21			21	21	
ANSI and EMI Manuals/Handbooks Installed					21	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Capacity Decals Installed, Secure, Legible	21			21	21	
All Decals/Placards Installed, Secure, Legible	21			21	21	
Walk-Around Inspection Performed	21					
Annual Machine Inspection Due				21		
No Unauthorized Modifications or Additions				21	21	
All Relevant Safety Publications Incorporated				21	21	
General Structural Condition and Welds				2,4	2,4	
All Fasteners, Pins, Shields, and Covers				1,2	1,2	
Grease and Lubricate to Specifications				22	22	
Function Test of All Systems	21			21	21, 22	
Paint and Appearance				7	7	
Stamp Inspection Date on Frame					22	
Notify JLG of Machine Ownership					22	

Footnotes:

[1] Prior to use each day; or at each Operator change

[2] Prior to each sale, lease, or delivery

[3] In service for 3 months or 150 Hours; or Out of service for 3 months or more; or Purchased used

[4] Annually, no later than 13 months from the date of the prior inspection

Performance Codes:
1 - Check for proper and secure installation
2 - Visual inspection for damage, cracks, distortion or excessive wear
3 - Check for proper adjustment
4 - Check for cracked or broken welds
5 - Operates Properly
6 - Returns to neutral or "off" position when released
7 - Clean and free of debris
8 - Interlocks function properly
9 - Check for signs of leakage
10 - Decals installed and legible
11 - Check for proper fluid level
12 - Check for chafing and proper routing
13 - Check for proper tolerances
14 - Properly lubricated
15 - Torqued to proper specification
16 - No gouges, excessive wear, or cords showing
17 - Properly inflated and seated around rim
18 - Proper and authorized components
19 - Fully charged
20 - No loose connections, corrosion, or abrasions
21 - Verify
22 - Perform
23 - Sealed Properly
24 - Drain, Clean, Refill

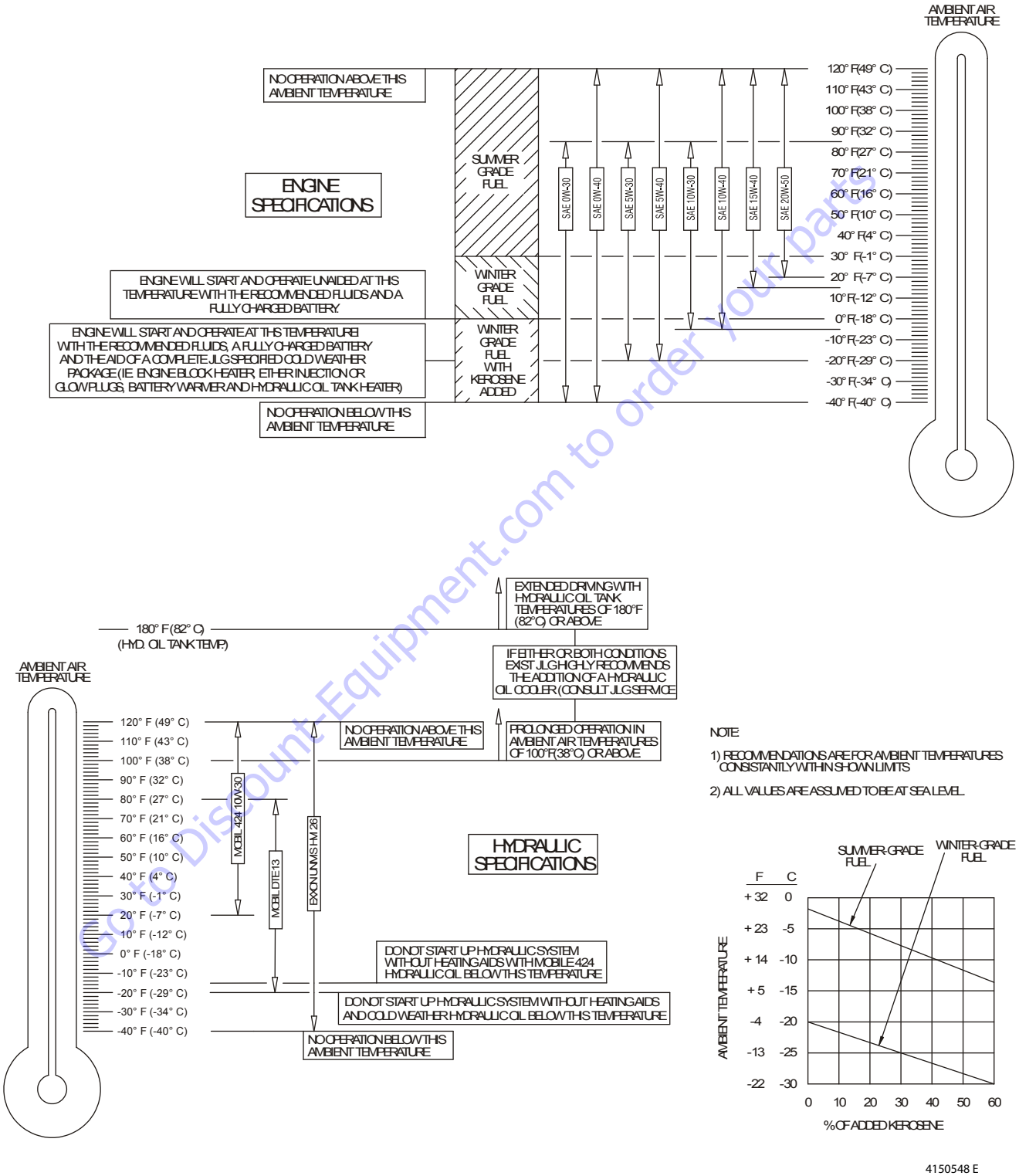


Figure 2-1. Engine Operating Temperature Specifications - Deutz

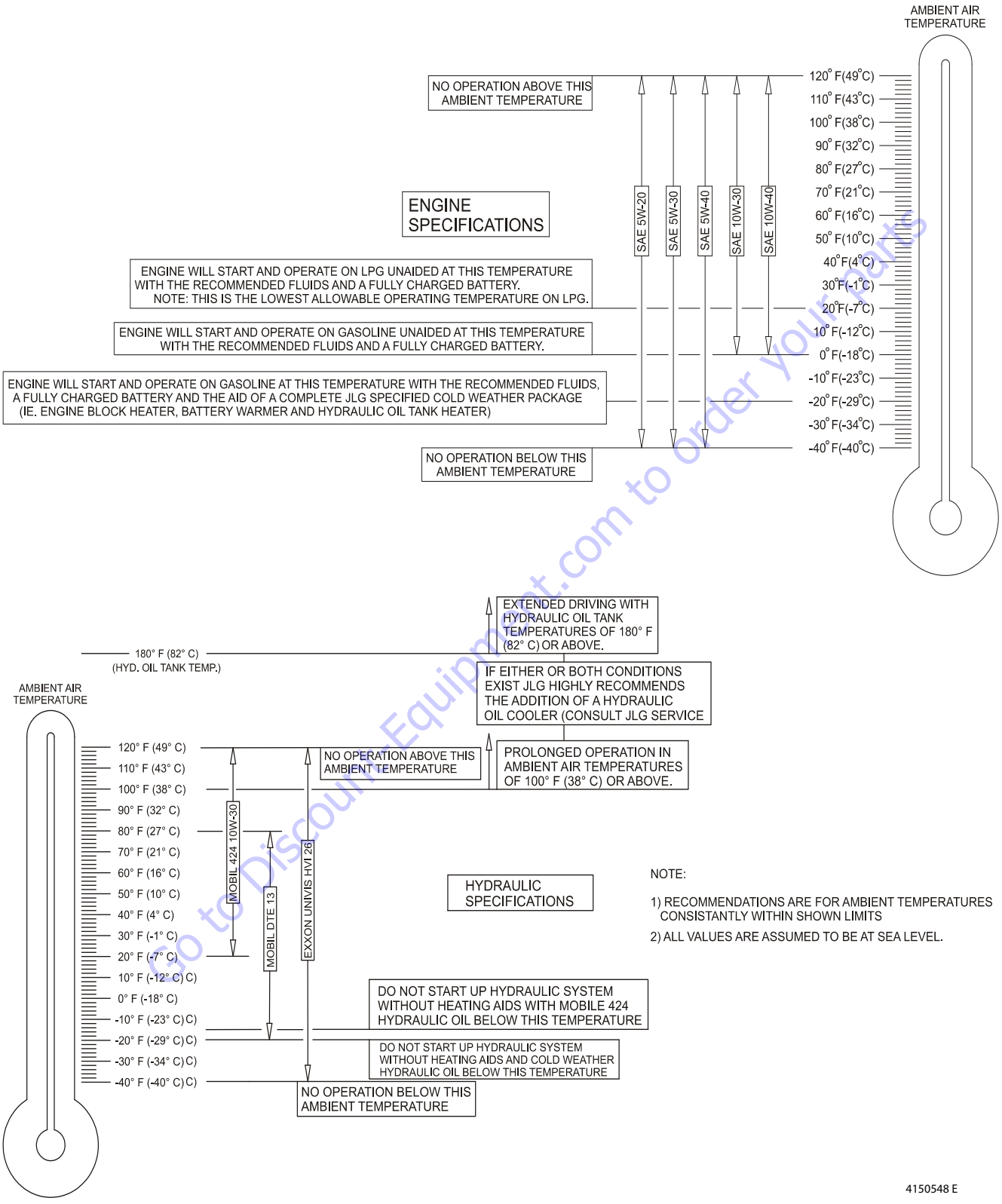


Figure 2-2. Engine Operating Temperature Specifications - Ford

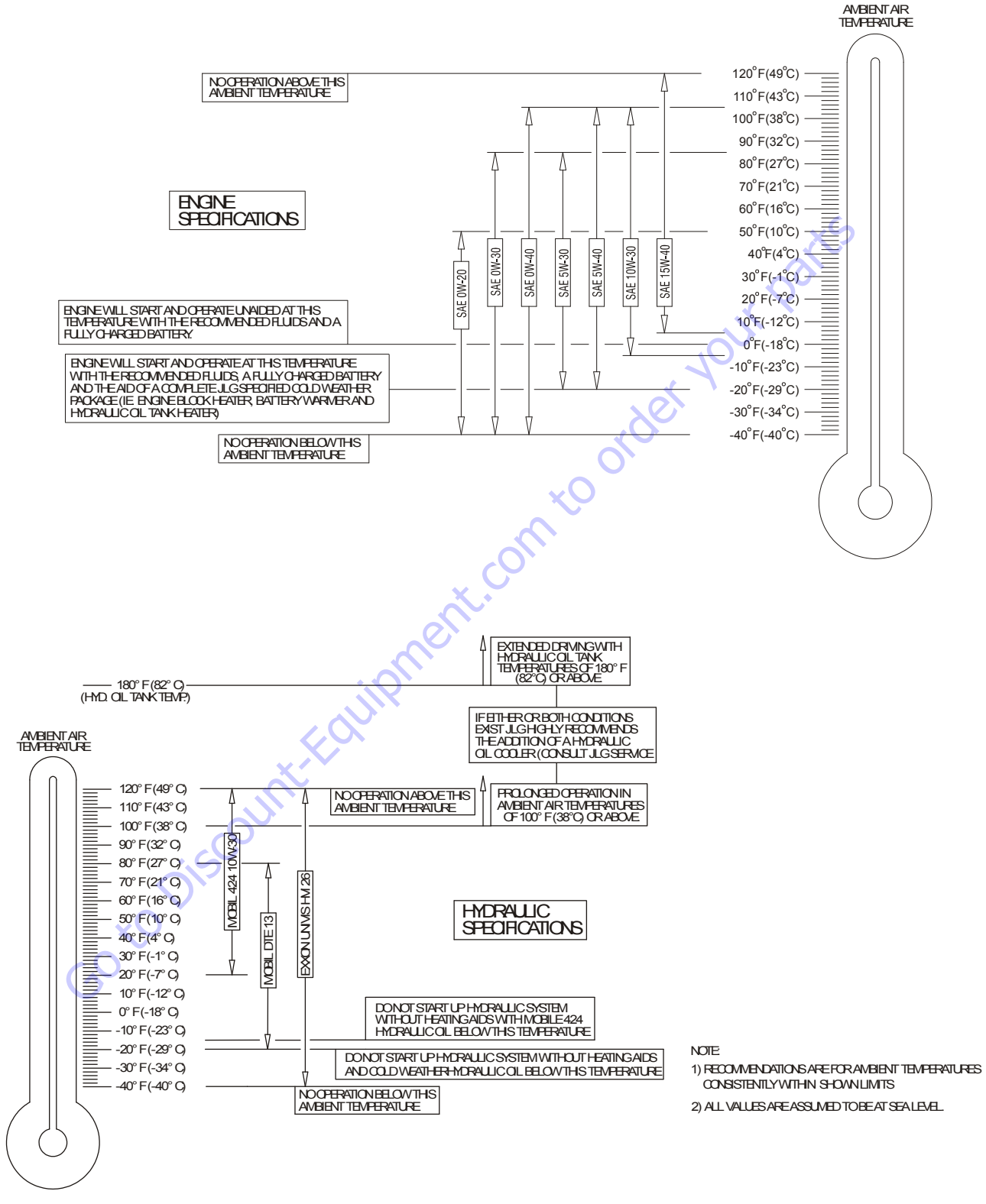


Figure 2-3. Engine Operating Temperature Specifications - Caterpillar

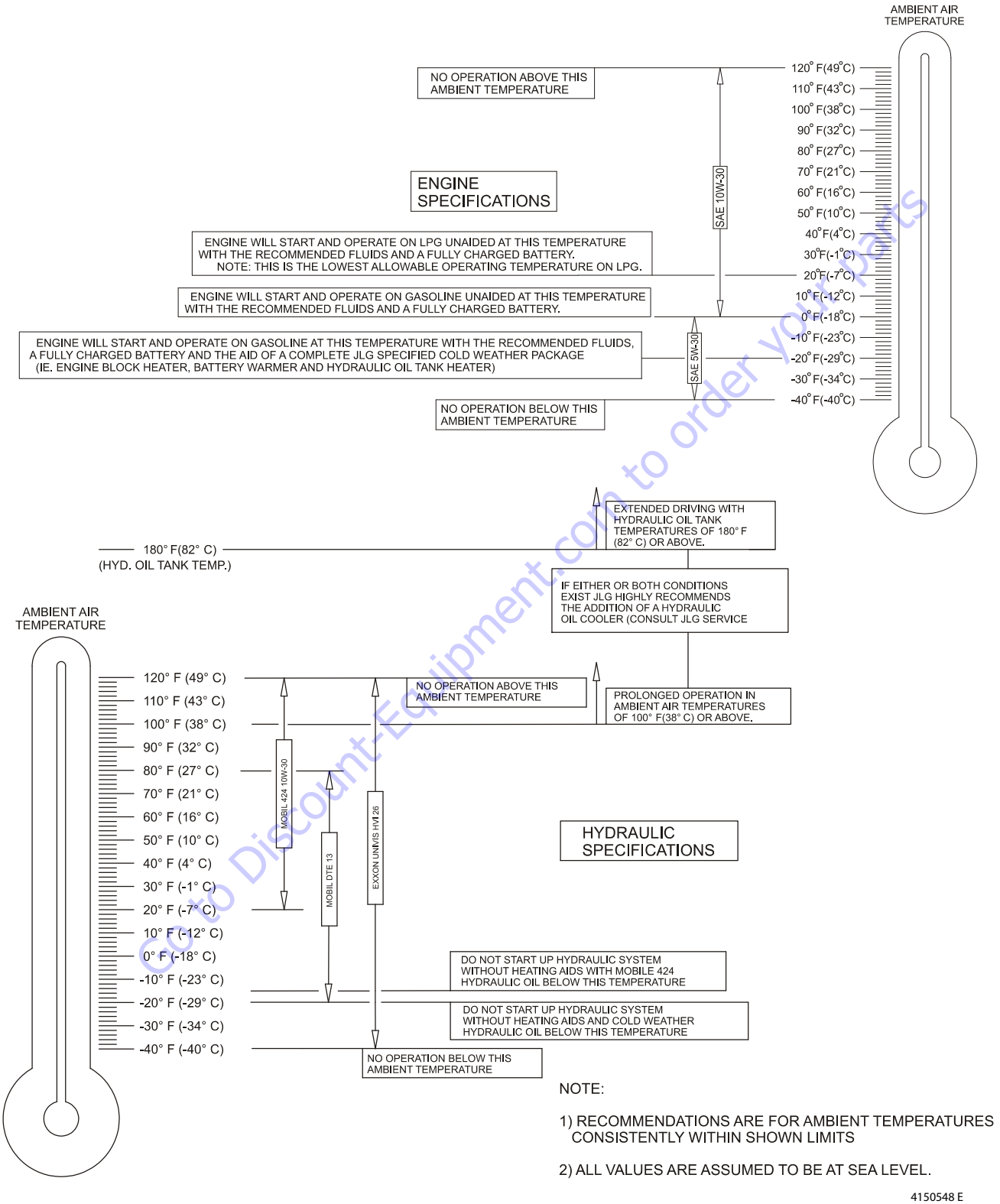
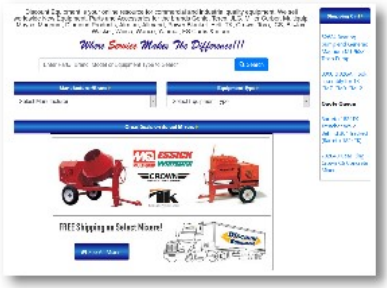


Figure 2-4. Engine Operating Temperature Specifications - GM

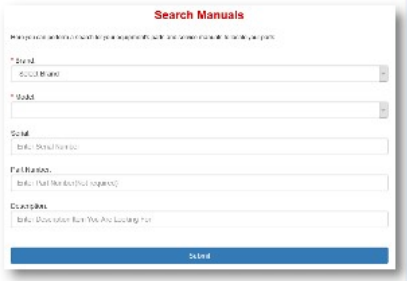
PARTS FINDER

Search Website by Part Number

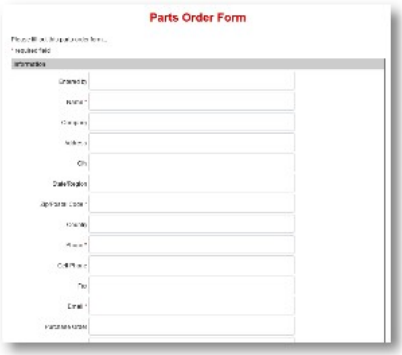
Discount Equipment



Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote



Can't Find Part or Manual? Request Help by Manufacturer, Model & Description



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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Inflation

The air pressure for pneumatic tires must be equal to the air pressure that is stenciled on the side of the JLG product or rim decal for safe and proper operational characteristics.

Tire Damage

For pneumatic tires, JLG Industries, Inc. recommends that when any cut, rip, or tear is discovered that exposes sidewall or tread area cords in the tire, measures must be taken to remove the JLG product from service immediately. Arrangements must be made for replacement of the tire or tire assembly.

For polyurethane foam filled tires, JLG Industries, Inc. recommends that when any of the following are discovered, measures must be taken to remove the JLG product from service immediately and arrangements must be made for replacement of the tire or tire assembly.

- a smooth, even cut through the cord plies which exceeds 3 inches (7.5 cm) in total length
- any tears or rips (ragged edges) in the cord plies which exceeds 1 inch (2.5 cm) in any direction
- any punctures which exceed 1 inch in diameter
- any damage to the bead area cords of the tire

If a tire is damaged but is within the above noted criteria, the tire must be inspected on a daily basis to insure the damage has not propagated beyond the allowable criteria.

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. Please refer to the JLG Parts Manual for the part number of the approved tires for a particular machine model. If not using a JLG approved replacement tire, we recommend that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original
- Tire tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original

Unless specifically approved by JLG Industries Inc. do not replace a foam filled or ballast filled tire assembly with a pneumatic tire. When selecting and installing a replacement tire, ensure that all tires are inflated to the pressure recommended by JLG. Due to size variations between tire brands, both tires on the same axle should be the same.

Wheel Replacement

The rims installed on each product model have been designed for stability requirements which consist of track width, tire pressure, and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in an unsafe condition regarding stability.

Wheel Installation

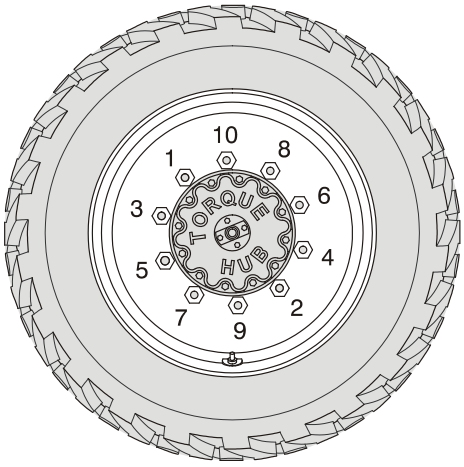
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

WHEEL NUTS MUST BE INSTALLED AND MAINTAINED AT THE PROPER TORQUE TO PREVENT LOOSE WHEELS, BROKEN STUDS, AND POSSIBLE DANGEROUS SEPARATION OF WHEEL FROM THE AXLE. BE SURE TO USE ONLY THE NUTS MATCHED TO THE CONE ANGLE OF THE WHEEL.

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-tightening will result in breaking the studs or permanently deforming the mounting stud holes in the wheels. The proper procedure for attaching wheels is as follows:

1. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.
2. Tighten nuts in the following sequence:



3. The tightening of the nuts should be done in stages. Following the recommended sequence, tighten nuts per wheel torque chart.

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
70 ft. lbs. (95 Nm)	170 ft. lbs. (225 Nm)	300 ft. lbs. (405 Nm)

4. Wheel nuts should be torqued after first 50 hours of operation and after each wheel removal. Check torque every 3 months or 150 hours of operation.

3.2 OSCILLATING AXLE BLEEDING PROCEDURE AND LOCKOUT TEST

Lockout Cylinder Bleeding

To start the test, the axle must be fully oscillated in one direction. Start with oscillating the axle so that the left lockout cyl. is fully retracted (left front tire up), and the right lockout cyl. Is fully extended (right front tire down).

NOTICE

ENSURE PLATFORM IS FULLY LOWERED AND BOOM IS CENTERED OVER REAR AXLE PRIOR TO BEGINNING BLEEDING PROCEDURE. MAKING SURE MACHINE IS ON A LEVEL SURFACE AND REAR WHEELS ARE BLOCKED, BRAKE WIRE IS DISCONNECTED.

1. Making sure machine is on a level surface and rear wheels are blocked, brake wire is disconnected.
2. Center boom over rear axle making sure that cam valve is depressed.

NOTE: *Step (2) is applicable for machines built Prior to S/N 0300083331.*

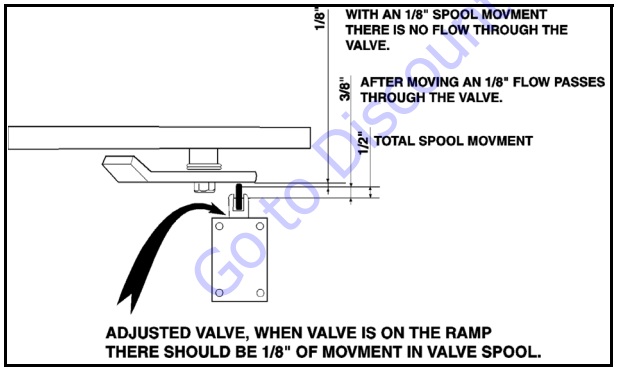


Figure 3-1. Oscillating Valve Adjustment

NOTE: *To oscillate the axle, the lockout valve plunger must be depressed.*

3. Using a Phillips screwdriver, remove screw from connection on the brake valve and remove connector as shown.

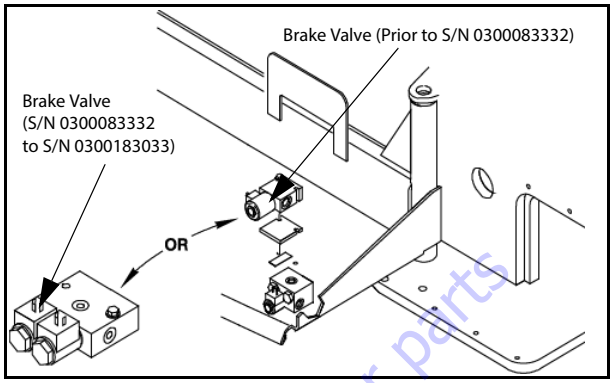


Figure 3-2. Brake Valve Wiring Connection

4. Use suitable container to retain any residual hydraulic fluid, place container under the lockout cylinder.
5. With the left lockout cyl. retracted, open the bleeder on top of the cylinder, then have an operator from the platform (on high engine) feather drive. Activate drive just enough so the engine is under load but not enough to stall the engine.
6. Close the bleeder when there is a steady stream of oil and not air.
7. With the axle in the same position, go to the right lockout cyl. and open the bleeder at the rod end. Activate drive in the same manner and close when all air has been purged.
8. Close the bleeder when there is a steady stream of oil and not air.
9. Oscillate the axle the other direction, left lockout cyl. extended (tire down), right lockout cyl. retracted (tire up). Use the same procedure for the bleeder in the rod end of the left lockout cyl., Then the piston end of the right lockout cyl. then close.
10. Repeat this process one more time to ensure that all air has been purged from the system.
11. Perform oscillating axle lockout test.
12. If necessary, repeat steps 1 thru 9.
13. Reinstall the brake wires. See Figure 3-2.

NOTE: *Bleeding of the oscillating axles is an infrequent operation performed after hydraulic line failure and or lockout cylinder repair.*

Oscillating Axle Lockout Test

NOTICE

LOCKOUT SYSTEM TEST MUST BE PERFORMED QUARTERLY, ANY TIME A SYSTEM COMPONENT IS REPLACED, OR WHEN IMPROPER SYSTEM OPERATION IS SUSPECTED.

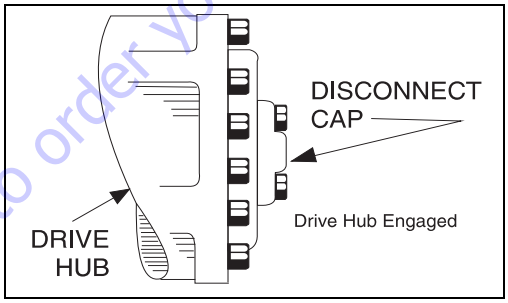
NOTE: *Ensure boom is fully retracted, lowered, and centered between drive wheels prior to beginning lockout cylinder test.*

1. Place a 6 inch (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, activate machine hydraulic system.
3. Place FUNCTION SPEED CONTROL and DRIVE SPEED/TORQUE SELECT control switches to their respective LOW positions.
4. Place DRIVE control lever to FORWARD position and carefully drive machine up ascension ramp until left front wheel is on top of block.
5. Carefully activate SWING control lever and position boom over right side of machine.
6. With boom over right side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.
7. Have an assistant check to see that left front wheel remains locked in position off of ground.
8. Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). When boom reaches center, stowed position, lockout cylinders should release and allow wheel to rest on ground, it may be necessary activate DRIVE to release cylinders.
9. Place the 6 inch (15.2 cm) high block with ascension ramp in front of right front wheel.
10. Place DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until right front wheel is on top of block.
11. Carefully activate SWING control lever and position boom over left side of machine.
12. With boom over left side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.
13. Have an assistant check to see that right front wheel remains locked in position off of ground.
14. Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). When boom reaches center, stowed position, lockout cylinders should release and allow wheel to rest on ground, it may be necessary activate DRIVE to release cylinders.
15. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.3 FREE WHEELING OPTION

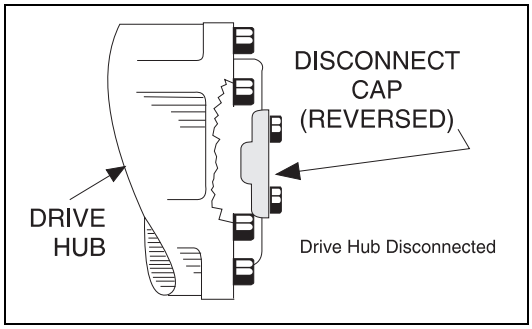
To Disengage Drive Motors and Brakes (Free Wheel) for Emergency Towing

1. Chock wheels securely if not on flat level surface.
2. Disconnect both drive hubs by reversing the disconnect caps in the center of the hubs.
3. If equipped, move steer/tow selector valve to float (tow) position by pulling control knob out.



To Engage Drive Motors and Brakes (Normal Operation)

1. If equipped, move steer/tow valve to steer position by pushing valve knob in.
2. Connect both drive hubs by inverting disconnect cap in center of hub.
3. Remove chocks from wheels as required.



3.4 TORQUE HUB, DRIVE

Disassembly

1. Position hub over suitable container and remove drain plugs (10) from unit. Allow oil to completely drain, then replace drain plugs.
2. Remove bolts (41) securing cover assembly to hub (7). Remove cover assembly (23) and discard o-ring seal (22).
3. Lift carrier assembly and top thrust washer and thrust bearing(39, 40) from hub. Thrust washer may stick inside cover.
4. Pry ring gear (21) loose from hub and remove it. Remove o-ring seal (22) from hub counterbore and discard it.
5. Remove input gear (37) and thrust spacer (36) from input shaft assembly and remove input shaft assembly from hub.
6. Lift internal gear (12) and thrust washer and thrust bearing (39, 40) from hub. Thrust washer may stick to bottom of carrier.
7. Remove retaining ring (9) from spindle (1) and discard; lift hub from spindle.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

8. Remove inside bearing cone (6) and bearing shim (8).
9. If necessary, pry seal (2) out of hub using screwdriver or pry bar. With seal removed, outside bearing cone (4) can be removed.
10. If necessary, remove inner and outer bearing cups (3, 5) using a suitable slide hammer puller or driven out with a punch.
11. To remove the cluster gears from the carrier, drive the anti-roll pin into the planet shaft of the cluster gear. After the planet shaft is removed, the roll pin should be driven out of the planet shaft.

NOTICE

WHEN REBUILDING TORQUE HUB, REMOVE AND REPLACE ALL O-RINGS AND RETAINING RINGS.

Cleaning and Inspection

1. Thoroughly clean all parts in an approved cleaning solvent.
2. Inspect bearing cups and cones for damage, pitting, corrosion, or excessive wear. If necessary, replace bearings as a complete set ensuring that they remain covered until use.
3. Inspect bearing mounting surfaces on spindle, hub, input shaft and carrier. Replace components as necessary.
4. Inspect all geared components for chipped or broken teeth and for excessive or uneven wear patterns.
5. Inspect carrier for damage, especially in anti-roll pin and planet shaft hole areas.
6. Inspect all planet shafts for scoring or other damage.
7. Inspect all threaded components for damage including stretching, thread deformation, or twisting.
8. Inspect seal mounting area in hub for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.
9. Inspect cover for cracks or other damage, and o-ring sealing area for burrs or sharp edges. Dress applicable surfaces or replace cover as necessary.

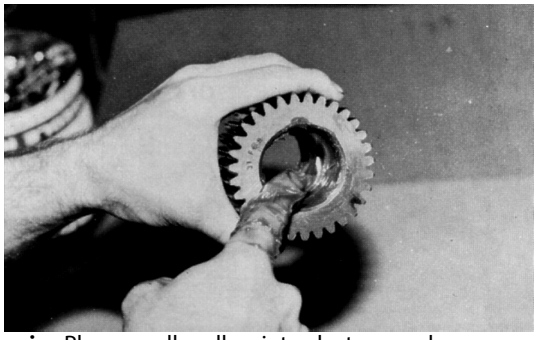
Repair

1. Cover Assembly.
   a. Remove two bolts (25) securing disconnect cap (26) to cover (23) and remove cap.
   b. Remove two bolts (25) securing cover cap (24) to cover and remove cap.
   c. Remove disconnect rod (27) from cap and remove o-rings (28, 29) from cover cap. Discard o-rings.
   d. If necessary, remove pipe plug (30) from cover.
   e. Clean and inspect parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.
   f. If removed, screw pipe plug into cover.
   g. Slip o-ring (29) over cover cap and against face.
   h. Place o-ring (28) into cover cap internal groove. Disconnect rod may be used to push o-ring into groove.
   i. Place cover cap into cover with large hole located over pipe plug. Secure cover cap to cover with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 Nm).
   j. Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 Nm).
   k. Turn cover over and push disconnect rod into cover cap. Rod will be held in place by friction from o-ring.
2. Carrier Assembly.
   a. Drive anti-roll pin (19) into planet shaft (17) using a suitable punch.
   b. Using a suitable press, press planet shaft from carrier (13). After planet shaft is removed, drive anti-roll pin from shaft.
   c. Remove cluster gear (18) and thrust washers (14) from carriers.
   d. Remove needle rollers (15) from cluster gear bore.
   e. Remove spacer (16) from cluster gear bore and remove second set of needle rollers (15).

f. Repeat steps (a) through (e) for remaining two cluster gears.

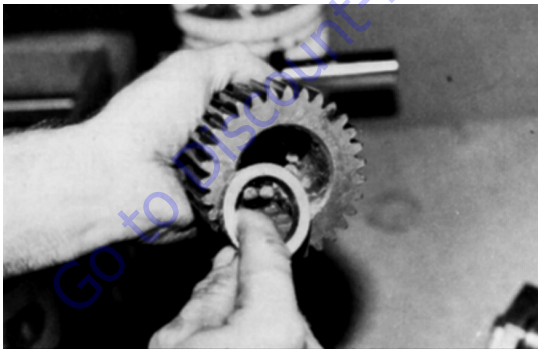
g. Clean and inspect all parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.

h. Apply a coat of grease or petroleum jelly to cluster gear bore.



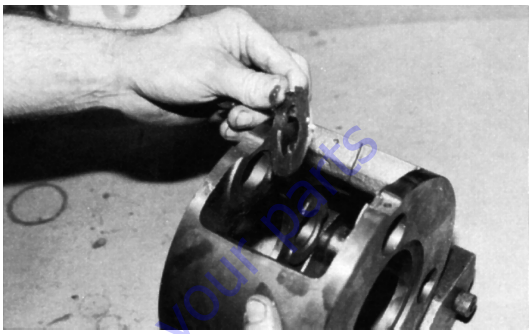
i. Place needle rollers into cluster gear bore.

j. Place spacer into opposite side of cluster gear and against needle rollers.

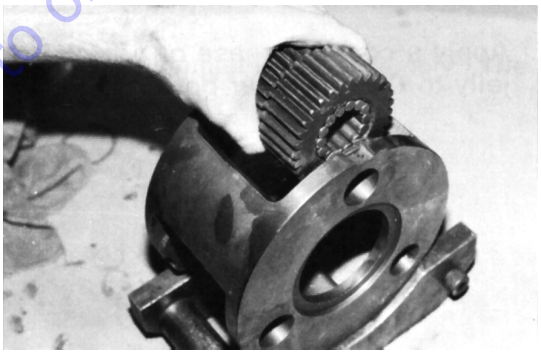


k. Place second set of needle rollers into cluster gear.

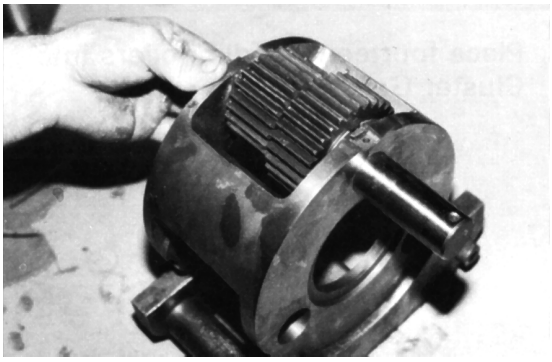
l. Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.



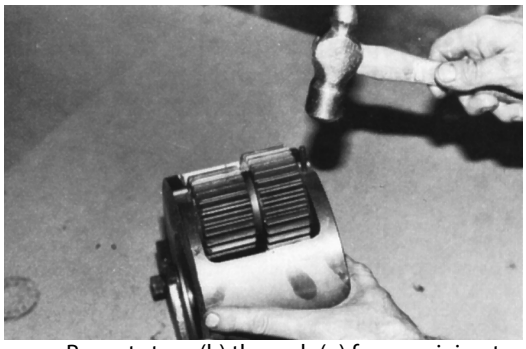
m. While keeping thrust washers in place, slide cluster gear into carrier with larger gear on side with small pin hole.



n. Line up cluster gear and thrust washers with hole in carrier and slide planet shaft through. Ensure chamfered side of hole in planet shaft is lined up with pin hole in carrier.



o. Drive anti-roll pin flush into carrier hole, locking planet shaft into place.



p. Repeat steps (h) through (o) for remaining two cluster gears.

3. Input Shaft Assembly.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL AND INSTALLATION

a. Carefully remove retaining ring (33) from counterbore in the spindle (1) and discard retaining ring.

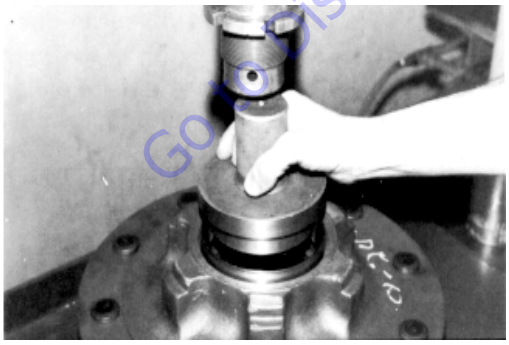
b. Remove two washers (31) and spring (32) from input shaft.

c. Clean and inspect all parts in accordance with Cleaning and Inspection procedures. Replace parts as necessary.

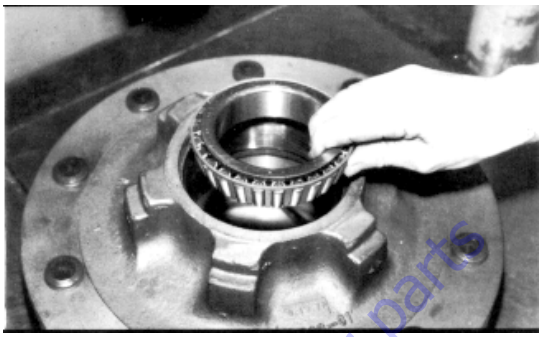
d. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.

Assembly

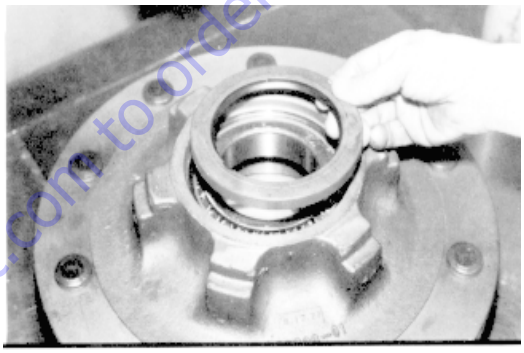
1. Using a suitable press, press new bearing cups (3, 5), with large inside diameters facing out, into hub (7) counterbores.



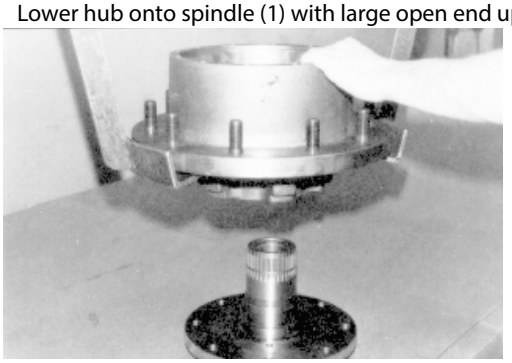
2. Place bearing cone (4) into bearing cup (3) in small end of hub.



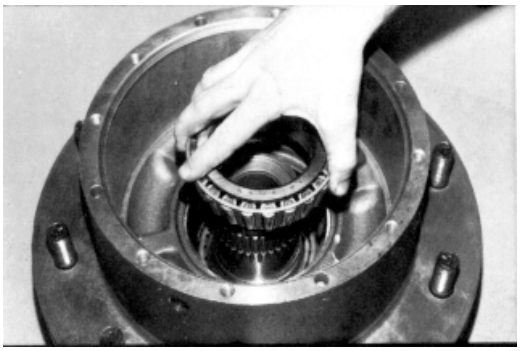
3. Press new seal (2) into hub counterbore with flat metal side facing in. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.



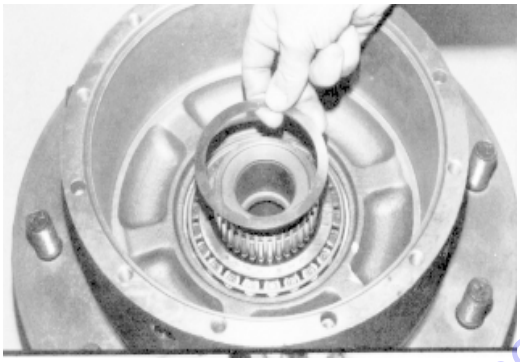
4. Lower hub onto spindle (1) with large open end up.



5. Place bearing cone (6) over end of spindle and into bearing cup.



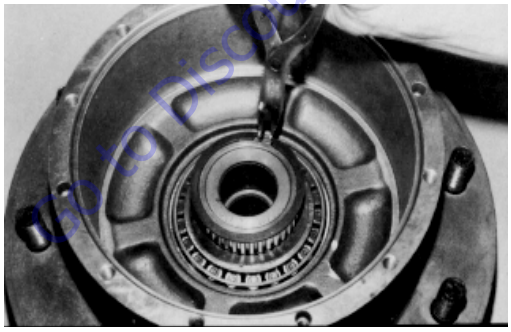
6. Place bearing shim (8) over end of spindle and against bearing cone.



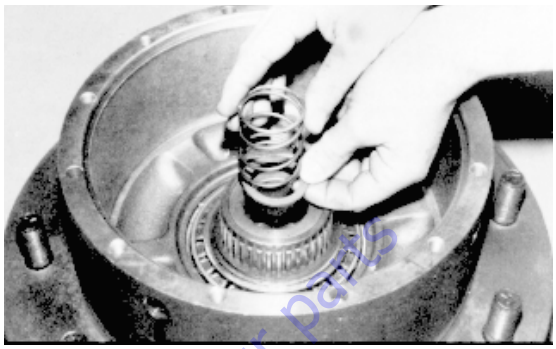
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

7. Install retaining ring (9) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.

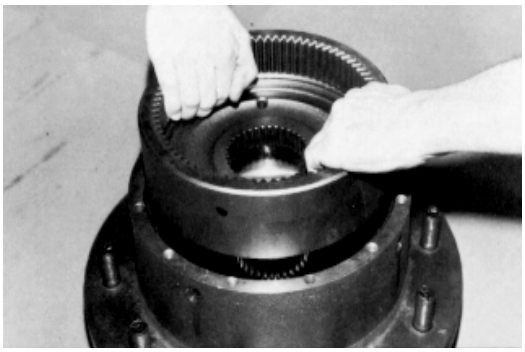


8. The disengage spacer and spring are installed into the counterbore of the spindle.

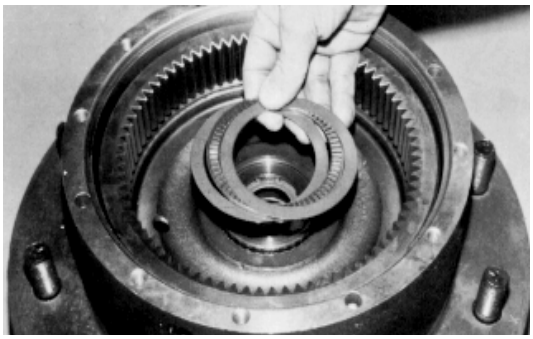


9. Install retaining ring into input shaft groove to secure spacers and spring to shaft.

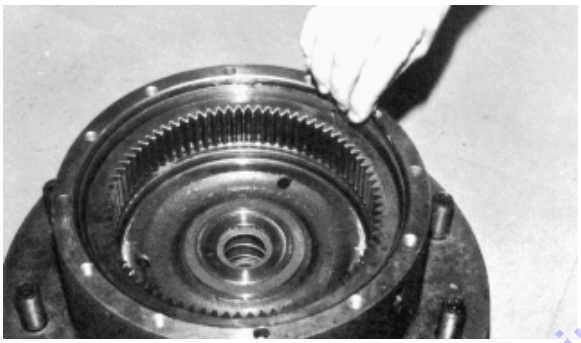
10. Place the internal gear (12) onto end of spindle by matching the bore spline, the spindle spline.



11. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.

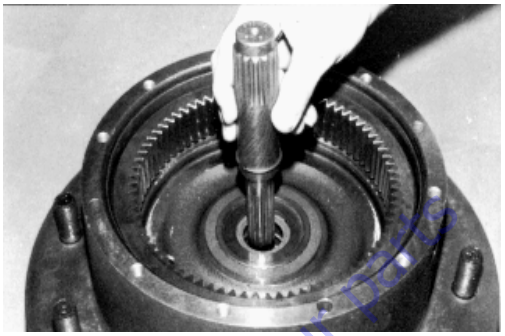


12. The o-ring is placed into the counterbore provided in the hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

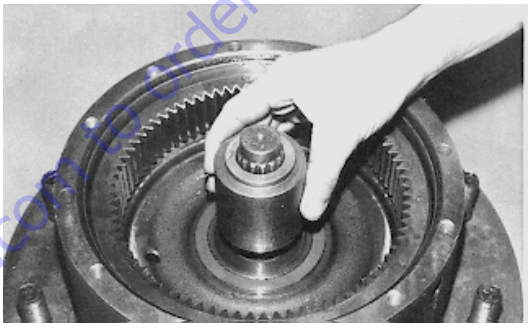


13. Install retaining ring (34) into input shaft retaining ring groove.

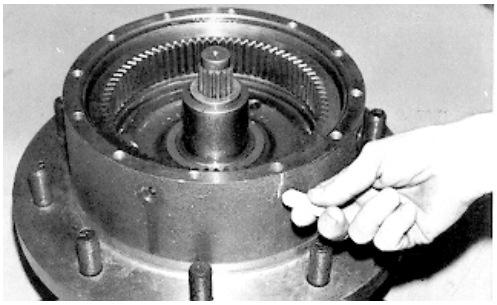
14. Place input shaft assembly (35) into spindle bore with unsplined end facing out.
The action of the spring should be checked at this point.



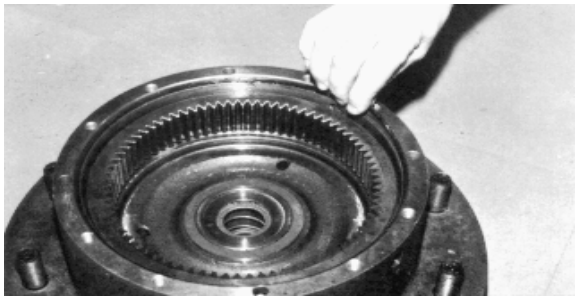
15. Place thrust spacer (36) over input shaft (35) with counterbore side facing spindle.



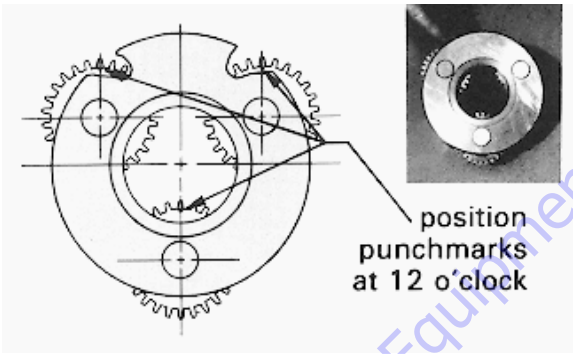
16. Locate the four counter reamed holes in the face of the hub, mark them for later identification.



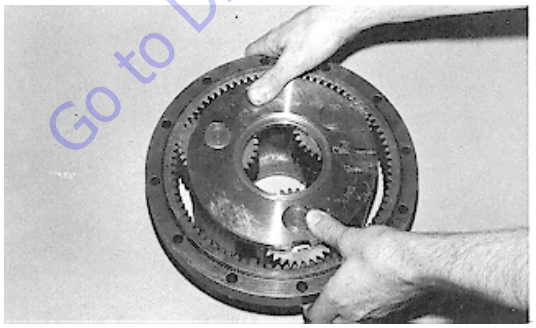
17. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.



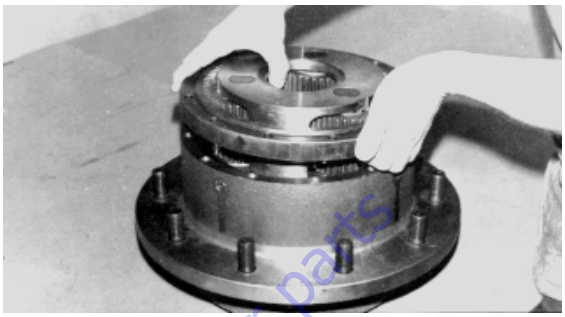
18. Place carrier assembly on a flat surface with large gears up and positioned as shown. Find punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin. Marked tooth will be located just under carrier on upper two gears.



19. With shoulder side of ring gear (21) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation. The side of the ring gear with 'X' stamped on it should be up.

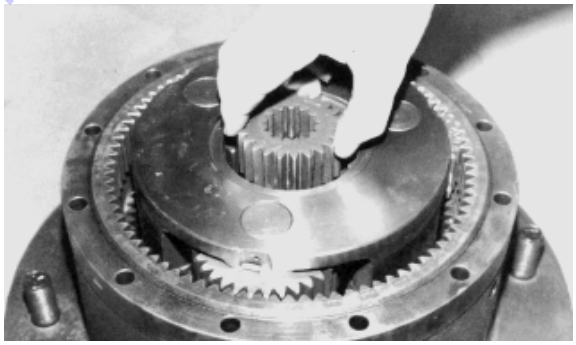


20. While holding ring gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked 'X' over one of the marked counterbored holes in hub.

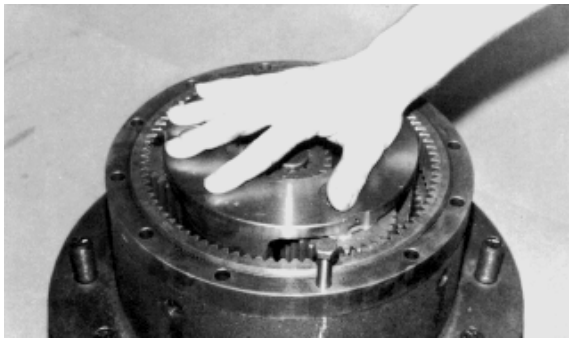


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster gear timing.*

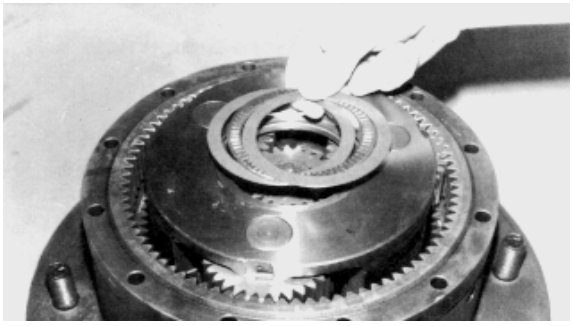
21. Install input gear (37) into the carrier assembly, meshing with large diameter cluster gears (18). Counterbore in bore of input gear must be to outside of carrier assembly.



22. After inserting at least one bolt in the proper location, rotate the carrier. Check freedom of rotation and timing.



23. Install thrust washers and thrust bearing (39, 40) into carrier counterbore.

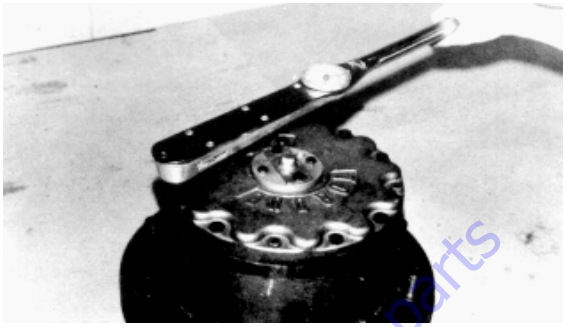


24. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place.

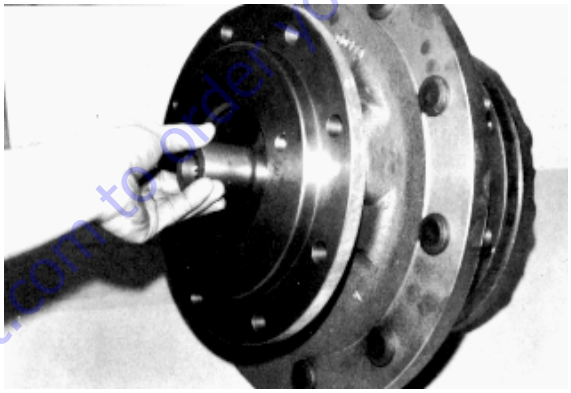
25. Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.

26. Locate four bolts (42), 90 degrees apart into counterbored holes in hub marked in step (16). Torque bolts to 47 ft. lbs. (64 Nm).

27. Install bolts (41) in remaining holes. Torque bolts to 47 ft. lbs. (64 Nm).



28. Place coupling (1) into spindle and onto input shaft.



29. Fill hub one-half full of EPGL 90 lubricant before operation.

1. Spindle
2. Seal
3. Bearing Cup
4. Bearing Cone
5. Bearing Cup
6. Bearing Cone
7. Hub
8. Spacer
9. Retaining Ring
10. Plug
11. Wheel Bolt
12. Internal Gear
13. Carrier
14. Thrust Washer
15. Needle Roller
16. Spacer
17. Planet Shaft
18. Cluster Gear
19. Roll Pin
20. Not Used
21. Cluster Gear
22. O-ring
23. Cover
24. Cover Cap
25. Bolt
26. Disconnect Cap
27. Disconnect Rod
28. O-ring
29. O-ring
30. Pipe Plug
31. Washer
32. Spring
33. Retaining Ring
34. Retaining Ring
35. Input Shaft
36. Thrust Spacer
37. Input Gear
38. Not Used
39. Thrust Washer
40. Thrust Bearing
41. Bolt
42. Coupling

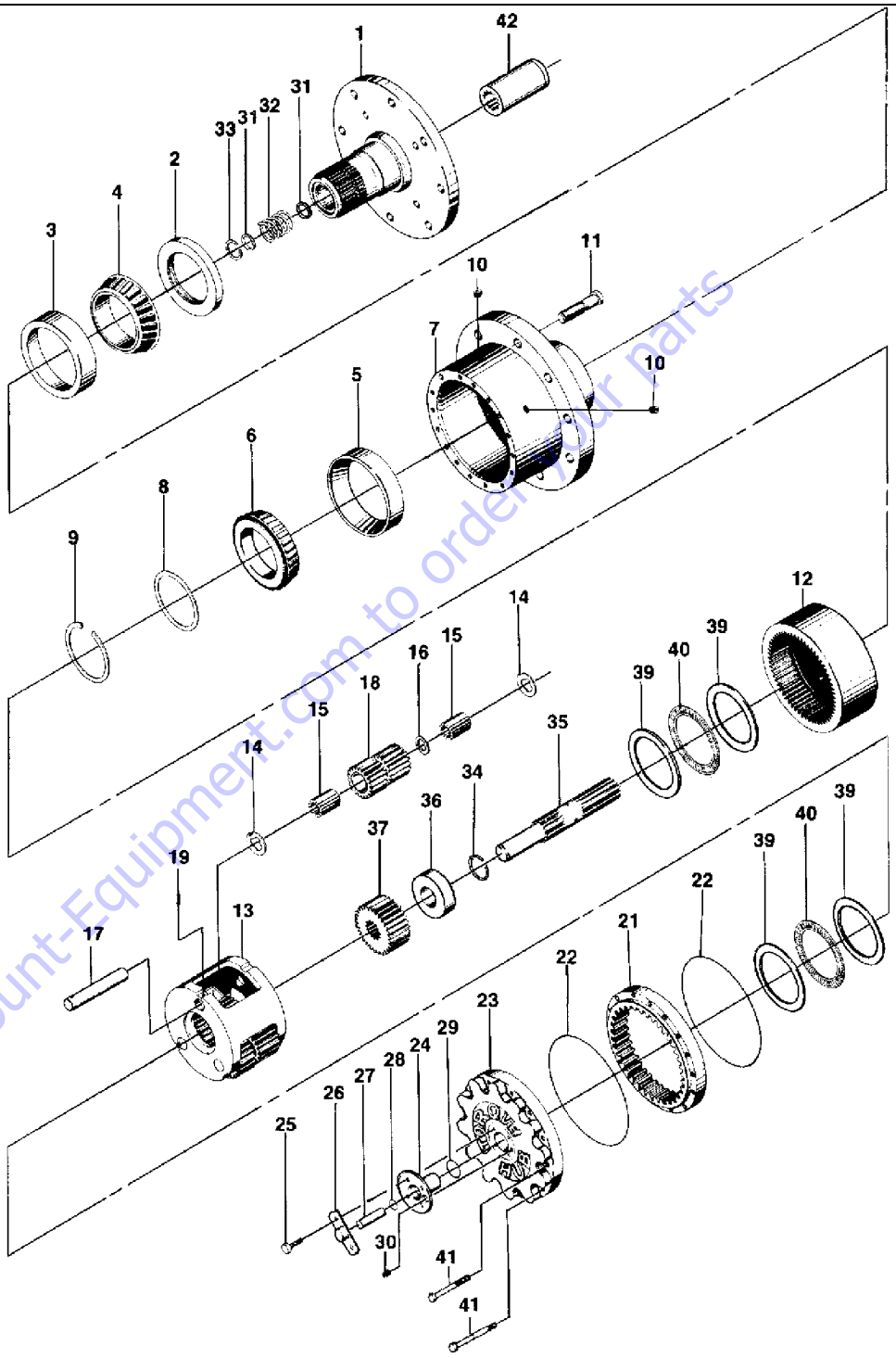


Figure 3-3. Torque Hub Drive (Fairfield)

3.5 DRIVE BRAKE - AUSCO (PRIOR TO S/N 0300056875)

Disassembly

1. With shaft protrusion downward, disassemble the parts in the following order; bolts (24 alternately, washers (23), power plate (21), and gasket.
2. Remove the following parts; stationary discs (14), rotating discs (12), primary disc (11), torque pins (3), springs (8 & 9), and the spring retainer (7).

NOTE: *If the bearing and seal are removed for any reason, both must be replaced.*

3. Further disassembly is not recommended and should not be attempted unless necessary to replace the bearing (4), the seal (6), or the shaft (10). If further dissembly is needed, proceed as follows;
   a. The shaft (10) may be removed by pressing on the end of the shaft with a shop press.
   b. Using an appropriate tool, pry the seal (6) out from the inside of the brake. Take care not to damage the bore. Remove the retaining ring (5). Tap the bearing (4) out with a plastic mallet.
4. Remove the piston (15) from the power plate (21) by introducing low pressure air into the hydraulic inlet and make sure the piston is directed away from the operator. Remove the o-rings (17 & 19) and backup rings (16 & 18) from the piston O.D. and I.D. grooves. Do not remove backup rings (16 & 18) unless replacement is necessary because they will be damaged. With shaft protrusion downward, remove the end cover (13) by removing capscrews (12).

Inspection

5. Clean all parts thoroughly.
6. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.
7. Discard seals and o-rings.
8. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

NOTE: *Bearings may be reused if, after thorough inspection, they are inspection, they are found to be in good condition.*

Assembly

NOTE: *Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.*

NOTICE

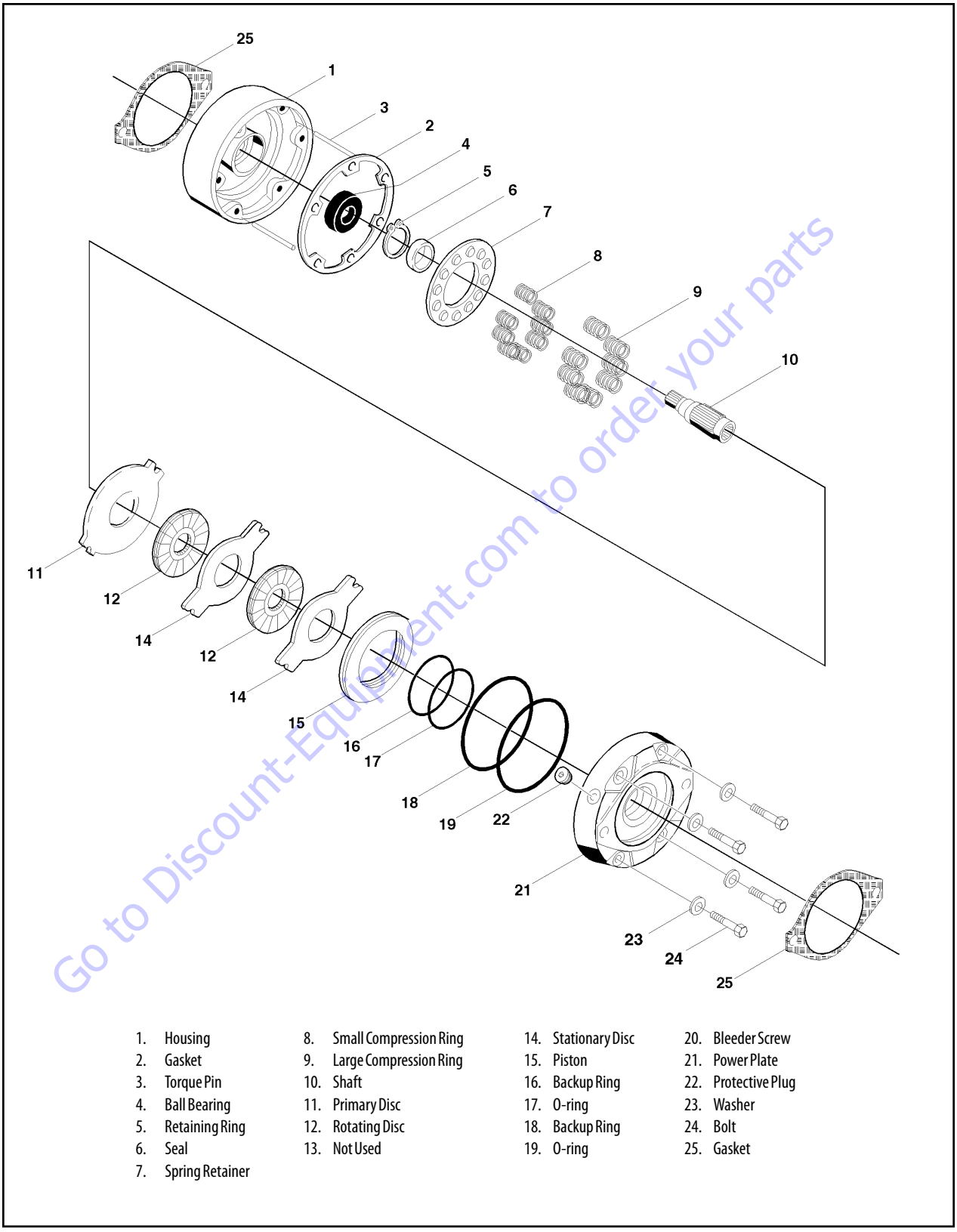
THERE MAY BE MORE PARTS IN A SERVICE KIT THAN YOUR BRAKE REQUIRES. CHECK THE PARTS LIST CAREFULLY FOR THE EXACT QUANTITY. IN THE CASE OF SPRINGS, SPACE THE SPRINGS AS SHOWN IN FIGURE 3-4.

1. Worn o-rings and damaged or worn Teflon backup rings must be replaced prior to assembly.
2. The cylinder of the power plate, piston, and o-rings must be clean prior to assembly and pre-lubed with the system hydraulic fluid.
3. Assemble the piston (15) into the power plate (21) using a shop press, being careful not to damage the o-rings or Teflon back-up rings. Visually align the center of the cutouts in the piston with the torque pin (3) holes in the power plate (21).

⚠ CAUTION

THE DEPTH THE PISTON IS INSTALLED INTO THE POWER PLATE IS CRITICAL. THE SURFACE OF THE PISTON AT THE CUTOUTS MUST BE FLUSH TO 0.120 IN.(3.0 MM) BELOW THE SURFACE OF THE POWER PLATE. DO NOT EXCEED THE 0.120"(3.0 MM) DEPTH OR THE PISTON WILL COCK RESULTING IN COMPLETE LOSS OF BRAKING.

4. For replacement of the seal;
   a. Use a shop press to install the bearing (4) into the housing. Press the outer surface of the bearing only. Install the retaining ring (5) into the groove.
   b. Press the seal (6) into the housing (1) until it is flush with the face of the housing. The lip of the seal must face towards the bearing.
5. Press the shaft into the housing until it stops on the bearing. Support the inner race of the bearing during the press operation.
6. Rotating discs must be clean and dry. The lining material and mating surfaces of the stationary discs must be thoroughly clean and free of debris. Worn or scored rotating discs must be replaced.
7. Install bolts (24) with washers (23) in the power plate (21. Tighten sequentially, one turn at a time, until the power plate is properly seated. Torque 105-115 ft. lbs.(142.4-155.9 Nm)



1. Housing
2. Gasket
3. Torque Pin
4. Ball Bearing
5. Retaining Ring
6. Seal
7. Spring Retainer
8. Small Compression Ring
9. Large Compression Ring
10. Shaft
11. Primary Disc
12. Rotating Disc
13. Not Used
14. Stationary Disc
15. Piston
16. Backup Ring
17. O-ring
18. Backup Ring
19. O-ring
20. Bleeder Screw
21. Power Plate
22. Protective Plug
23. Washer
24. Bolt
25. Gasket

Figure 3-4. Drive Brake, Ausco (Prior to S/N 0300056875)

3.6 DRIVE BRAKE - MICO (S/N 0300056875 TO S/N 0300083332)

Disassembly

1. Remove pressure plate (3) from cover plate (16) by removing cap screws (1) and washers (2).

⚠ CAUTION

PRESSURE PLATE IS UNDER SPRING TENSION OF APPROXIMATELY 907 KGF (2000 IBS). THE TWO CAP SCREWS MUST BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE, 1361 KGF (3000 IBS) MINIMUM, THE PRESSURE PLATE CAN BE HELD IN POSITION WHILE REMOVING THE CAP SCREWS. COVER PLATE (16) MUST BE SUPPORTED AS SHOWN IN FIGURE 3-5.

2. Remove case seal (4) from cover plate (16).
3. Remove piston (7) from pressure plate (3).
4. Remove o-ring (5), back-up ring (6), o-ring (8) and back-up ring (9) from piston (7).
5. Remove stator disc (11), rotor disc (12) and return plate (13) from cover (16).

NOTE: *Not all models use the same number of springs or spring pattern.*

6. Remove dowel pins (15) and springs (14) from cover plate (16). Record spring pattern for assembly purposes.
7. Remove retaining ring (19) from cover plate (16).
8. Remove shaft (10) by pressing or using a soft mallet on male end of shaft (10).

NOTE: *Cover plate (16) must be supported as shown in FIGURE 3-5.*

9. Remove retaining ring (20) from cover plate (16) and press out oil seal (17) and bearing (18) if required.

NOTE: *Cover plate (16) must be supported as indicated in Figure 3-5.*

Assembly

NOTICE

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Use an alkaline wash to clean parts before assembly.
2. Press oil seal (17) into cover plate (16) until it is flush with bearing shoulder. Note direction of seal.
3. Press bearing (18) into position until it bottoms out on borestep.

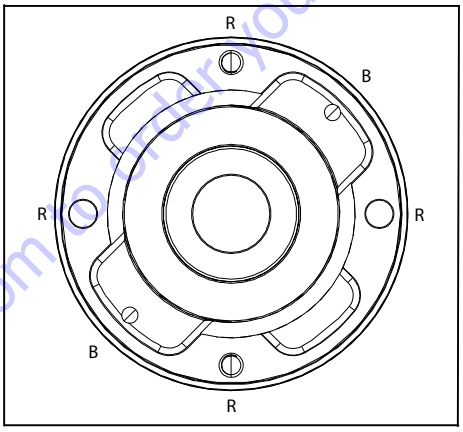
NOTE: *Cover plate (16) must be supported as indicated in Figure 3-5.*

4. Install retaining ring (20) in cover plate (16).
5. Press shaft (10) into bearing (18) until it bottoms on shoulder.

NOTE: *Bearing (18) inner race and cover plate (16) must be supported as indicated in Figure 1 during this operation.*

6. Install retaining ring (19) on shaft (10).
7. Insert dowel pins (15) and springs (14) in cover plate (16).

NOTE: *Be sure to use the same number of springs and spring pattern as recorded during disassembly.*



NOTE: *Start with the red springs and space them as evenly as possible throughout the spring retainer, then take the first blue spring and put it in any one of the remaining empty holes, second blue spring should be placed as directly across from the first blue spring as possible.*

8. Position return plate (13) on springs (14).

NOTE: *Discs (11 & 12) and return plate (13) must remain dry during installation. No oil residue must be allowed to contaminate disc surfaces.*

9. Install rotor disc (12) and stator disc (13).
10. Install o-ring (5), back-up ring (6), a-ring (8) and back-up ring (9) on piston (7). Note order of a-rings and back-up rings. Insert piston (7) into pressure plate (3).

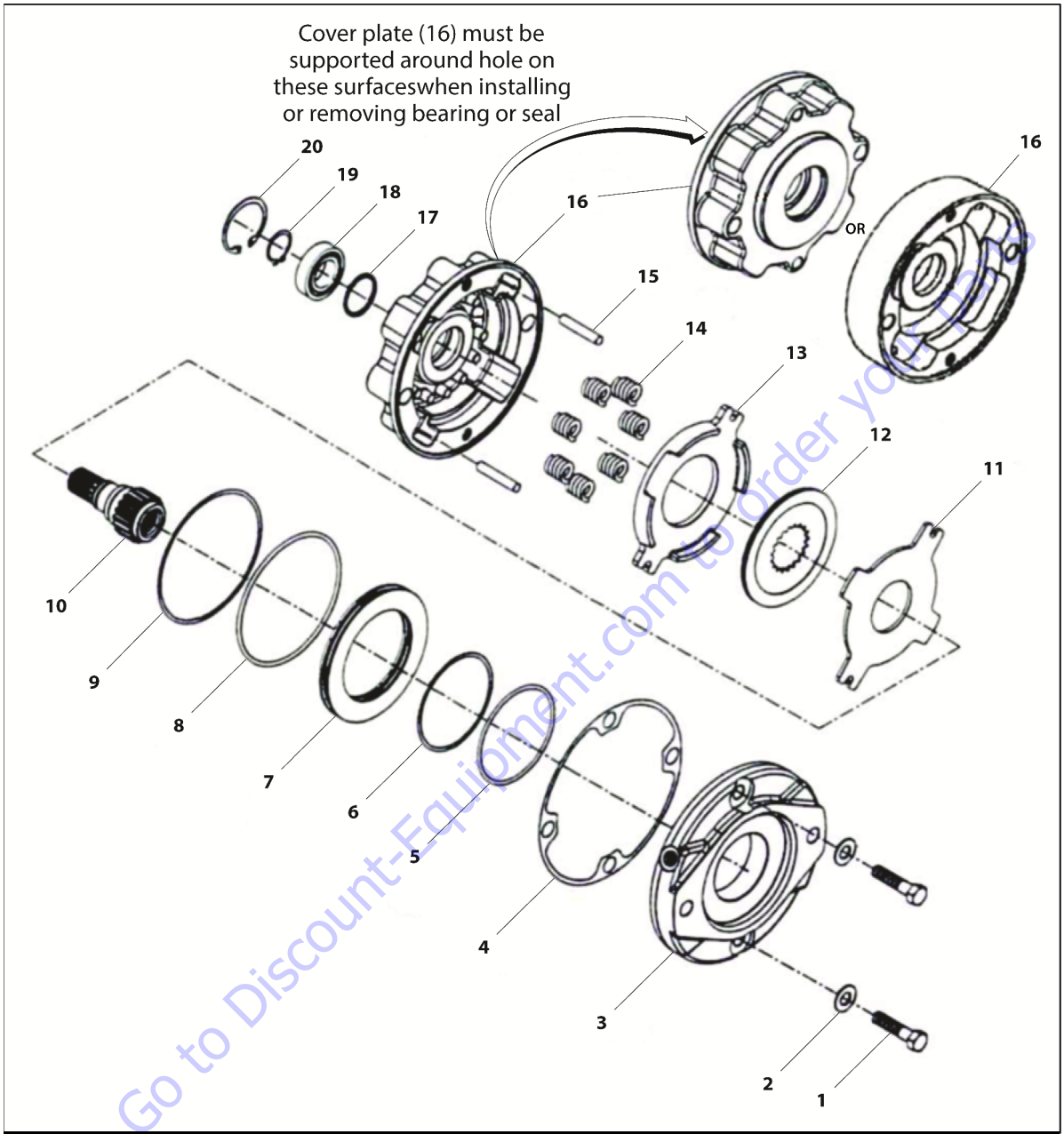
NOTE: *Be careful not to shear o-rings or back-up rings. Be careful not to scratch or mar piston.*

11. Install new case seal (4) in cover plate (16).
12. Position pressure plate (3) on cover plate (16) aligning dowel pins (15) with holes in pressure plate.
13. Install cap screws (1) and washers (2) and tighten evenly to draw pressure plate (3) to cover plate (16). Torque cap screws 65.1-67.8 N-m (48-50 lb-ft).

NOTE: *A hydraulic press will simplify installation of pressure plate on cover. Clamp pressure plate in position while tightening the cap screws. Cover plate (16) must be supported as indicated in Figure 3-5.*

⚠ CAUTION

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE MUST NOT EXCEED 134.5 BAR (500 PSI).



1. Capscrew
2. Washer
3. Pressure Plate
4. Case Seal
5. O-ring
6. Backup Ring
7. Piston
8. O-ring
9. Backup Ring
10. Shaft
11. Stator Disc
12. Rotor Disc
13. Return Plate
14. Springs
15. Dowel Pin
16. Cover Plate
17. Oil Seal
18. Bearing
19. Retaining Ring
20. Retaining Ring

Figure 3-5. Drive Brake - Mico (S/N 0300056875 to S/N 0300083332)

Bleeding

1. Install brake in system and connect pressure lines.
2. Bleed pressure release section of brake by pressurizing side inlet port and allowing air to escape from top port. Pressure should not exceed 6.9 bar (100 psi) during bleeding.
3. Apply sufficient pressure to release brake and check for proper operation in system.

Table 3-2. Troubleshooting

PROBLEM	CAUSE	EXPLANATION	ACTION
Brake slips	Excessive pressure in hydraulic system	If there is back pressure in the actuation line of the brake, holding torque will be reduced.	Check filters, hose size, restrictions in other hydraulic components.
	Oil in brake if designed for dry use	Wet linings generate 67% of the dry torque rating. If the brake has oil in it, check the type of oil hydraulic or gearbox. 1. Gearbox oil 2. Hydraulic oil	Replace oil seal in brake. Check motor seal Check piston seals **NOTE:** *Internal components will need to be inspected, cleaned and replaced as required.*
	Disc plates worn	The thickness of the disc stack sets the torque level. A thin stack reduces torque.	Check disc thickness.
	Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - a rare occurrence.	Check release pressure. (See spring replacement).
Brake drags or runs hot	Low actuation pressure	The brake should be pressurized to minimum of 1.38 bar (20 psi) over the full release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system on.
	Bearing failure	If the bearing should fail, a large amount of drag can be generated.	Replace bearing.
Brake will not release	Stuck or clogged valve	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure. Replace inoperative line or component.
	Bad o-rings	If release piston will not hold pressure, brake will not release.	Replace o-rings.
	Discs frozen	These brakes are designed for only limited dynamic braking. A severe emergency stop or prolonged reduced release pressure operation may result in this type of damage.	Replace disc stack.

3.7 DRIVE BRAKE (S/N 0300083332 TO S/N 0300183033)

Disassembly

1. Supporting brake:, remove the six socket head capscrews and washers [Items 13 & 14) In equal increments to ensure the spring pressure within the brake is reduced gradually and evenly.

   If a press is available, the cylinder housing (8) can be restrained while removing the six capscrews and washers (13 & 14).

   The brake assembly can now be fully dismantled and the parts examined.
2. Remove cylinder housing (8) and piston (9) subassembly and dismantle if required, removing O-ring seals (15 & 17) and backing rings (16 & 18) as necessary.
3. Remove gasket (7) from housing (2).
4. Remove friction plates (3 & 6) and pressure plate (4).
5. Remove 2 dowel pins (19).
6. Remove springs (22 & 23).
7. Should it be necessary to replace ball bearing (10) or shaft seal (12), reverse remainder of brake subassembly, supporting on face C of housing (2).
8. Remove internal retaining ring (11).
9. Using arbor press or similar to break Loctite seal, remove brake shaft (1) from housing (2) and lay aside.
10. Reverse housing (2) and press out ball bearing (10). Shaft seal (12) can also be removed if necessary.

Inspection

1. Inspect friction plates (3 & 6) and friction surface on pressure plate (4) for wear or damage.
2. Examine friction plates (3) and brake shaft (1) for wear or damage to the splines.
3. Examine input and output splines of brake shaft (1) for wear or damage.
4. Examine compression springs (22 & 23) for damage or fatigue.
5. Check ball bearing (10) for axial float or wear.
6. Examine O-ring seals (15 & 17) and backing rings (16 & 18) for damage.

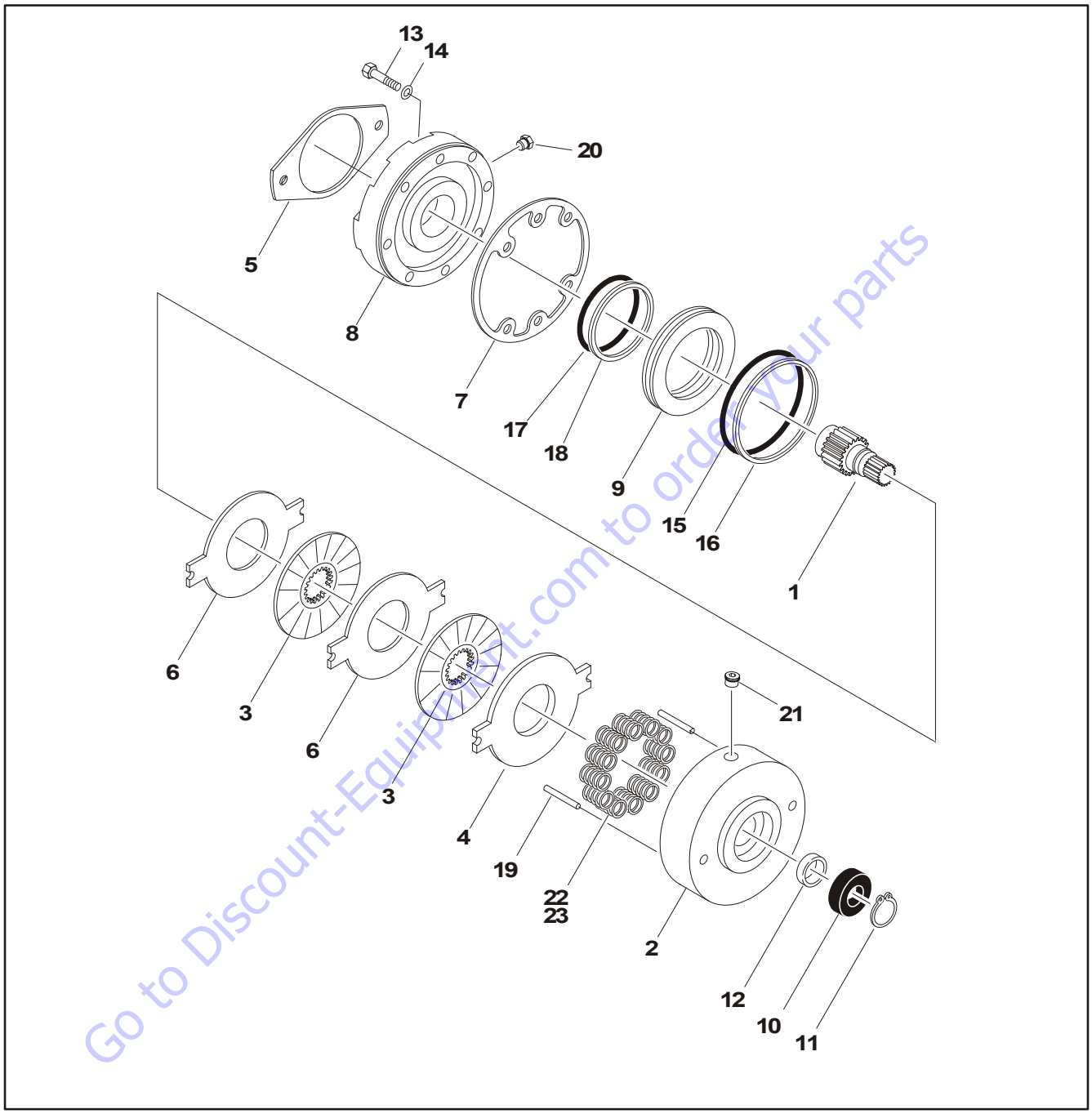
Assembly

1. Lightly lubricate rotary shaft seal (12) and assemble to housing (2) taking care not to damage seal lip.
2. Apply ring of Loctite 641 or equivalent adhesive to full circumference of housing (2) bearing recess adjacent to shoulder.

   Apply complete coverage of Loctite 641 to outside diameter of bearing (10) and assemble fully In housing (2), retaining with internal retaining ring (11). Remove excess adhesive with a clean cloth.

   Press shaft (1) through bearing (10), ensuring bearing inner ring Is adequately supported.
3. Assemble correct quantity of springs (22 & 23) in orientation required.
4. Lubricate O-ring seals (15 & 17) with Molykote 55M (or equivalent) silicon grease and assemble together with backing rings (16 & 18) to piston (9). To ensure correct brake operation. It is important that the backing rings are assembled opposite to the pressurized side of piston.
5. Correctly orientate piston (9) aligning spaces with the two dowel pin holes and, assemble into cylinder housing (8) taking care not to damage seals and carefully lay aside.
6. Locate 2-off pins (19) in housing (2) followed by pressure plate (4) and friction plates i.e. an inner (3) followed by an outer (6) in correct sequence.
7. Position gasket (7) in correct orientation.
8. Align two holes in cylinder with dowel pins (19) and assemble piston & cylinder sub-assembly to remainder of brake securing with 6 capscrews and washers (13 & 14). Torque to 55 ft.lbs. (75 Nm).

NOTE: *The use of a suitable press (hydraulic or arbor) pressing down on cylinder end face B will ease assembly of the capscrews (13).*



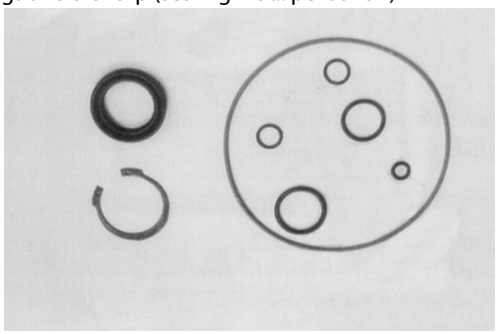
1. Shaft
2. Housing
3. Friction Plate
4. Pressure Plate
5. Gasket
6. Outer Plate
7. Gasket
8. Cylinder
9. Piston
10. Ball Bearing
11. Retaining Ring
12. Shaft Seal
13. Capscrew
14. Lockwasher
15. O-ring
16. Backup Ring
17. O-ring
18. Backup Ring
19. Dowel Pin
20. Plug
21. Plug
22. Spring (Natural)
23. Spring (Blue)

Figure 3-6. Drive Brake (S/N 0300083332 to S/N 0300183033)

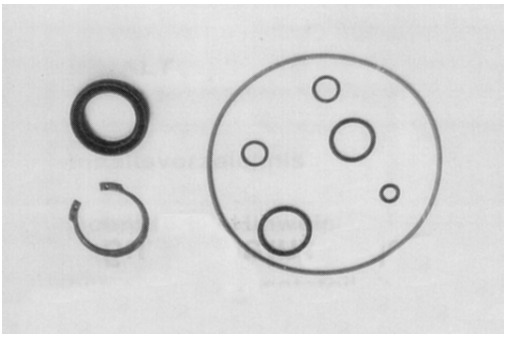
3.8 DRIVE MOTOR (PRIOR TO S/N 0300083332)

Spare Parts Kits

Sealing kit, existing spare parts: shaft sealing ring, 6 different O-rings and a circlip (sealing mat.: perbunan)

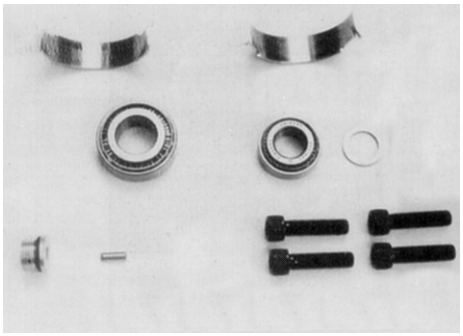


Same sealing kit like shown above only seal material changed to Viton

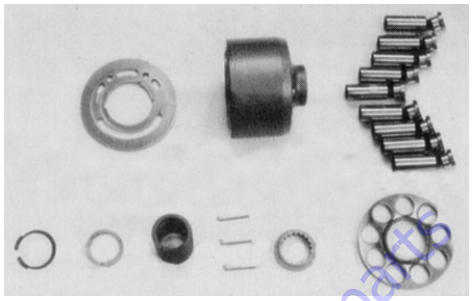


Drive shaft

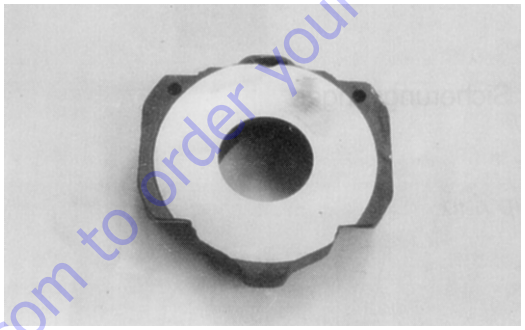
Bearing set/miscellaneous parts



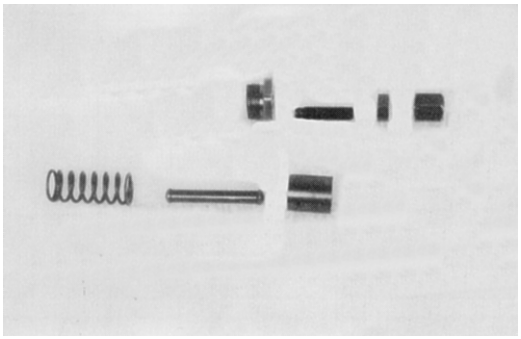
Rotary group complete 9 pistons, cylinder sub-assembly, valve plate (cw or ccw corresponding to the order) retaining plate and retaining ball.



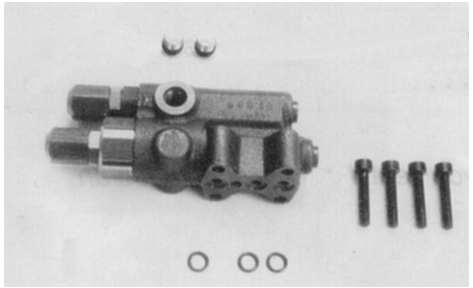
Swash Plate



Parts of the control device: control piston, piston rod, plug, spring stopper max flow, hex. nut, and hex. head nut



Spare parts kit DFR pilot valve



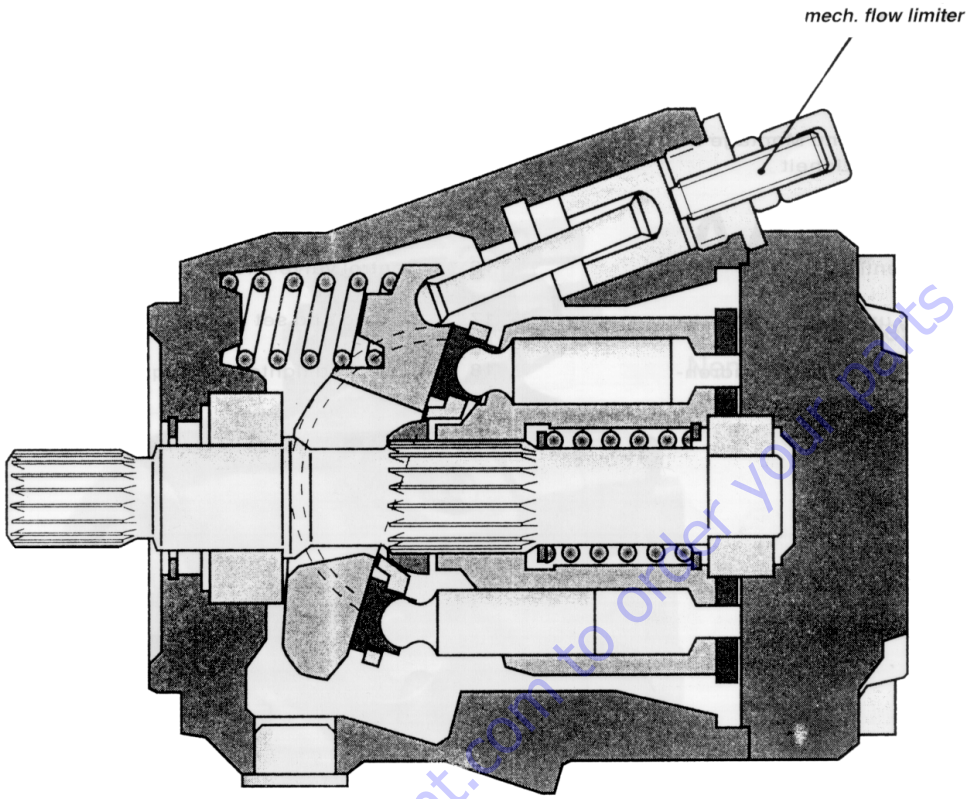
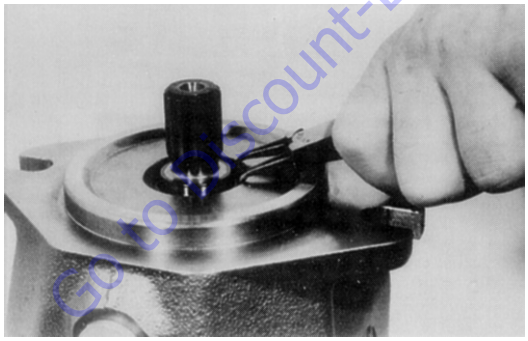


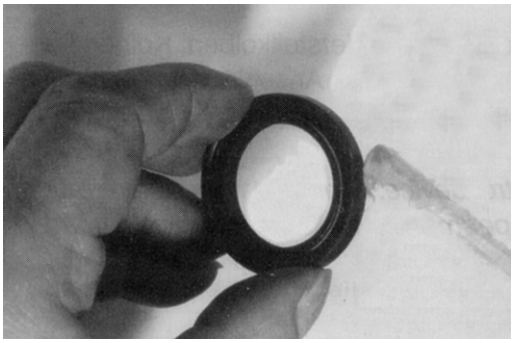
Figure 3-7. Drive Motor Cutaway

Replacing the Drive Shaft Seal

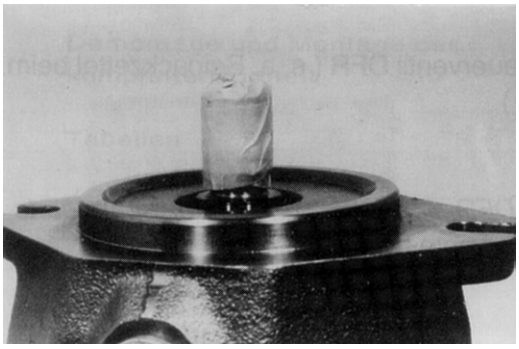
1. Remove the snap ring



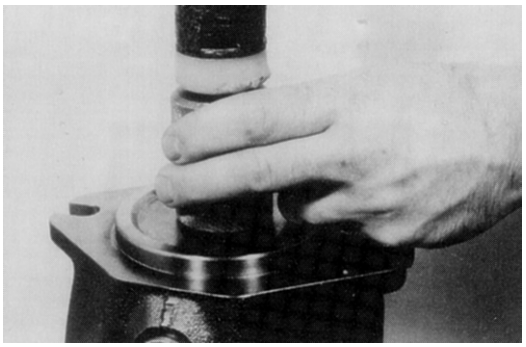
2. Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.



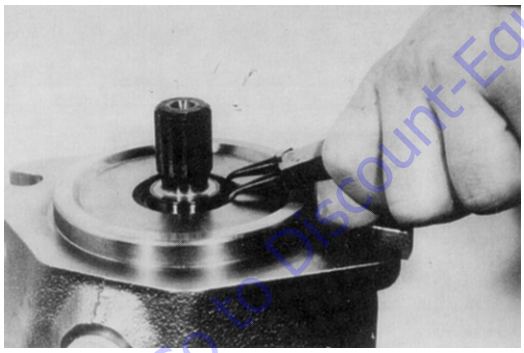
3. Be careful while you seal the drive shaft, use an adhesive tape to protect the splines.



4. Assemble the sealing ring. The fitting tool will hold the sealing ring in the correct position in the pump housing.



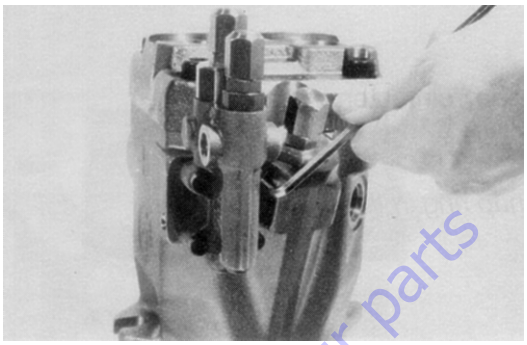
5. Assemble the snap ring.



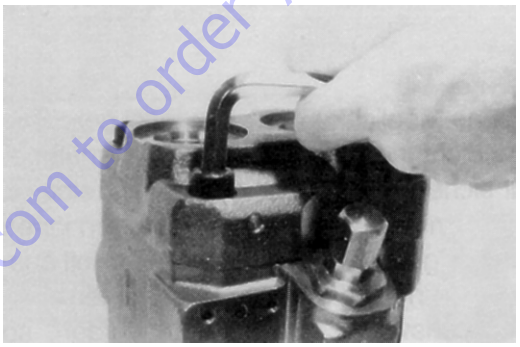
6. Assemble the snap ring in the correct position.

Disassembly and Assembly

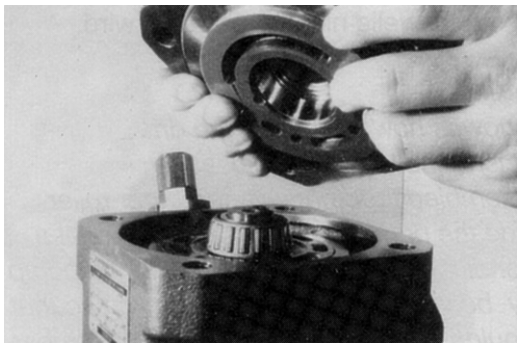
1. Disassemble the pilot valve.



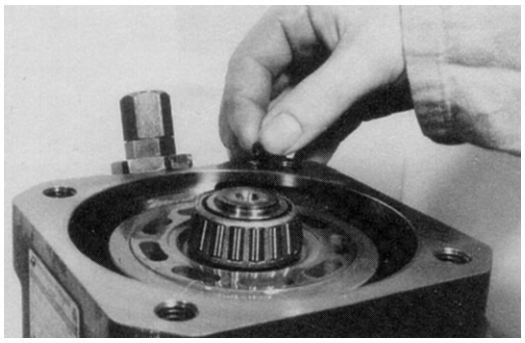
2. Mark the position of the port plate and remove the socket screw from the port plate.



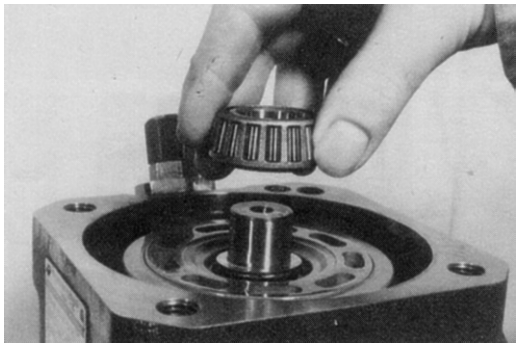
3. Remove the port plate together with the valve plate (hold the valve plate so that the plate can't fall down).



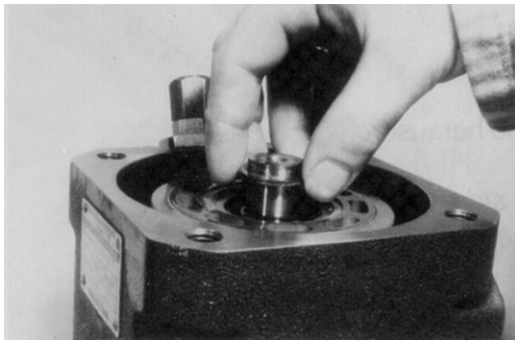
4. Remove the O-ring.



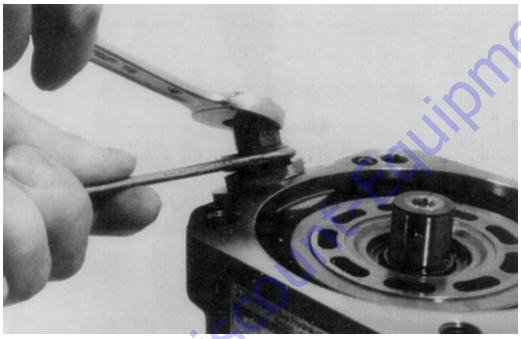
5. Disassemble the taper roller bearing.



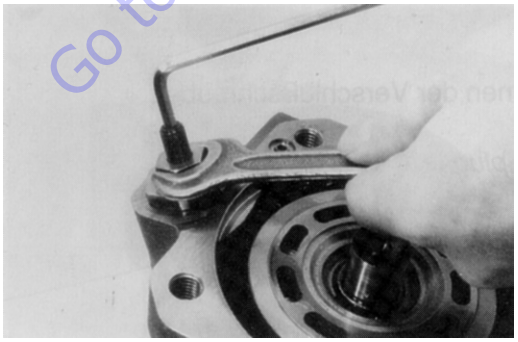
6. Remove the adjustment shim.



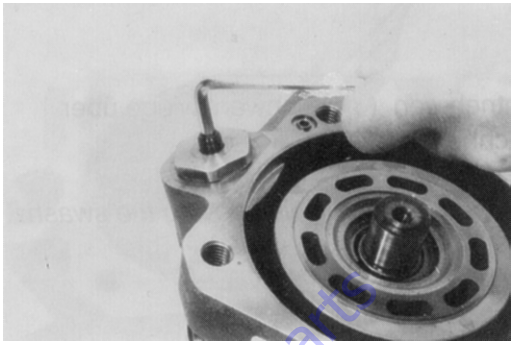
7. Unscrew the cap nut and remove it.



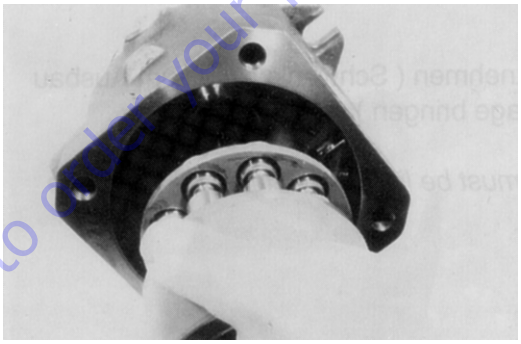
8. Loosen the retaining nut of the stopper max flow and remove it.



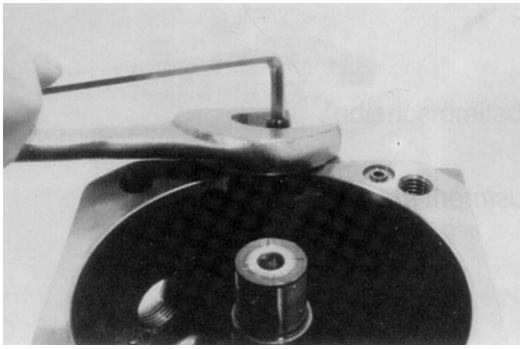
9. Turn in the stopper max flow to get swivel angle zero.



10. Disassemble the rotary group in horizontal position.



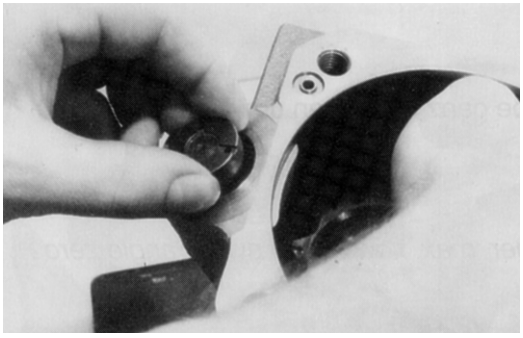
11. Disassemble the stopper - max. flow.



12. Remove the threaded pin (stopper - max.flow)

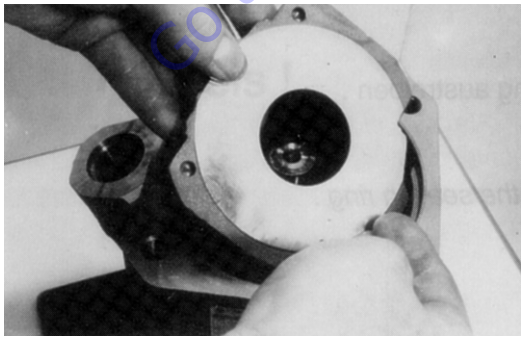
13. Disassemble the plug.

14. Disassemble the control piston while moving the swash plate.

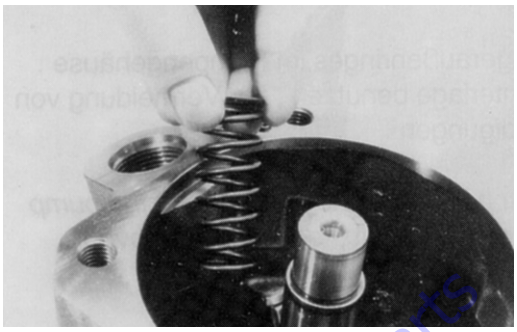


15. The swash plate must be lifted a little bit to disassemble the piston rod.

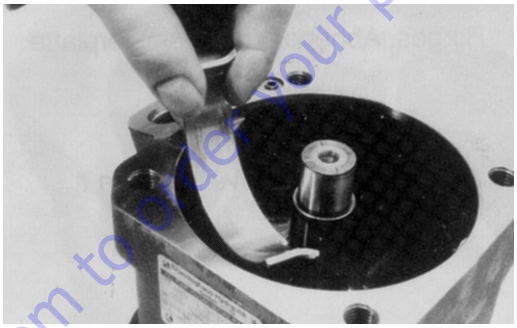
16. Disassembly of the swash plate.



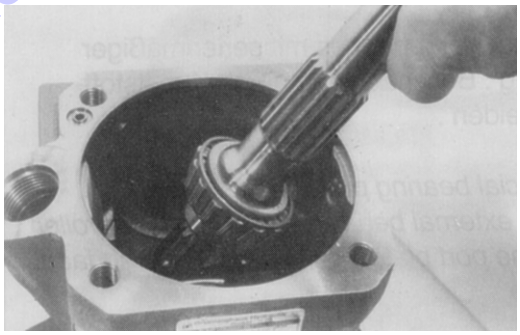
17. Remove the spring.



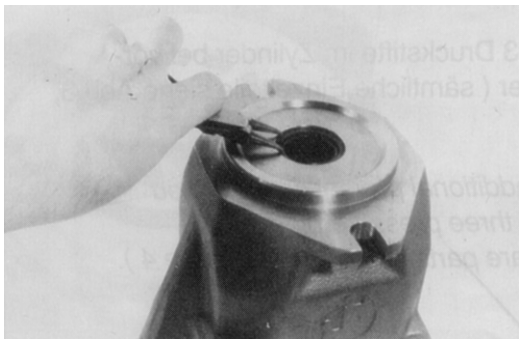
18. Remove both bearing shells.



19. Remove the drive shaft.

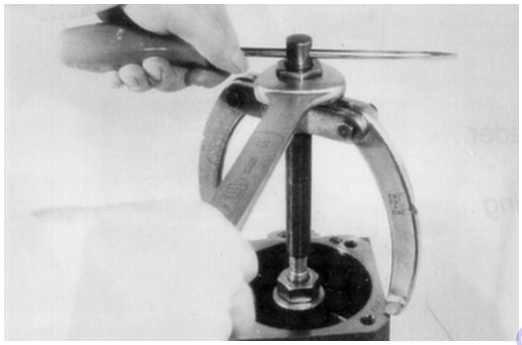


20. Remove the snap ring.

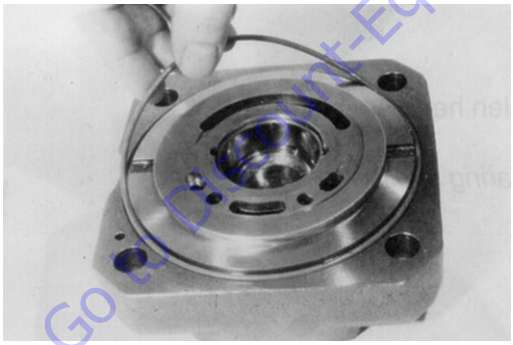


21. Disassemble the sealing ring.

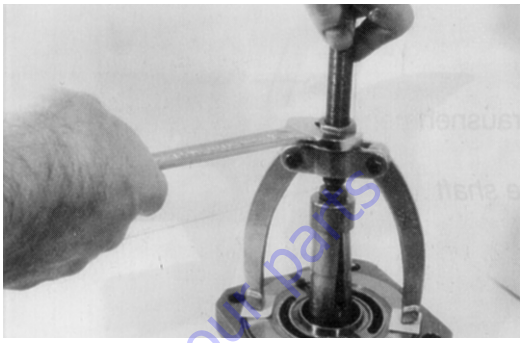
22. The external front bearing ring is pulled out of the pump housing.



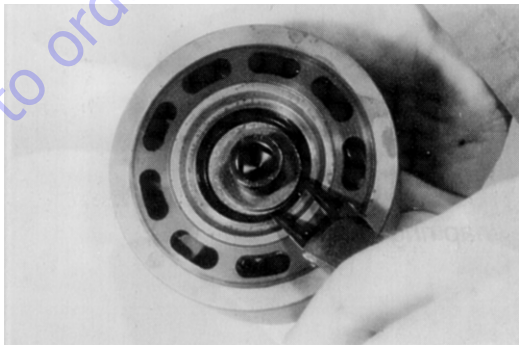
23. Remove the O-ring. Lifting of the valve plate isn't shown.



24. A usual commercial bearing puller is used to disassemble the external bearing ring of the taper roller bearing inside the port plate. Take care not to damage the surface of the port plate.

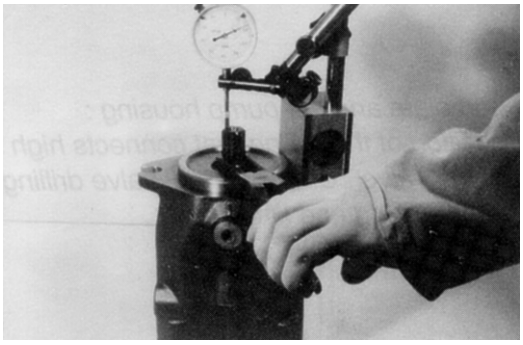


25. The spring has additional pretension while you disassemble the three pressure pins inside the cylinder.

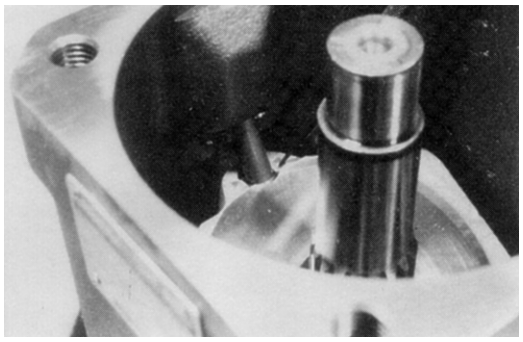


Assembly Notes

1. Measurement of the taper roller bearing pretension.

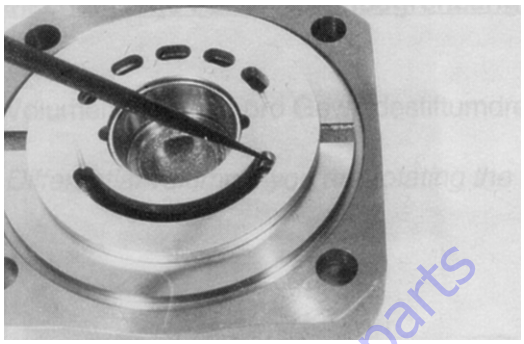


2. Note that there is a correct connection of the piston rod and the swash plate.

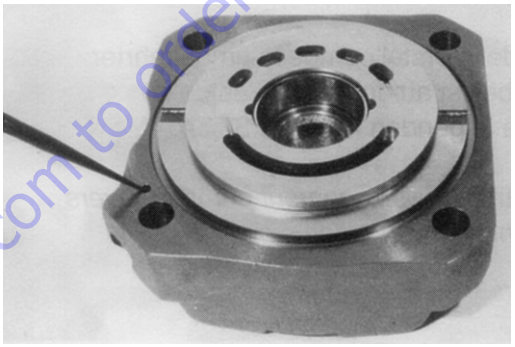


3. Pumps clockwise driven must have a position to the valve plate 4 degrees out of center in the same direction de-centered like drive direction. (Note spare parts exist as cw and ccw valve plates.)

4. Pumps counterclockwise driven must have a position of the valve plate 4 degrees de-centered in ccw position.

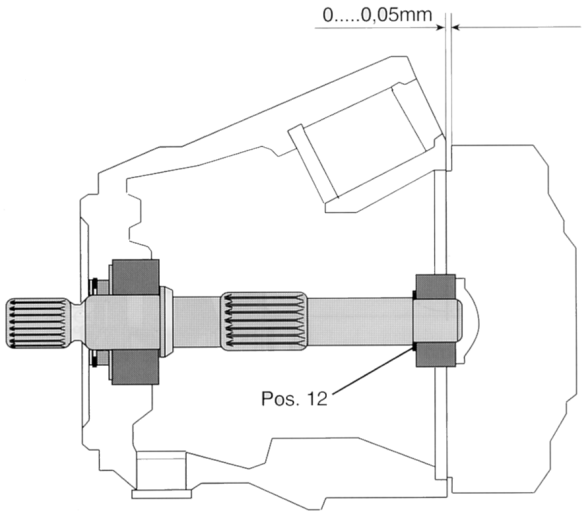


5. Assembly of the port plate and the pump housing: Note the correct position of the drilling that connects high pressure to the control valve. Check control valve drill position at the pump housing and fit together.

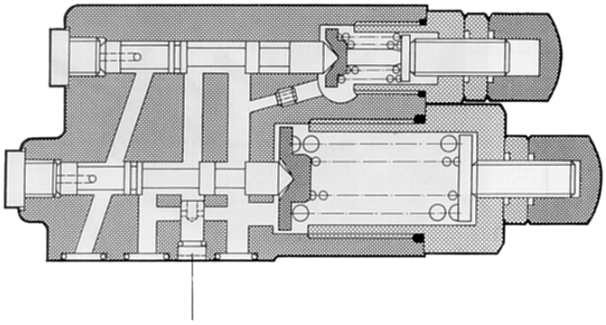


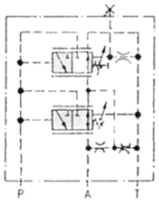
Taper Roller Bearing Initial Tension

Cast iron pump housing must have initial tension of the bearings: 0.....0,05 mm, grind Pos. 12 if necessary.

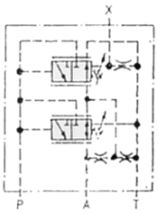


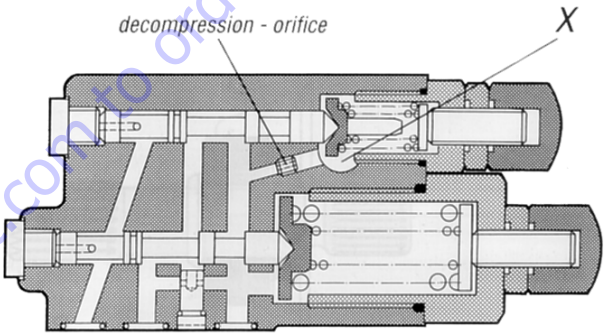
all valves shown here do have open position of the orifice (see picture below "pos. of orifice").



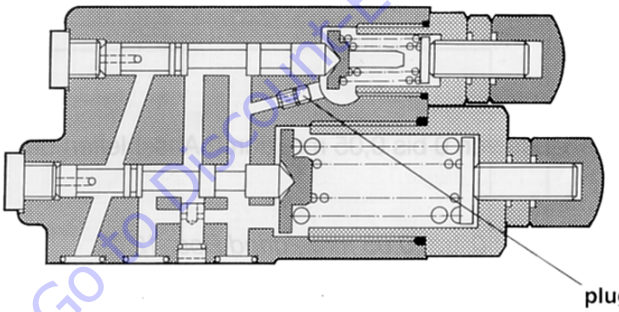


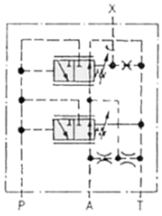
pressure compensator DR
Both X- ports are pluged .
Flow control blocked.



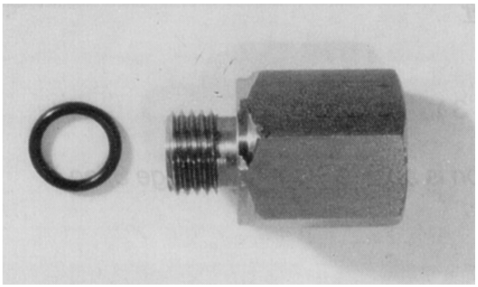


pressure compensator and flow control DFR
One X - port is plugged .





pressure compensator and flow control DFR 1
One X - port is pluged . Decompression orifice X-T is pluged by the plug.



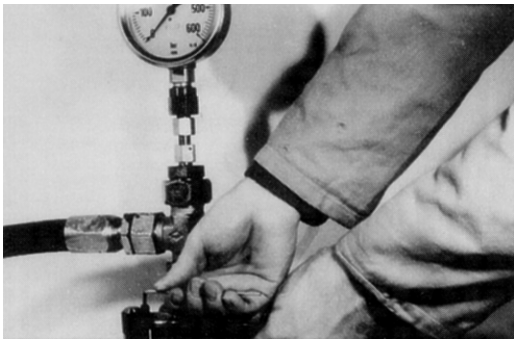
Adapter without orifice of the DFR-pilot valve , if you use a metric pilot pipe connection X .

NOTE: *Differential volume if you are rotating the threaded pin - each rotation is appr. 3,1 cm3.*

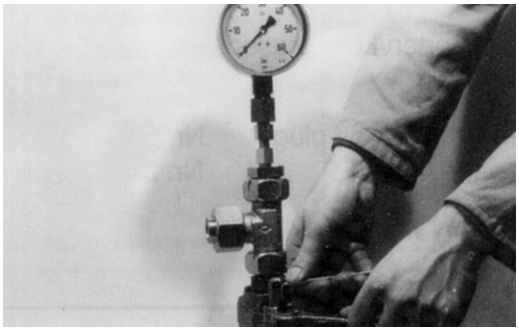
Figure 3-8. Flow Control Pilot Valves

Testing and Setup

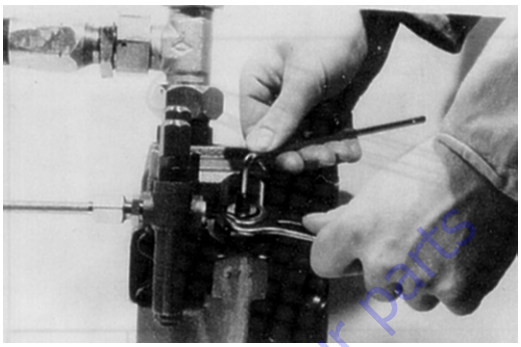
DR: When pressure line is closed adjust the pressure of the controller (if it's DFR design then open the adjustable orifice and increase force of the spring - FR -).



FR: If swivel angle is in the mid position adjust differential pressure 14 bar adjustable orifice is partly closed).



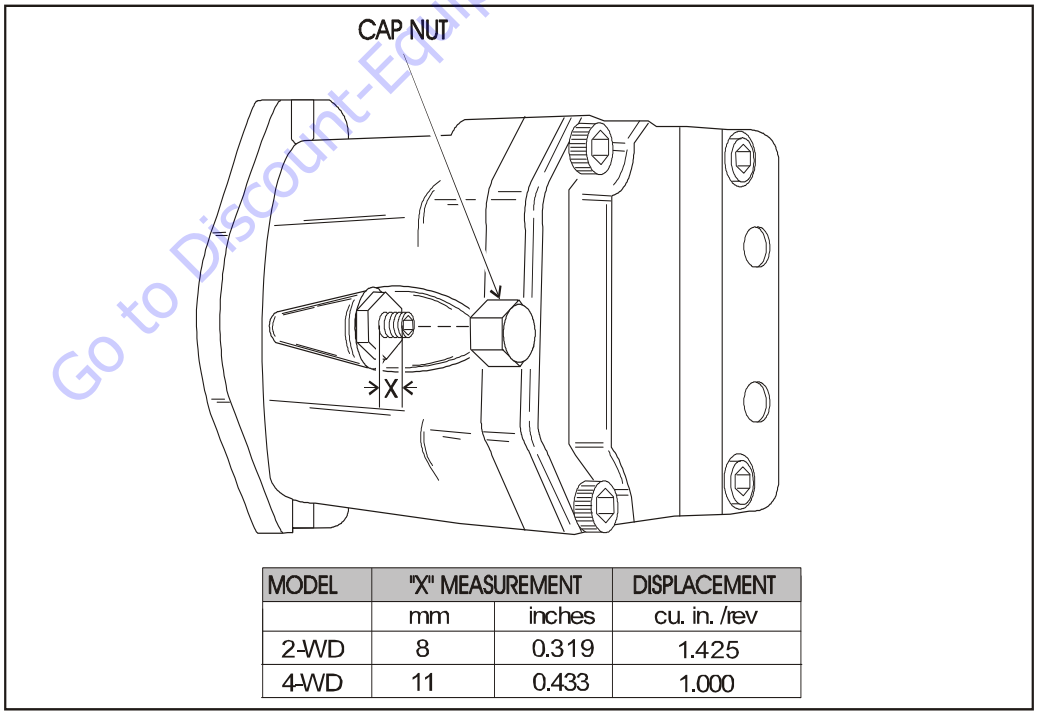
Mechanical flow limiter: While screwing in the threaded pin you will be able to reduce the flow from Vg max to 50% of Vg max.



3.9 DRIVE MOTOR ADJUSTMENT PROCEDURE (PRIOR TO S/N 0300083332)

1. Remove the cap nut from adjustment screw.
2. Loosen jam nut on the adjustment screw and make adjustment.
3. Measure from top of jam nut to the end of adjustment screw. Refer to Figure 3-9., Drive Motor Adjustment (Prior to S/N 0300083332).
4. Tighten jam nut, install cap nut.

NOTE: *The "o" ring must be seated in groove in cap nut.*



MODEL	"X" MEASUREMENT		DISPLACEMENT
	mm	inches	cu. in. /rev
2-WD	8	0.319	1.425
4-WD	11	0.433	1.000

Figure 3-9. Drive Motor Adjustment (Prior to S/N 0300083332)

3.10 DRIVE MOTOR (S/N 0300083332 TO S/N 0300183033)

Description

The drive motors are low to medium power, two-position axial piston motors incorporating an integral servo piston. They are designed for operation in both open and closed circuit applications. The standard control is a direct acting single line hydraulic control. The integral servo piston controls motor displacement.

The motors are spring biased to maximum displacement and hydraulically shifted to minimum displacement. Minimum and maximum displacement can be set with fixed internal stops. The large diameter servo piston allows smooth acceleration and deceleration with relatively large circuit orificing.

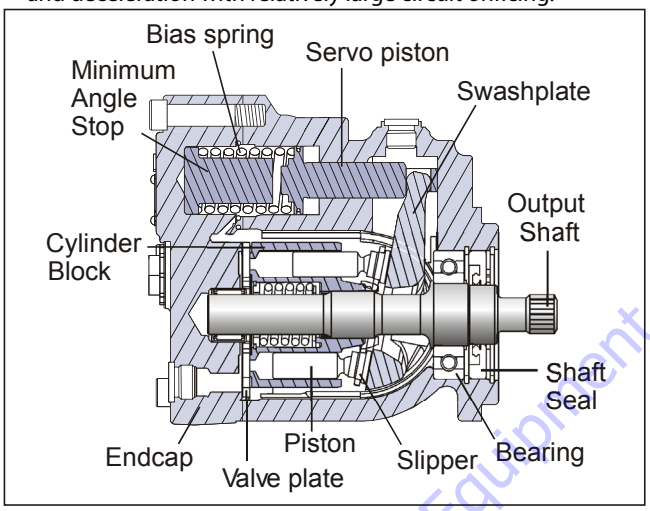
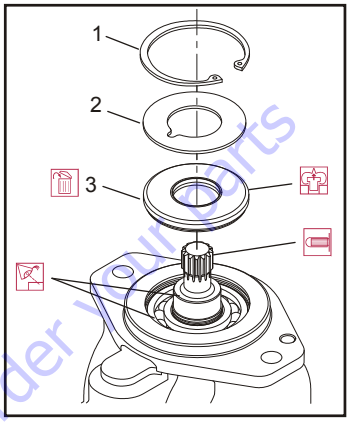


Figure 3-10. Drive Motor Cross Section

Shaft Seal Replacement

REMOVAL

1. Remove the snap ring (1) retaining the shaft seal and support washer.



1. Snap Ring
2. Support Washer
3. Shaft Seal

Figure 3-11. Removing the Shaft Seal

2. Remove the support washer (2).
3. Carefully pry out the shaft seal (3).

   To avoid damaging the shaft during removal, install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.
4. Discard the seal.

INSPECT THE COMPONENTS

Inspect the new seal, the motor housing seal bore, and the sealing area on the shaft for rust, wear, and contamination. Polish the shaft and clean the housing if necessary.

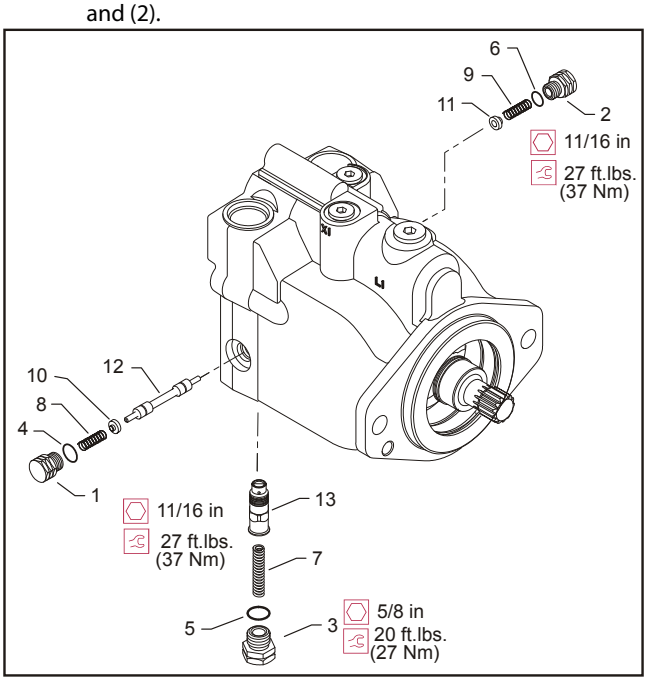
INSTALLATION

1. Cover the shaft splines with an installation sleeve to protect the shaft seal during installation.
2. Install a new shaft seal with the cupped side facing the motor. Press seal into housing until it bottoms out. Press evenly to avoid binding and damaging the seal.
3. Install seal support washer.
4. Install snap ring.
5. Remove the installation sleeve.

Loop Flushing Valve

REMOVAL

1. Using a 11/16 in internal hex wrench remove plug (1) and (2).



1.	Plug	6.	O-ring	11.	Washer
2.	Plug	7.	Spring	12.	Shift Spool
3.	Plug	8.	Spring	13.	Orifice Poppet
4.	O-ring	9.	Spring		
5.	O-ring	10.	Washer		

Figure 3-12. Loop Flushing Spool

2. Using a 1/4 in hex wrench remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).

INSPECT THE COMPONENTS

Inspect new O-rings and the sealing area for rust, wear, or contamination. Also check springs and poppet for wear.

INSTALLATION

1. Install orifice poppet (13).
2. Install shift spool (12).
3. Install spring retaining washers onto springs (10 and 11).
4. Carefully install centering springs (7, 8, and 9).
5. Install new O-rings (6, 4, and 5).
6. Using a 1/4 in hex wrench torque plug (3) to 20 ft. lbs. (27 Nm).
7. Using a 11/16 in internal hex, torque plugs (2 and 1) to 27 ft.lbs. (37 Nm).

Troubleshooting

Table 3-3. Excessive Noise and/or Vibration

Item	Description	Action
Check oil level in reservoir and oil supply to the motor.	Insufficient hydraulic fluid could lead to cavitation that would cause system noise.	Fill the reservoir to the proper level and ensure that oil supply to the motor is adequate and the lines are unobstructed.
Check for air in the system.	Air trapped within the system lines, or the motor itself, could result in cavitation that would cause system noise.	Ensure that all of the system lines and components are purged of air.
Inspect the output shaft couplings.	A loose or incorrect shaft coupling will produce vibrations that could result in system noise.	Ensure that the correct coupling is used and that it fits properly onto the shaft.
Inspect the output shaft alignment.	Misaligned shafts create excessive frictional vibration that could result in system noise.	Ensure that the shafts are properly aligned.
Hydraulic oil viscosity above limits.	Viscosity above acceptable limits will result in cavitation that would lead to system noise.	Replace hydraulic oil with appropriate fluid for operating conditions.

Table 3-4. System Operating Hot

Item	Description	Action
Check oil level in reservoir and oil supply to the pump.	Insufficient amount of hydraulic fluid will not meet the cooling demands of the system.	Fill the reservoir to the proper level.
Inspect the heat exchanger, (if so equipped).	If the heat exchanger fails, or becomes obstructed, it may not meet the cooling demands of the system.	Ensure that heat exchanger is receiving adequate air flow and that the heat exchanger is in good operating condition. Repair or replace as necessary.
Check the system relief valves.	If a system relief valve becomes unseated for an extended period of time or fails for any other reason, the system could become overheated.	Repair or replace any malfunctioning relief valves as applicable and verify that the loads on the machine are not excessive.

Table 3-5. Won't Shift or Slow to Start

Item	Description	Action
Check the signal line to the servo control port.	Obstructed or restricted flow through the servo control signal lines could result in slow shift or no shift conditions within the motor.	Ensure that the signal lines are not obstructed or restricted and that signal pressure is adequate to shift the motor.
Check that the correct supply and drain orifices are properly installed, and are not obstructed.	Supply and drain orifices determine the shift rate of the motor. The smaller the orifice, the longer the time it takes to shift the motor. Obstruction will also increase shift times.	Ensure that the proper control orifices are installed in the motor and verify that they are not obstructed. Clean or replace as necessary.

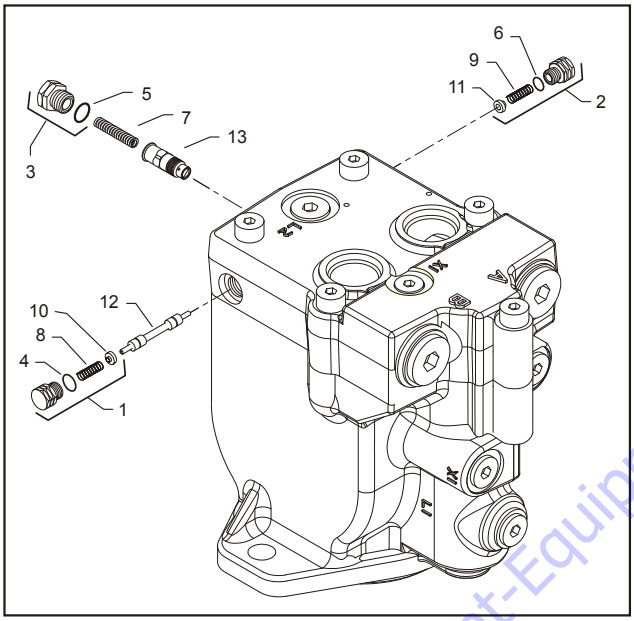
Disassembly

NOTE: *Removal of the endcap voids warranty.*

During assembly, coat all moving parts with a film of clean hydraulic oil. This assures that these parts will be lubricated during start-up.

Replace all O-Rings and gaskets.

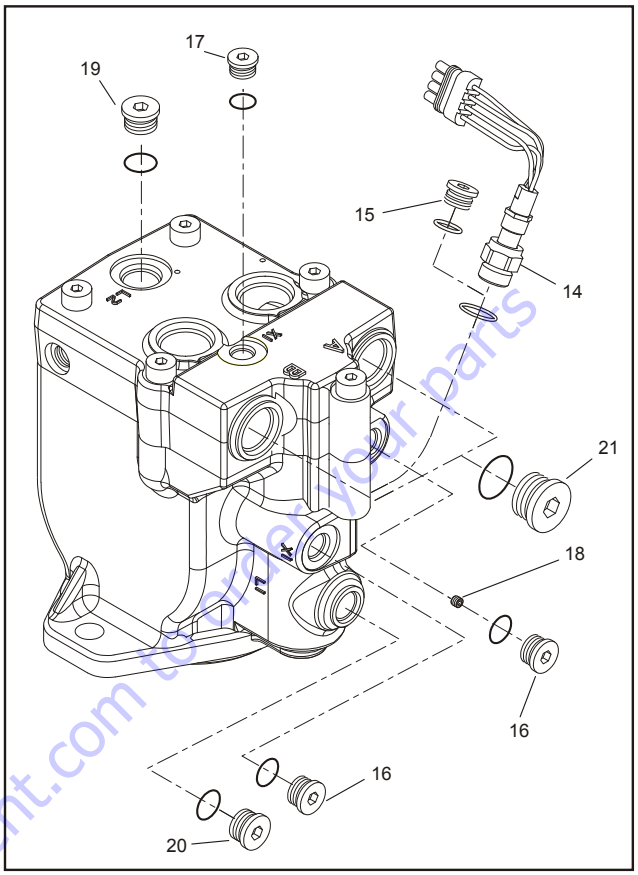
It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.



1. Plug
2. Plug
3. Plug
4. O-ring
5. O-ring
6. O-ring
7. Spring
8. Spring
9. Spring
10. Washer
11. Washer
12. Shift Spool
13. Orifice Poppet

Figure 3-13. Loop Flushing Spool

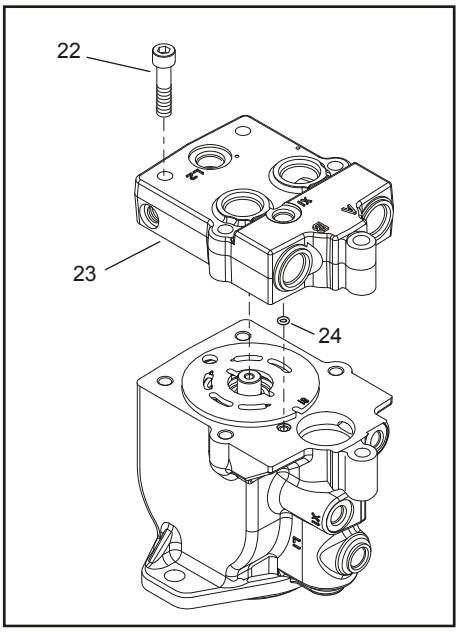
1. Using a 11/16 in wrench remove plug (1) and (2).
2. Using a 5/8 in hex wrench remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).



14. Lock Nut
15. O-ring Plug
16. Control Line Plug
17. Control Line Plug
18. Cavity Plug
19. Drain Plug
20. Drain Plug
21. Work Port Plug

Figure 3-14. Plugs, Fittings, and Speed Sensor

8. Remove all fittings from the unit. Discard any O-rings on the fittings.
9. Using an 11/16 inch hex wrench, loosen the speed sensor lock nut (14) if equipped. Then remove the speed sensor using a Vi inch hex wrench. Units without speed sensor have an O-ring plug (15) installed in that location; remove it with a Va inch internal hex wrench.
10. Using a 1/4 inch internal hex wrench, remove control line plugs (16, 17). Discard O-rings. Using a 3 mm hex wrench, remove cavity plug (18, if equipped with two-line control) from X2 cavity.
11. Using a 5/16 inch internal hex wrench, remove drain plugs (19, 20). Discard O-rings.
12. Using a 9/16 inch internal hex wrench, remove work port plugs (21, if equipped with axial ports). Discard O-rings.



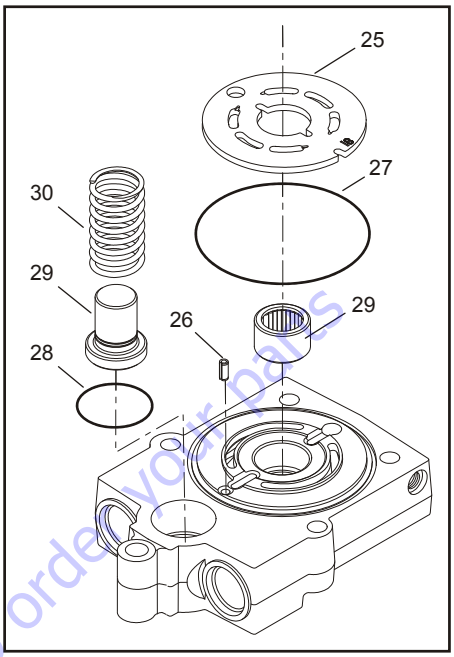
22. Screw
23. End Cap
24. O-ring

Figure 3-15. End Cap

13. Using an 8 mm internal hex wrench, remove the endcap screws (22).

14. Remove the endcap (23). Remove O-ring (24) from the housing or endcap.

When the endcap screws are removed, pressure from the servo spring will cause the endcap to bind on the shaft. Press down on the portion of the endcap covering the servo piston and hold the endcap level while removing.



25. Valve Plate
26. End Cap
27. O-ring
28. O-ring
29. Angle Stop
30. Servo Spring

Figure 3-16. Valve Plate & Rear Shaft Bearing

NOTICE

TAKE CARE NOT TO SCRATCH THE SURFACE OF THE VALVE PLATE.

15. Remove the valve plate (25) and timing pin (26) from the endcap.

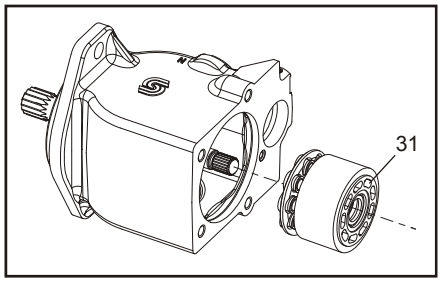
Each displacement has a unique valve plate. For identification, the last two digits of the valve plate part number are stamped on its surface.

16. Remove and discard the O-rings (27, 28).

17. Remove the rear shaft bearing (29) from the endcap with a bearing puller.

The bearing may be difficult to remove with a puller. Try this as an alternative: Pack the bearing cavity with heavy grease. After the shaft is removed, insert it into the bearing cavity and tap lightly with a soft mallet on the splined end. The grease will force the bearing out. Use caution not to drive the bearing past the rear shaft journal as the bearing may become trapped on the shaft and damaged.

18. Remove minimum angle stop (29) and servo spring (30) from the housing.



31. Cylinder Kit Assembly

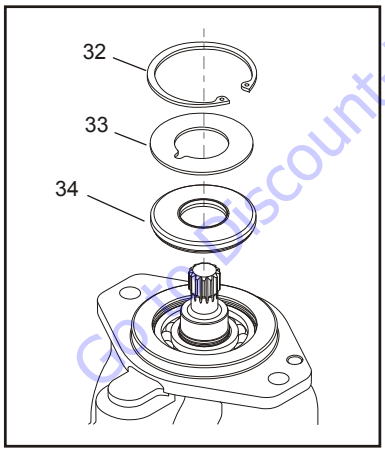
Figure 3-17. Cylinder Kit

19. Turn the housing on its side and remove the cylinder kit assembly (31). Set the assembly aside, being careful not to scratch the running surface.

NOTE: *Grooves on the surface of the cylinder kit identify its displacement:*

Table 3-6. Displacement Identifiers

# of Grooves	Frame L	Frame K
1	25	38
2	30	45
3	35	--

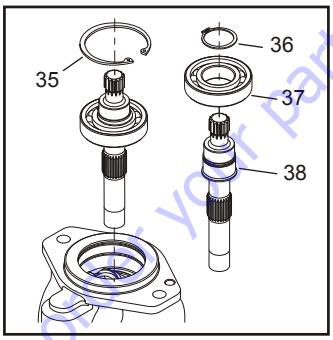


32. Snap Ring
33. Support Washer
34. Shaft Seal

Figure 3-18. Shaft Seal

20. Turn the housing over and remove the snap ring (32) retaining the shaft seal and support washer. Remove the support washer (33) and carefully pry out the shaft seal (34). Discard the seal.

To avoid damaging the shaft during seal removal. Install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.

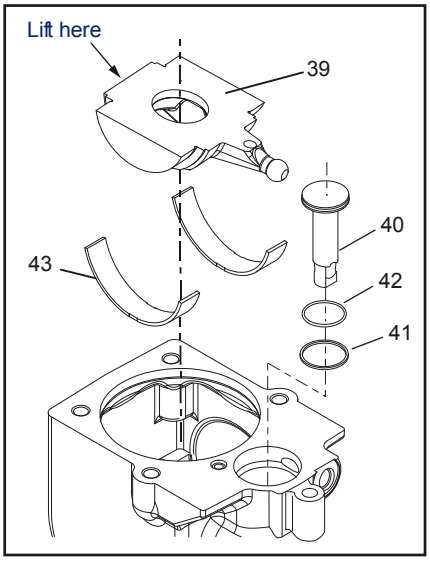


35. Inner Snap Ring
36. Snap Ring
37. Bearing
38. Shaft

Figure 3-19. Shaft & Front Bearing

21. Remove the inner snap ring (35) and the shaft / bearing assembly.

22. Remove the snap-ring (36) retaining the shaft front bearing. Pull the bearing (37) off of the shaft (38).



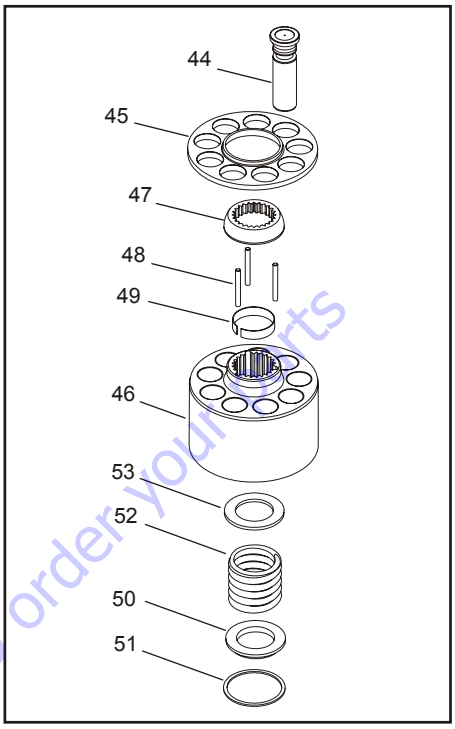
39. Swashplate
40. Servo Piston
41. Piston Seal
42. O-ring
43. Journal Bearings

Figure 3-20. Swash Plate & Servo Piston

23. Turn housing over and remove the swashplate (39) by lifting on the end opposite the servo lever.

24. Remove the servo piston (40). Remove the piston seal (41) and O-ring (42) from the servo piston. Discard the seal and O-ring.

25. Remove the journal bearings (43) from the housing. If the bearings are to be reused, note the location and orientation of each bearing for reassembly.



44. Piston
45. Slipper Retainer
46. Cylinder Block
47. Ball Guide
48. Holddown Pins
49. Retaining Ring
50. Block Spring Washer
51. Spiral Retaining Ring
52. Block Spring
53. Inner Block Spring Washer

Figure 3-21. Cylinder Kit Disassembly

26. Remove pistons (44) and slipper retainer (45) from the cylinder block (46).

The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.

27. Remove the ball guide (47), hold-down pins (48), and retaining ring (49) from the cylinder block.

NOTE: *Most repairs do not require block spring removal. Perform this procedure only if you suspect problems with the block spring.*

⚠ WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES FORCE OF ABOUT 80 TO 90 LBF (350 TO 400 N). USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO REMOVE THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS REMOVED.

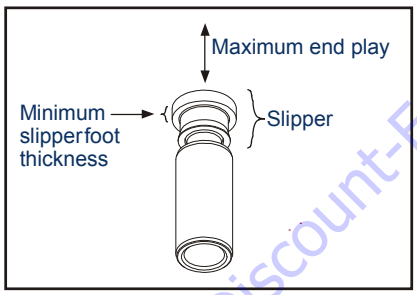
28. Turn the block over. Using a press, apply pressure on the block spring washer (50) to compress the block spring. Compress the spring enough to safely remove the spiral retaining ring (51). While maintaining pressure, unwind the spiral retaining ring (51). Carefully release the pressure and remove the outer block spring washer (50), block spring (52), and inner block spring washer (53) from the cylinder block.

Inspection

After disassembly, wash all parts (including the end-cap and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and endcap with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after any rework or resurfacing.

PISTON

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.



SLIPPERS

Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Measure the slipper foot thickness. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.

Minimum slipper foot thickness and maximum axial end-play are given in the table below.

Table 3-7. Slipper Foot Thickness & End Play

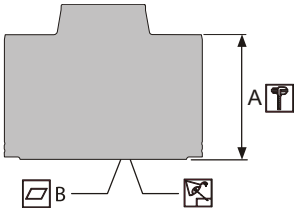
Measurement		L Frame	K Frame
Slipper Foot Thickness	mm (in.)	2.71 (0.11)	4.07 (0.16)
Piston/Slipper End Play		0.15 (0.006)	

CYLINDER BLOCK

Measure the cylinder block height. Replace blocks worn beyond the minimum height specification. Inspect the running surface of the cylinder block. Replace or resurface worn or scratched blocks. Blocks may be resurfaced to the specifications shown in the drawing, provided resurfacing will not reduce the block height below the minimum specification. Table 3-8, Cylinder Block Measurements.

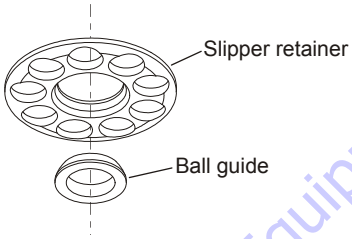
Table 3-8. Cylinder Block Measurements

Measurement	L25	L30	L35	K38	K45
Minimum Cylinder Block Height (A)	50.8 (2.00)	50.8 (2.00)	50.8 (2.00)	54.4 (2.14)	54.4 (2.14)
Cylinder Block Surface Flatness	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)	0.002 (0.0000079)



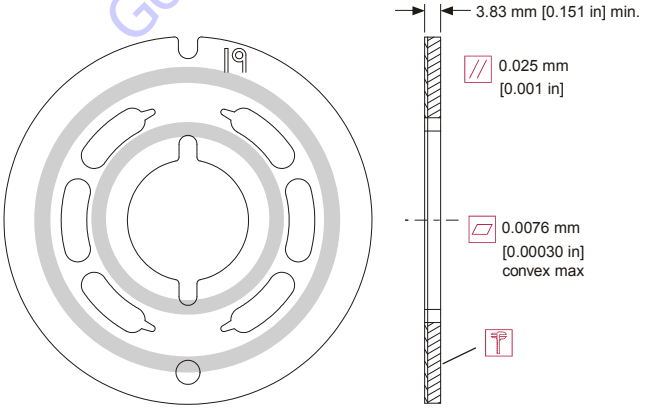
BALL GUIDE AND SLIPPER RETAINER

Inspect the ball guide and slipper retainer for damage, discoloration, or excessive wear. A discolored ball guide or slipper retainer indicates excessive heat. Do not reuse.



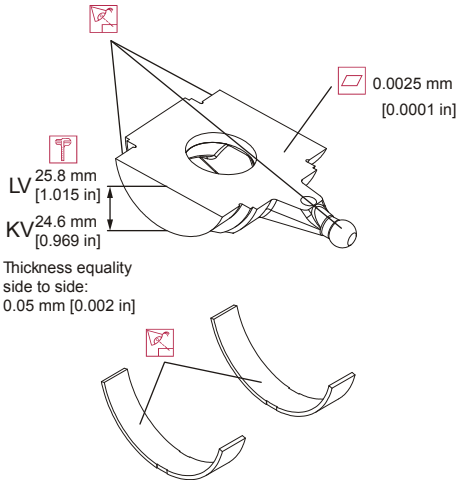
VALVE PLATE

The condition of the valve plate is critical to the efficiency of the motor. Inspect the valve plate surfaces carefully for excessive wear, grooves, or scratches. Replace or resurface grooved or scratched valve plates. Measure the valve plate thickness and replace if worn beyond the minimum specification. Valve plates may be resurfaced to the specifications shown in the drawing, provided resurfacing will not reduce the thickness below the minimum specification.



SWASHPLATE AND JOURNAL BEARINGS

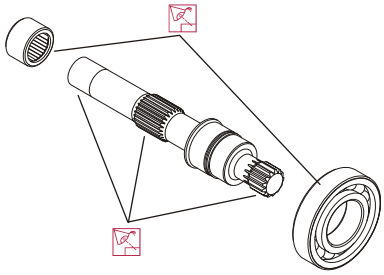
Inspect the running face, servo ball-joint, and swashplate journal surfaces for damage or excessive wear. Some material transfer may appear on these surfaces and is acceptable providing the surface condition meets specifications shown. Measure the swashplate thickness from the journals to the running face. Replace swashplate if damaged or worn beyond minimum specification. Replace swashplate if the difference in thickness from one side to the other exceeds specification.



Inspect the journal bearings for damage or excessive wear. Replace journal bearings if scratched, warped, or excessively worn. The polymer wear layer must be smooth and intact.

SHAFT BEARINGS

Inspect bearings for excessive wear or contamination. Rotate the bearings while feeling for uneven movement. Bearings should spin smoothly and freely. Replace bearings that appear worn or do not rotate smoothly.

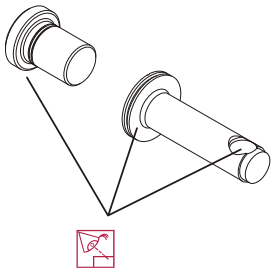


SHAFT

Inspect the motor shaft. Look for damage or excessive wear on the output and block splines. Inspect the bearing surfaces and sealing surface. Replace shafts with damaged or excessively worn splines, bearing surfaces, or sealing surfaces.

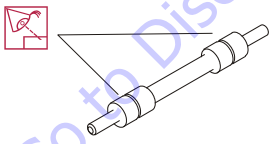
SERVO PISTON AND MINIMUM ANGLE STOP

Inspect the minimum angle stop, servo piston head, and servo piston ball-socket for damage or excessive wear. Replace if necessary.



LOOP FLUSHING SPOOL

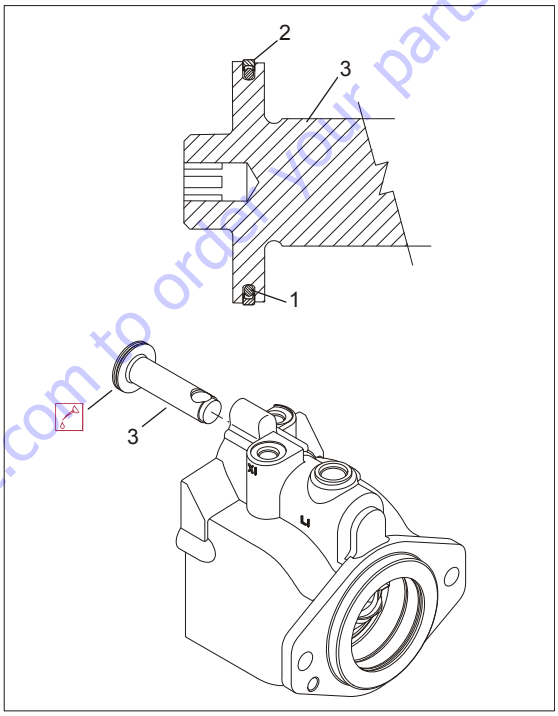
Inspect the loop flushing spool. Check for cracks or damage. Replace if necessary.



Assembly

1. Install new O-ring (1) and piston seal (2) to the servo piston (3). Install the piston seal over the O-ring.

   Installing the piston seal stretches it, making it difficult to install the servo piston in its bore. Allow 30 minutes for the seal to relax after installation. To speed up seal relaxation, compress the seal by installing the piston head into the servo cavity in the end-cap and let it stand for at least five minutes.



1. O-ring
2. Piston Seal
3. Servo Piston

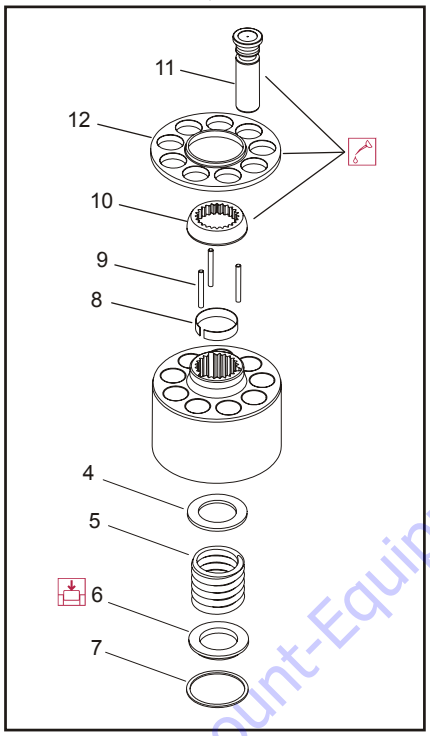
Figure 3-22. Servo Piston

2. After piston seal has relaxed, lubricate and install servo piston into the housing bore. Align the piston with the ball socket facing the inside of the housing.

⚠ WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 80 TO 90 LBF (350 TO 400 N) OF FORCE. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO INSTALL THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS INSTALLED.

3. Install the inner block spring washer (4), block spring (5), and outer washer (6) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (7) into the groove in the cylinder block.



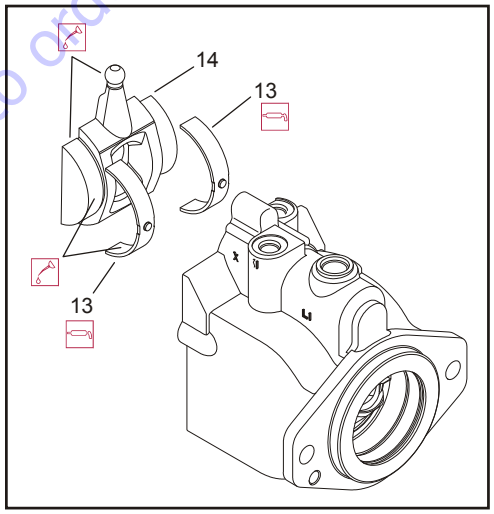
4. Block Spring Washer
5. Block Spring
6. Outer Washer
7. Spiral Retaining Ring
8. Retaining Ring
9. Holddown Pins
10. Ball Guide
11. Piston
12. Slipper Retainer

Figure 3-23. Cylinder Kit Assembly

4. Turn the block over and install the retaining ring (8), hold-down pins (9), and ball guide (10) to the cylinder block.

5. Install the pistons (11) to the slipper retainer (12). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you're reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.

6. Install the journal bearings (13) into the housing seats. Use assembly grease to keep the bearings seated during assembly. Ensure the locating nubs drop into the cavities in the seats. If you're reusing the bearings, install them in the original location and orientation. Lubricate the journal bearings.

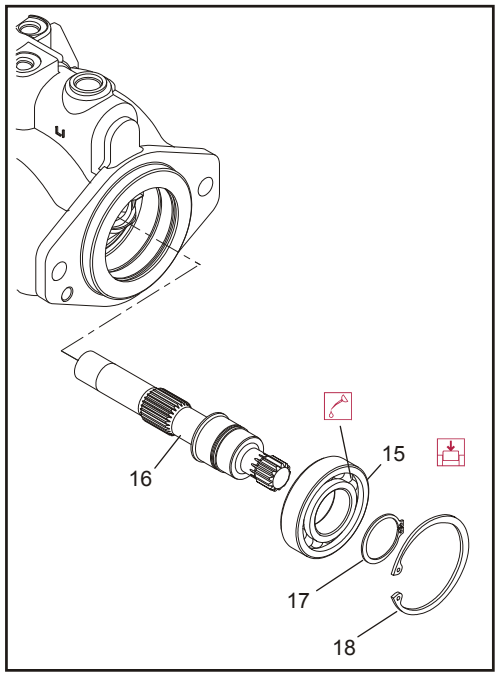


13. Journal Bearings
14. Swash Plate

Figure 3-24. Swash Plate and Journal Bearing

7. Install the swashplate (14) into the housing. Tilt the swashplate and guide the servo lever ball into its socket in the servo piston rod. Ensure the swashplate seats into the journal bearings and moves freely. Lubricate the running surface of the swashplate.

8. Press front shaft bearing (15) onto shaft (16). Press bearing onto shaft with lettering facing out. Lubricate bearing rollers. Install snap-ring (17) onto shaft.

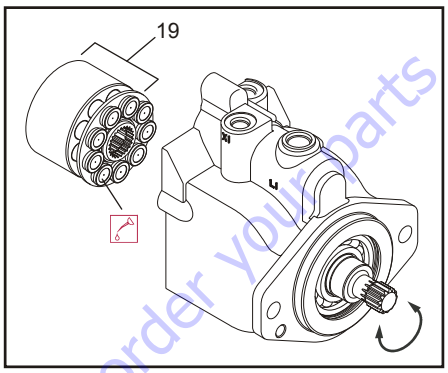


15. Front Shaft Bearing
16. Shaft
17. Snap Ring
18. Snap Ring

Figure 3-25. Shaft and Front Bearing

9. While holding the swashplate in place, turn the housing on its side. Install the install shaft/bearing assembly into housing from the flange end. Install the snap-ring (18).

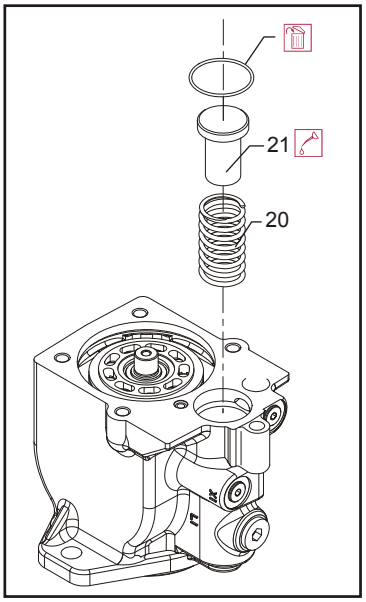
10. Verify swashplate and bearings are properly seated. Install the cylinder kit (19) onto the shaft. Install with the slippers facing the swashplate. Rock the shaft to align the block splines and slide the cylinder kit into place. Orient the motor with the shaft pointing downward and verify the cylinder kit, swashplate, journal bearings, and servo piston are all secure and properly installed.



19. Cylinder Kit

Figure 3-26. Cylinder Kit Installation

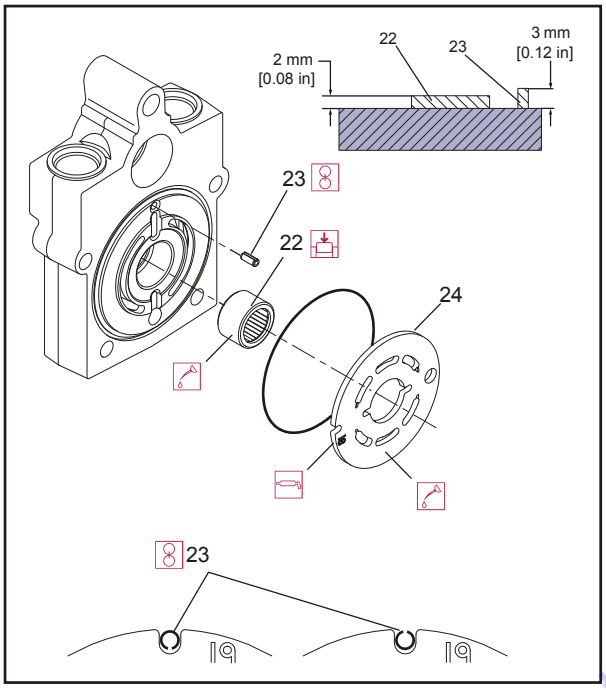
11. Lubricate and install the servo spring (20), and minimum angle stop (21) into the housing bore.



20. Servo Spring
21. Minimum Angle Stop

Figure 3-27. Servo Spring and Minimum Angle Stop

12. Press the rear shaft bearing (22) into the endcap. Install the bearing with letters facing out. Press until bearing surface is 0.08 ±0.01 in (2 ±0.25 mm) above endcap surface.



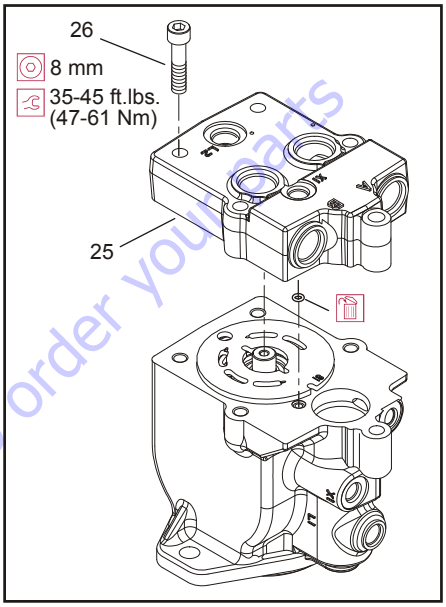
22. Rear Shaft Bearing
23. Timing Pin
24. Valve Plate

Figure 3-28. Valve Plate and Rear Bearing

13. Install timing pin (23) into its bore in the endcap. Install the pin with its groove facing toward or away from the shaft. Press the pin until the end protrudes 0.12 ±0.01 in (3 ±0.25 mm) above endcap surface.

14. Install the valve plate (24) onto the endcap. Install the valve plate with the yellow surface toward the cylinder block. Align the slot in the valve plate with the timing pin. Apply a liberal coat of assembly grease to the endcap side of the valve plate to keep it in place during installation.

15. Install the endcap (25) onto the housing with the endcap screws (26). Check to ensure the endcap will properly seat onto the housing without interference. Improper assembly of the internal components may prevent the endcap from seating properly. Ensure the O-rings seat properly when installing the endcap.



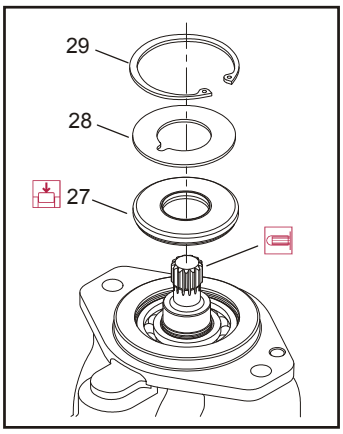
25. End Cap
26. Screw

Figure 3-29. End Cap

16. Using an 8 mm internal hex wrench, tighten the endcap screws. Tighten the screws in opposite corners slowly and evenly to compress the servo spring and properly seat the endcap. Torque endcap screws 35-45 ft.lbs. (47-61 Nm).

17. Before installing the shaft seal, ensure the shaft turns smoothly with less than 120 in.lbs. (13.5 Nm) of force. If the shaft does not turn smoothly within the specified maximum force, disassemble and check the unit.

18. Cover shaft splines with an installation sleeve. Install a new shaft seal (27) with the cup side facing the motor. Press seal into housing until it bottoms out. Press evenly to avoid binding and damaging the seal. Install seal support washer (28) and snap ring (29).



27. Shaft Seal
28. Seal Support Washer
29. Snap Ring

Figure 3-30. Shaft Seal

19. Install remaining plugs and fittings to the housing. Refer to the drawing below for wrench sizes and installation torques.

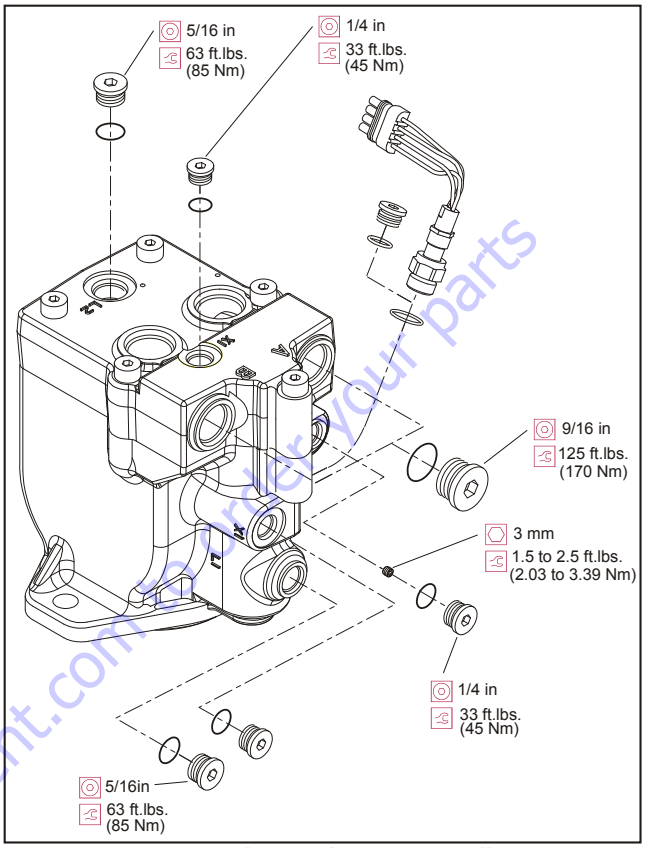
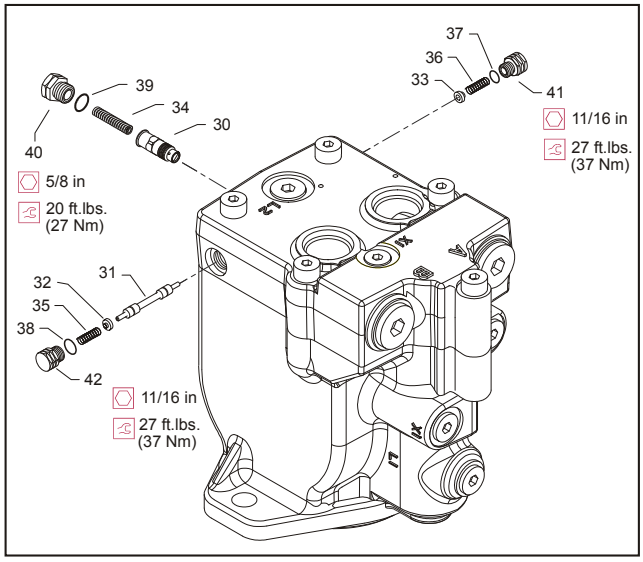


Figure 3-31. Plugs and Fittings Installation

20. Install orifice poppet (30).



30. Orifice Poppet	34. Spring	37. O-ring	40. Plug
31. Shift Spool	35. Spring	38. O-ring	41. Plug
32. Spring	36. Spring	39. O-ring	42. Plug
33. Spring			

Figure 3-32. Loop Flushing Spool

21. Install shift spool (31).

22. Install spring retaining washers onto springs (32 and 33).

23. Carefully install centering springs (34, 35, and 36).

24. Install new O-rings (37, 38, and 39).

25. Using a 5/8 in wrench torque plug (40) to 20 ft.lbs. (27 Nm).

26. Using a 11/16 in wrench, torque plugs (41 and 42) to 27 ft.lbs. (37 Nm).

Initial Start-up Procedures

Follow this procedure when starting-up a new motor or when installing a motor that has been removed.

Prior to installing the motor, inspect for damage incurred during shipping. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

1. Fill the reservoir with recommended hydraulic fluid. Always filter fluid through a 10 micron filter when pouring into the reservoir. Never reuse hydraulic fluid.

2. Fill the inlet line leading from the pump to the reservoir. Check the inlet line for properly tightened fittings and be certain it is free of restrictions and air leaks.

3. Fill the pump and motor housing with clean hydraulic fluid. Pour filtered oil directly into the upper most case drain port.

4. To ensure the pump and motor stay filled with oil, install case drain lines into the upper most case drain ports.

5. Install a 0 to 500 psi (0 to 35 bar) gauge in the charge pressure gauge port of the pump to monitor system pressure during start up.

6. While watching the pressure gauge, run the engine at the lowest possible speed until system pressure builds to normal levels (minimum 160 psi [11 bar]). Once system pressure is established, increase to full operating speed. If system pressure is not maintained, shut down the prime mover, determine cause, and take corrective action.

7. Operate the hydraulic system for at least fifteen minutes under light load conditions.

8. Check and adjust control settings as necessary after installation.

9. Shut down the prime mover and remove the pressure gauge. Replace plug at the charge pressure gauge port.

10. Check the fluid level in the reservoir; add clean filtered fluid if necessary. The motor is now ready for operation.

3.11 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

NOTE: *This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with JLG Threadlocker P/N 0100019. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.*

1. Check the frame to bearing attach bolts as follows:
   - **a.** Elevate the fully extended upper boom to horizontal. (See Figure 3-34.)
   - **b.** At the positions indicated on Figure 3-35. try to insert a.0015 feeler gauge between the bolt and hardened washer at the arrow indicated position.
   - **c.** Ensure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
   - **d.** Swing the turntable 90 degrees, and check some selected bolts at the new position.
   - **e.** Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing Attach bolts as follows:
   - **a.** Elevate the fully retracted upper boom to full elevation.
   - **b.** At the position indicated on Figure 3-33. try to insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   - **c.** Lower the boom to horizontal and fully extend the boom.
   - **d.** At the position indicated on Figure 3-35., try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

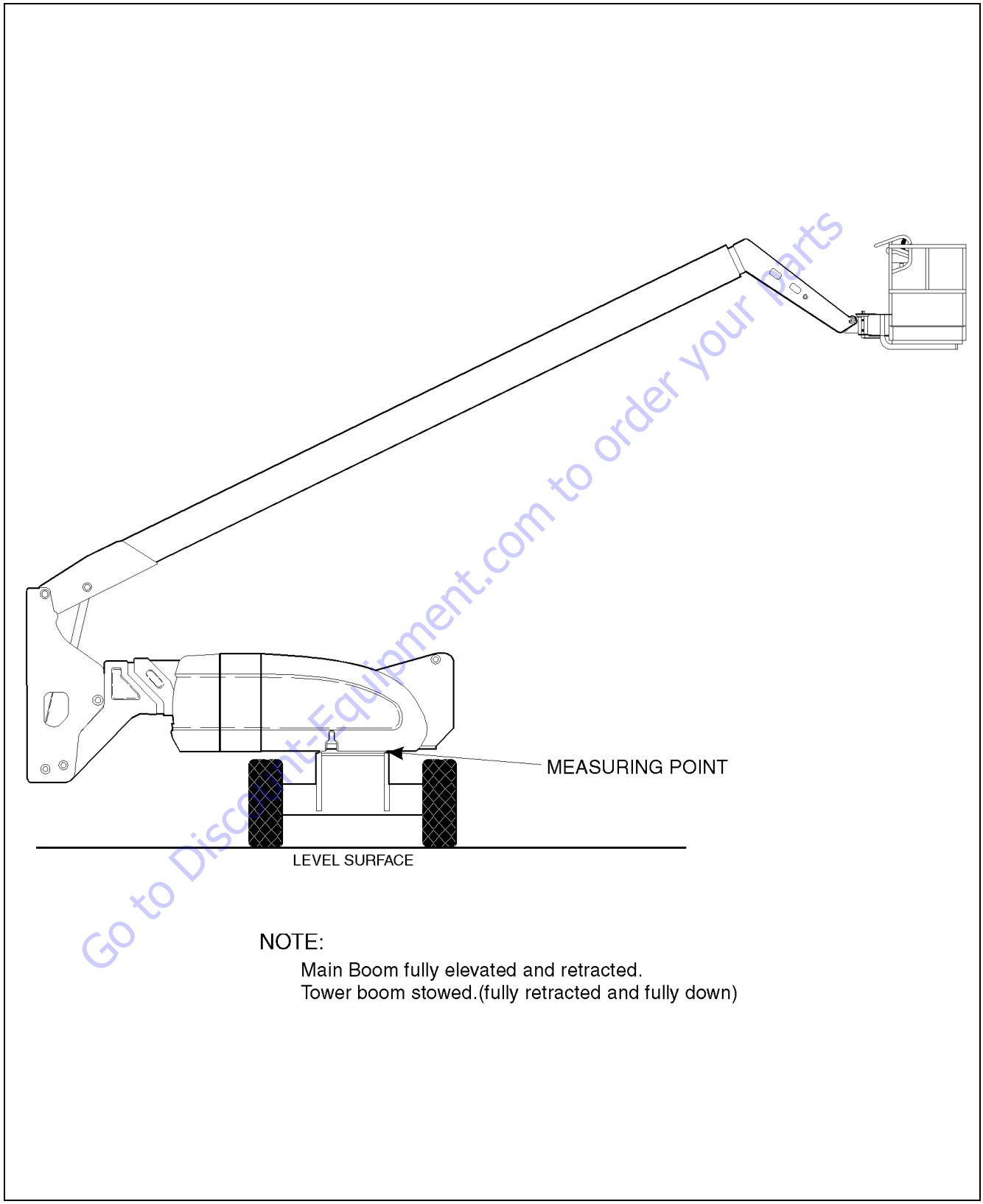


Figure 3-33. Swing Bearing Tolerance Boom Placement (Sheet 1 of 2)

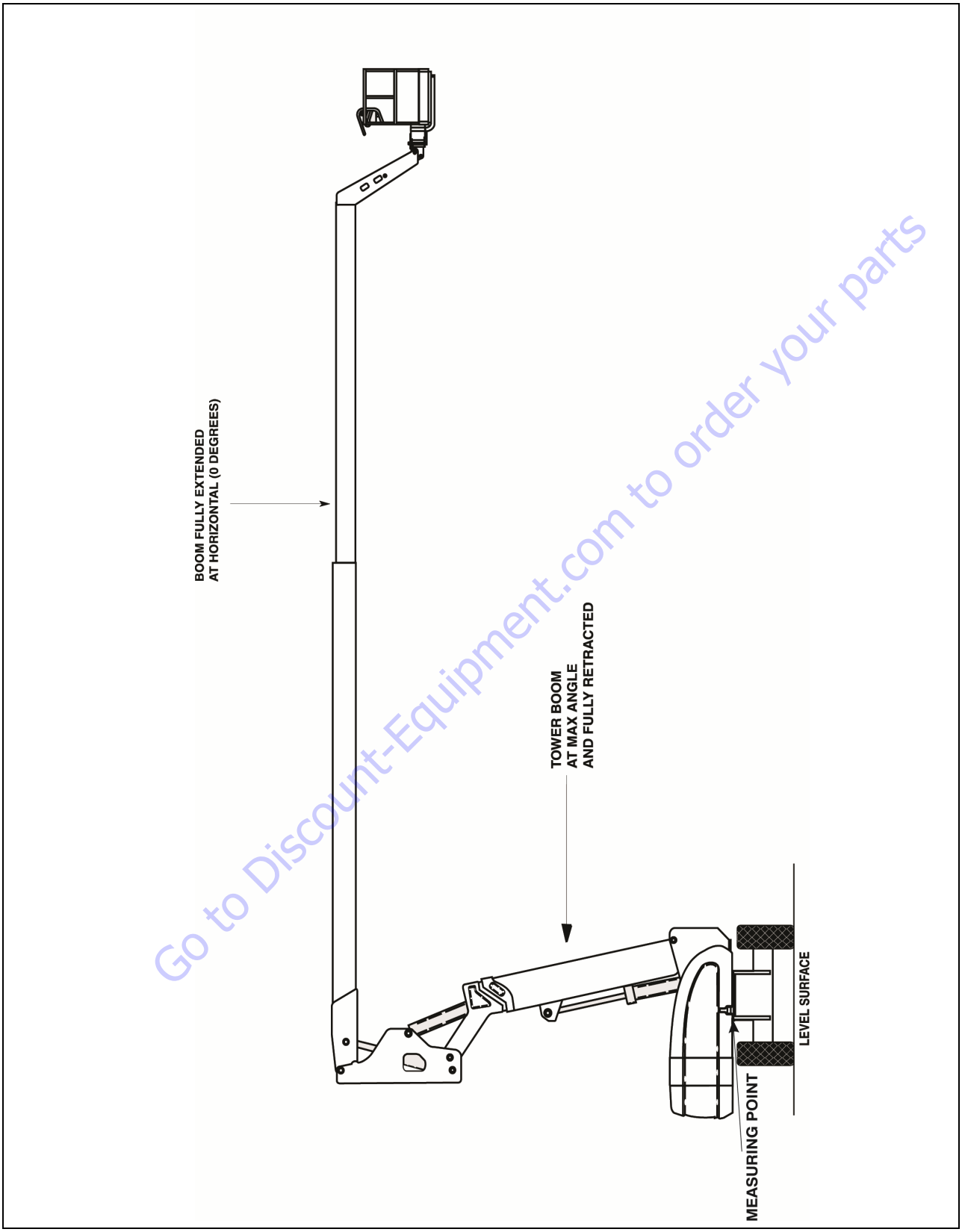


Figure 3-34. Swing Bearing Tolerance Boom Placement (Sheet 2 of 2)

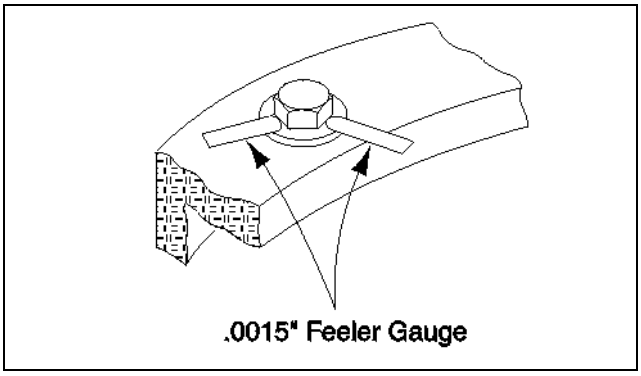


Figure 3-35. Swing Bolt Feeler Gauge Check

Wear Tolerance

1. From the underside of the machine, at rear center, with the upper boom fully elevated and fully retracted, and tower boom stowed, as shown in Figure 3-33., Swing Bearing Tolerance Boom Placement (Sheet 1 of 2), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-36., Swing Bearing Tolerance Measuring Point
2. At the same point, with the upper boom at horizontal and fully extended, and the tower boom fully elevated and fully retracted as shown in Figure 3-34., Swing Bearing Tolerance Boom Placement (Sheet 2 of 2). Using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. See Figure 3-36., Swing Bearing Tolerance Measuring Point
3. If a difference greater than 0.079 in. (2.00 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.079 in. (2.00 mm) is determined, and any of the following conditions exist, the bearing should be removed, disassembled, and inspected for the following:
   a. Metal particles in the grease.
   b. Increased drive power required.
   c. Noise.
   d. Rough rotation.
5. If bearing inspection shows no defects, reassemble and return to service.

NOTICE

THE SWING BEARING IS ONE OF THE MOST CRITICAL POINTS ON AN AERIAL LIFT. IT IS HERE THAT THE STRESSES OF LIFTING ARE CONCENTRATED, AT THE CENTER OF ROTATION. BECAUSE OF THIS, PROPER MAINTENANCE OF THE SWING BEARING BOLTS IS A MUST FOR SAFE OPERATION.

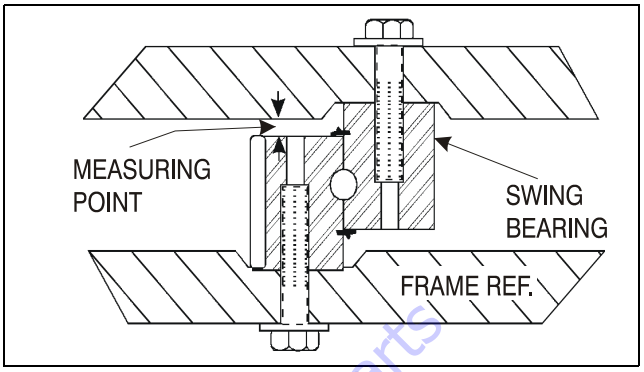


Figure 3-36. Swing Bearing Tolerance Measuring Point

Swing Bearing Replacement

1. Removal.
   a. From Ground Control station, operate the boom adequately to provide access to frame opening to rotary coupling.

⚠ WARNING

NEVER WORK BENEATH THE BOOM WITHOUT FIRST ENGAGING BOOM SAFETY PROP OR PROVIDING ADEQUATE OVERHEAD SLING SUPPORT AND/OR BLOCKING.

   b. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.
   c. From inside turntable, remove mounting hardware which attach rotary coupling retaining yoke brackets to turntable.

NOTICE

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

   d. Tag and disconnect the hydraulic lines from the fittings on the top of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
   e. Attach suitable overhead lifting equipment to the base of the turntable weldment.
   f. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the turntable to the bearing inner race. Discard the bolts.
   g. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame-mounted components.

h. Carefully place the turntable on a suitably supported trestle.

i. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame, then move the bearing to a clean, suitably supported work area.

2. Installation.

a. Using suitable lifting equipment, carefully lower the swing bearing into position on the frame. Ensure the scribed line of the outer race of the bearing aligns with the scribed line on the frame. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the frame.

⚠ CAUTION

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED BEARING BOLTS BE DISCARDED AND REPLACED WITH NEW BOLTS. SINCE THE SWING BEARING IS THE ONLY STRUCTURAL LINK BETWEEN THE FRAME AND TURNTABLE, IT IS IMPERATIVE THAT SUCH REPLACEMENT HARDWARE MEETS JLG SPECIFICATIONS. USE OF GENUINE JLG HARDWARE IS HIGHLY RECOMMENDED.

b. Apply a light coating of JLG Threadlocker P/N 0100019 to the new bearing bolts, and loosely install the bolts and washers through the frame and outer race of bearing.

NOTICE

IF COMPRESSED AIR OR ELECTRICALLY OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

c. Refer to the Torque Sequence diagram as shown in Figure 3-39., Swing Bearing Torque Sequence. Clean any residue off the new bearing bolts, then apply a light coating of JLG Threadlocker P/N 0100019 and install the bolts and washers through the frame and outer race of the bearing. Tighten the bolts to an initial torque of 190 Ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

d. Remove the lifting equipment from the bearing.

e. Using suitable lifting equipment, carefully position the turntable assembly above the machine frame.

f. Carefully lower the turntable onto the swing bearing, ensuring that the scribed line of the inner race of the bearing aligns with scribed line on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the turntable.

g. Clean any residue off the new bearing bolts, then apply a light coating of JLG Threadlocker P/N 0100019 and install the bolts and washers through the turntable and inner race of the bearing.

h. Following the Torque Sequence diagram shown in Figure 3-39., Swing Bearing Torque Sequence, tighten the bolts to a torque of 190 ft. lbs. (260 Nm) w/Loctite.

i. Remove the lifting equipment.

j. Install the rotary coupling retaining yoke brackets, apply a light coating of JLG Threadlocker P/N 0100011 to the attaching bolts and secure the yoke to the turntable with the mounting hardware.

k. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.

l. At ground control station, use boom lift control to lower boom to stowed position.

m. Using all applicable safety precautions, activate the hydraulic system and check the swing system for proper and safe operation.

Swing Bearing Torque Values

1. Outer Race - 190 ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

2. Inner Race - 190 ft. lbs. (260 Nm) w/JLG Threadlocker P/N 0100019.

3. See Swing Bearing Torquing Sequence.

⚠ WARNING

CHECK THE INNER AND OUTER SWING BEARING BOLTS FOR MISSING OR LOOSENESS AFTER FIRST 50 HOURS OF OPERATION, AND EVERY 600 HOURS THEREAFTER.

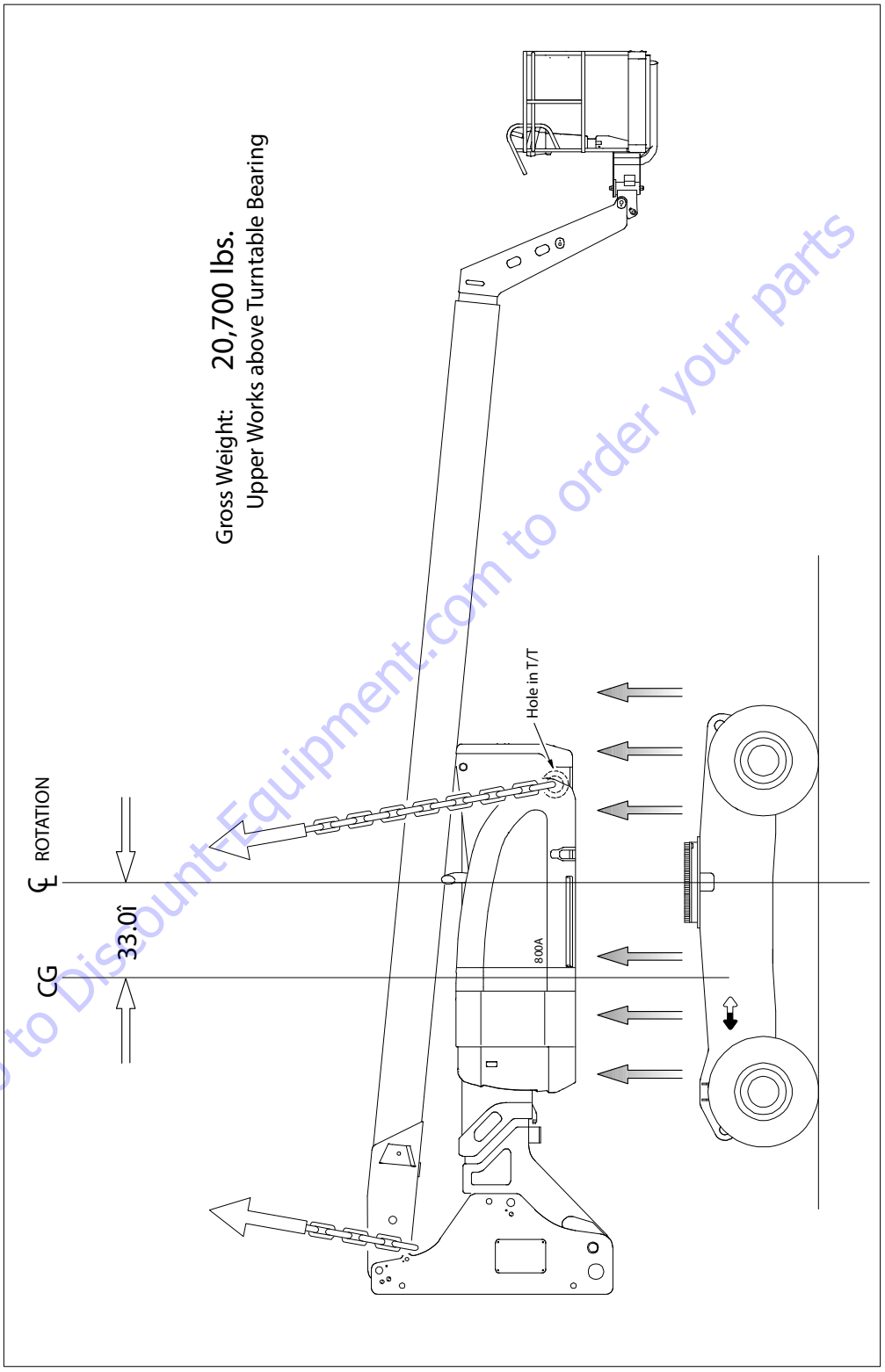


Figure 3-37. Swing Bearing Removal (800A)

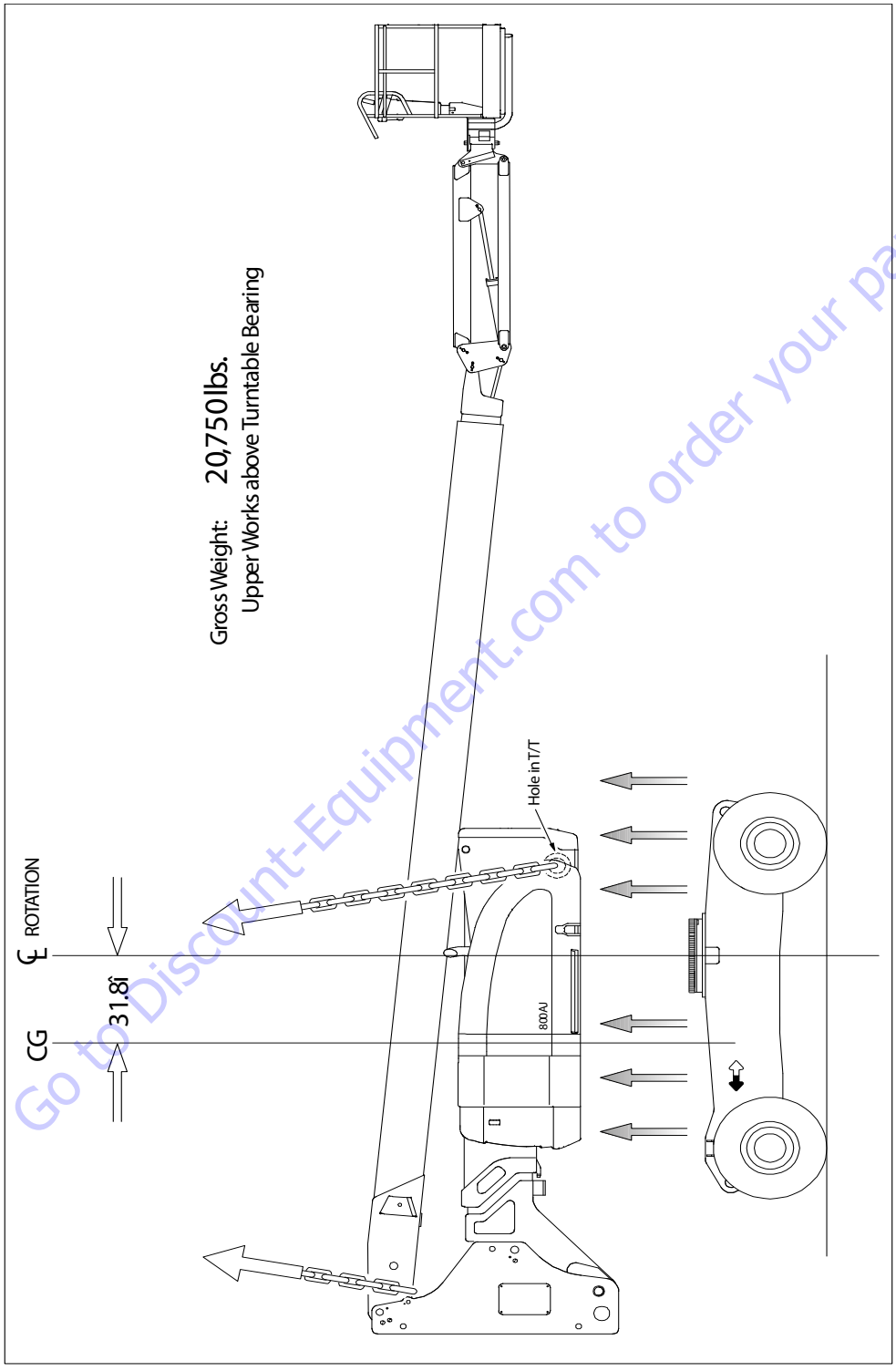
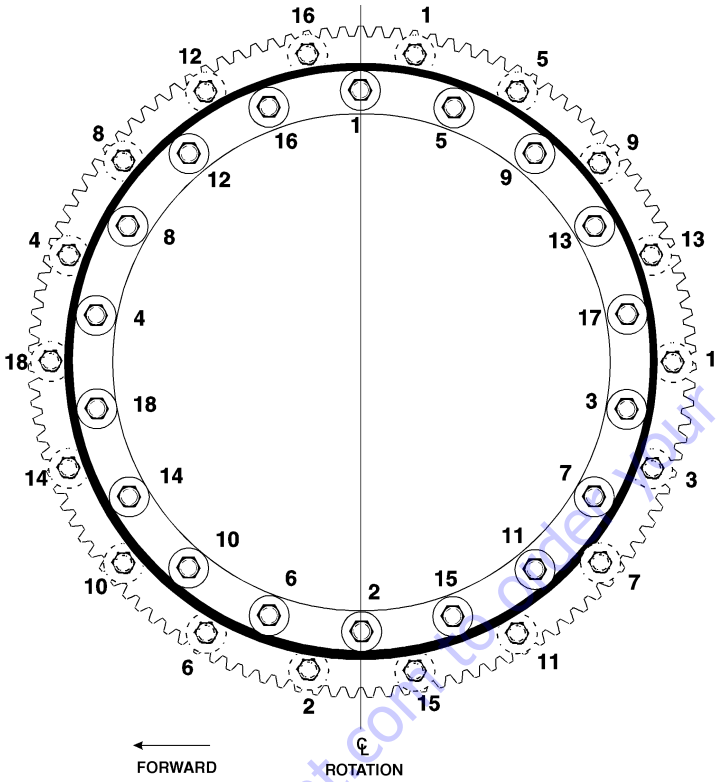
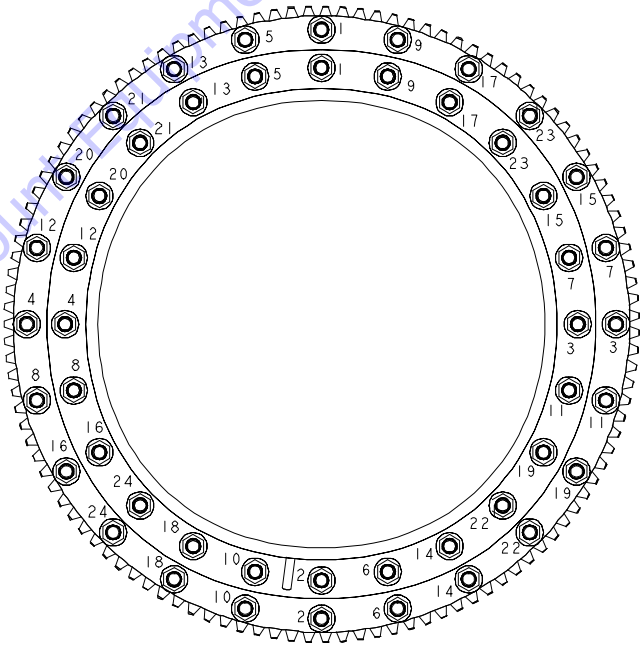


Figure 3-38. Swing Bearing Removal (800AJ)



Machines built prior to S/N 0300068040



NOTE: *Swing Bearing Torque Sequence is typical for both inner and outer races.*

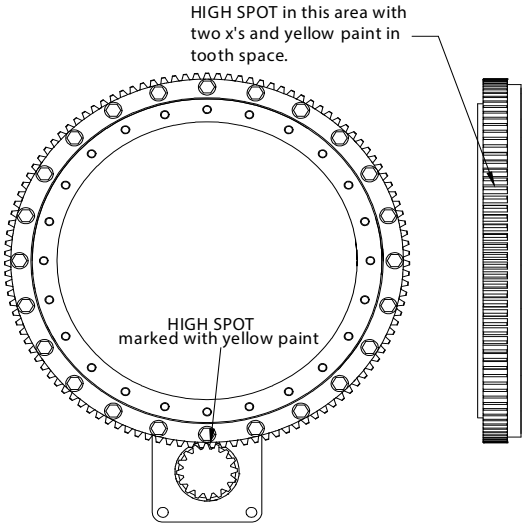
Machines built S/N 0300068040 to S/N 0300183033

Figure 3-39. Swing Bearing Torque Sequence

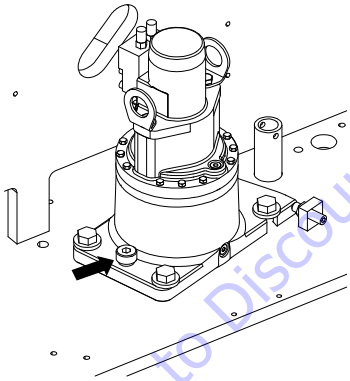
3.12 PROCEDURE FOR SETTING SWING GEAR BACKLASH

Set backlash to 0.008 in. to 0.012 in. (0.2 mm - 0.3 mm) using the following procedure:

1. Place the machine on firm, level ground.
2. Place shim between pinion and bearing at bearing high spot.

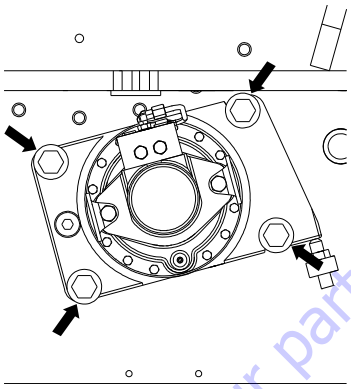


3. Apply JLG Threadlocker P/N 0100019 and torque shoulder screw to 420 ft. lbs. (569 Nm).

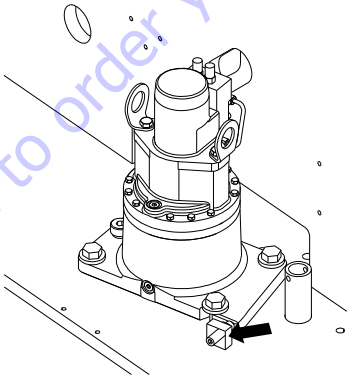


NOTE: *Make sure the turntable is properly supported during the following step. The turntable can swing a few degrees when the turntable lock is removed if the turntable is not balanced properly.*

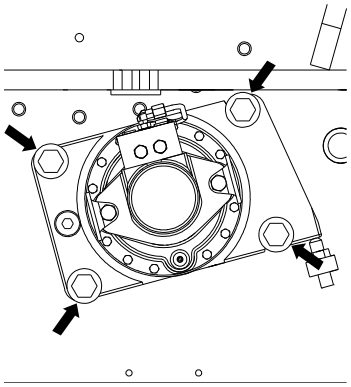
4. Remove turntable lock pin.
5. Apply JLG Threadlocker P/N 0100019 and pre-torque bolt to 30 ft. lbs. (42 Nm).



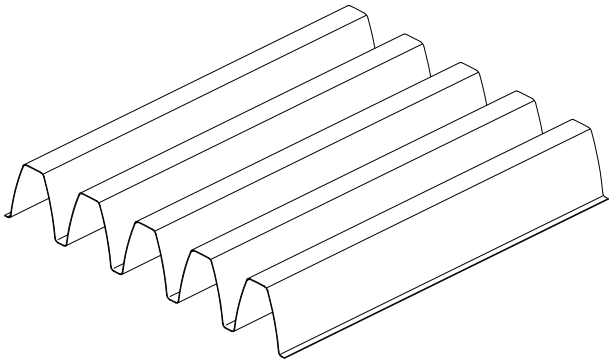
6. Tighten setscrew until pinion is completely snug against shim and bearing then back off setscrew.



7. Apply JLG Threadlocker P/N 0100019 and torque setscrew 50 ft. lbs. (67.5 Nm) (w/JLG Threadlocker P/N 0100019).
8. Apply JLG Threadlocker P/N 0100019 and tighten jam nut.
9. Torque the bolt to 420 ft. lbs. (569 Nm).



10. Discard the shim.



3.13 SWING HUB (PRIOR TO S/N 0300068040)

Disassembly

1. Loosen all 12 Cover Bolts (12) and (13) and drain the oil from the unit.

2. Remove the 12 Cover Bolts (12) and (13) and lift off the Cover (6). Remove and discard the o-ring (5) from the counterbore of the Cover (6).

3. Remove the Input Gear (8) and Thrust Washer (10).

4. Lift out the Carrier Assembly (3) and top Thrust Washer (11). This Thrust Washer (11) may stick to the inside of the Cover (6).

5. Remove the Input Thrust Spacer (9).

6. Lift out the Internal Gear (2) and Thrust Washer (11). The Thrust Washer (11) may stick to the under side of the Carrier (3).

7. Remove the Retaining Ring (1I) from the Output Shaft (1A) and discard.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING (1L) REMOVAL.

8. Remove Bearing Shim (1H) from the Output Shaft (1A).

9. The Output Shaft (1A) may now be pressed out of the Hub (1G).

10. The Bearing Cups (1C) and (1E) will remain in Hub (1G) as will Bearing Cone (1F). Bearing Cone (1D) will remain on the Output Shaft (1A). The Seal (1B) will be automatically removed during this procedure.

NOTE: *If Bearing replacement is necessary, the Bearing Cups can be removed with a slide hammer puller or driven out with a punch.*

11. To remove the Cluster Gears (3F) from the Carrier (3A), drive the Anti-roll Pin (3G) into the Planet Shaft (3E). The Planet Shaft (3E) may now be tapped out of the Carrier. After Planet Shaft (3E) has been removed the Roll Pin (3G) can be driven out.

12. The Cluster Gear (3F) can now be removed from the Carrier (3A). The Thrust Washers (3B) will be removed with the Cluster Gear (3F).

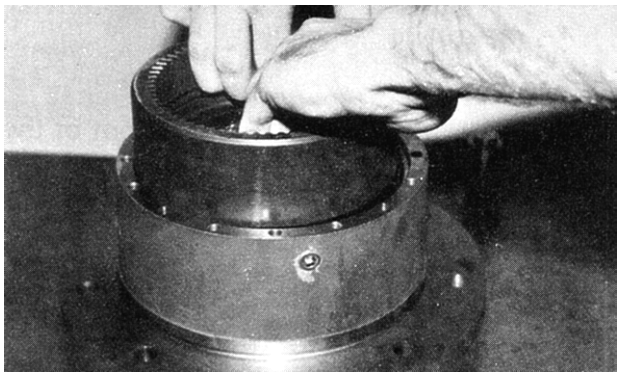
13. The Needle Rollers (3C) and Spacer (3D) are now removed from the Cluster Gear (3F).

NOTICE

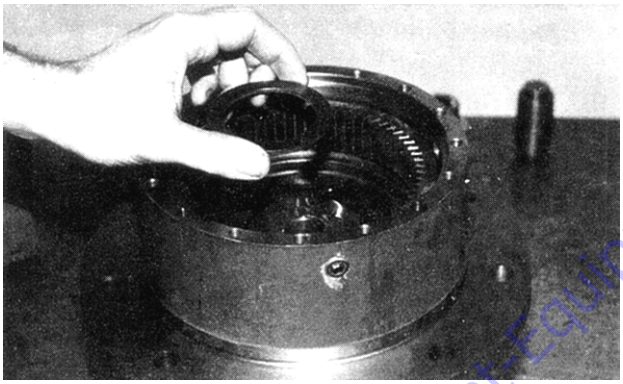
WHEN REBUILDING OR REPAIRING THE UNIT, THE RETAINING RING (1I), O-RINGS (5) AND SEAL (1B) SHOULD ALWAYS BE REPLACED.

Assembly

1. With the Hub Shaft Sub-assembly resting on the Shaft (1A) install Internal Gear (2). The Spline of the Internal Gear (2) bore will mesh with the Spline of the Output Shaft (1A).



2. Thrust Washer (11) is installed on the face of the Output Shaft (1A). Sufficient Grease or Petroleum Jelly should be used to hold Thrust Washer (11) in place.

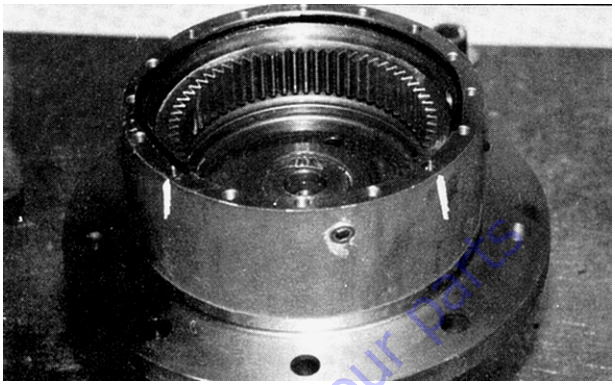


3. Place o-ring (5) into Hub counterbore. Use petroleum jelly to hold o-ring in place.

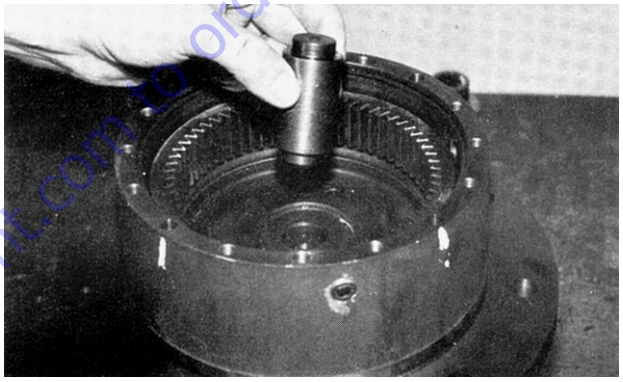
⚠ CAUTION

BEWARE OF SHARP EDGES OF THE COUNTERBORE WHILE SEATING THIS O-RING.

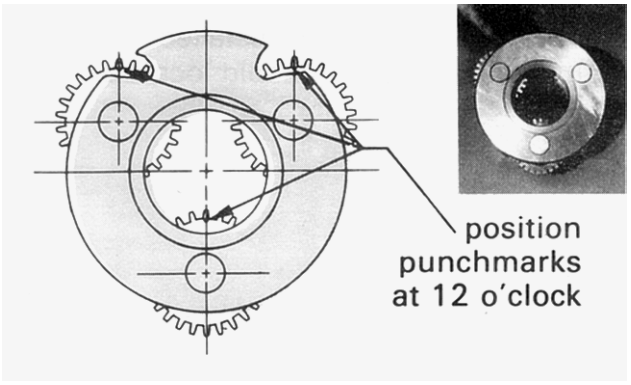
Also at this time locate and mark the 4 counter beamed holes in the face of the Hub (1G). This is for identification later in the assembly.



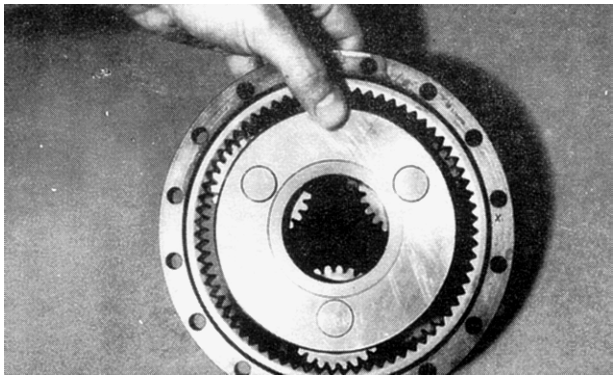
4. Thrust Spacer (9) is installed into the bore of the Output Shaft (1A). This should be a slip fit and the Thrust Spaces should rotate in this location.



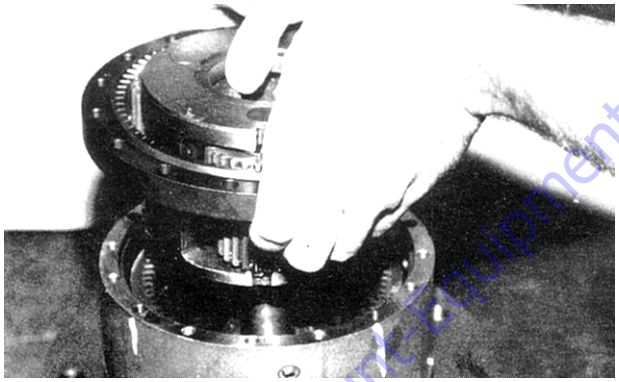
5. Place Carrier Assembly (3) on a flat surface with the large gears (3F) up and positioned as shown. Find the punch marked tooth on each large gear (3F) and locate at 12 o'clock (straight-up) from each planet pin. Marked tooth will be located just under the Carrier (3A) on upper two gears (3F).



6. With shoulder side of Ring Gear (4) facing down, place Ring Gear over (into mesh with) large gears. Be sure that punch marks remain in correct location during Ring Gear installation. The side of the Ring Gear with an X stamped on it should be up.

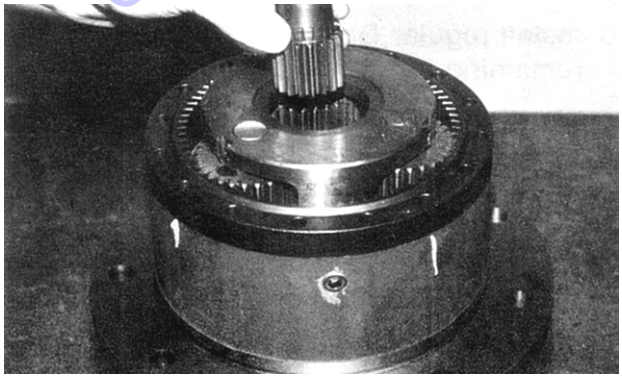


7. While holding Ring Gear (4) and Cluster Gears (3F) in mesh, place small side of Cluster Gears (3F) into mesh with the Internal Gear (2) and Input Gear (13). On the Ring Gear locate the hole marked X over one of the marked counterbored holes (Step 3) in Hub (1G).

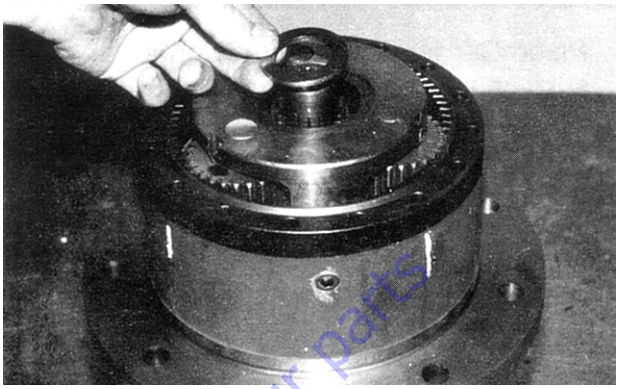


NOTE: *If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.*

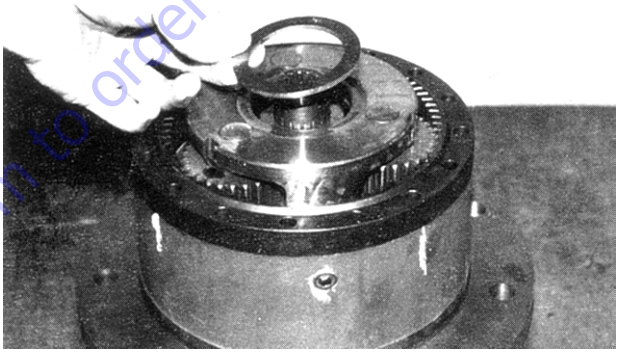
8. Input Gear (8) is installed, meshing with the teeth of the large diameter Cluster Gear (3F). The counterbore on the Input Gear (8) locates on the shoulder of the Thrust Spacer (9). This is to be a slip fit and operate freely.



9. Thrust Washer (10) is installed onto the Input Gear (8) and should locate on the gear teeth shoulder.



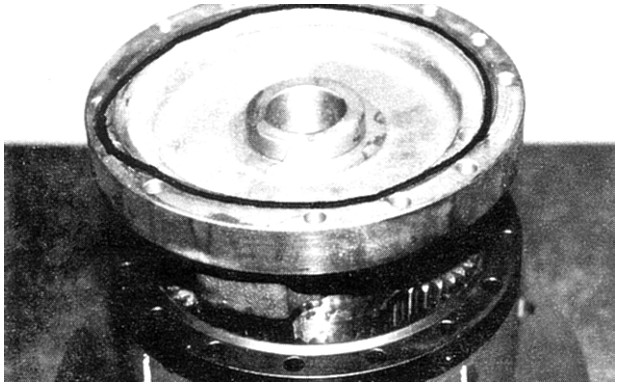
10. Thrust Washer (11) is installed into the counterbore of the Carrier (3).



11. Place o-ring (5) into Cover (6) counterbore. Use petroleum jelly to hold o-ring in place.

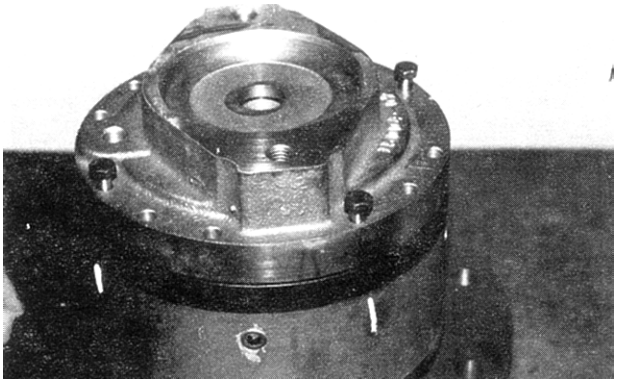
⚠ WARNING

BEWARE OF SHARP EDGES OF THE COUNTERBORE WHILE SEATING THIS O-RING.

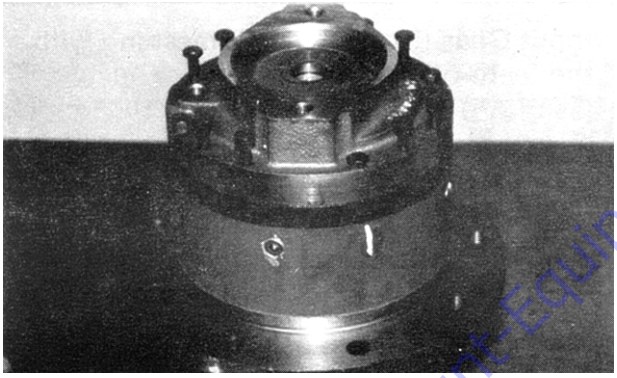


12. The Cover (6) is now installed on this assembly. Taking care to correctly align Pipe Plug hole (20) with those in the Hub (1J), usually 90° to one another.

    Locate the 4 counterbore holes in Hub (1G) [marked in Step 3] and install 4 Shoulder Bolts (13). A slight tap with a hammer may be necessary to align Shoulder Bolt with Hub (1G) counterbore.

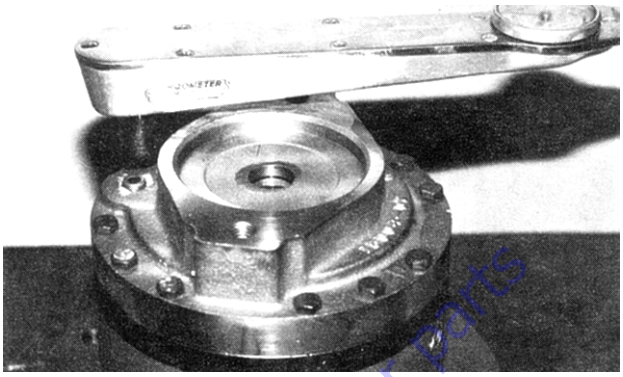


13. Install regular Grade 8 Bolts (12) into remaining holes.



14. Pipe Plugs (20) are to be installed into Cover (6) using a lubricant seal of some sort.

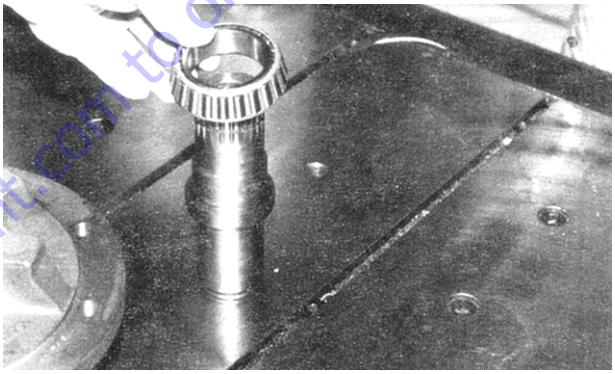
15. Torque Shoulder Bolts (13) to 23-27 ft.-lbs. and regular Grade 8 Bolts (12) to 23-27 ft.– lbs.



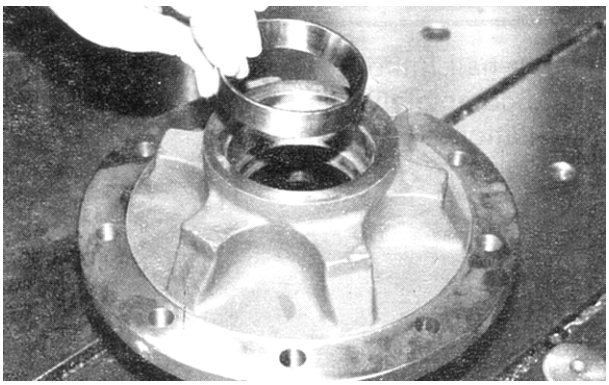
16. The unit must be completely filled with EP 90 lubricant before operation.

Hub Shaft Sub-Assembly

1. Press Bearing Cone (1D) onto Shaft (1A).

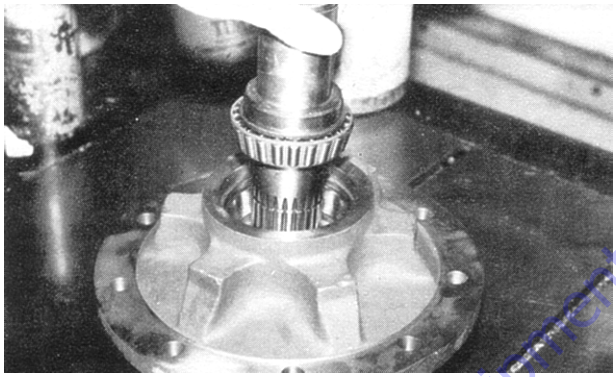


2. Press Bearing Cup (1C) into Hub (1G) taking care to insure cup start square with the bore of Hub (1G).



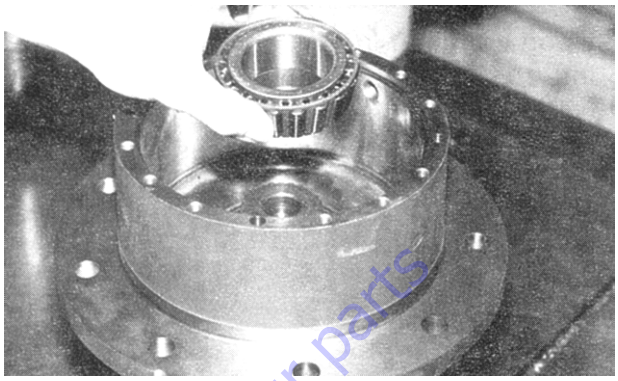
3. Invert Hub (1G) and press Bearing Cup (1E) into inter-counterbore of housing (1G).

4. Returning the Hub (1G) to locate on the large diameter end, the Output Shaft (1A) is carefully installed into the Hub (1G).

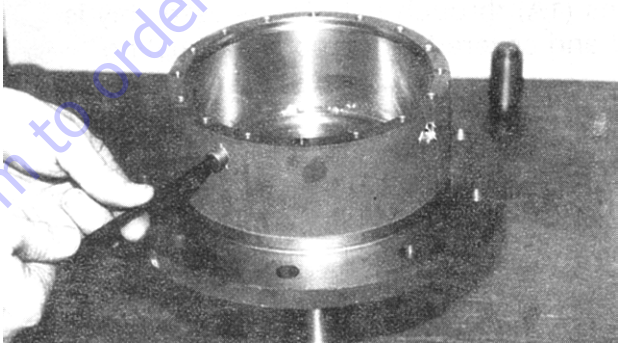


5. The Shaft Seal (1B) is installed over the Output Shaft (1A) and into the counterbore of the Hub (1G). Care should be taken to insure the Seal (1B) is being correctly installed (smooth face UP and located just flush with the counterbore face).

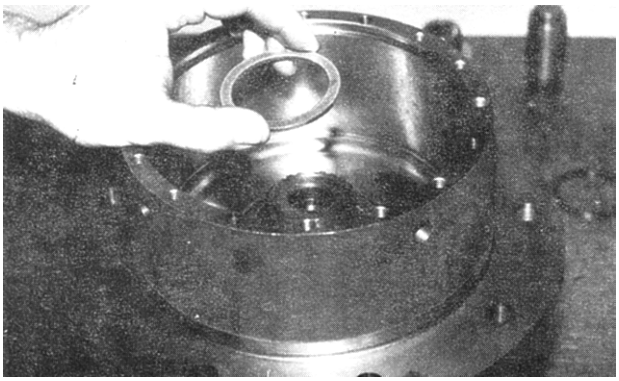
6. The Bearing Cone (1F) is an interference fit and has to be pressed or tapped on.



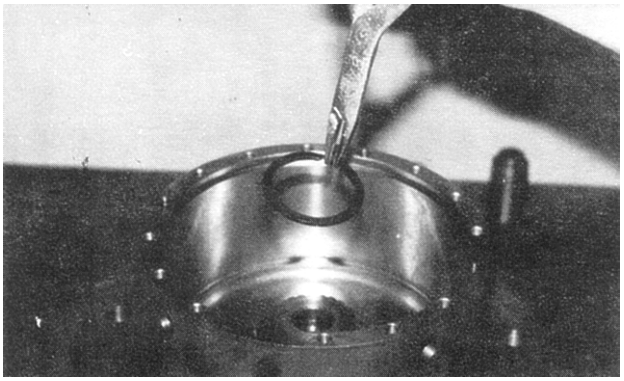
7. Pipe Plugs (1J & 1K) should be checked and/or installed at this time in the assembly.



8. Bearing Spacer (1H) is installed around the Output Shaft (1A) and locates on Bearing Cone (1F).



9. Retaining ring (11) installed into the groove provided in the Output Shaft (1A). This Retaining Ring (1I) should never be reused in a repair or rebuild.



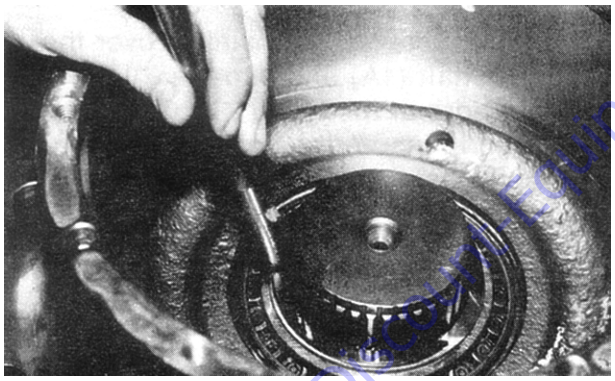
⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.

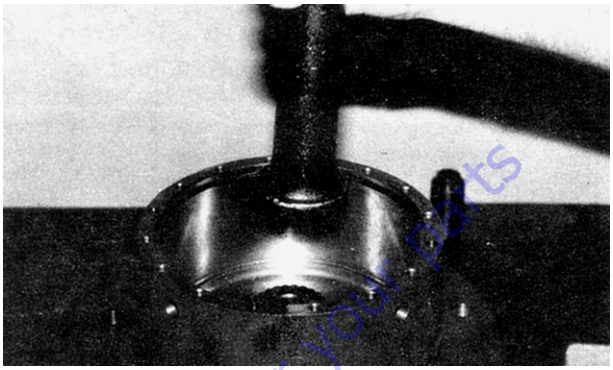
10. A soft metal punch should be used to insure that this Retaining Ring (11) is completely seated in the groove of the Output Shaft (1A).

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.



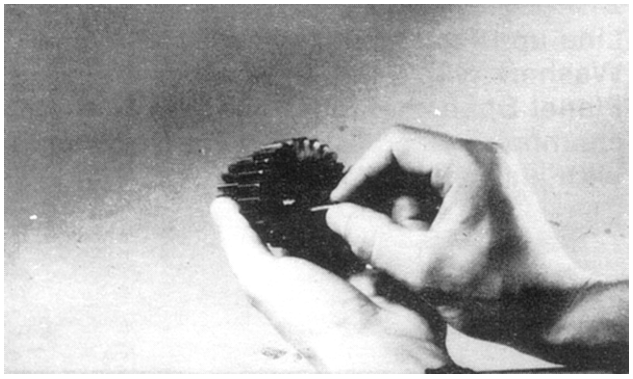
11. Upon completion of Step 10, rap the internal end of the Output Shaft (1A) twice with a piece of soft metal rod. This will release the preload which was on the Bearings.
12. If the assembly is not going to be used right away, it should be oiled and covered to help prevent rusting.



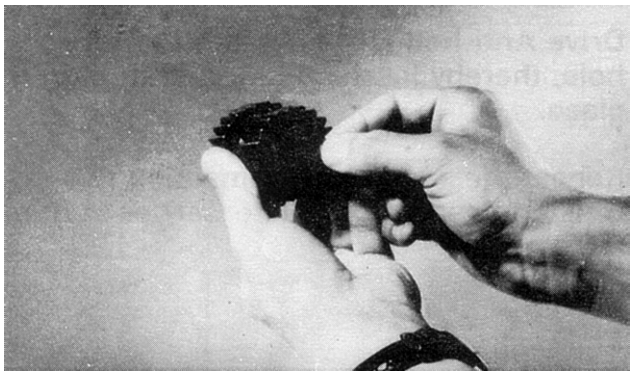
Carrier Sub-Assembly

1. Apply a coat of grease or petroleum jelly to Cluster Gear bore.

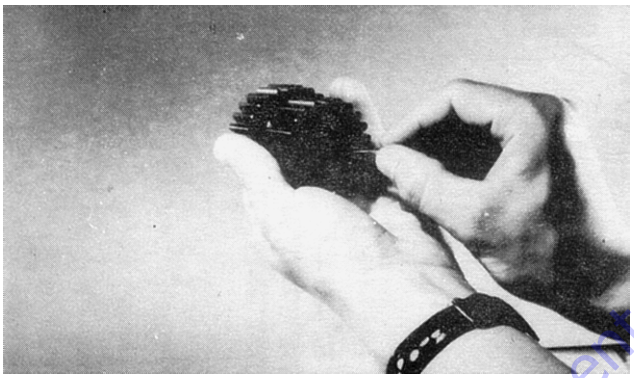
2. Place Needle Rollers into Cluster Gear bore.



3. Place Spacer washer into opposite side of Cluster Gear and against Needle Rollers.



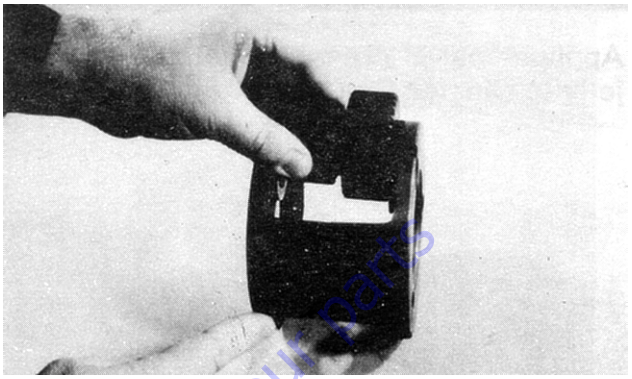
4. Place second set of Needle Rollers into Cluster Gear.



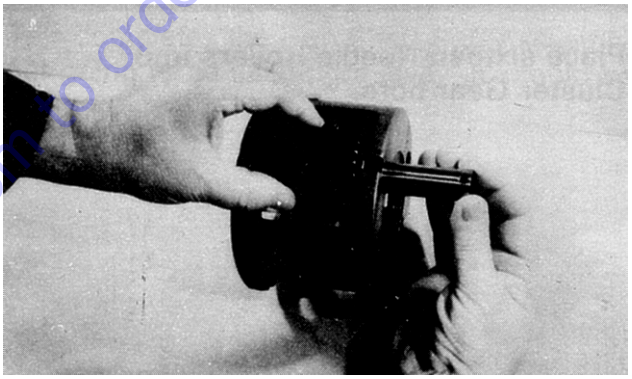
5. Apply grease or petroleum jelly to the tang side of two Thrust Washers. Place Thrust Washers against bosses in Carrier with washer tang fitting into slot in Carrier outside diameter.

NOTE: *Some old style Carriers will not have slots and tangs should be located inside boss relief.*

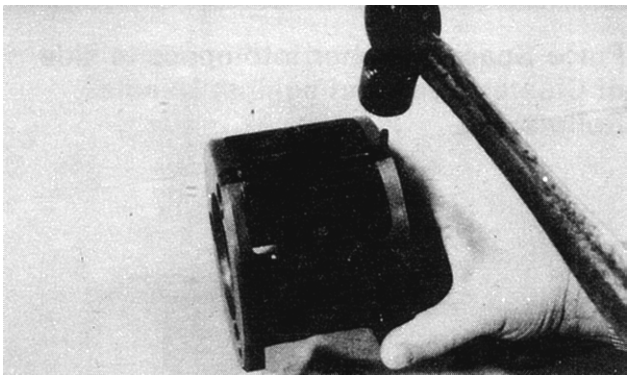
6. While keeping Thrust Washers in place, slide Cluster Gear into Carrier with the larger gear on the side with the small pin hole.



7. Line up Cluster Gear and thrust Washers with hole in Carrier and slide Planet Shaft through. Line up chamfered side of hole in Planet Shaft with pin hole in Carrier.



8. Drive Anti-Roll Pin flush into Carrier hole, thereby locking Planet Shaft into place.



9. Repeat these steps for remaining two Cluster Gears to complete Carrier Sub Assembly.

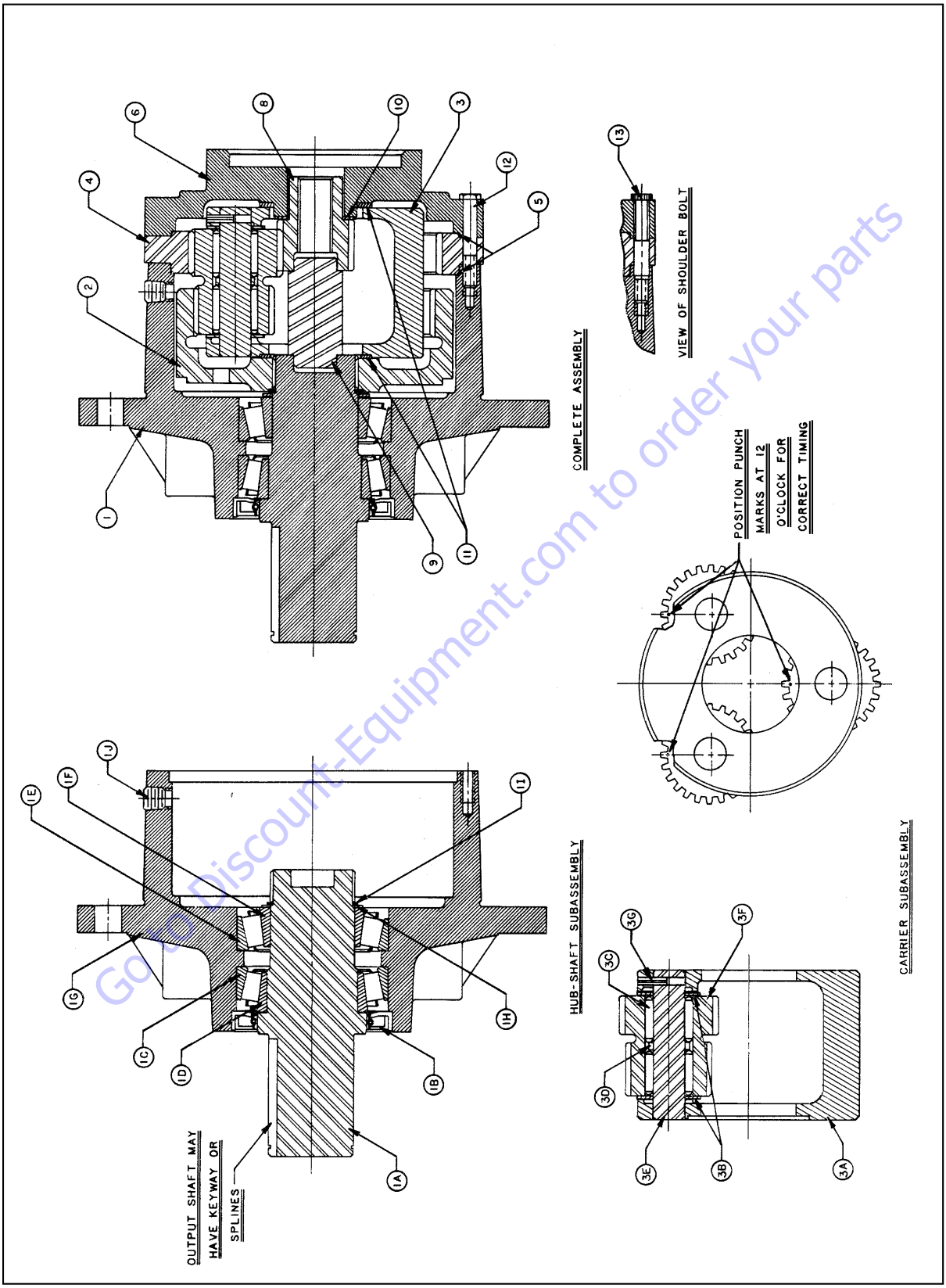


Figure 3-40. Swing Hub

3.14 SWING BRAKE - AUSCO (PRIOR TO S/N 0300064566)

Disassembly

1. With the shaft protrusion downward, Disassemble the parts in the following order; bolts (24) alternately, washers (23), power plate (21), and gasket.
2. Remove the following parts; stationary discs (14), rotating discs (12), primary disc (11), torque pins (3), springs (8 & 9), and the spring retainer (7).

NOTE: *If the bearing and seal are removed for any reason, both must be replaced.*

3. Further disassembly is not recommended and should not be attempted unless necessary to replace the bearing (4), the seal (6), or the shaft (10). If further dissembly is needed, proceed as follows;
   a. The shaft (10) may be removed by pressing on the end of the shaft with a shop press.
   b. Using an appropriate tool, pry the seal (6) out from the inside of the brake. Take care not to damage the bore. Remove the retaining ring (5). Tap the bearing (4) out with a plastic mallet.
4. Remove the piston (15) from the power plate (21) by introducing low pressure air into the hydraulic inlet and make sure the piston is directed away from the operator. Remove the o-rings (17&19) and backup rings (16 & 18) from the piston O.D. and I.D. grooves. Do not remove backup rings (16 & 18) unless replacement is necessary because they will be damaged. With shaft protrusion downward, remove the end cover (13) by removing capscrews (12).

Inspection

1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

NOTE: *Bearings may be reused if, after thorough inspection, they are found to be in good condition.*

Assembly

NOTE: *Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.*

NOTICE

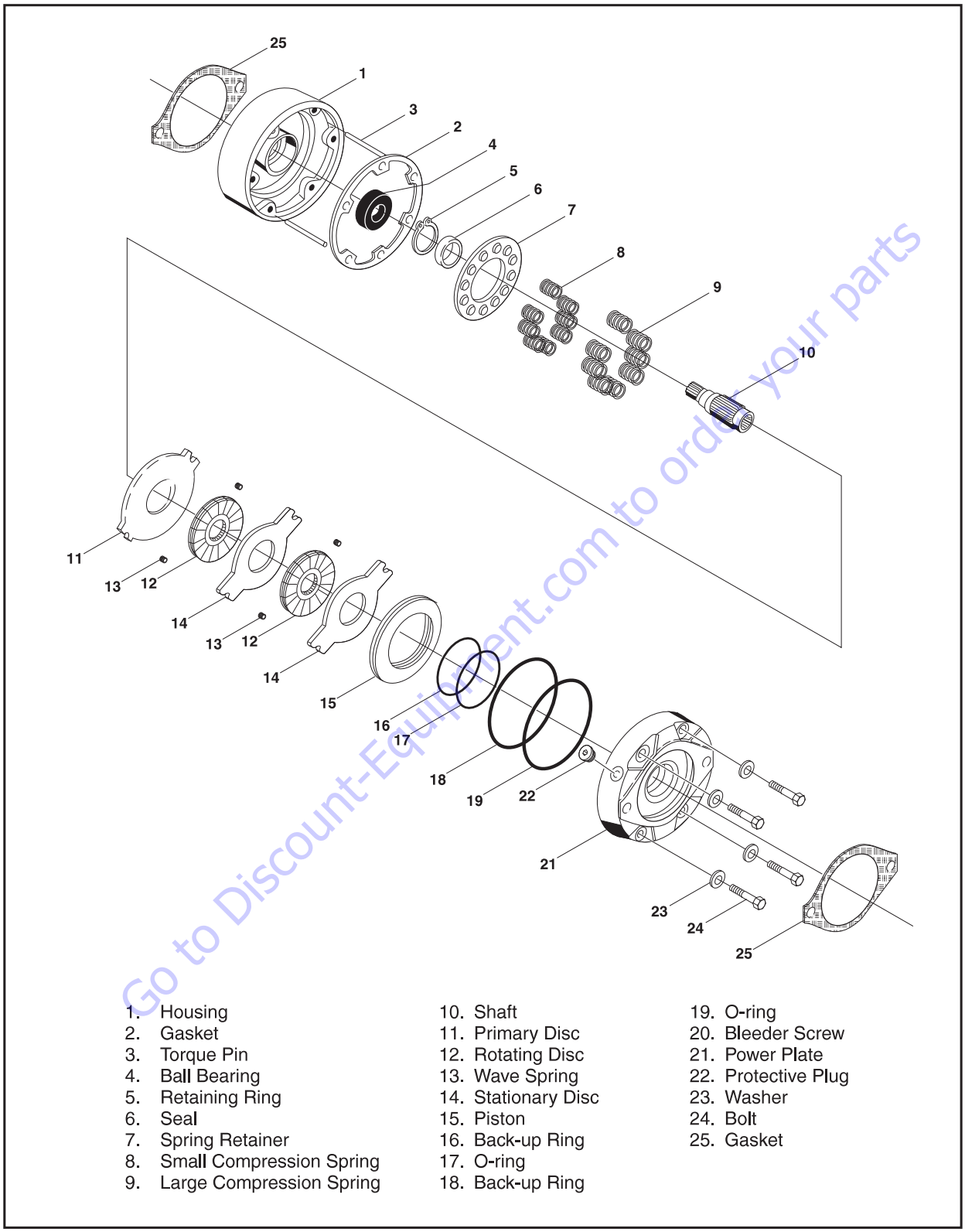
THERE MAY BE MORE PARTS IN A SERVICE KIT THAN YOUR BRAKE REQUIRES. CHECK THE PARTS LIST CAREFULLY FOR THE EXACT QUANTITY. IN THE CASE OF SPRINGS, SPACE THE SPRINGS AS SHOWN IN FIGURE 3-41.

1. Worn o-rings and damaged or worn Teflon backup rings must be replaced prior to assembly.
2. The cylinder of the power plate, piston, and o-rings must be clean prior to assembly and pre-lubed with the system hydraulic fluid.

⚠ CAUTION

THE DEPTH THE PISTON IS INSTALLED INTO THE POWER PLATE IS CRITICAL. THE SURFACE OF THE PISTON AT THE CUTOUTS MUST BE FLUSH TO 0.120 IN (3.0 MM). BELOW THE SURFACE OF THE POWER PLATE. DO NOT EXCEED THE 0.120"(3.0 MM) DEPTH OR THE PISTON WILL COCK RESULTING IN COMPLETE LOSS OF BRAKING.

3. Assemble the piston (15) into the power plate (21) using a shop press, being careful not to damage the o-rings or Teflon back-up rings. Visually align the center of the cutouts in the piston with the torque pin (3) holes in the power plate (21).
4. For replacement of the seal;
   a. Use a shop press to install the bearing (4) into the housing. Press the outer surface of the bearing only. Install the retaining ring (5) into the groove.
   b. Press the seal (6) into the housing (1) until it is flush with the face of the housing. The lip of the seal must face towards the bearing.
5. Press the shaft into the housing until it stops on the bearing. Support the inner race of the bearing during the press operation.
6. Rotating discs must be clean and dry. The lining material and mating surfaces of the stationary discs must be thoroughly clean and free of debris. Worn or scored rotating discs must be replaced.
7. Install bolts (24) with washers (23) in the power plate (21. Tighten sequentially, one turn at a time, until the power plate is properly seated. Torque 105 to 115 Ft. Lbs. (147 to 161 Nm)



1. Housing
2. Gasket
3. Torque Pin
4. Ball Bearing
5. Retaining Ring
6. Seal
7. Spring Retainer
8. Small Compression Spring
9. Large Compression Spring
10. Shaft
11. Primary Disc
12. Rotating Disc
13. Wave Spring
14. Stationary Disc
15. Piston
16. Back-up Ring
17. O-ring
18. Back-up Ring
19. O-ring
20. Bleeder Screw
21. Power Plate
22. Protective Plug
23. Washer
24. Bolt
25. Gasket

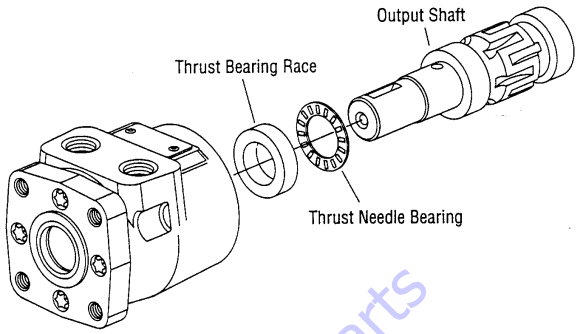
Figure 3-41. Swing Brake Assembly (Ausco) (Prior to S/N 0300064566)

3.15 SWING MOTOR (EATON) (PRIOR TO S/N 0300068040)

Cleanliness is extremely important when repairing hydraulic motors. Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the motor. Before disassembly, drain oil from the motor. Then plug the ports and thoroughly clean the exterior of the motor. Check the output shaft, remove any burrs, nicks, or sharp edges.

Disassembly

1. Clamp the motor in a vise so the shaft is vertical and the end cap is on the top. Clamp on the mounting flange, use just enough clamping force to hold the motor securely. Protect the mounting flange with soft vise jaws.
2. Remove the 7 cap screws from the end cap and disassemble the motor as shown.
3. Unclamp the motor and remove the output shaft, thrust needle bearing, and thrust bearing race.
4. Clamp the motor in a vise so the mounting flange is on top.Clamp across the port area. **Do not clamp on motor housing.** Use just enough clamping force to hold the motor securely.

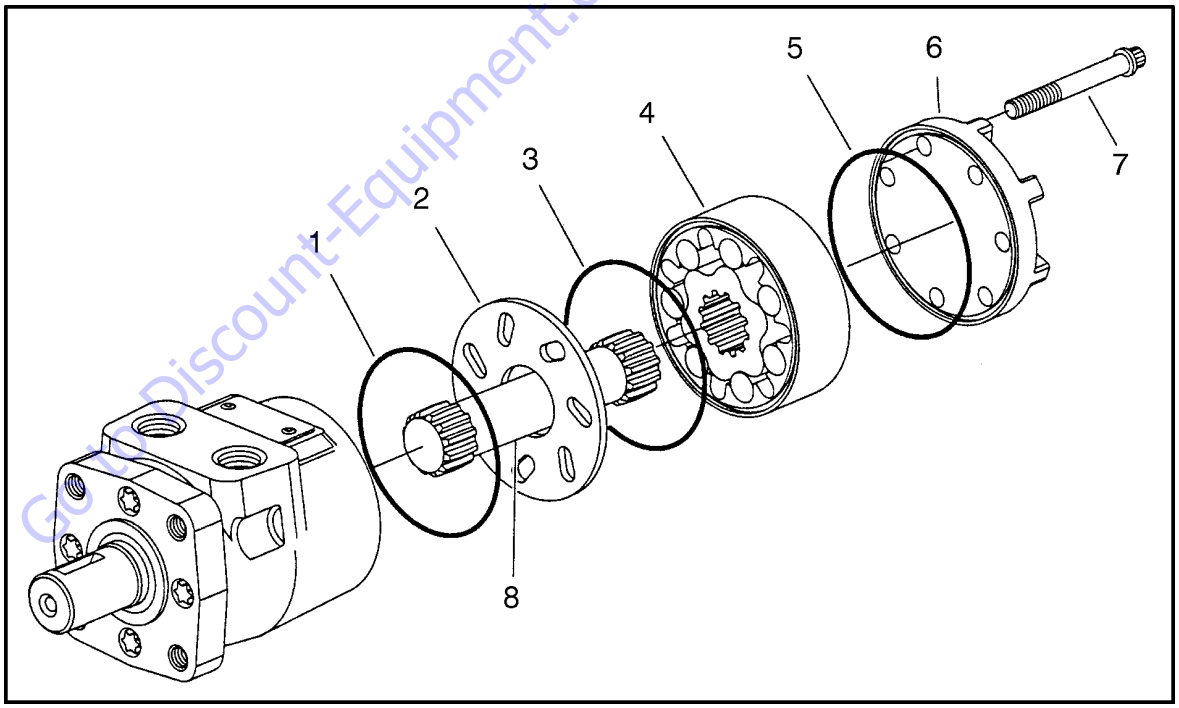


5. Remove the four cap screws that hold the mounting flange to the motor housing.

NOTICE

THESE SCREWS WERE LOCTITED DURING ASSEMBLY. DO NOT EXCEED 500 IN. LBS (56 NM) OF REMOVAL TORQUE

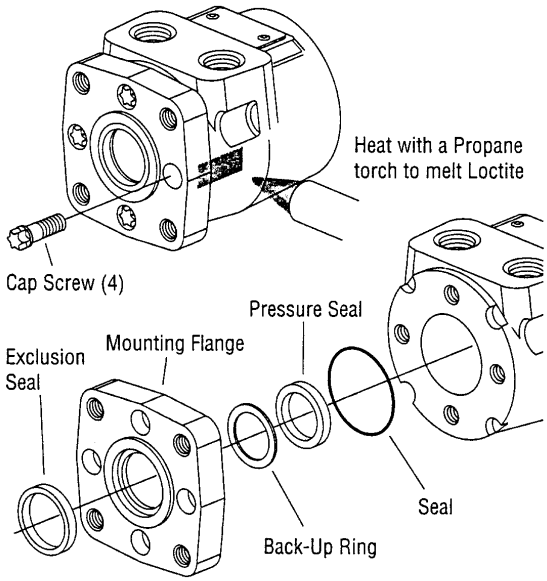
If the Loctite is holding the screws too tightly, heat the motor housing, with a propane torch, while turning screw. Apply heat to where the screw threads into the motor housing.



1. Seal
2. Spacer Plate
3. Seal
4. Geroler
5. Seal
6. End Cap
7. Capscrew
8. Drive

Figure 3-42. End Cap Removal

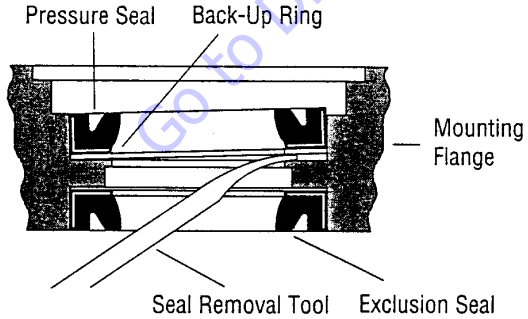
Apply just enough heat to remove screw, do not over heat the motor housing or mounting flange.



6. Remove the mounting flange from the motor housing. The exclusion seal, pressure seal, and back - up ring will come off with the mounting flange.
7. Carefully remove the exclusion seal, pressure seal, and back - up ring from the mounting flange. A seal removal tool may be fabricated by bending and rounding the end of a small blade screwdriver.

NOTICE

DO NOT DAMAGE THE MOUNTING FLANGE WHERE THE SHAFT PASSES THROUGH IT.



Reassembly

Check all mating surfaces. Replace any parts with scratches or burrs that could cause leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage. Check the key way and chamfered area of the output shaft; remove any nicks, burrs, or sharp edges that could damage the shaft seal during assembly.

NOTE: *Always use new seals when reassembling hydraulic motors.*

NOTICE

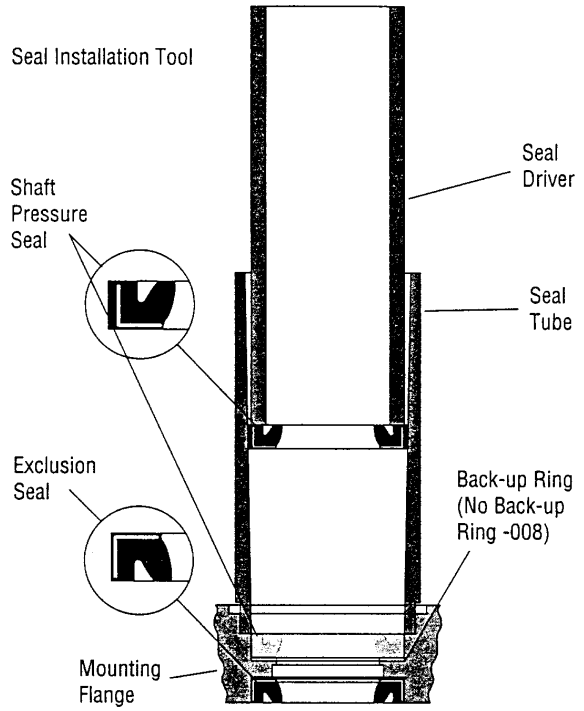
DURING REASSEMBLY LUBRICATE THE NEW SEALS WITH A PETROLEUM JELLY LIKE VASELINE. ALSO LUBRICATE MACHINED SURFACES AND BEARINGS WITH CLEAN HYDRAULIC FLUID.

1. Remove all of the old Loctite from the mounting flange cap screws and their threaded holes. The threads must be clean and dry for the new Loctite to hold properly.
2. Lubricate and install the output shaft, needle thrust bearing, and bearing race into the housing.

NOTICE

DO NOT PERMIT OIL TO GET INTO THE FOUR THREADED HOLES.

3. Lubricate the exclusion seal and press it into its seat in the mounting flange.
4. Lubricate and install the back - up ring and pressure. Use a seal installation tool to press the pressure seal into place.



NOTICE

BE SURE THE EXCLUSION SEAL AND PRESSURE SEAL ARE UNDAMAGED AND PROPERLY SEATED.

5. Clamp the motor in the vise so the output shaft is vertical and down. Clamp on the mounting flange.
6. Pour clean hydraulic fluid into the motor to provide start - up lubrication.
7. Lubricate and install one of the three largest diameter seals in the groove in the motor housing.
8. Install the drive.

NOTE: *If the splined ends of the Drive are different lengths, install the longer end into the shaft.*

Motor Timing

1. Align shaft timing dot with any bolt hole. Bolt hole will be used for timing reference.
2. Install spacer plate, and note the position of the threaded hole in housing aligned with the timing dot on shaft.

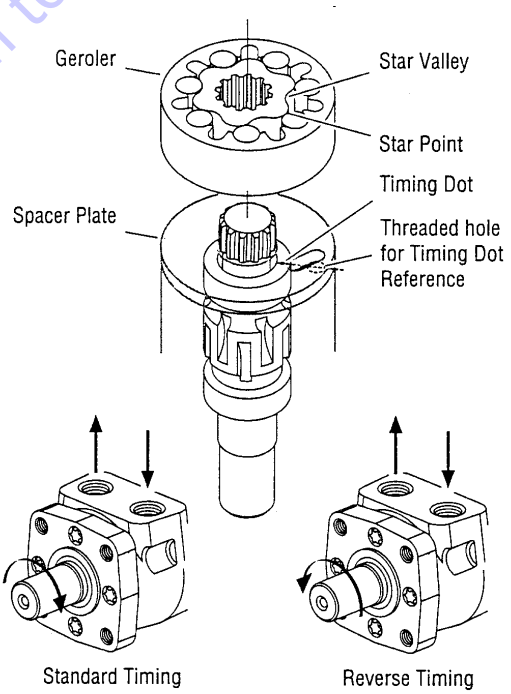
NOTICE

BE SURE THE SLOTS IN THE SPACER PLATE PROVIDE PASSAGE FOR HYDRAULIC FLUID AS WELL AS THE CAP SCREWS. IF THE SPACER PLATE IS FLIPPED THE MOTOR WILL NOT OPERATE.

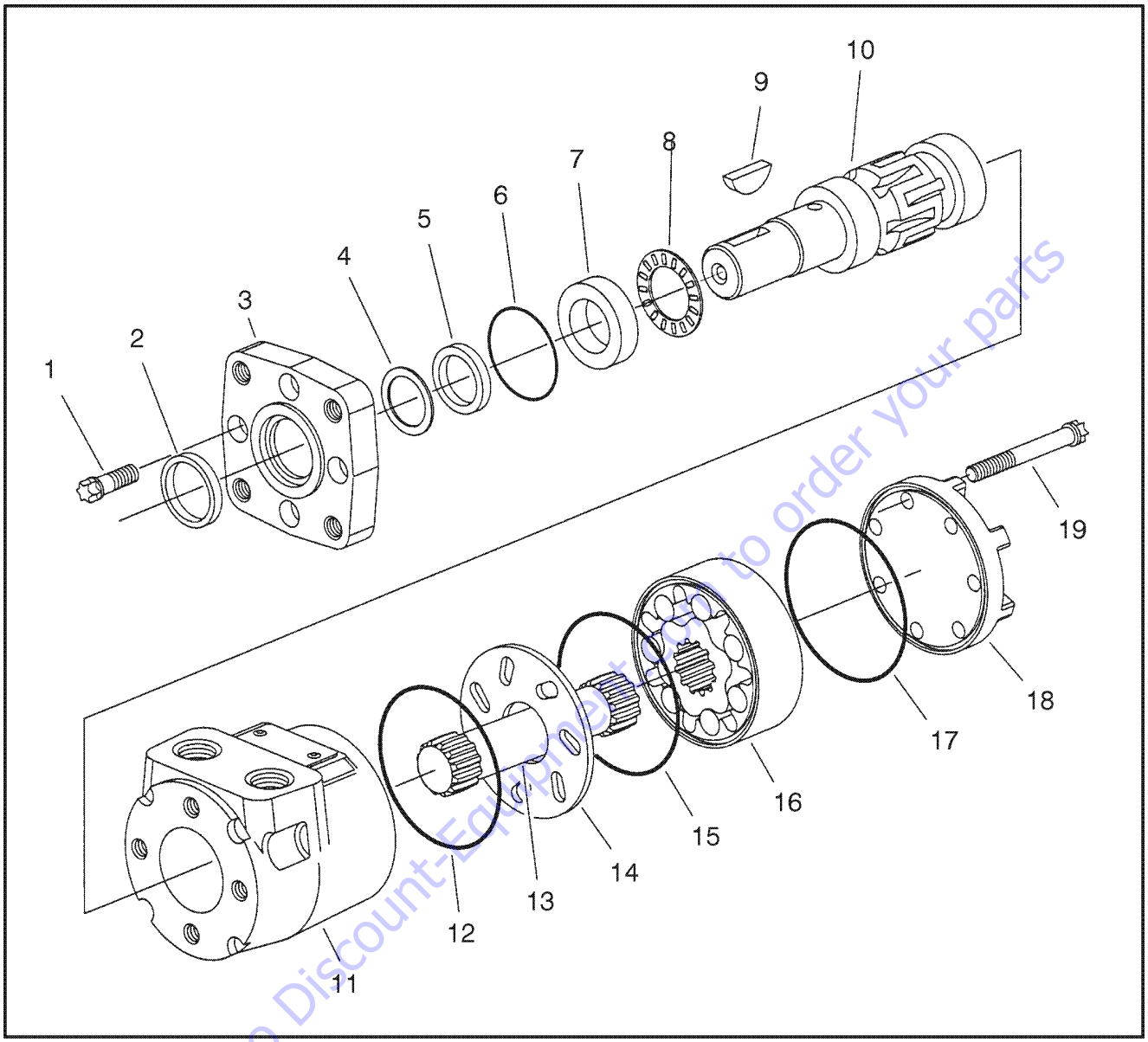
3. Lightly stretch, lubricate and install the second of the three larger diameter seals in the groove in the Geroler.

   Standard Timing: Align any star point with threaded hole noted for the location of the timing dot.

   Reverse Timing: Align any star valley with the threaded hole noted for the location of the timing dot.
4. Rotate the geroler to align the screw holes and install driver spacer if applicable.
5. Lubricate and install the last one of the three larger diameter seals in the groove in the end cap.
6. Install the end cap and seven cap screws.
7. Tighten the cap screws, in a criss - cross pattern, to 300 in lbs. (34 Nm).



8. The level down relief valve is located right next to the check port. Turn clockwise to increase and counterclockwise to decrease.



1. Capscrew
2. Exclusion Seal
3. Mounting Flange
4. Backup Ring
5. Pressure Seal
6. Seal
7. Bearing Race
8. Needle Thrust Bearing
9. Key
10. Output Shaft
11. Housing
12. Seal
13. Drive
14. Spacer Plate
15. Seal
16. Geroler
17. Seal
18. End Cap
19. Capscrew

Figure 3-43. Swing Motor (Prior to S/N 0300068040)

3.16 SWING HUB (S/N 0300068040 TO S/N 0300183033)

Disassembly

1. Loosen all 12 cover bolts (12)&(13) and drain the oil from the unit.
2. Remove the 12 cover bolts (12)& (13) and lift off the cover (6). Remove and discard the O-ring (5) from the counterbore of the cover (6).
3. Remove the input gear (8) and thrust washer (10).
4. Lift out the carrier assembly (3) and top thrust washer (11). The thrust washer (11) may stick to the inside of the carrier (3).
5. Remove the input thrust spacer (9).
6. Lift out the internal gear (2) and thrust washer (11). The thrust washer (11) may stick to the under side of the carrier (3).
7. Remove the retaining ring (1I) from the output shaft (1A) and discard.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING (1I) REMOVAL.

8. Remove bearing shim (1H) from the output shaft (1A).
9. The output shaft (1A) may now be pressed out of the hub (1G).
10. THe bearing cups (1C)&(1E) will remain in hub (1G) as will bearing cone (1F). Bearing cone (1D) will remain on the same output shaft (1A). The seal (1B) will be automatically removed during this procedure.

NOTE: *If bearing replacement is necessary, the bearing cups can be removed with a slide hammer puller driven out with a punch.*

11. To remove the cluster gears (3F) from the carrier (3A), drive the anti-roll pin (3G) into the planet shaft (3E) may now be tapped out of the carrier. After planet shaft (3E) has been removed the roll pin (3G) can be driven out.
12. The cluster gear (3F) can now be removed from the carrier (3A). THe thrust washers (3B) will be removed with the cluster gear (3F).
13. The needle rollers (3C) and spacer (3D) are now removed from the cluster gear (3F).

⚠ WARNING

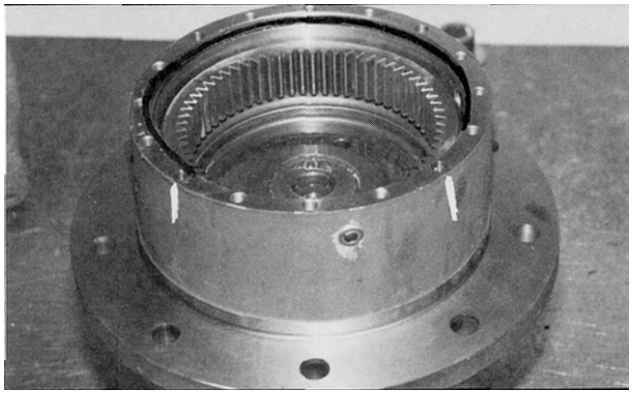
WHEN REBUILDING OR REPAIRING THE UNIT, THE RETAINING RING (1I), O-RINGS (5) AND SEAL (1B) SHOULD ALWAYS BE REPLACED.

Main Assembly Procedure

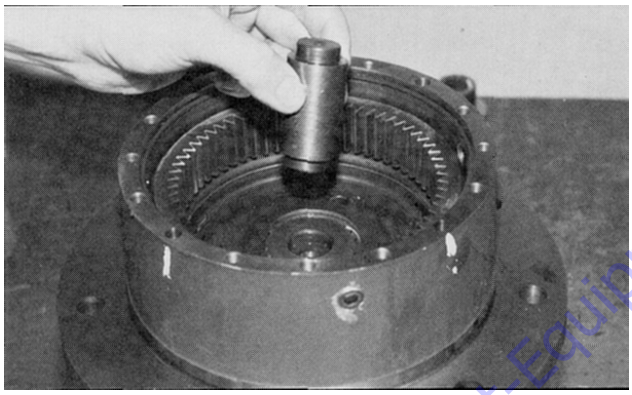
1. With the hub shaft sub-assembly resting on the shaft (1A) install internal gear (2). The spline of the internal gear (2) bore will mesh the spline of the output shaft (1A).

2. Thrust washer (11) is installed on the face of the output shaft (1A). Sufficient grease or petroleum jelly should be used to hold thrust washer in place.

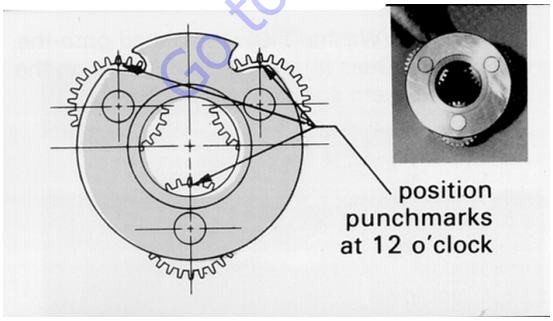
3. Place O-ring (5) into hub counterbore. Use petroleum jelly to hold O-ring in place. Also at this time locate and mark the 4 counter beamed holes in the face of the hub (1G). This is for identification later in the assembly.



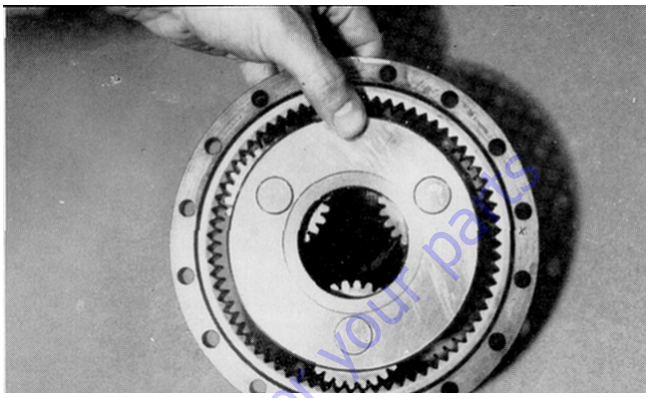
4. Thrust spacer (9) is installed into the bore of the output shaft (1A). This should be a slip fit and thrust spaces should rotate in this location.



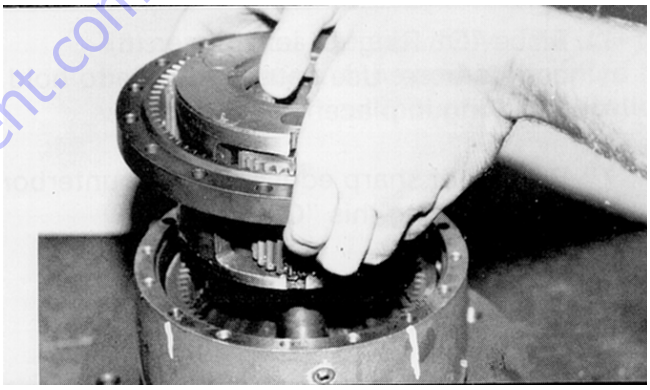
5. Place carrier assembly (3) on a flat surface with the large gears (3F) up and positioned as shown. Find the punch marked tooth on each large gear (3F) and locate at 12 0'clock (straight-up) from each planet pin. Marked tooth will be located just under the carrier (3A) on upper two gears (3F).



6. With shoulder side of ring gear (4) facing down, place ring gear over (into mesh with) large gears. Be sure that punch marks remain in correct location during ring gear installation. The side of the ring gear with an x stamped on it should be up.

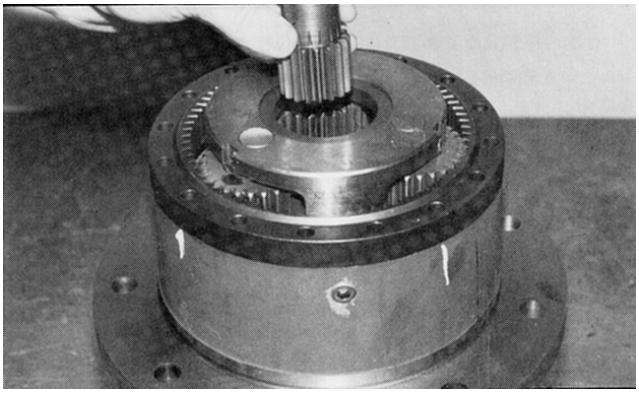


7. While holding ring gear (4) and cluster gears (3F) in mesh, place small side of cluster gears (3F) into mesh with the internal gear (2) and input gear (13). On the ring gear locate the hole marked "x" over one of the marked counterbore holes (step 3) in hub (1G).

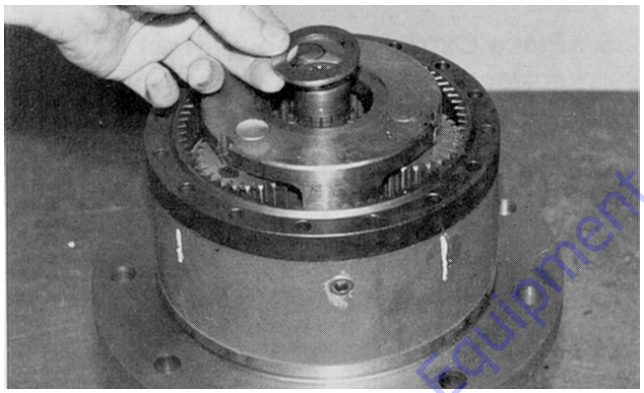


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove the carrier and ring gear and check the cluster gear timing.*

8. Input gear (8) is installed, meshing with teeth of the large diameter cluster gear (3F). The counterbore on the input gear (8) locates on the shoulder of the thrust spacer (9). This is to be a slip fit and operate freely.



9. Thrust washer (10) is installed onto the input gear (8) and should locate on the gear teeth shoulder.



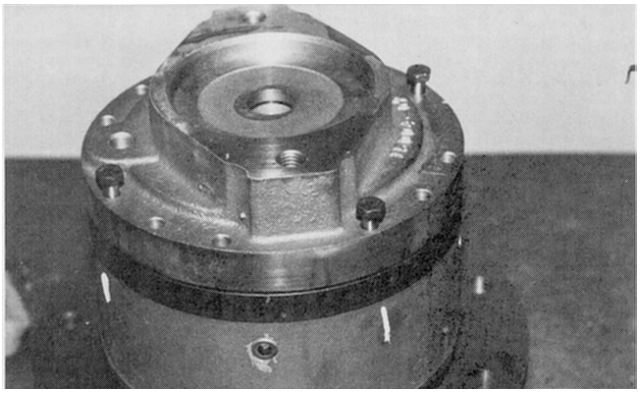
10. Thrust washer (11) is installed into the counterbore of the carrier (3).

11. Place O-ring (5) into cover (6) counterbore. Use petroleum jelly to hold O-ring in place.

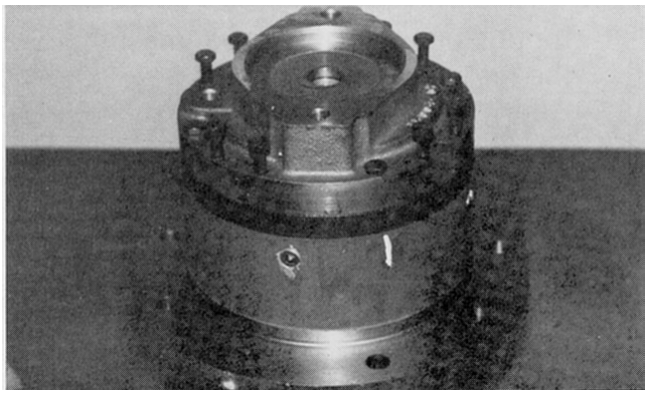
⚠ CAUTION

BEWARE OF SHARP EDGES OF THE COUNTERBORE WHILE SEATING THIS O-RING.

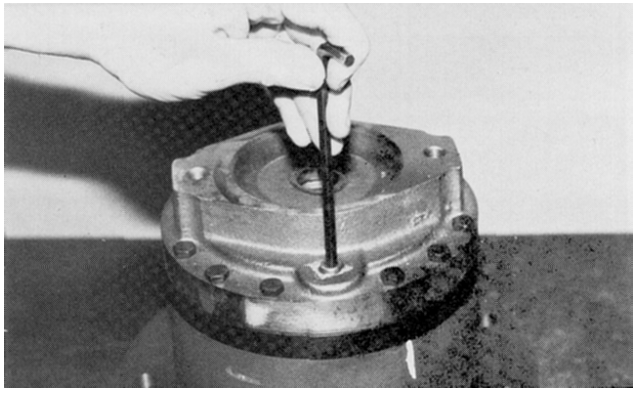
12. The cover (6) is now installed on this assembly. Taking care to correctly align pipe plug hole (20) with those in the hub (1J), usually 90° to one another.
Locate the 4 counterbore holes in hub (1G) (marked in step 3) and install 4 shoulder bolts (13). A slight tap with a hammer may be necessary to align shoulder bolt with hub (1G) counterbore.



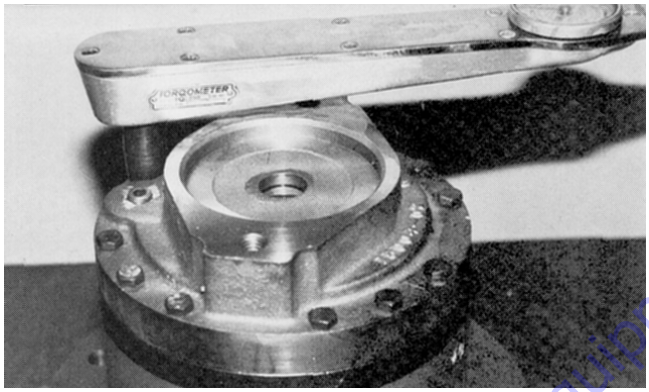
13. Install regular grade 8 bolts (12) into remaining holes.



14. Pipe plugs (20) are to be installed into cover (6) using a lubricant of some sort.



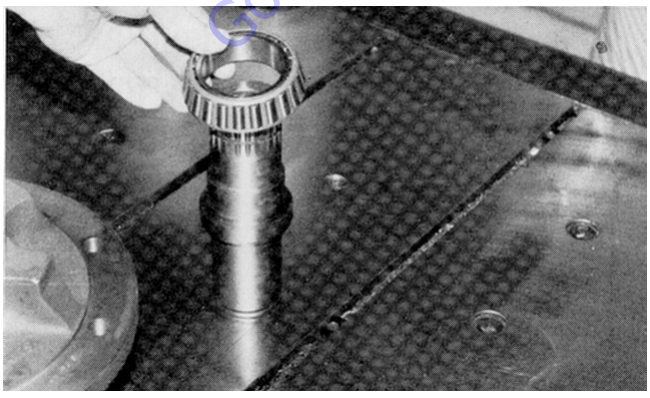
15. Torque shoulder bolts (13) to 23-27 ft. lbs. and regular grade 8 bolts (12) to 23-27 ft. lbs.



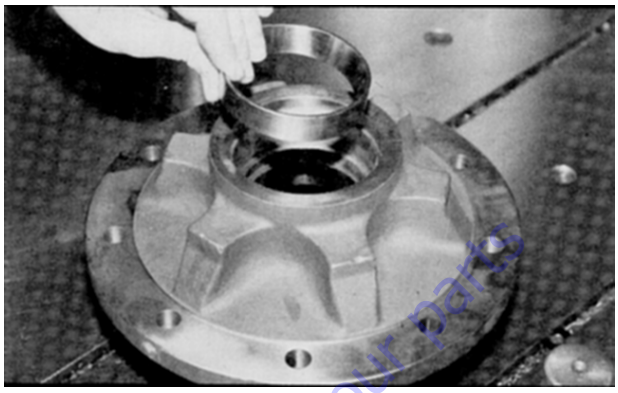
This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation if the unit is mounted horizontally, and completely filled if mounted vertically. In vertical mounting application case oil circulation is recommended.

Hub Shaft Sub-Assembly

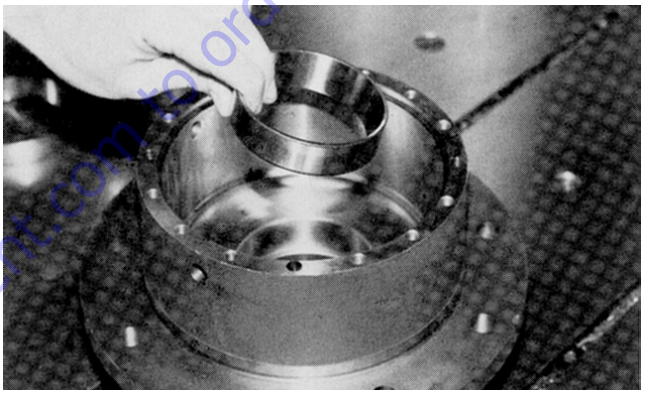
1. Press bearing cone (1D) onto shaft (1A).



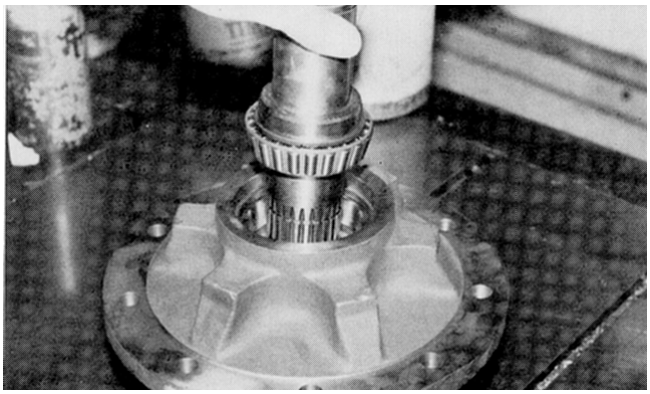
2. Press bearing cup (1C) into hub (1G) taking care to insure cup start square with the bore of the hub.



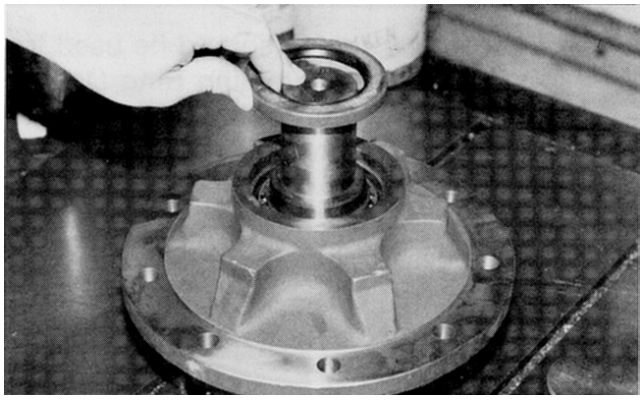
3. Invert hub (1G) and press bearing cup (1E) into inter counterbore of hub (1G).



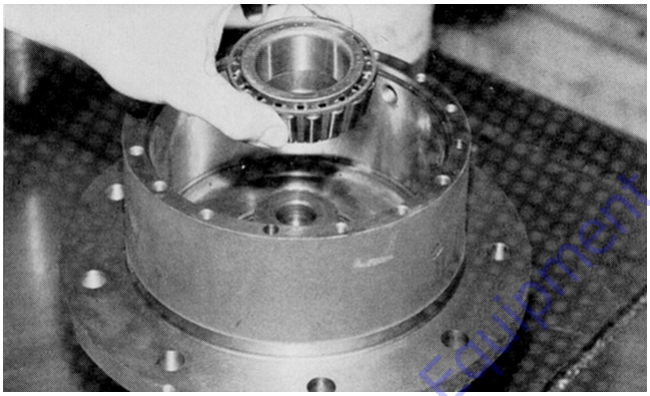
4. Returning the hub (1G) to locate on the large diameter end, the output shaft (1A) is carefully installed into the hub (1G).



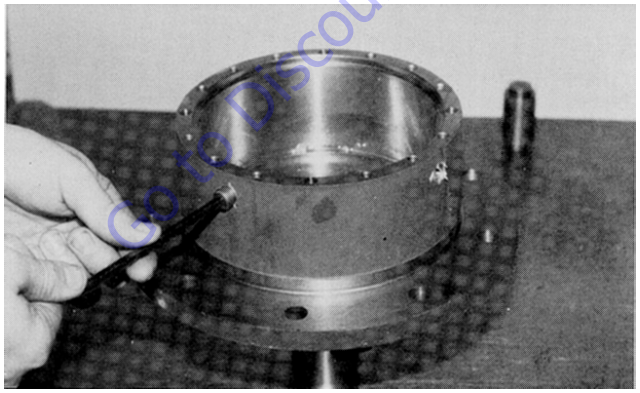
5. The shaft seal (1B) is installed over the output shaft (1A) and into the counterbore of the hub (1G). Care should be taken to insure the seal (1B) is being correctly installed (smooth face up and located just flush with the counterbore face).



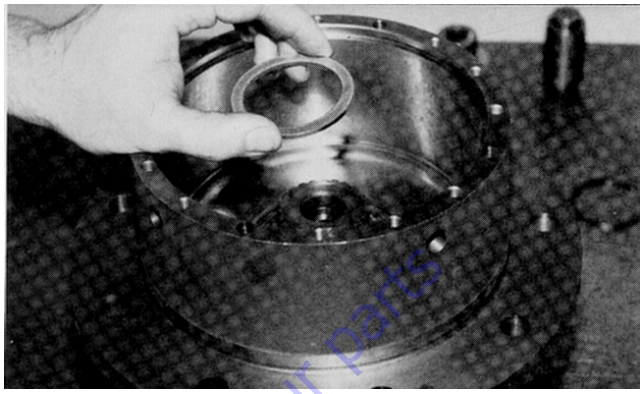
6. The bearing cone (1F) is an interference fit and has to be pressed or tapped on.



7. Pipe plugs (1J & 1K) should be checked and/ or installed at this time in the assembly.



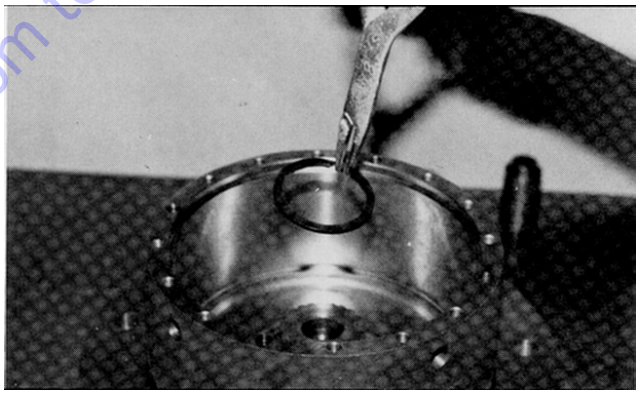
8. Bearing spacer (1H) is installed around the output shaft (1A) and locates on bearing cone (1F).



9. Retaining ring (1I) installed into groove provided in the output shaft (1A). This retaining ring (1I) should never be reused in a repair or rebuild.

⚠ CAUTION

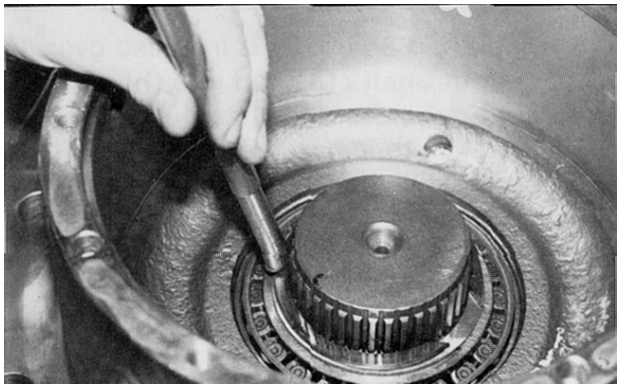
EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.



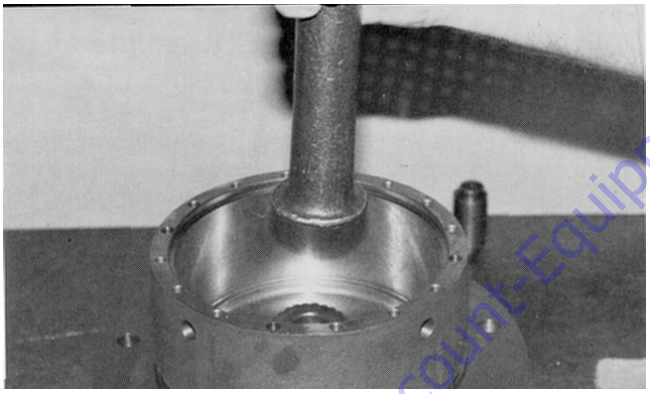
10. A soft metal punch should be used to insure that this retaining ring (1I) is completely seated in the groove of the output shaft (1A).

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.



11. Upon completion of step 10, rap the internal end of the output shaft (1A) twice with a piece of soft metal rod. This will release the preload which was on the bearings.

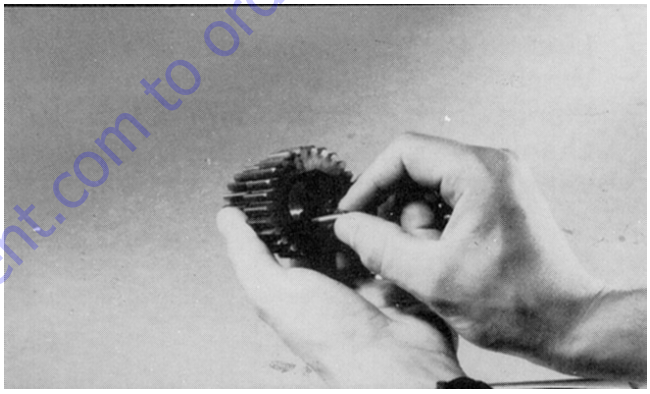


This completes the hub shaft sub-assembly —items (1A) through (1J). If this assembly is not going to be used right away, it should be oiled and covered to help prevent rusting,

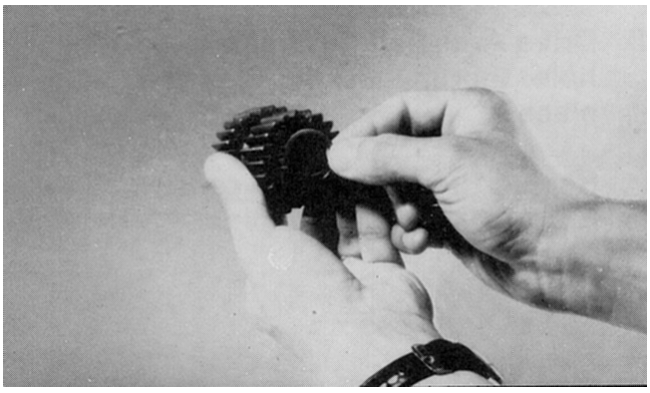
Carrier Sub-Assembly

1. Apply a coat of grease or petroleum jelly to cluster gear bore.

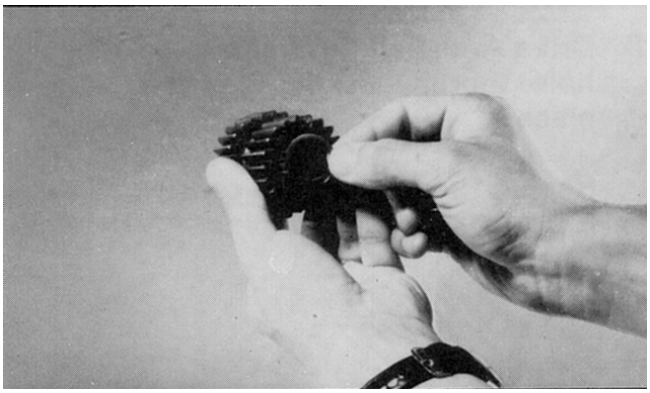
2. Place needle rollers into cluster gear bore.



3. Place spacer washer into opposite side of cluster gear and against needle rollers.

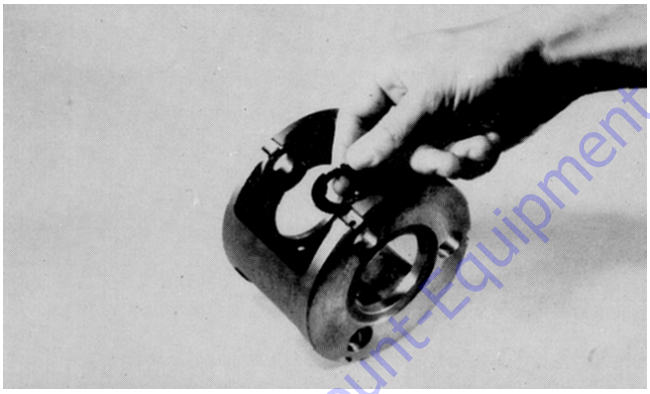


4. Place second set of needle rollers into cluster gear.

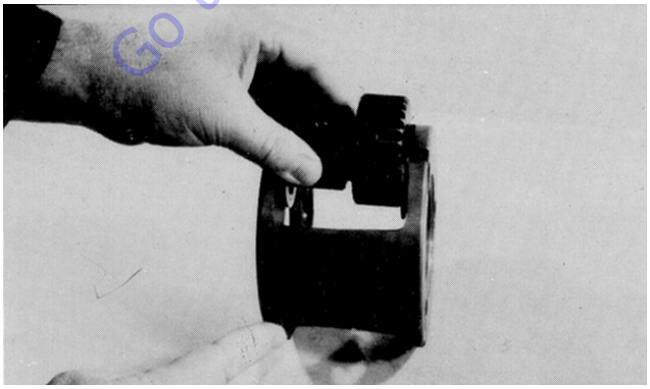


5. Apply grease or petroleum jelly to the tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.

NOTE: *Some old style carriers will not have slots and tangs should be located inside boss relief.*

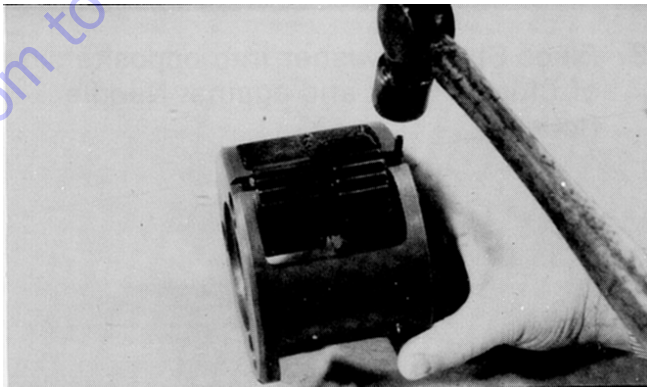


6. While keeping thrust washers in place, slide cluster gear into carrier with the larger gear on the side with the small pin hole.



7. Line up cluster gear and thrust washer with hole in carrier and slide planet shaft through. Line up chamfered side of hole in planet shaft with pin hole in carrier.

8. Drive anti-roll pin flush into carrier hole, thereby locking planet shaft into place.
Repeat these steps for remaining two cluster gears to complete carrier assembly.



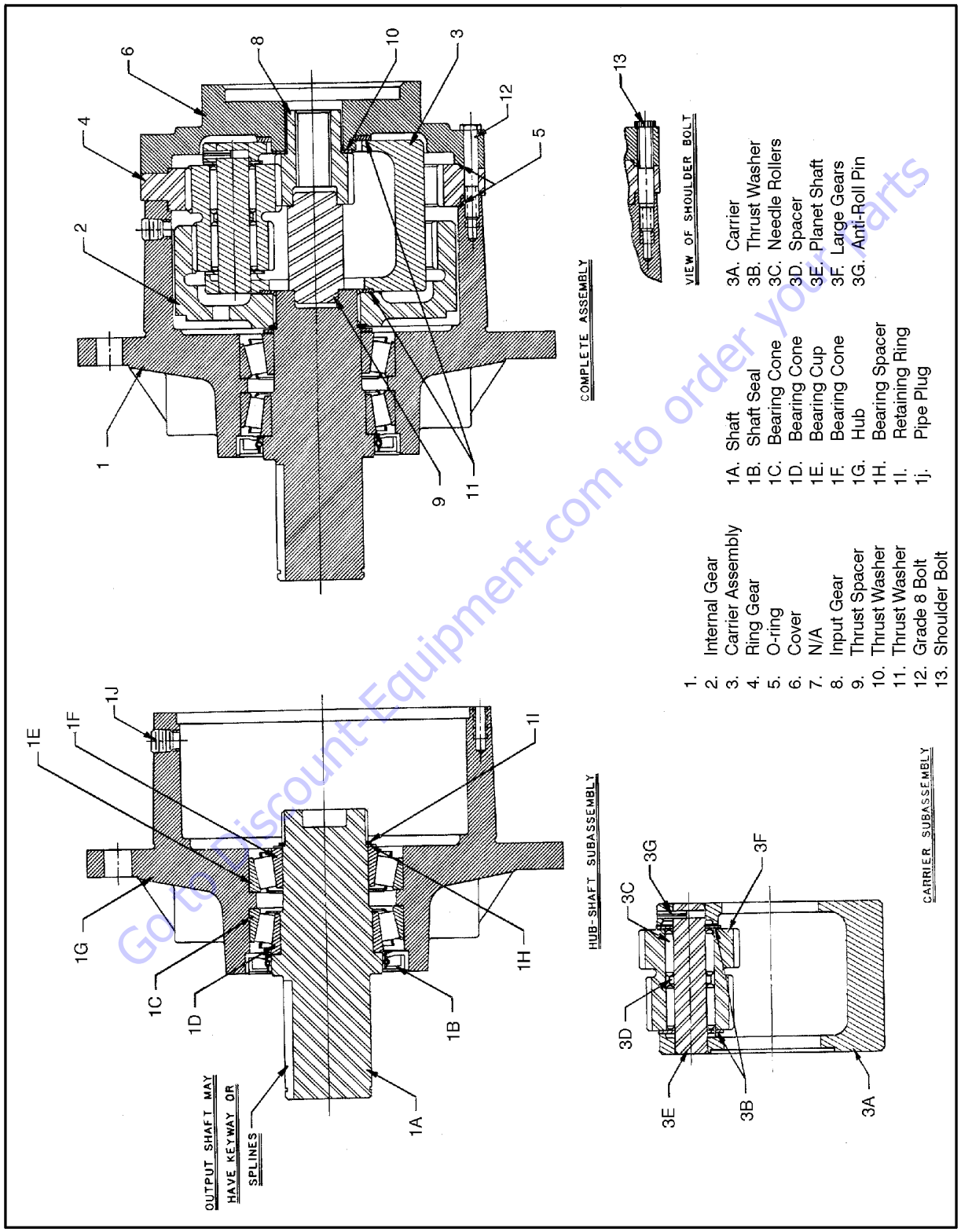


Figure 3-44. Swing Drive Hub (Fairfield) (S/N 0300068040 to S/N 0300183033)

3.17 SWING BRAKE (S/N 0300068040 TO S/N 0300183033)

Disassembly

1. Remove pressure plate (2) from cover (16) by removing washer head cap screws (1).

⚠ CAUTION

PRESSURE PLATE IS UNDER SPRING TENSION OF APPROXIMATELY 907 KGF (2000 LBS.) THE TWO WASHER HEAD CAP SCREWS MUST BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE, 1361 KGF (3000 LBS.) MINIMUM, THE PRESSURE PLATE CAN BE HELD IN POSITION WHILE REMOVING THE WASHER HEAD CAP SCREWS.

2. Remove case seal (3) from cover (16).
3. Remove piston (6) from pressure plate (2).
4. Remove o-ring (4), back-up ring (5), o-ring (7) and back-up ring (8) from piston (6).
5. Remove stack assembly, consisting of stator disc (10), rotor disc (11) and return plate (12) from cover (16).
6. Remove dowel pins (15), springs (13) and spring retainer (14) from cover (16).

NOTE: *Not all models use the same number of springs or spring pattern. Record this information for assembly purposes.*

7. Remove retaining ring (19) from cover (16).
8. Remove shaft by pressing or using a soft mallet on the male end of the shaft (9).
9. Remove retaining ring (20) from cover (16) and press out oil seal (17) and bearing (18) if required.

Assembly

NOTE: *Lubricate all rubber components from repair kit with clean type fluid used in the system*

1. Use an alkaline wash to clean parts before assembly.
2. Press oil seal (17) into cover (16) until it is flush with bearing shoulder. Note direction of seal.
3. Press bearing (18) into position until it bottoms out on borestep.
4. Install retaining ring (20) in cover (16).
5. Press shaft (9) into bearing (18) until it bottoms on the shoulder. Bearing (18) inner race must be supported during this operation.
6. Install retaining ring (19) on shaft (9).
7. Insert dowel pins (15), spring retainer (14) and springs (13) in cover (16).

NOTE: *Be sure to use the same number of springs and the same spring pattern as recorded during disassembly.*

8. Position plate (12) on spring (13).

NOTE: *Discs (10 & 11) and plate (12) must remain dry during installation. No oil residue must be allowed to contaminate disc surfaces.*

9. Install rotor disc (11) and stator disc (10).
10. Install o-ring (4), back-up ring (5), o-ring (7) and back-up ring (8) on piston (6). Note order of o-rings and back-up rings. Insert piston (6) into pressure plate (2).

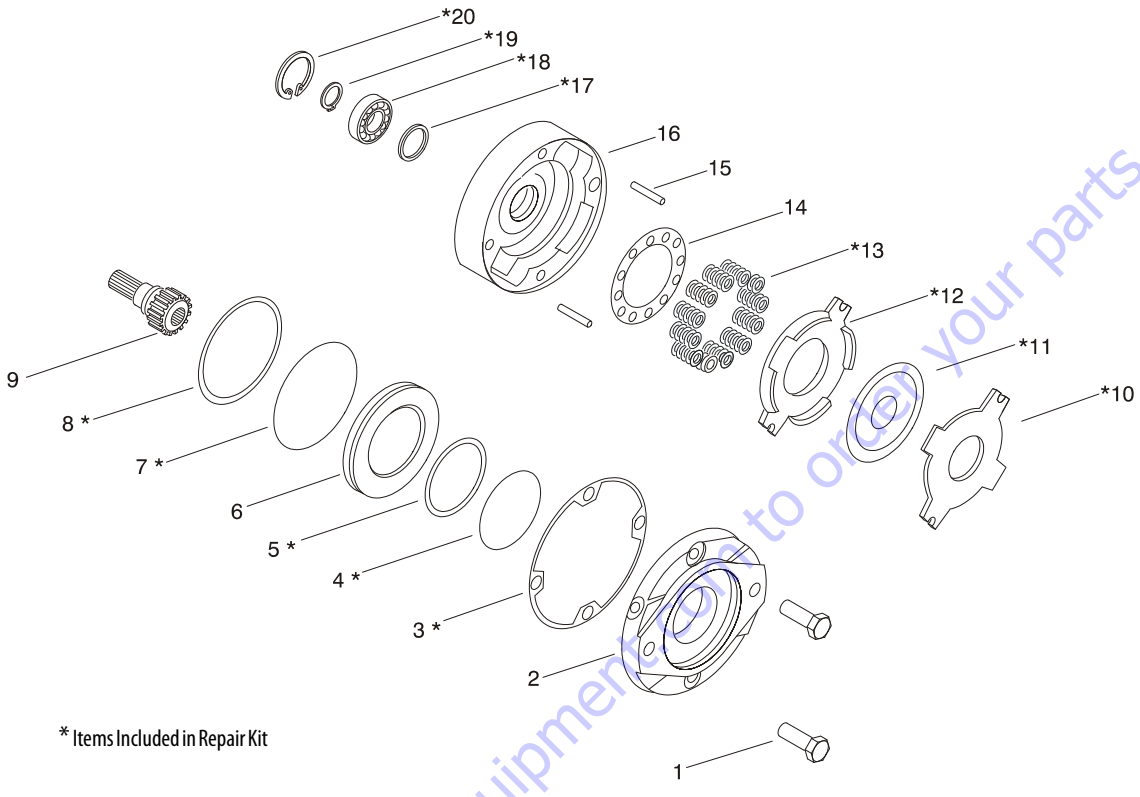
NOTE: *Be careful not to shear o-rings or back-up rings. Be careful not to scratch or mar piston.*

11. Install new case seal (3) in cover (16).
12. Position pressure plate (2) on cover (16) aligning dowel pins (15) with holes in pressure plate.
13. Install washer head cap screws (1) and tighten evenly to draw pressure plate (2) to cover (16). Torque washer head capscrews 55 ft. lbs. (75 Nm).

NOTE: *A hydraulic press will simplify installation of pressure plate on cover. Clamp pressure plate in position while tightening the washer head cap screws.*

⚠ CAUTION

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE MUST NOT EXCEED 137.9 BARS (2000 PSI) UNLESS TWO ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.



* Items Included in Repair Kit

1. Capscrew
2. Pressure Plate
3. Case Seal
4. O-ring
5. Backup Rings
6. Piston
7. O-rings
8. Backup Rings
9. Shaft
10. Stator Disc
11. Rotor Disc
12. Return Plate
13. Springs
14. Spring Retainer
15. Dowel Pin
16. Cover
17. Oil Seal
18. Bearing
19. Retaining Ring
20. Retaining Ring

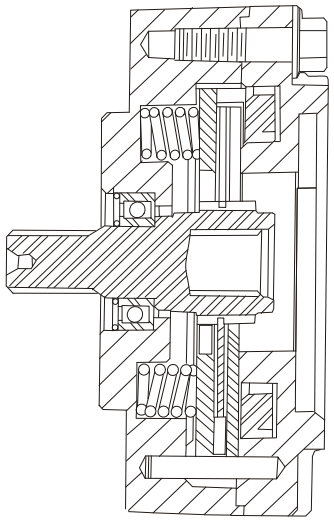


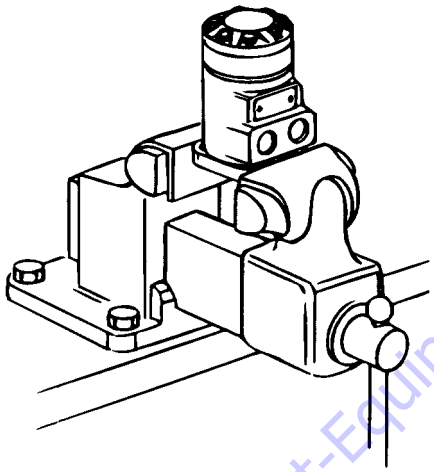
Figure 3-45. Swing Brake (S/N 0300068040 to S/N 0300183033)

3.18 SWING MOTOR (S/N 0300068040 TO S/N 0300183033)

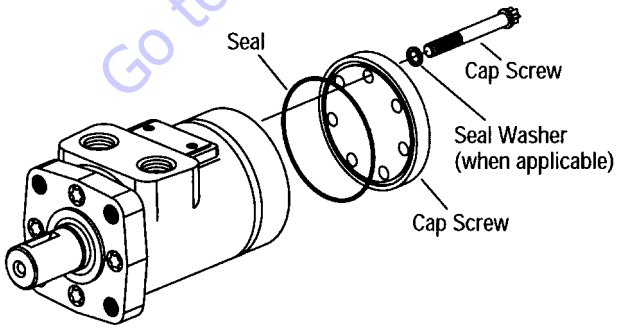
Disassembly

Cleanliness is extremely important when repairing these motors. Work in a clean area. Before disconnecting lines, clean port area of motor. Remove key when used. Check shaft and key slot. Remove burrs, nicks and sharp edges. Before disassembly, drain oil from motor. Then plug ports and thoroughly clean exterior of motor.

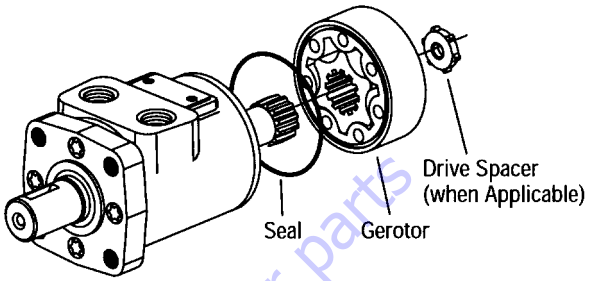
Although not all drawings show motor in a vise, we recommend that you keep the motor in a vise during disassembly. Follow the clamping procedures explained throughout the manual.



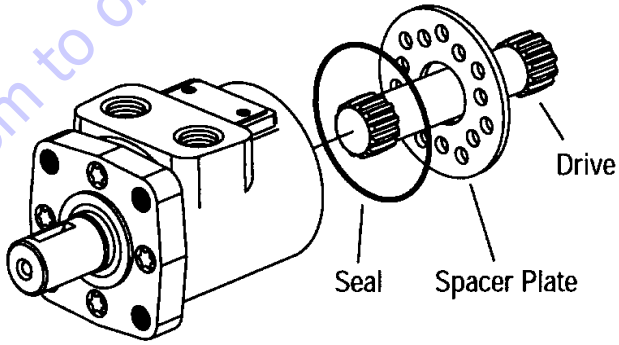
1. Place motor in vice and clamp across edge of flange with output shaft down. When clamping, use protective device on vice such as special soft jaws, pieces of hard rubber or board.



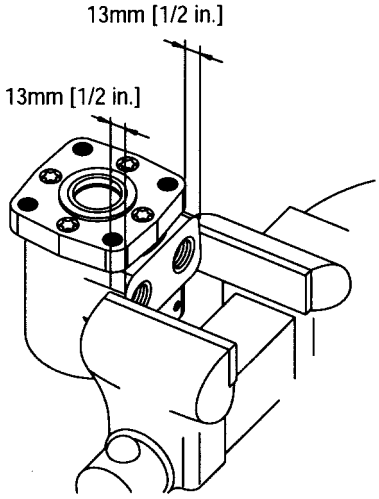
2. remove cap screws and seal washers.
3. Remove end cap.
4. Remove seal from end cap.



5. Remove gerotor.
6. Remove seal from gerotor.
7. Remove drive spacer if applicable.



8. Remove drive.
9. Remove spacer plate.
10. Remove seal from housing.
11. Remove output shaft from housing.
12. Remove needle thrust bearing from shaft or housing.



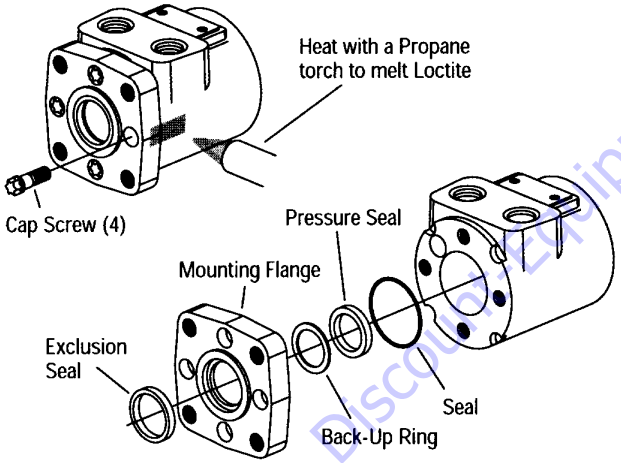
13. Reposition motor in vise. Clamp across ports as shown above. Do not clamp side of housing. Excessive clamping pressure on side of housing causes distortion.

14. Remove cap screws from mounting flange. These screws are assembled with Loctite to hold them in place.

    The screws will require 35-45 Nm (300 - 400 in/lbs) of torque to break loose and 11 Nm (100 in/lbs) torque to remove. Do not use impact wrench on screws that have been secured with Loctite. THis could result in rounded heads or broken sockets.

NOTE: *If torque higher than given above is required to break screws loose, apply heat according to following instructions.*

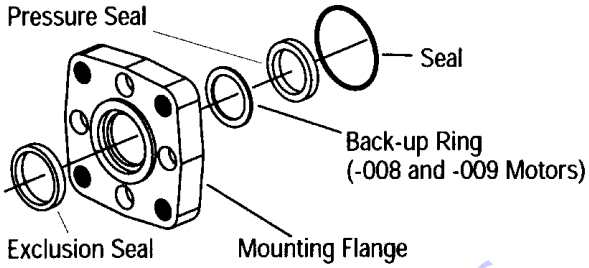
When heated, Loctite partially melts. This reduces the torque required to remove screw. Use small flame propane torch to heat small area of housing where screw enters (see figure below). Be careful not to overheat housing and damage motor. Gradually apply torque to screw with socket wrench as heat is applied for 8 to 10 seconds. As soon as screw breaks loose, remove heat from housing. Continue turning screw until it is completely removed.



15. Carefully remove flange from housing.

NOTICE

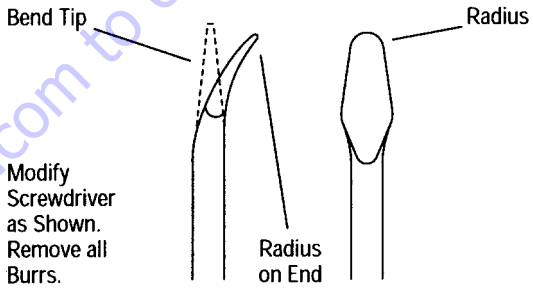
SOME MOTORS MAY HAVE A QUAD SEAL AND BACK-UP RING IN PLACE OF THE PRESSURE SEAL. THE QUAD SEAL AND BACK-UP RING ARE NO LONGER AVAILABLE AND ARE REPLACED BY THE PRESSURE SEAL. THEY ARE INTERCHANGEABLE, BUT SOME PRECAUTIONS MUST BE TAKEN TO INSURE PROPER INSTALLATION. FOLLOW THE REASSEMBLY INSTRUCTIONS.

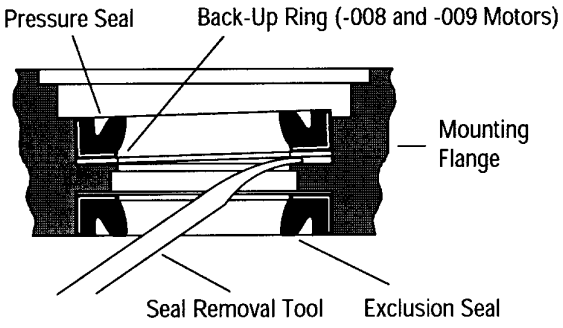


16. Exclusion seal, back-up ring, pressure seal and seal will come off with flange. Use seal removal tool as shown to remove exclusion and pressure seals.

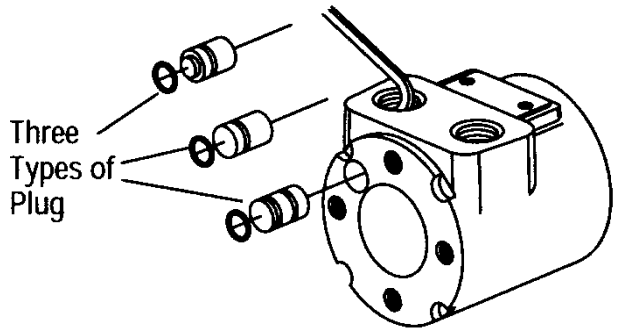
NOTICE

BE CAREFUL NOT TO SCRATCH SEAL CAVITY O.D. THIS COULD CREATE A LEAK PATH.





Work from outer side for both (either) Seals.



17. A metal plug, with seal, plugs a machining hole in the housing. It is not necessary to remove plug and replace seal unless leakage occurs around plug. To remove plug, insert 5 mm (0.187 in.) hex key through port opening and push it out. The 009 plug is not interchangeable with 007 and 008 plugs.

Inspection and Cleaning

Check all mating surfaces. Replace any parts with scratches or burrs that could cause leakage or damage. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe parts with cloth or paper towel because lint or other matter could get into the hydraulic system and cause damage.

Check around key slot and chamfered area of shaft for burrs, nicks or sharp edges that could damage seals during reassembly. Remove nicks or burrs with hard smooth stone (such as an Arkansas stone). Do not file or grind motor parts.

NOTE: *Lubricate all seals with petroleum jelly. Use new seals when reassembling motor.*

NOTICE

DO NOT STRETCH SEALS BEFORE INSTALLING THEM.

Cleanliness is extremely important in the successful application of Loctite. Before Loctite can be applied, the parts should be cleaned as follow:

NOTE: *Fully cured Loctite resists most solvents, oils, gasoline and kerosene and is not affected by cleaning operations. It is not necessary to remove cured Loctite that is securely bonded in tapped holes; however, any loose particles of cured Loctite should be removed.*

a. Wash the housing with solvent to remove oil, grease and debris. Pay particular attention to four tapped holes on flanged end.

b. Blow dry with compressed air. Clean and dry tapped holes.

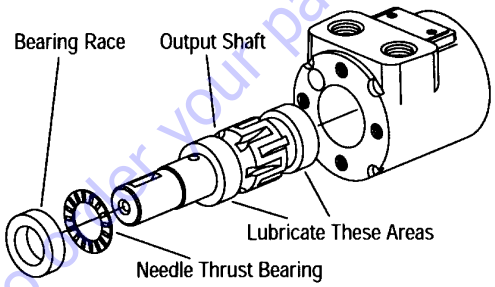
c. Wire brush screw threads to remove cured Loctite and other debris. Discard any screws that have damaged threads or rounded heads.

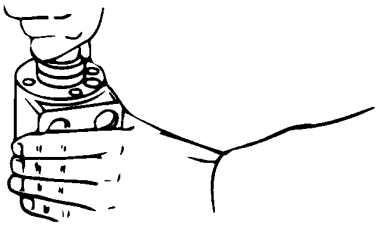
d. Wash screws with non-petroleum base solvent. Blow dry with compressed air.

Assembly

SHAFT END

1. If you remove plug and seal, lubricate seal and install on plug. Some plugs have two o-ring grooves but require only one o-ring. Install o-ring in groove closest to end of plug. Push plug into housing. Be careful not to damage seal.



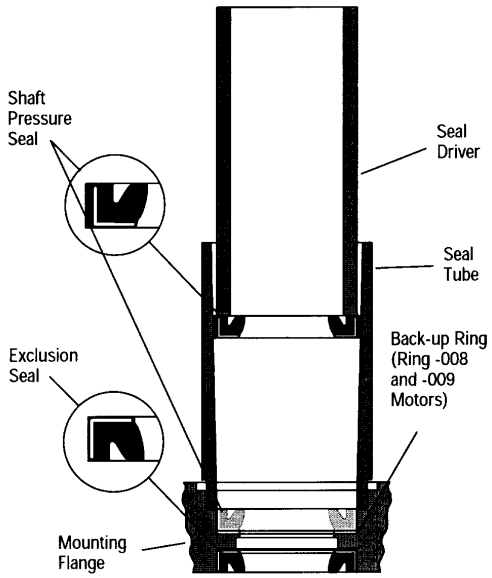


2. Lubricate output shaft with hydraulic oil, then install shaft in housing.

NOTICE

DO NOT PERMIT OIL TO GET INTO THE FOUR TAPPED HOLES.

3. Install needle thrust bearing, then bearing race on shaft. Pull shaft partially out of housing. Push all three parts in housing together. The bearing race must rotate freely when in position.



Seal Installation Tool
No. 600470 (007 Motors)
No. 600523 (008, 009 Motors)

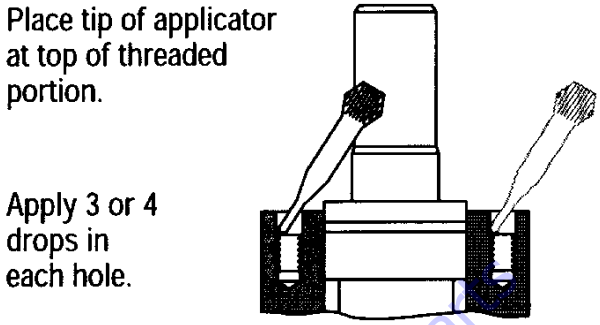
4. Install exclusion seal in flange. Carefully press exclusion seal into place.
5. Visually check seal seat in mounting flange for scratches or other marks that might damage the pressure seal. Check for cracks in flange that could cause leakage.
6. Lubricate I.D. of seal tube and O.D. of shaft pressure seal with light film of petroleum jelly. Align small I.D. end of seal tube with seal seat in mounting flange. Install back-up ring and pressure seal in tube with lip seal face up. Insert seal driver in tube and firmly push seal seat with a rotating action.

NOTICE

AFTER INSTALLING SEAL IN FLANGE, EXAMINE SEAL CONDITION. IF DAMAGED OR IMPROPERLY INSTALLED, YOU MUST REPLACE IT BEFORE CONTINUING WITH REASSEMBLY.

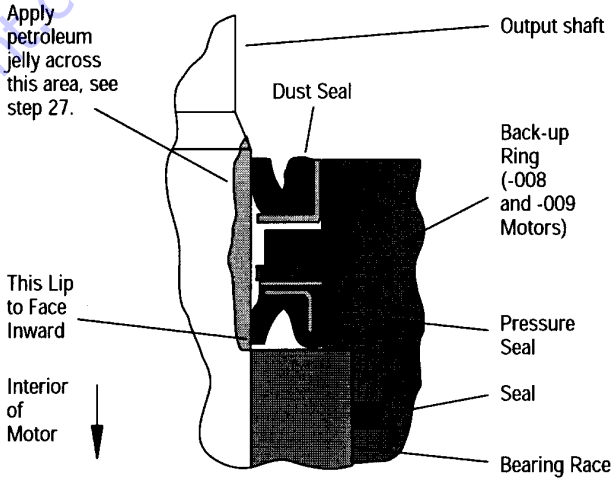
7. Install 49 mm (1.937 in.) I.D. seal in flange.
8. It is recommended to apply a light coat of Loctite Primer NF in tapped holes of housing. Allow primer to dry for at least 1 minute. Do not force dry with air jet; the primer will blow away.

   Use of primer is optional. With primer, curing time is approximately 15 minutes. Without primer curing time is approximately 6 hours.



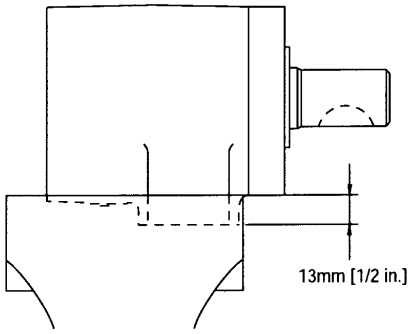
9. Apply 3 or 4 drops of Loctite sealant at top of threads for each of the four holes in housing. Do not allow parts with Loctite applied to come on contact with metal parts other than those for assembly.Wipe off excess Loctite from housing face, using a non petroleum base solvent.

   Do not apply Loctite to threads more than 15 minutes before installing screws. If housing stands for more than 15 minutes, repeat application. No additional cleaning or removal of previously applied Loctite is necessary.



10. Before installing flange and seal assembly over shaft, place protective sleeve or bullet over shaft. Then lubricate space between exclusion seal and pressure seal, as well as lips of both seals.

    Install flange. Rotate flange slowly while pushing down over shaft. Be careful not to invert or damage seals.



11. After removing bullet, clamp motor in vise as shown above. Make sure shaft cannot fall out. Install dry screws and alternately torque them immediately to 250 in/lbs (28 Nm). If you use primer, allow to cure 10 to 15 minutes. Without primer, allow 6 hours curing time before subjecting to high torque reversals. On all other applications, you can run motor immediately.
If you use new screws, make sure they are correct length: 22 mm (0.875 in.) under head length. See parts book for correct part number.

GEROTOR END

1. Reposition motor with gerotor end up, then clamp across ports. Do not clamp on side of housing.

NOTICE

TO AID INSTALLATION OF SEALS, APPLY LIGHT COAT OF CLEAN PETROLEUM JELLY TO SEALS. DO NOT STRETCH SEALS BEFORE INSTALLING THEM IN GROOVE.

2. Pour approximately 35 cc of clean hydraulic oil in output shaft cavity.

3. Install 73 mm (2.875 in.) I.D. seal in housing seal groove. Avoid twisting seal.

Timing Procedure

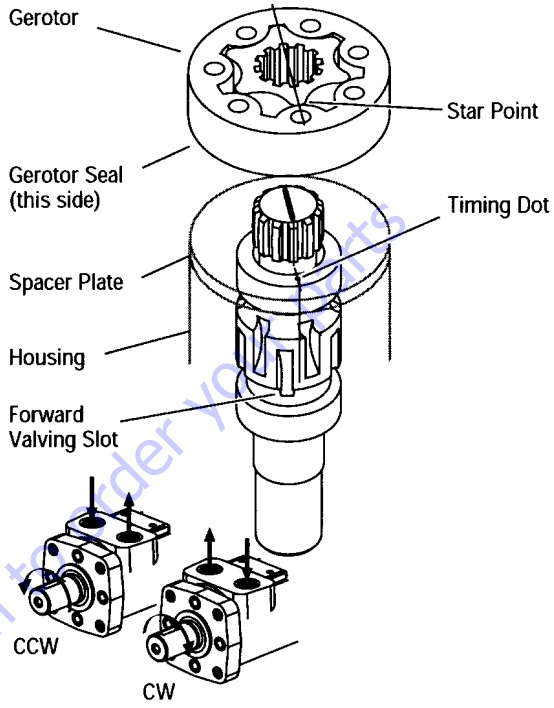
a. Install drive. Use felt tip marker to mark or drive tooth. Align this tooth with timing dot on shaft.

NOTE: *If drive is not symmetrical, install larger splined end into shaft.*

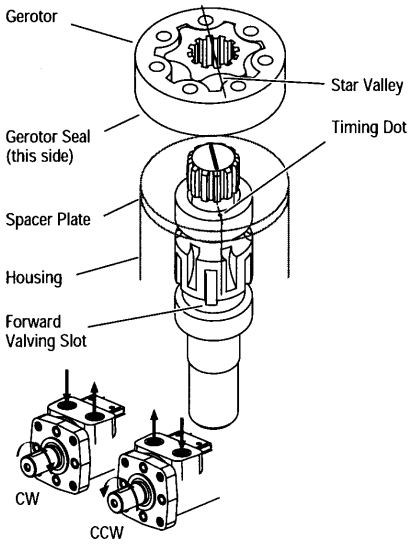
b. Install spacer plate.

c. Install 73 mm (2.875 in) I.D. seal in gerotor seal groove. Carefully place gerotor on spacer plate, seal side toward spacer plate.

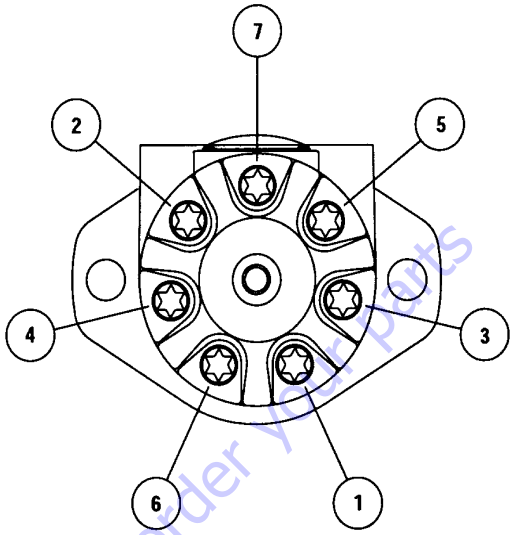
Standard rotation align any star point with tooth marked on drive (see figure below).



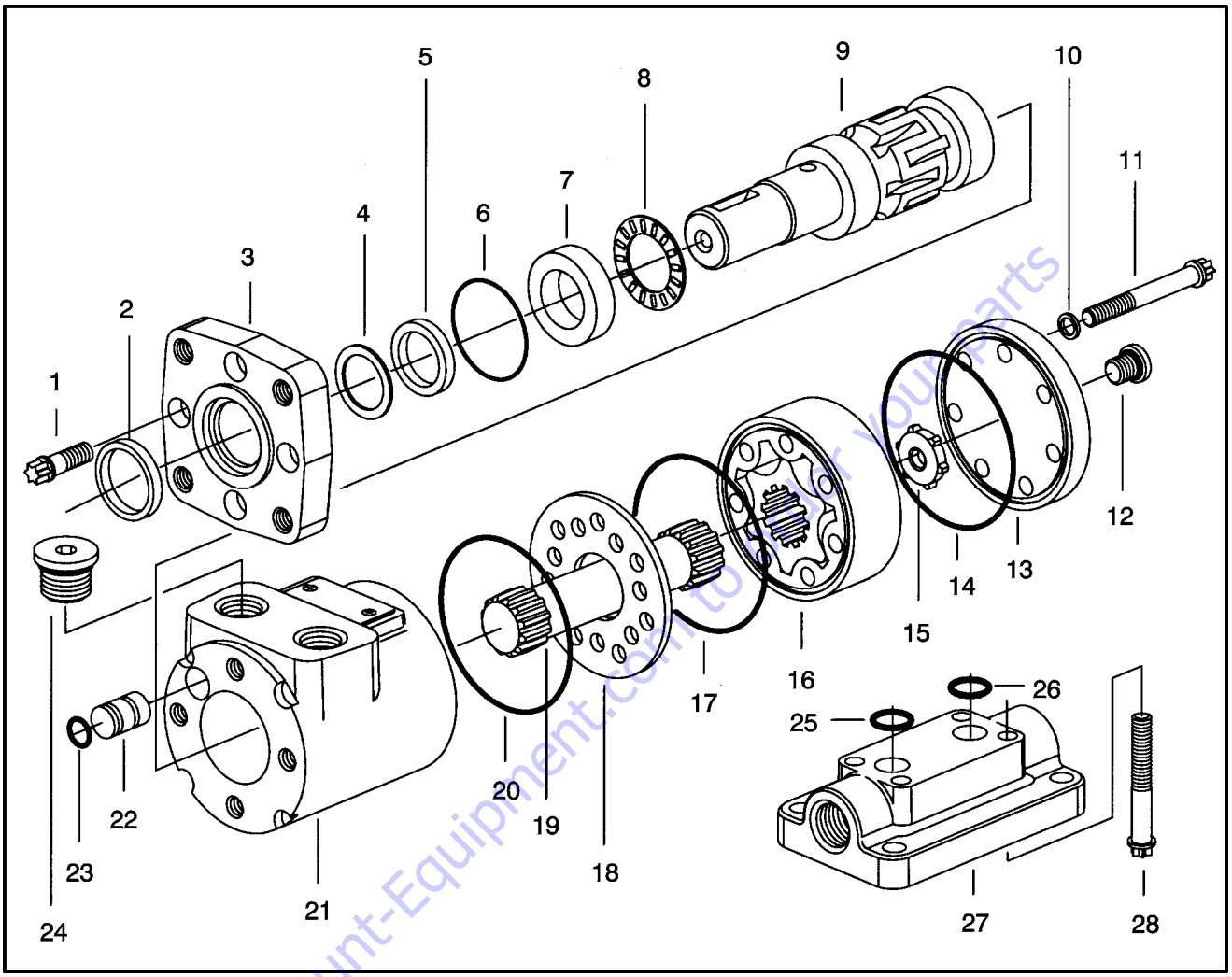
Reverse rotation align any star valley with marked tooth (see figure below).



1. Rotate gerotor to line up with bolt holes. Be careful not to disengage star from drive or disturb gerotor seal.
2. Install drive spacer if applicable.
3. Install 73 mm (2.875 in.) seal in end cap. Carefully place end cap on gerotor.



4. Install cap screws and seal washers (if applicable) in end cap. Pre-tighten screws to 7.4 Nm (40 in/lbs). Make sure seal washers are properly seated. Then torque screws to 27 - 28 Nm (235 - 250 in/lbs) in sequence, as shown above.



1. Capscrew
2. Exclusion Seal
3. Mounting Flange
4. Backup Ring (-008, -009 Motors)
5. Pressure Seal
6. Seal
7. Bearing Race
8. Needle Bearing Thrust
9. Output Shaft
10. Seal Washer (When Applicable)
11. Capscrew
12. Plug/O-ring S/A
13. End Cap
14. Seal
15. Drive Spacer (When Applicable)
16. Gerotor
17. Seal
18. Spacer Plate
19. Drive
20. Seal
21. Housing
22. Plug
23. Seal
24. Plug/O-ring S/A (End Ported Motors)
25. O-ring
26. O-ring
27. Optional - Base Block Mounting Kit
28. Capscrew

Figure 3-46. Swing Motor (S/N 0300068040 to S/N 0300183033)

3.19 ROTARY COUPLING

Use the following procedure to install the seal kit.

NOTE: *Step 1 is applicable for machines S/N 0300083332 to S/N 0300183033.*

1. If not already removed, remove the axle oscillation valve from the cylinder barrel. The spool of the valve protrudes into the barrel and will damage the spool and seals if left in place.
2. Remove snap ring (7) from end.
3. Remove thrust ring (3) from the same end.
4. Remove center body (1) from housing (3).
5. Cut off old seals (2, 4, 5).
6. Assemble lip seals (2) in direction shown in Figure 3-47., Rotary Coupling Seal Installation.
7. Reassemble O-ring (4).
8. Heat cap seals (5) in hydraulic oil for 5 minutes at 300° F (149° C).
9. Assemble cap seals over O-rings
10. Reinsert center body into housing (lube with hydraulic oil).
11. Replace thrust ring and snap ring.

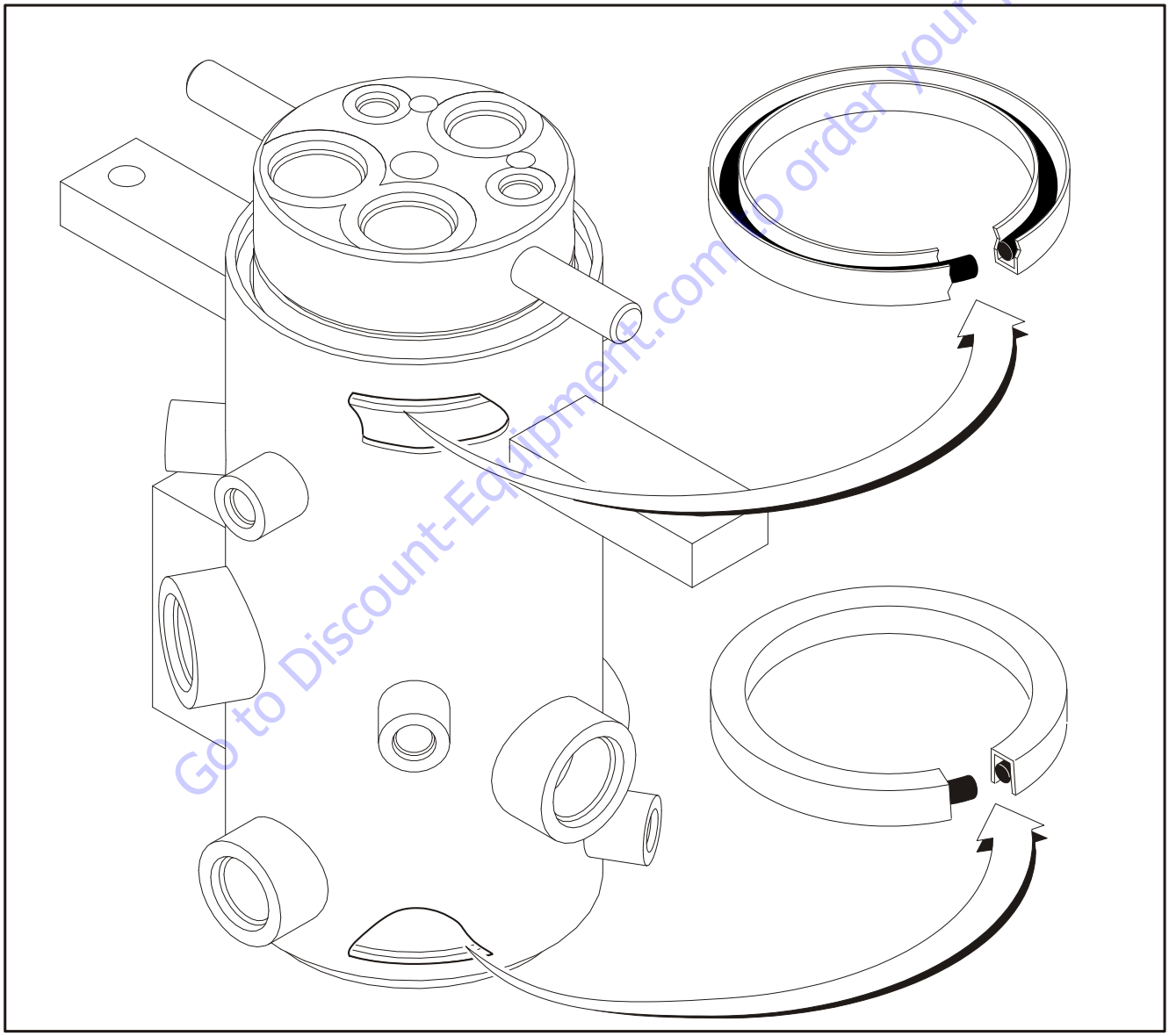
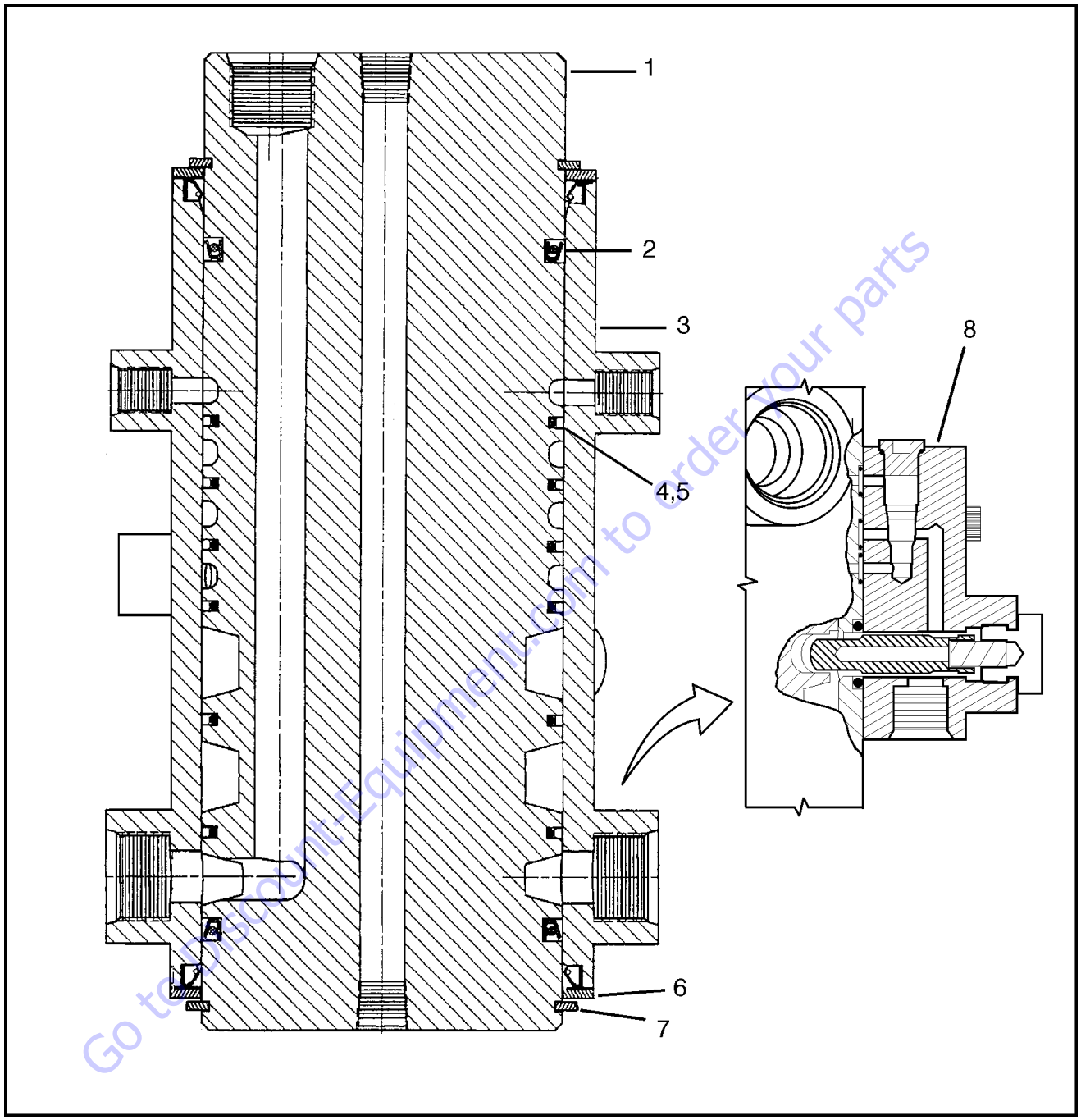


Figure 3-47. Rotary Coupling Seal Installation



1. Center Body
2. Seal
3. Housing
4. O-ring
5. Seal
6. Thrust Ring
7. Snap Ring
8. Valve Block (Axle Oscillation)

Figure 3-48. Rotary Coupling Cutaway

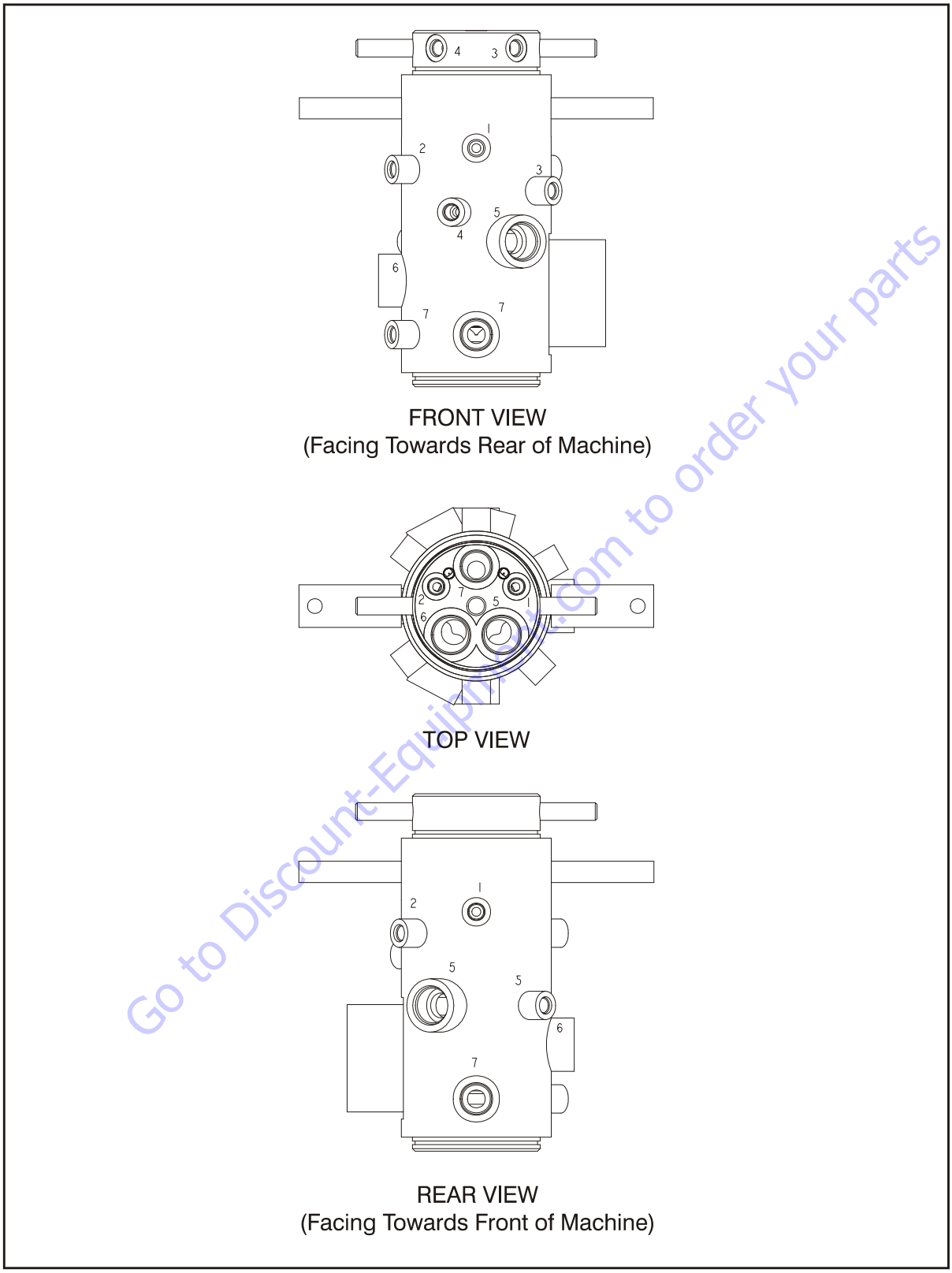


Figure 3-49. Rotary Coupling Port Location (7 Port)

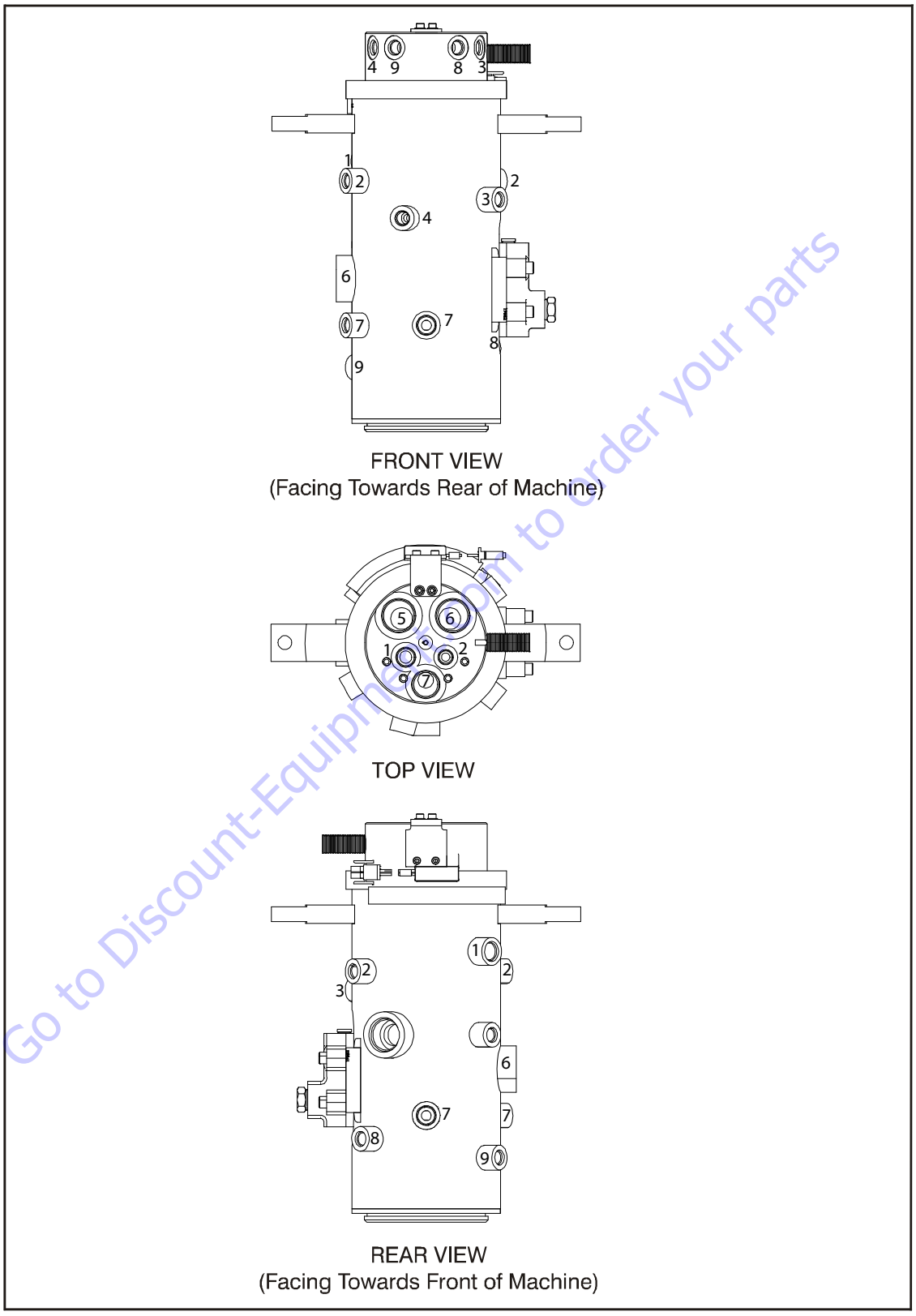
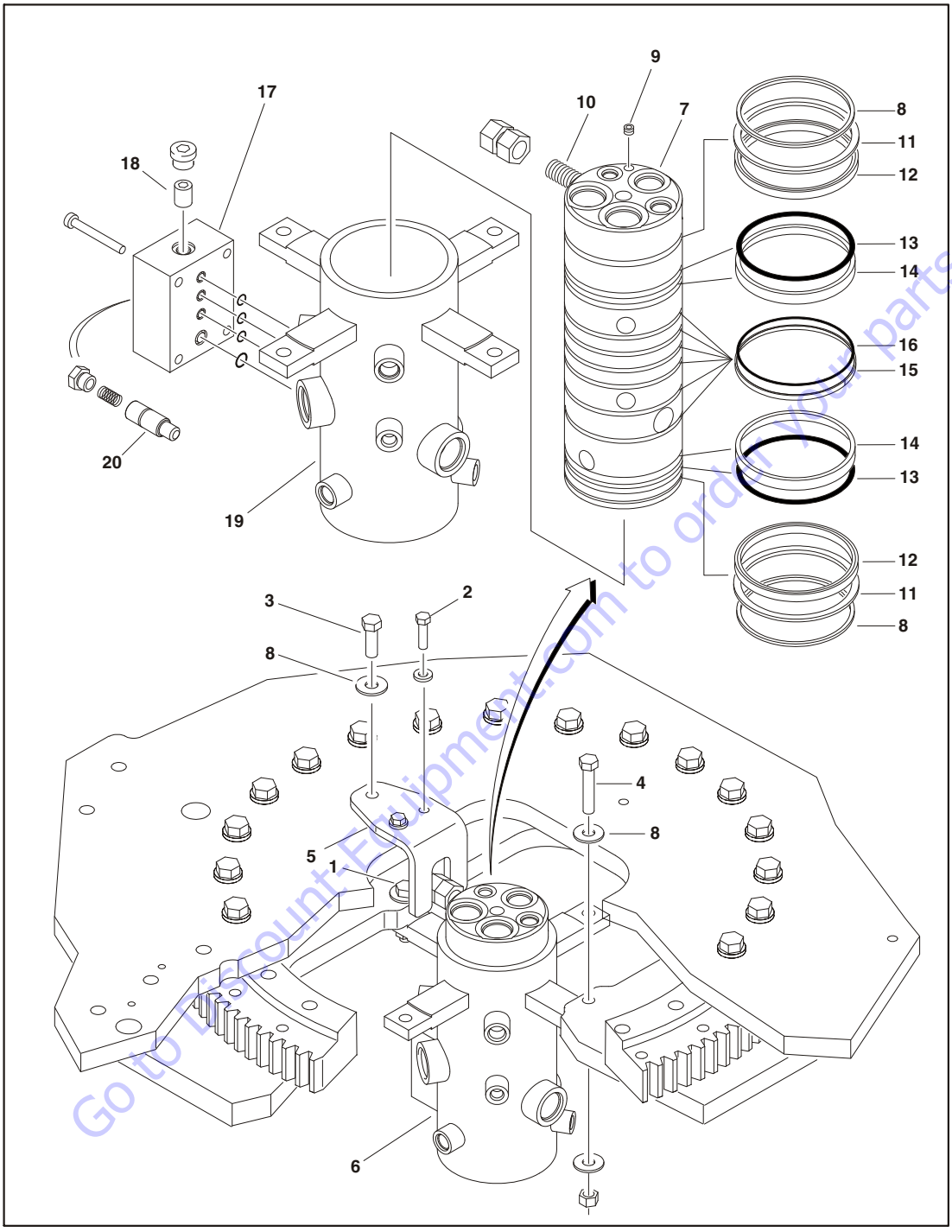


Figure 3-50. Rotary Coupling Port Location (9 Port)



1.	JLG Threadlocker	6.	Rotary Coupling	11.	Ring	16.	O-ring
2.	Bolt	7.	Spool	12.	Seal	17.	Valve
3.	Bolt	8.	Retaining Ring	13.	O-ring	18.	Check Valve
4.	Bolt	9.	Plug	14.	Bearing	19.	Case
5.	Bracket	10.	Torque Lug	15.	Cap Seal	20.	Plunger Valve

Figure 3-51. Rotary Coupling Installation

Table 3-9. Coupling Port Information Table (7 port)

Port No.	Outlets	Port Size	Description	Operating Pressure PSI (Bar)	Proof Pressure PSI (Bar)
1	2	-6	Brake	450 (31)	675 (46.5)
2	2	-6	2 Speed	4500 (310)	6750 (465)
3	1	-6	Steer	2500 (172)	3750 (258.5)
4	1	-6	Steer	2500 (172)	3750 (258.5)
5	3	2-16, 1-6	Drive Reverse	4500 (310)	6750 (465)
6	1	-16	Drive Forward	4500 (310)	6750 (465)
7	2	-12	Drain	250 (17)	375 (26)

Table 3-10. Coupling Port Information Table (9 port)

Port No.	Outlets	Port Size	Description	Operating Pressure PSI (Bar)	Proof Pressure PSI (Bar)
1	1	-8	Brake	450 (31)	675 (46.5)
2	2	-6	2 Speed	4500 (310)	6750 (465)
3	1	-6	Steer	2500 (172)	3750 (258.5)
4	1	-6	Steer	2500 (172)	3750 (258.5)
5	2	1-6, 1-16	Drive Reverse	4500(310)	6750(465)
6	1	-16	Drive Forward	4500 (310)	6750 (465)
7	3	2-8, 1-6	Drain	250 (17)	375 (26)
8	1	-6	Steer	2500 (172)	3750 (258.5)
9	1	-6	Steer	2500(172)	3750 (258.5)

3.20 TILT ALARM SWITCH (PRIOR TO S/N 0300065534)

⚠ CAUTION

PERFORM TILT ALARM SWITCH LEVELING PROCEDURE A MINIMUM OF EVERY SIX MONTHS TO ENSURE PROPER OPERATION AND ADJUSTMENT OF SWITCH.

Manual Adjustment

1. Park the machine on a flat, level surface. Ensure machine is level and tires are filled to rated pressure.

NOTE: *Ensure switch mounting bracket is level and securely attached.*

2. Level the base of the indicator by tightening the three flange nuts through approximately one quarter of its spring travel. DO NOT ADJUST THE "X" NUT DURING THE REMAINDER OF THE PROCEDURE.
3. With the electrical connections complete, using bubble level on top of indicator, slowly tighten or loosen the three flange nuts until indicator is level.
4. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the flange nuts have been tightened too far. Loosen the "X" nut and repeat steps (2) through (4) LIMIT SWITCHES ADJUSTMENTS.

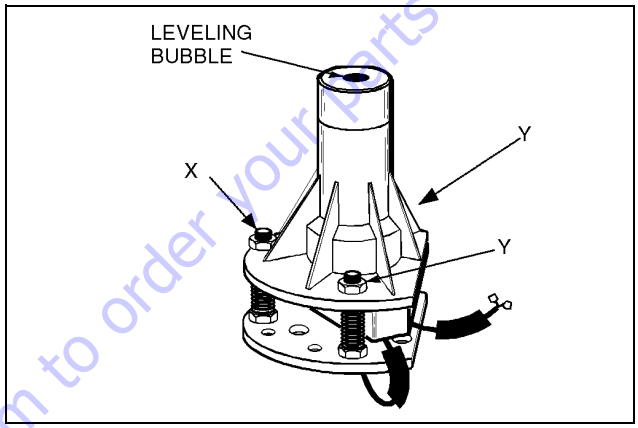


Figure 3-52. Tilt Switch Adjustment

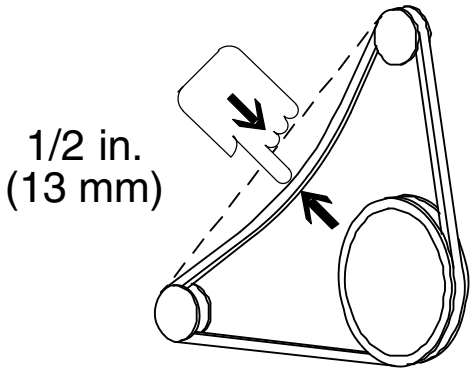
3.21 SPARK ARRESTER CLEANING INSTRUCTIONS

1. Remove the cleanout plug in the bottom of spark arrester (muffler).
2. Without causing deformation (or any type of damage to the spark arrester) repeatedly tap on the arrester near the cleanout plug. This may be enough to begin drainage of the spark trap.
3. An industrial vacuum cleaner can do a complete job at this point.
   a. Or, IN A SAFE AREA, start the engine. Then alternate between low idle and high idle for two to three minutes.
   b. Or, operate the engine as required by the application for two to three minutes.
4. Install the cleanout plug.

3.22 GENERATOR

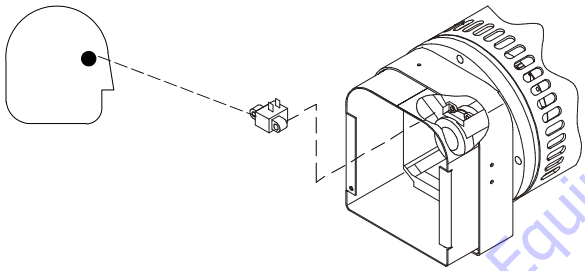
Every 250 hours

Every 250 hours of operation, check the drive belt for proper tension.

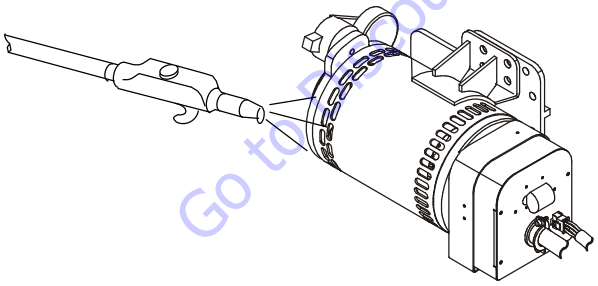


Every 500 hours

Every 500 hours of operation, service the generator brushes and slip rings. Hostile environments may require more frequent service.



Every 500 hours of service, blow out the inside of the generator. If operating in a hostile environment, clean monthly.

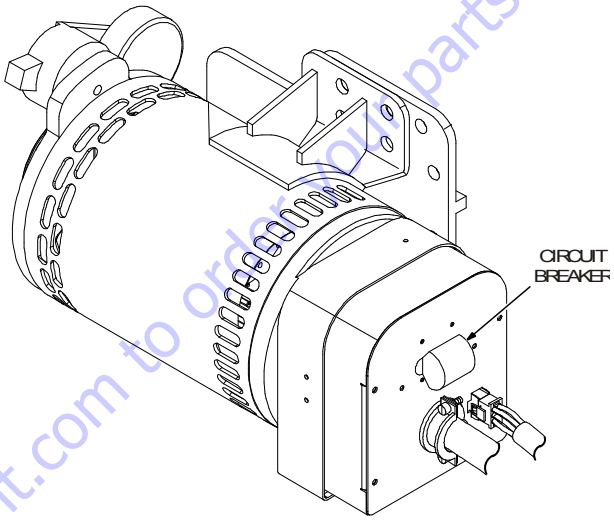


Overload Protection

⚠ CAUTION

STOP THE ENGINE WHENEVER CHECKING OR INSPECTING THE CIRCUIT BREAKER.

The circuit breaker protects the generator windings from overload. If the circuit breaker opens, generator output stops. If the circuit breaker continues to open, check for faulty equipment connected to the platform receptacles.



Inspecting Brushes, Replacing Brushes, and Cleaning Slip Rings

Refer to Figure 3-53., Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings.

INSPECTING BRUSH POSITION

Inspect brush alignment with slip rings. View alignment through the air vents in the stator barrel. The brushes must ride completely on the slip rings.

INSPECTING BRUSHES

Remove the end panel. Inspect the wires. Remove the brush holder assembly. Pull the brushes from the holders.

Replace the brushes if damaged, or if the brush is at or near minimum length.

CLEANING SLIP RINGS

Visually inspect the slip rings. Under normal use, the rings turn dark brown.

If the slip rings are corroded or their surface is uneven, remove the belt to turn the shaft by hand for cleaning.

Clean the rings with 220 grit emery paper. Remove as little material as possible. If the rings are deeply pitted and do not clean up, consult generator factory service.

Reinstall the belt, brush holder assembly, and end panel.

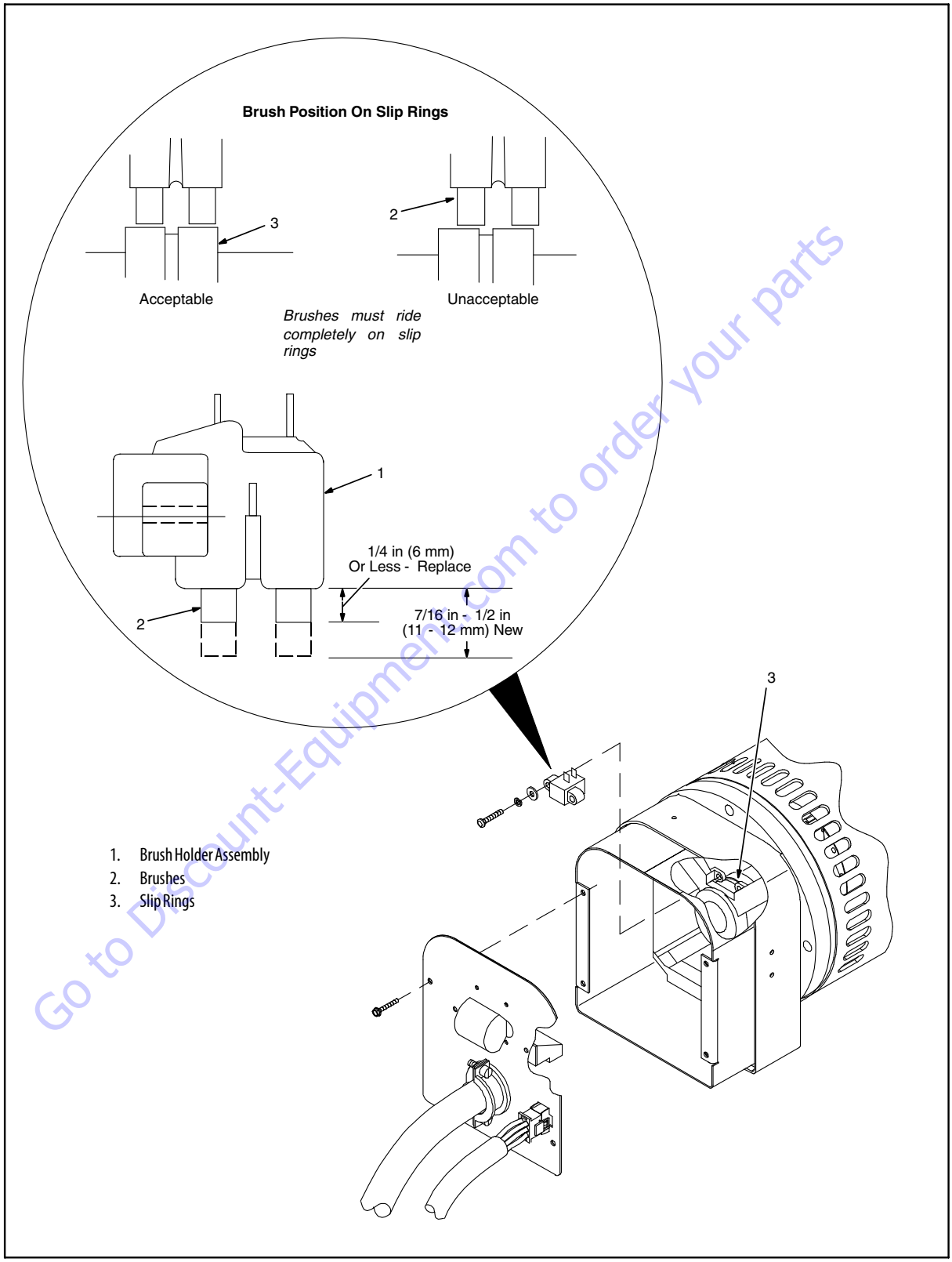


Figure 3-53. Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings

3.23 DUAL FUEL SYSTEM

⚠ CAUTION

IT IS POSSIBLE TO SWITCH FROM ONE FUEL SOURCE TO THE OTHER WITHOUT ALLOWING THE ENGINE TO STOP. EXTREME CARE MUST BE TAKEN AND THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

Changing from Gasoline to LP Gas

1. Start the engine from the ground control station.
2. Open the hand valve on the LP gas supply tank by turning counterclockwise.

⚠ CAUTION

BE SURE ALL GASOLINE IS EXHAUSTED BEFORE SWITCHING TO LP GAS.

3. While the engine is operating, place the two position LPG/Gasoline switch at the platform control station to the LP position. Allow the engine to operate without load until the engine regains smoothness.

Changing from LP Gas to Gasoline

1. With engine operating on LP under a no load condition, throw the LPG/Gasoline switch at the platform control station to the “Gasoline” position. Allow the engine to operate with no load until the engine regains smoothness
2. Close the hand valve on the LP gas supply tank by turning clockwise.

3.24 EFI ENGINE

Performing Diagnostics

1. Verify the complaint and determine if it is a deviation from normal operation.
2. Once the complaint has been verified, preliminary checks can be done. Conduct a thorough visual inspection, be alert for unusual sounds or odors, and gather diagnostic trouble code information.
3. Perform a system check that will verify the proper operation of the system in question and check for recent information updates.
4. If a diagnostic trouble code (DTC) is stored, contact a JLG distributor to make an effective repair.
5. If no DTC is stored, select the symptom from the symptom tables and follow the diagnostic path or suggestions to complete the repair.
6. After the repair has been made and validated for proper operation, the old part should be momentarily reinstalled to verify that it was indeed the source of the problem.

If no matching symptom is available, analyze the complaint and develop a plan for diagnostics utilizing the wiring diagrams, technical assistance, and repair history.

Intermittent conditions may be resolved by using a check sheet to pinpoint the circuit or electrical system component. Some diagnostic charts contain Diagnostic Aids which give additional information about a system. Be sure to use all of the information that is available to you.

VISUAL/PHYSICAL ENGINE INSPECTION CHECK

Perform a careful visual and physical engine inspection before performing any diagnostic procedure. Perform all necessary repairs before proceeding with additional diagnosis, this can often lead to repairing a problem without performing unnecessary steps. Use the following guidelines when performing a visual/physical inspection check:

- Inspect engine for modifications or aftermarket equipment that can contribute to the symptom; verify that all electrical and mechanical loads or accessory equipment is "OFF" or disconnected before performing diagnosis.
- Inspect engine fluids for correct levels and evidence of leaks.
- Inspect vacuum hoses for damage, leaks, cracks, kinks and improper routing, inspect intake manifold sealing surface for a possible vacuum leak.
- Inspect PCV valve for proper installation and operation.
- Inspect all wires and harnesses for proper connections and routing; bent or broken connector pins; burned, chafed, or pinched wires; and corrosion. Verify that harness grounds are clean and tight.
- Inspect engine control module (ECM), sensors, and actuators for physical damage.
- Inspect ECM grounds for cleanliness, tightness, and proper location.
- Inspect fuel system for adequate fuel level, and fuel quality (concerns such as proper octane, contamination, winter/summer blend).
- Inspect intake air system and air filter for restrictions.
- Inspect battery condition and starter current draw.

If no evidence of a problem is found after visual/physical engine check has been performed, proceed to MIL DTC retrieval procedure.

EFI Diagnostics (Prior to S/N 0300065534)

The EFI diagnostics are designed to assist in locating a faulty circuit or component. When a malfunction is detected by the Engine Control Module (ECM), a diagnostic trouble code (DTC) is set and the Malfunction Indicator Lamp (MIL) will be illuminated.

MIL DTC RETRIEVAL

Diagnostic trouble codes (DTCs) can be retrieved by pushing and holding the test button on the side of the ground control box. The Malfunction Indicator Light will illuminate for 2-3 seconds when the key is positioned to the on position to act as a self-test. If a DTC is present, the light will illuminate and stay on.

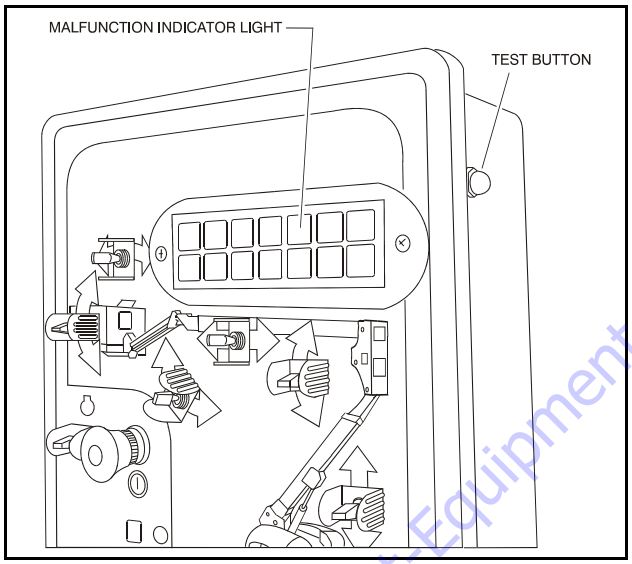


Figure 3-54. Malfunction Indicator and Test Button

When reading Diagnostic Trouble Codes thru the MIL, the following conditions apply:

- The flashing MIL is on for 0.4 second and off for 0.4 second.
- The MIL is off for 1.2 seconds between digits of two digit DTCs.
- The MIL is off for 2.4 seconds between DTCs.
- Each DTC repeats 3 times before the next stored DTC begins flashing.
- Up to 6 DTCs can be stored.
- Once all stored DTCs are flashed, the process repeats with the first stored DTC.
- DTCs are stored in the order in which they were set.

CLEARING TROUBLE CODES

To clear the trouble codes from the ECM, the electrical current running to the ECM must be shut off. To do this, disconnect the negative terminal from the battery for a period of approximately 15 minutes.

ECM and Sensors

CRANKSHAFT POSITION (CKP) SENSOR

The crankshaft position (CKP) sensor provides a signal used by the engine control module (ECM) to calculate the ignition sequence. The CKP sensor initiates the reference pulses which the ECM uses to calculate RPM and crankshaft position.

CAMSHAFT POSITION (CMP) SENSOR AND SIGNAL

The camshaft position (CMP) sensor sends a CMP signal to the ECM. The ECM uses this signal as a "sync pulse" to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. The CMP uses a Hall Effect sensor to measure piston position. This allows the ECM to calculate true sequential fuel injection (SFI) mode of operation. If the ECM detects an incorrect CMP signal while the engine is running, DTC 53 will set. If the CMP signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine will continue to nun. As long as the fault is present, the engine can be restarted. It will run in the previously established injection sequence.

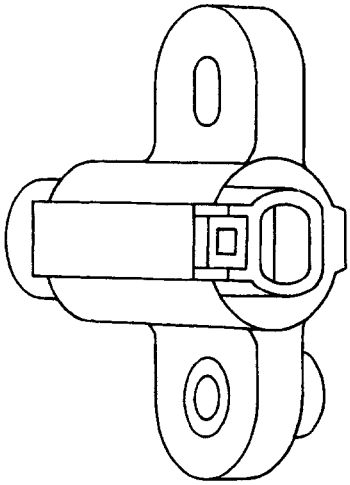


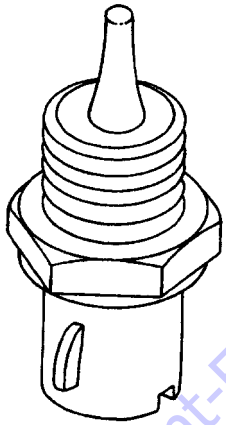
Table 3-11. ECM Diagnostic Trouble Codes

Diagnostic Trouble Code	Description
11	All Systems OK
12	Throttle Position (TP) Sensor Low Voltage
14	Manifold Absolute Pressure (MAP) Low Voltage
21	Overspeed
22	Throttle Position (TP) Sensor High Voltage
24	Manifold Absolute Pressure (MAP) High Voltage
31	Fuel Pump Low Voltage
32	Heated Oxygen Sensor (HO2S) Low Voltage
33	Engine Coolant Temperature (ECT) Sensor High Voltage
35	Intake Air Temperature (IAT) Sensor High Voltage
41	Fuel Pump High Voltage
42	Heated Oxygen Sensor (HO2S) High Voltage
43	Engine Coolant Temperature (ECT) Sensor Low Voltage
45	Intake Air Temperature (IAT) Sensor Low Voltage
51	Low Oil Pressure
52	Crankshaft Position (CKP) Sensor Extra/Missing Pulses
53	Camshaft Position Sensor (CMP) Sensor Illegal Pattern
54	Engine Control Module (ECM) Fault Illegal Operation
55	Engine Control Module (ECM) Fault Illegal Interruption
56	Engine Control Module (ECM) Fault COP (Computer Operating Properly) Failure
61	System Voltage Low
62	System Voltage High

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

The engine coolant temperature (ECT) sensor is a g thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance of 100,000 ohms at -40°C (-40°F). High temperature causes a low resistance of 70 ohms at 130°C (266°F). The ECM supplies a 5-volt signal to the ECT sensor through resistors in the ECM and measures the voltage. The signal voltage will be high when the engine is cold and low when the engine is hot. By measuring the voltage, the ECM calculates the engine coolant temperature. Engine coolant temperature affects most of the systems that the ECM controls.

After engine start-up, the temperature should rise steadily to about 85°C (185°F). it then stabilizes when the thermostat opens. If the engine has not been run for several hours (overnight), the engine coolant temperature and intake air temperature displays should be close to each other. A fault in the engine coolant sensor circuit will set DTC 33 or DTC 43.



ELECTRICALLY ERASABLE PROGRAMMABLE READ ONLY MEMORY (EEPROM)

The electrically erasable programmable read only memory (EEPROM) is a permanent memory chip that is located within the ECM. The EEPROM contains the pro-gram and the calibration information that the ECM needs to control engine operations.

If the ECM is replaced, the new ECM will need to be programmed. An IBM-compatible computer and software containing the correct program and calibration for the application are required to program the ECM.

HEATED OXYGEN SENSOR

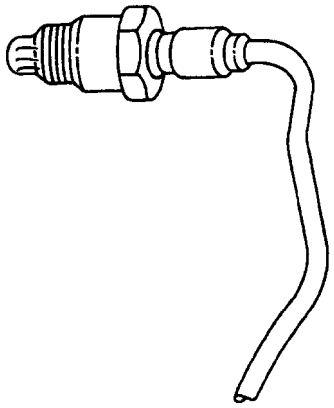
The heated oxygen sensor is mounted in the exhaust stream where it can monitor the oxygen content of the exhaust gas. The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100 mV to 900 mV. The heated oxygen sensor voltage can be monitored on an IBM PC-compatible computer with diagnostic software. By monitoring the voltage out-put of the oxygen sensor, the ECM calculates the pulse width command for the injectors to produce the proper combustion chamber mixture.

Low HO2S voltage indicates a lean mixture which will result in a rich command to compensate.

High HO2S voltage indicates a rich mixture which will result in a lean command to compensate.

A constant voltage below 200 mV for 10 consecutive seconds will set OTC 32. A constant voltage above 650 mV for 10 consecutive seconds will set OTC 42.

When installing a new oxygen sensor, tighten to a torque of 29.5 to 40 ft. lbs. (40 to 54 Nm).



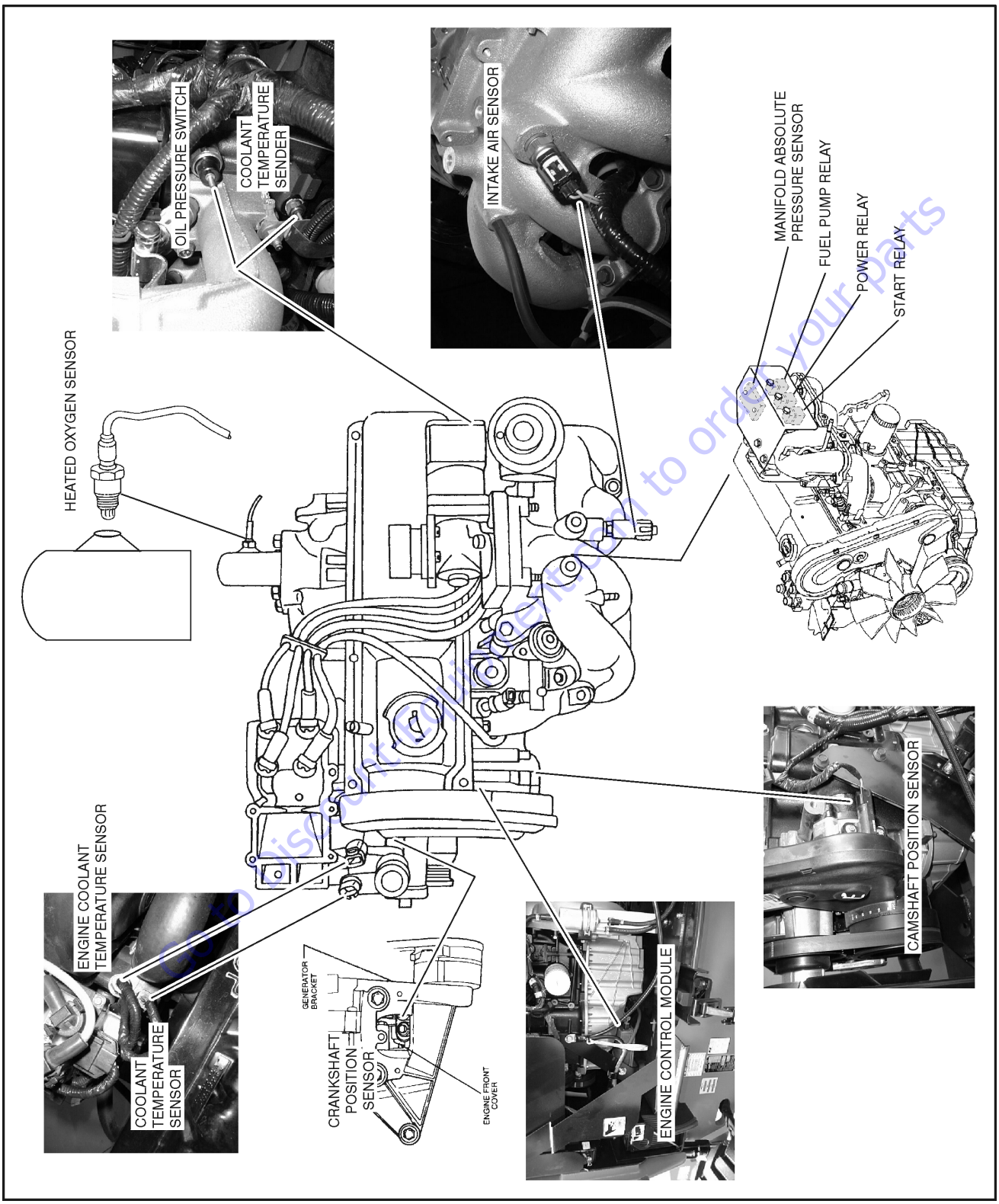
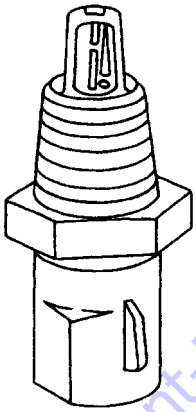


Figure 3-55. EFI Component Location

INTAKE AIR TEMPERATURE (IAT) SENSOR

The intake air temperature (IAT) sensor is a thermistor which changes its resistance based on the temperature of air entering the engine. Low temperature produces a high resistance of 100,000 ohms at -40°C (-40°F). High temperature causes a low resistance of 70 ohms at 130°C (266°F). The ECM supplies a 5-volt signal to the sensor through a resistor in the ECM and monitors the signal voltage. The signal voltage will be high when the incoming air is cold and low when the incoming air is hot. By measuring the voltage, the ECM calculates the incoming air temperature. The IAT sensor signal is used to adjust spark timing according to the incoming air density. An IBM PC-compatible computer with diagnostic soft-ware can be used to display the temperature of the air entering the engine. The temperature should read close to the ambient air temperature when the engine is cold, and rise as engine compartment temperature increases. If the engine has not been run for several hours (overnight), the IAT sensor temperature and engine coolant temperature should read close to each other. A failure in the IAT sensor circuit will set DTC 35 or DTC 45.



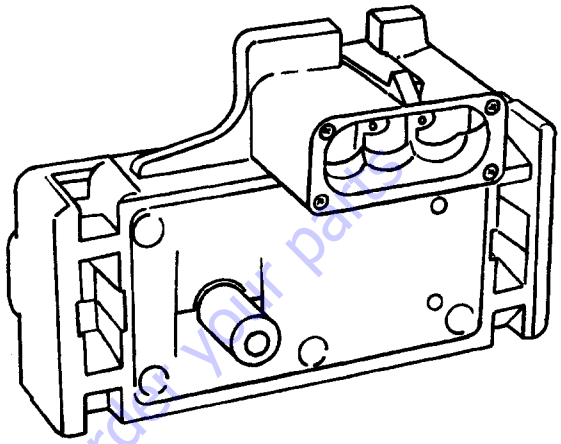
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP sensor signal voltage to the ECM varies from below 2 volts at idle (high vacuum) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (low vacuum).

The MAP sensor is used to determine the following:

- Engine vacuum level for engine control purposes.
- Barometric pressure (BARO)

If the ECM detects a voltage that is significantly lower than the estimated MAP value for 2 or more consecutive seconds, DTC 14 will be set. A signal voltage significantly higher than the estimated MAP value for 2 or more consecutive seconds will set DTC 24.



ENGINE CONTROL MODULE (ECM)

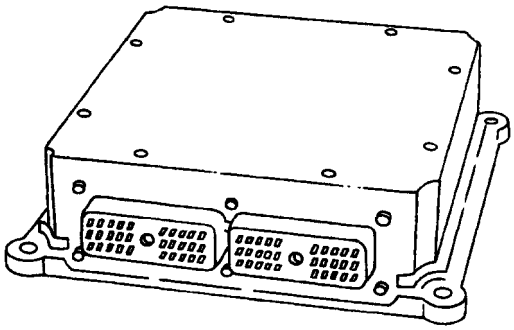
The ECM controls the following:

- Fuel metering system
- Ignition timing
- On-board diagnostics for engine functions

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect engine performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the operator through the Malfunction Indicator Lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the problem areas to aid the technician in making repairs.

The ECM supplies either 5 or 12 volts to power various sensors or switches. The power is supplied through resistances in the ECM which are so huh in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter with at least 10 meg ohms input impedance is required to ensure accurate voltage readings. The ECM controls output circuits such as the fuel injectors, electronic governor, etc., by control ling the ground or the power feed circuit through transistors or other solid state devices.

The ECM is designed to maintain exhaust emission levels to government mandated standards while providing excellent operation and fuel efficiency. The ECM monitors numerous engine functions via electronic sensors such as the throttle position (TP) sensor and the heated oxygen sensor (HO2S).



ECM INPUTS/OUTPUTS

Inputs—Operating Conditions

- Engine Coolant Temperature
- Crankshaft Position
- Exhaust Oxygen Content
- Manifold Absolute Pressure
- Battery Voltage
- Throttle Position
- Fuel Pump Voltage
- Intake Air Temperature
- Camshaft Position

Outputs - System Controlled

- Fuel Control
- Idle Air Control
- Electric Fuel Pump
- Diagnostics:
  - Malfunction Indicator Lamp
  - Data Link Connector (DLC)

ECM SERVICE PRECAUTIONS

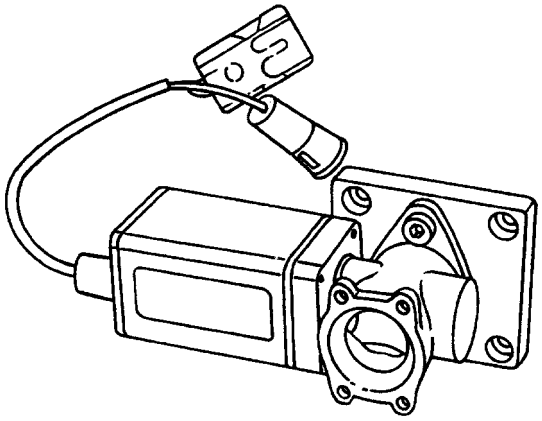
The ECM is designed to withstand normal current draws associated with engine operation. When servicing the ECM, observe the following guidelines:

- Do not overload any circuit.
- Do not probe wires for testing. This can cause a voltage drop that would be critical to the operation of the ECM.
- When testing for opens and shorts, do not ground or apply voltage to any of the ECM's circuits unless instructed to do so.
- When measuring voltages, use only a digital voltmeter with an input impedance of at least 10 megohms.
- Do not jump start with more than 12 volts. This could cause damage to the electronic components.
- Do not employ any non-standard practices such as charging the battery with an arc welder.
- Take proper precautions to avoid static damage to the ECM. Refer to "Electrostatic Discharge Damage" for more information.

THROTTLE POSITION (TP) SENSOR

The throttle position (TP) sensor is a potentiometer connected to the throttle shaft on the throttle body which is built into the electronic governor. The ECM monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed, the TP sensor signal also changes. At a closed throttle position, the output of the TP sensor is low. As the throttle valve opens, the output increases so that at wide open throttle (WOT), the output voltage should be above 4 volts.

The ECM calculates fuel delivery based on throttle valve angle (operator demand). A broken or loose TP sensor may cause intermittent bursts of fuel from an injector and unstable idle because the ECM thinks the throttle is moving. A hard failure in the TP sensor 5-Volt reference or signal circuits for greater than 2 consecutive seconds will set either a DTC 12 or DTC 22. A hard failure with the TP sensor ground circuit for more than two consecutive seconds may set DTC 22. If either DTC 12 or DTC 22 are set, the throttle will be forced to a 6% (idle) position.



USE OF CIRCUIT TESTING TOOLS

Do not use a test light to diagnose the engine electrical systems unless specifically instructed by the diagnostic procedures. A test light can put an excessive load on an ECM circuit and result in component damage. For volt-age measurements, use only a digital voltmeter with an input impedance of at least 10 megohms.

ELECTROSTATIC DISCHARGE DAMAGE

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, It takes as much as 4000 volts for a person to feel the spark of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

An example of charging by friction is a person sliding across a seat.

Charge by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to-use care when handling and testing electronic components.

To prevent possible electrostatic discharge dam-age, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the equipment.
- If the part has been handled while sliding across a seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.

Engine Performance Module (EPM)

SYSTEM DESCRIPTION

The new Engine Performance Module (EPM) engine control system is designed to be a complete engine control system for Ford industrial engines running on gasoline, propane or natural gas. Each module can be set up to run an engine on any two of the three fuels in certified closed-loop control, with virtually transparent on-the-fly fuel switching.

Each module can also be set up to run on a variety of electronic governing:

• It can be programmed to provide up to four specific speeds with use of a matching toggle switch.

• It can be programmed to provide an infinite variety of speeds (with customer-specified minimum and maximum) based on a variable signal input.

• It can be an electronic replacement for a throttle cable with maximum speed governing (throttle-by-wire).

• Or it can switch between throttle-by-wire and a second fixed or variable input based on a neutral/parking brake signal.

With the new EPM system, a laptop and a communications cable, diagnosis becomes simpler. The technician can either view engine data with a real time graphing program, or store that data into a numeric data file. Every time a fault is set, the laptop will give you detailed information about the fault, including:

• when it happened

• if the fault still exists

• a list of essential engine data from the time of the fault.

It can also display a 10 second graph of critical engine data, from 8 seconds before the fault occurred to two seconds after. And if you only want to view engine parameters and fault codes, all you need is a PDA (Personal Digital Assistant) and our easy to load software and a communications cable.

With many OEMs using control modules to control their machinery, the new EPM has the ability to communicate engine data to and receive commands from other control modules through a Controller Area Network (CAN) link, with messages written in the J1939 protocol. This allows large amounts of data to move throughout the machine through only two wires, and can be used to run some module based gauge packages.

The EPM also carries auxiliary features that can be programmed to control OEM devices, allowing the OEM to eliminate components from their machinery.

The EPM is also equipped with multiple safety and protection devices that protect the user and engine from hazards such as:

• over speed

• over temperature

• over voltage

• low oil pressure

• unauthorized tampering.

Table 3-12. Diagnostics Fault Codes

Diagnostic Trouble Code	Description
111	Closed Loop Multiplier High (LPG)
112	HO2S Open/Inactive (Bank 1)
113	HO2S Open/Inactive (Bank 2)
121	Closed Loop Multiplier High Bank 1 (Gasoline)
122	Closed Loop Multiplier Low Bank 1 (Gasoline)
124	Closed Loop Multiplier Low (LPG)
125	Closed Loop Multiplier High (Natural Gas)
126	Closed Loop Multiplier Low (Natural Gas)
131	Closed Loop Multiplier High Bank 2 (Gasoline)
132	Closed Loop Multiplier Low Bank 2 (Gasoline)
141	Adaptive Lean Fault (High Limit- Gasoline)
142	Adaptive Rich Fault (Low Limit Gasoline)
143	Adaptive Learn High (LPG)
144	Adaptive Learn Low (LPG)
145	Adaptive Learn High (Natural Gas)
146	Adaptive Learn Low (Natural Gas)
161	System Voltage Low
162	System Voltage High
211	IAT High Voltage
212	IAT Low Voltage
213	IAT Higher Than Expected 1
214	IAT Higher Than Expected 2
215	Oil Pressure Low
221	CHT/ECT High Voltage
222	CHT/ECT Low Voltage
223	CHT Higher Than Expected 1
224	CHT Higher Than Expected 2
231	DMAP High Pressure
232	MAP Low Voltage

Table 3-12. Diagnostics Fault Codes

Diagnostic Trouble Code	Description
234	BP High Pressure
235	BP Low Pressure
242	Crank Sync Noise
243	Never Crank Synced At Start
244	Camshaft Sensor Loss
245	Camshaft Sensor Noise
253	Knock Sensor Open
254	Excessive Knock Signal
311	Injector Driver #1 Open (2.5L)
311	Injector Driver #1 Open (4.2L)
312	Injector Driver #1 Shorted (2.5L)
312	Injector Driver #1 Shorted (4.2L)
313	Injector Driver #2 Open (2.5L)
313	Injector Driver #2 Open (4.2L)
314	Injector Driver #2 Shorted (2.5L)
314	Injector Driver #2 Shorted (4.2L)
315	Injector Driver #3 Open (2.5L)
315	Injector Driver #3 Open (4.2L)
316	Injector Driver #3 Shorted (2.5L)
316	Injector Driver #3 Shorted (4.2L)
321	Injector Driver #4 Open (2.5L)
321	Injector Driver #4 Open (4.2L)
322	Injector Driver #4 Shorted (2.5L)
322	Injector Driver #4 Shorted (4.2L)
323	Injector Driver #5 Open (4.2L)
324	Injector Driver #5 Shorted (4.2L)
325	Injector Driver #6 Open (4.2L)
326	Injector Driver #6 Shorted (4.2L)
351	Fuel Pump Loop Open or High Side Short To Ground
352	Fuel Pump High Side Shorted To Power

Table 3-12. Diagnostics Fault Codes

Diagnostic Trouble Code	Description
411	Coil Driver #1 Open (2.5L)
411	Coil Driver #1 Open (4.2L)
412	Coil Driver #1 Shorted (2.5L)
412	Coil Driver #1 Shorted (4.2L)
413	Coil Driver #2 Open (2.5L)
413	Coil Driver #2 Open (4.2L)
414	Coil Driver #2 Shorted (2.5L)
414	Coil Driver #2 Shorted (4.2L)
415	Coil Driver #3 Open (4.2L)
416	Coil Driver #3 Shorted (4.2L)
511	FPP1 High Voltage
512	FPP1 Low Voltage
513	FPP1 Higher Than IVS Limit
514	FPP1 Lower Than IVS Limit
521	FPP2 High Voltage
522	FPP2 Low Voltage
531	TPS1 (Signal Voltage) High
532	TPS1 (Signal Voltage) Low
533	TPS2 (Signal Voltage) High
534	TPS2 (Signal Voltage) Low
535	TPS1 Higher Than TPS2
536	TPS1 Lower Than TPS2
537	Throttle Unable To Open
538	Throttle Unable To Close
545	Governor Interlock Failure
551	Max Govern Speed Override
552	Fuel Rev Limit
553	Spark Rev Limit
611	COP Failure
612	Invalid Interrupt

Table 3-12. Diagnostics Fault Codes

Diagnostic Trouble Code	Description
613	A/D Loss
614	RTI 1 Loss
615	Flash Checksum Invalid
616	RAM failure
631	External 5V Ref Lower Than Expected
632	External 5V Ref Higher Than Expected
655	RTI 2 Loss
656	RTI 3 loss

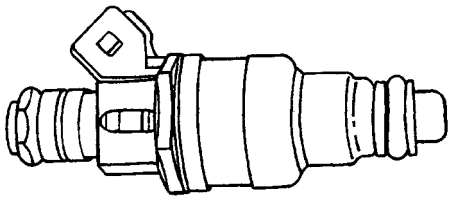
Fuel System

FUEL INJECTOR

The Electronic Fuel Injection (EFI) fuel injector is a solenoid-operated device controlled by the ECM. The ECM energizes the solenoid, which opens a valve to allow fuel delivery.

The fuel is injected under pressure in a conical spray pattern at the opening of the intake valve. Excess fuel not used by the injectors passes through the fuel pressure regulator before being returned to the fuel tank.

A fuel injector which is stuck partly open will cause a loss of fuel pressure after the engine is shut down, causing long crank times.



FUEL METERING SYSTEM COMPONENTS

The fuel metering system is made up of the following parts:

- The fuel injectors
- The fuel rail
- The fuel pressure regulator/filter assembly
- The electronic governor
- The ECM
- The crankshaft position (CKP) sensor
- The camshaft position (CMP) sensor
- The fuel pump
- The fuel pump relay

BASIC SYSTEM OPERATION

The fuel metering system starts with the fuel in the fuel tank. The fuel is drawn up to the fuel pump through a pre-filter. The electric fuel pump then delivers the fuel to the fuel rail through an inane fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A fuel pressure regulator in the fuel filter assembly keeps fuel available to the fuel injectors at a constant pressure. A return line delivers unused fuel back to the tank.

FUEL METERING SYSTEM PURPOSE

The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each intake valve.

The main control sensor is the heated oxygen sensor (H02S) located in the exhaust system. The H02S tells the ECM how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by control-ling the amount of time that the fuel injector is "ON." The best mixture to minimize exhaust emissions is 14.7 parts of air to 1 part of gasoline by weight, which provides the most efficient combustion. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called "modes." All modes are controlled by the ECM. Refer to "Open Loop and Closed Loop Operation" for more information.

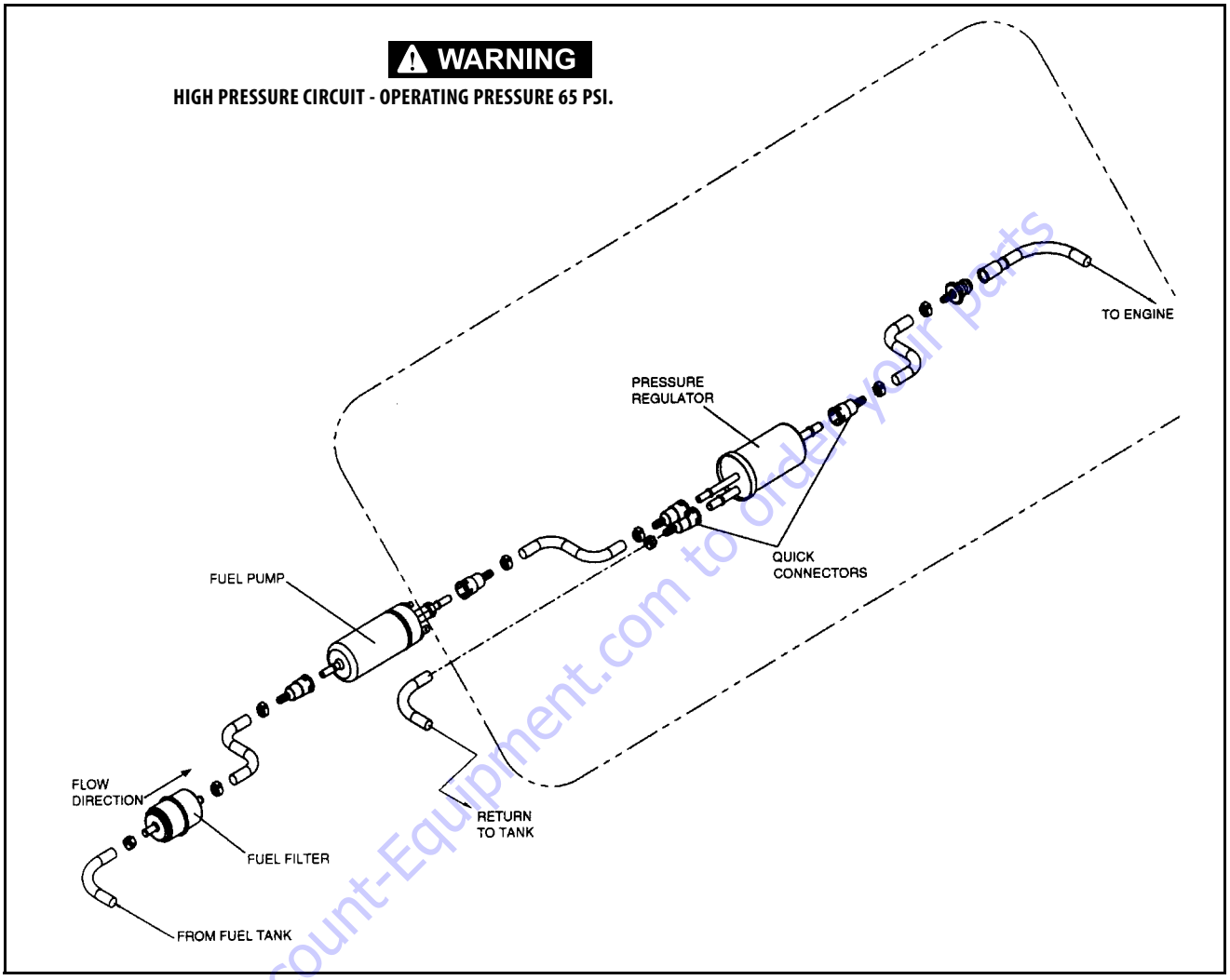


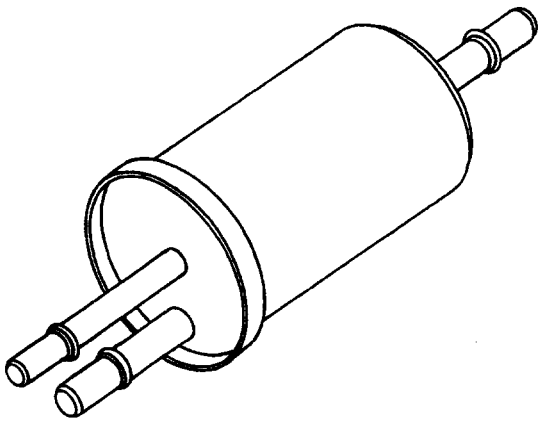
Figure 3-56. Typical Fuel System

FUEL PRESSURE REGULATOR

The fuel pressure regulator is a relief valve mounted in the fuel filter. It provides a constant fuel pressure of 441 kPa (64 psi).

If the pressure is too low, poor performance and a DTC 32 will set. If the pressure is too high, excessive odor and/or a DTC 42 will result.

When replacing the fuel filter, be sure to use an identical filter/regulator assembly. A standard fuel filter does not regulate pressure and could cause engine problems or component damage.



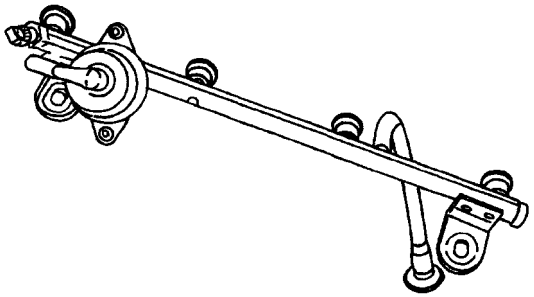
FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON," the ECM energizes the fuel pump relay for two seconds to build up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump off and waits until the engine is cranked. When the engine is cranked and crankshaft position signal has been detected by the SECM, the ECM supplies 12 volts to the fuel pump relay to energize the electric fuel pump.

An inoperative fuel pump will cause a "no-start" condition. A fuel pump which does not provide enough pressure will result in poor performance.

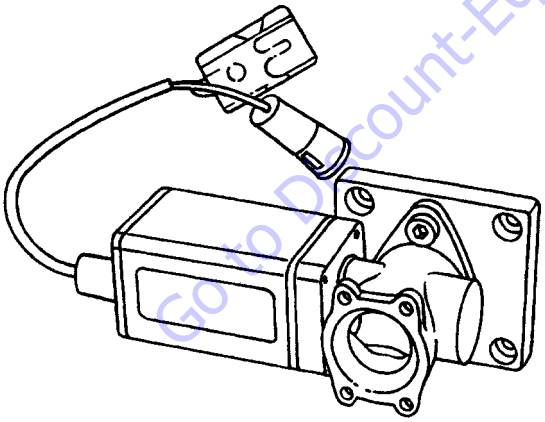
FUEL RAIL

The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines.



ELECTRONIC GOVERNOR AND THROTTLE BODY

In the 2.5L EFI industrial engine, throttle control is achieved by using an electronic governor which is controlled by the engine control module (ECM).



The electronic governor consists of a throttle body, an electronically-actuated throttle plate, and a built-in throttle position (TP) sensor. There are two pigtails that exit the governor body. The 3-wire pigtail connects the TP sensor to the ECM. Refer to "Throttle Position (TP) Sensor" for more information.

The 2-wire pigtail carries the throttle signal from the ECM to the governor. Desired engine speeds are stored in the configuration program for each specific application, and can be changed with the ECM calibration software. When an engine speed is selected with the toggle switch, the ECM sends the appropriate signal to the governor. This is a pulse-width modulated (PWM) signal which cannot be read with conventional diagnostic tools such as a voltmeter. A 12-volt signal is pulsed on and off at a high rate of speed. The width of the "on" pulse determines the amount of throttle opening. The ECM sends a signal with the appropriate pulse width to the governor based on the operator's choice of switch settings.

The electronic governor also acts as an idle air control (IAC) valve. Changes in engine load are detected by the ECM by comparing manifold absolute pressure (MAP) with throttle position. When the ECM detects a change in engine load, it can adjust idle speed by changing the PWM signal to the governor.

OPEN LOOP AND CLOSED LOOP OPERATION

The ECM will operate in the following two modes:

- Open loop
- Closed loop

When the engine is first started, the system is in "open loop" operation. In open loop, the ECM ignores the signal from the heated oxygen sensor (HO2S). it uses a pre-programmed routine to calculate the air/fuel ratio based on inputs from the TP, ECT, and MAP sensors.

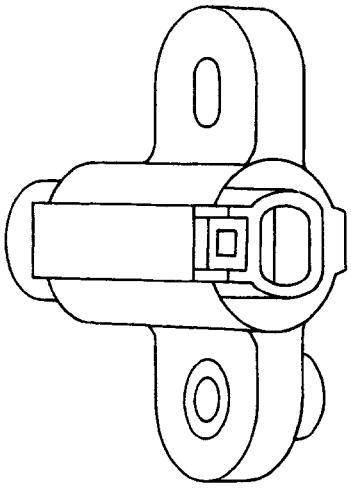
The system remains in open loop until the following conditions are met:

- The HO2S has a varying voltage output showing that it is hot enough to operate properly (this depends on temperature).
- The ECT has reached 160°F (71°C).
- Seven minutes has elapsed since starting the engine.

After these conditions are met, the engine is said to be operating in "closed loop." In closed loop, The ECM continuously adjusts the air/fuel ratio by responding to signals from the HO2S (except at wide-open throttle). When the HO2S reports a lean condition (low sensor signal voltage), the ECM responds by increasing the "on" time of the fuel injectors, thus enriching the mixture. When the HO2S reports a rich condition (high sensor signal Voltages the ECM responds by reducing the "on" time of the fuel injectors, thus leaning out the mixture.

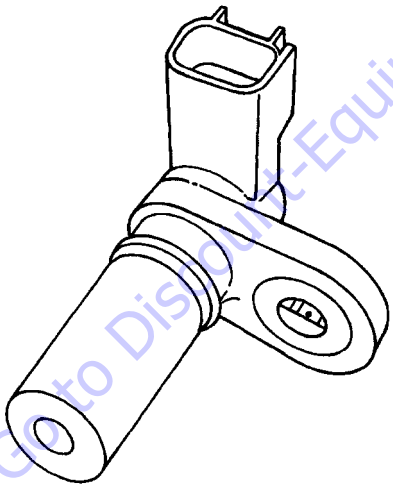
CAMSHAFT POSITION (CMP) SENSOR

The CMP sensor uses a variable reactor sensor to detect camshaft position. The CMP signal is created as piston #1 is a predetermined number of degrees after top dead center on the power stroke.



CRANKSHAFT POSITION (CKP) SENSOR

The crankshaft position (CKP) sensor provides a signal used by the engine control module (ECM) to calculate the ignition sequence. The sensor initiates the reference pulses which the ECM uses to calculate RPM and crank-shaft position.



ELECTRONIC IGNITION

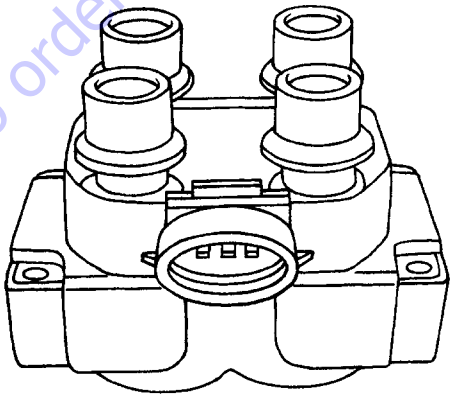
The electronic ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel w mixture at the correct time. To provide optimum engine performance, fuel economy, and control of exhaust emissions, the ECM controls the spark advance of the ignition system. Electronic ignition has the following advantages over a mechanical distributor system:

- No moving parts
- Less maintenance
- Remote mounting capability
- No mechanical load on the engine
- More coil cooldown time between firing events
- Elimination of mechanical timing adjustments
- Increased available ignition coil saturation time

IGNITION COIL

The electronic ignition system uses a coil pack with one ignition coil for each two cylinders in the engine. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on compression fires simultaneously with the opposing cylinder on exhaust. The spark that occurs in the cylinder on the exhaust stroke is referred to as a "waste spark."

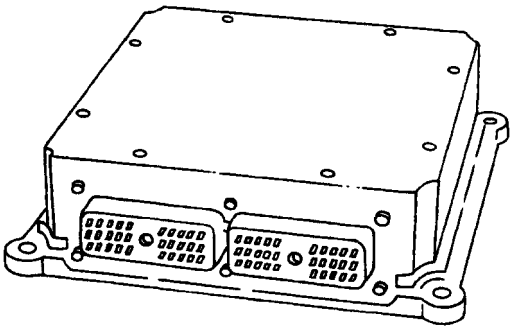
The primary coils in the coil pack are triggered by the "Ignition Coil Feed #1" and "Ignition Coil Feed #2" Signals from the ECM.



ENGINE CONTROL MODULE (ECM)

The ECM is responsible for maintaining proper spark and fuel injection timing for all operating conditions. To provide optimum operation and emissions, the ECM monitors the input signals from the following components in order to calculate spark timing:

- Engine coolant temperature (ECT) sensor
- Intake air temperature (IAT) sensor
- Throttle position sensor
- Crankshaft position sensor



3.25 FORD LPG SYSTEM (S/N 0300077500 TO S/N 03000140000)

NOTE: *+20° F (-6.6° C) is the low temperature limit for LP gas, for both starting and operation. This applies to all LP gas powered engines.*

Description

The LPG system starts at the tank. The liquid propane exits the tank, flows through the fuel lockoff solenoid, flows through the regulator (regulator converts the liquid to a vapor), flows through the megajector, flows through the mixer and into the engine.

Regulator

The regulator accepts LPG liquid at tank pressure (min = 30 psi; max = 312 psi [min = 207 kPa; max = 2151 kPa]) and reduces it to a regulator outlet pressure of 1.5 to 2.5 inches (3.8 to 6.3 cm) of H_2O at idle flow (approx. 750 RPM / no load). This regulator must have engine coolant flowing through it whenever the engine is running.

Megajector

The megajector is an electronic pressure regulator. This electronic regulator outputs a specific pressure needed at the mixer to maintain the desired air to fuel ratio. The megajector accepts LPG vapor at the regulator outlet pressure (1.5 to 2.5 inches [3.8 to 6.3 cm] of H_2O) and reduces it to a pressure value commanded by the EPM. The pressure command is sent by the EPM over the CAN link via the megajector harness. The megajector outlet pressure has units of inches of H_2O. The megajector outlet pressure is defined as the difference between the megajector outlet gas pressure and the balance line pressure (usually at or near barometric pressure depending on air intake restriction). The megajector outlet pressure can vary between -1.00 to -5.00 inches (-2.5 to -12.7 cm) of H_2O depending on the speed and load of the engine. The megajector must be mounted per the 2.5L 2004 Emission Installation Instructions. Torque mounting bolts to a maximum of 60 in.lbs. (7 Nm).

Mixer

The mixer accepts LPG vapor at the megajector outlet pressure (-1.00 to -5.00 inches [-2.5 to -12.7 cm] of H_2O) and mixes it with clean air. This mixture is then sucked into the engine via the actuator.

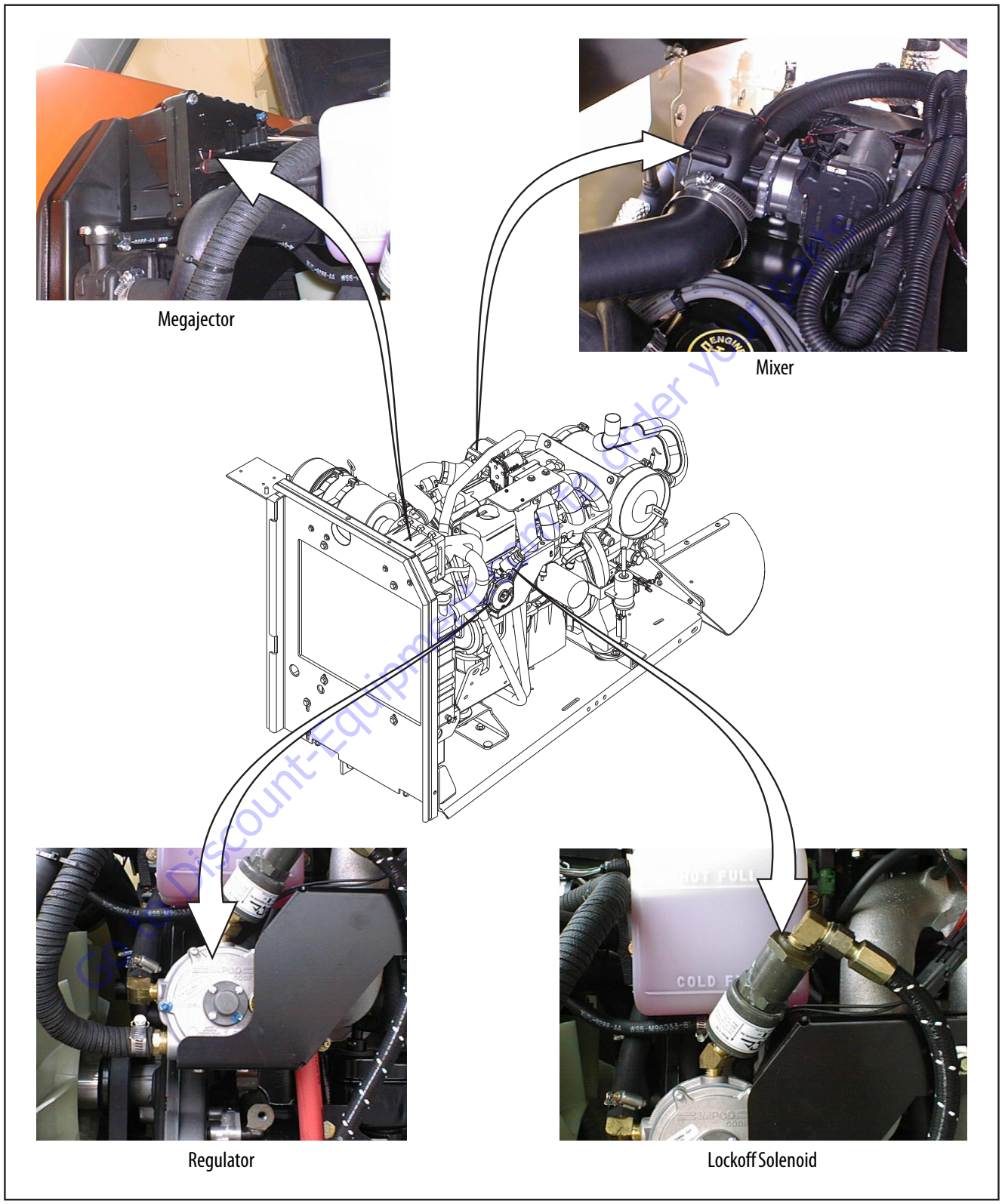


Figure 3-57. LPG System Components (S/N 0300077500 to S/N 03000140000)

Lockoff Solenoid

The lockoff solenoid is used to reduce the possibility of backfires. The EPM controls the opening and closing of the lockoff so that as a shutdown is commanded, the lockoff is closed, but the ignition system continues to operate to burn off unburned fuel in the manifold. This will cause longer than usual start times, because the manifold must fill up with fuel again before the engine will fire. This will also cause the engine to run for one to two seconds after ignition is turned off.

Megajector Diagnostic Code Descriptions

The following diagnostic codes are specific to the megajector. They will be displayed on the analyzer if the JLG Control System senses a fault dealing with the megajector. Refer to Section 6 - JLG Control System for more information concerning the Control System.

DTC 353 - Megajector delivery pressure higher than expected. This code will set if the difference between the Megajector actual pressure and the Megajector commanded pressure is greater than 4.00 inches (10.1 cm) of H_2O.

a. **Fuel Supply** - Check fuel supply pressure at the megajector inlet fitting. Fuel supply pressure on LPG applications should be between 3-5" (7.6-12.7 cm) H_2O.

b. **Lockoff Solenoid** - Check the lockoff to make sure it is sealing when closed. If it is not completely sealing, it could allow pressure creep in the fuel system.

c. **Reference Line** - Make sure the reference line is in place between the Megajector and the carburetor balance port. Make sure the hose is not kinked or restricted in any way and has no holes in it.

d. **Regulator** - Observe the regulator with the engine running to see if it is icing up. If it's icing up, refer to Engine Cooling System below.

e. **Engine Cooling System** - Make sure the engine cooling system is operating properly and there are no air locks in the system. Make sure the engine is operating at the proper temperature. Check the coolant hoses at the regulator and make sure they are both warm to verify proper coolant circulation.

If the fuel system is operating properly, the Megajector has an internal failure and must be replaced.

DTC 354 - Megajector delivery pressure lower than expected. This code will set if the difference between the Megajector actual pressure and the Megajector commanded pressure is less than -4.00 inches (10.1 cm) of H_2O.

a. **Fuel Supply** - Check fuel supply pressure at the megajector inlet fitting. Fuel supply pressure on LPG applications should be between 3-5" (7.6-12.7 cm) H_2O.

b. **Fuel System Hoses** - Make sure all fuel system hoses are in good condition. They should be clamped tight, free from kinks with no cuts, pinches, etc.

c. **Lockoff Solenoid** - Check the lock off to make sure it is opening properly. If it is not opening completely, it could cause low fuel pressure.

d. **Reference Line** - Make sure the reference line is in place between the Megajector and the carburetor balance port. Make sure the hose is not kinked or restricted in any way and has no holes in it.

e. **Regulator** - Observe the regulator with the engine running to see if it is icing up. If it's icing up, refer to Engine Cooling System below.

f. **Engine Cooling System** - Make sure the engine cooling system is operating properly and there are no air locks in the system. Make sure the engine is operating at the proper temperature. Check the coolant hoses at the regulator and make sure they are both warm to verify proper coolant circulation.

If the fuel system is operating properly, the Megajector has an internal failure and must be replaced.

DTC 355 - Megajector comm. lost. This codes will set if the communication (CAN link) between the Megajector and the EPM is not present.

a. **CAN Circuits** - Check CAN circuits for continuity and shorts to power or ground and for proper connections.

If the CAN circuits are ok and all wiring connections are good, the Megajector has an internal failure and must be replaced.

DTC 361 - Megajector voltage supply high.

a. **Voltage** - Check battery voltage. If the voltage at the battery is greater than 18 volts, either the charging system or the megajector is faulty.

DTC 362 - Megajector voltage supply low.

a. Voltage - Check battery voltage. If the voltage at the battery is less than 9.5 volts:

The battery is faulty

or

The charging system is faulty

or

The Megajector is faulty.

DTC 363 - Megajector Internal Actuator Fault Detection.

a. **Connections** - Check power, ground, and CAN circuits at the Megajector in addition to all electrical connections. Repair as necessary and retest.

b. **Megajector** - Megajector has an internal failure. Contact JLG Industries for further assistance.

DTC 364 - Megajector Internal Circuitry Fault Detection.

a. **Connections** - Check power, ground, and CAN circuits at the Megajector in addition to all electrical connections. Repair as necessary and retest.

b. **Megajector** - Megajector has an internal failure. Contact JLG Industries for further assistance.

DTC 365 - Megajector Internal Comm Fault Detection.

a. **Connections** - Check power, ground, and CAN circuits at the Megajector in addition to all electrical connections. Repair as necessary and retest.

b. **Megajector** - Megajector has an internal failure. Contact JLG Industries for further assistance.

3.26 ELECTRIC GOVERNOR INSTALLATION AND ADJUSTMENTS - FORD LRG425 ENGINE (PRIOR TO S/N 0300065534)

General

These instructions presume no electrical test equipment other than a multimeter for making the electrical measurements called for on the following pages. If no suitable meter is available, an inexpensive but adequate meter, part number 22-188 is available from any local Radio Shack store.

Many "governor problems" turn out to be installation problems, particularly in first-time applications. Careful attention to the directions provided will go far toward a successful installation made in the least amount of time.

Quick-start Installations

If you are experienced in installing and adjusting Electric Governor, follow these steps. Otherwise, refer to the more detailed instructions starting with "MOUNTING-ACTUATOR".

1. Mount Actuator rigidly to engine location which will permit a short, straight linkage to the carburetor or fuel valve. Avoid very hot areas.
2. Mount controller in a dry, fairly cool location. Accessibility for adjusting is required.
3. Wire per appropriate included schematic, using #16 wire.
4. Set up fuel linkage. This is critical, so review the section titled "LINKAGE".
5. Hold linkage for safety, and start engine.
6. Adjust engine speed to desired valve using High Engine pot. Turn CW to increase, CCW to decrease speed.

Mounting-Actuator

The Actuator may be mounted in any attitude - there is no preferred orientation.

With no power applied, the Actuator is spring-loaded to the minimum fuel position. The Actuator output shaft rotates toward the maximum fuel position against this spring through electrical power from the controller. This rotation is CW (clockwise) on one side of the Actuator, and CCW (counterclockwise) on the other. If necessary, reverse the Actuator on its mounting plate so that the desired direction of rotation is on the desired side to match the fuel system direction of travel.

Before selecting the mounting location, consider the linkage that will be required to connect the Actuator output arm to the butterfly or fuel valve. Read the following section on linkages before deciding on a mounting location!

1. Mount Actuator rigidly to engine location which will permit a short, straight linkage to the carburetor or fuel valve. Avoid very hot areas.

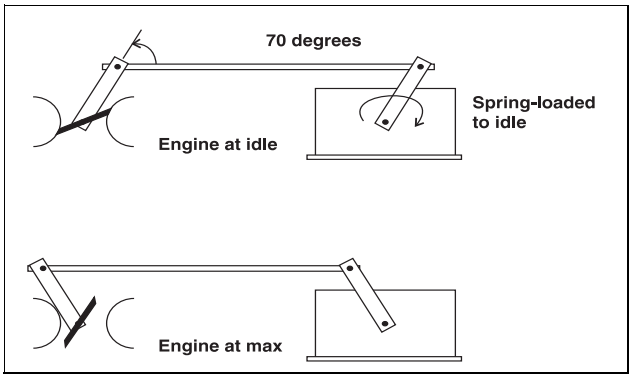
Linkage

1/4" -28 threaded rod and low friction rod-end bearings are recommended for linkage materials.

Keep the linkage as short and as straight as possible.

The linkage must not rub against the engine, brackets, hoses, etc. The linkage must be free of friction and lost motion or "slop".

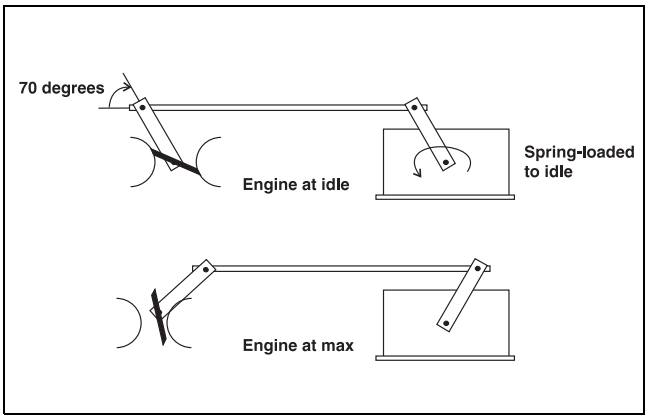
The following sketch indicates the proper linkage geometry for most installations.

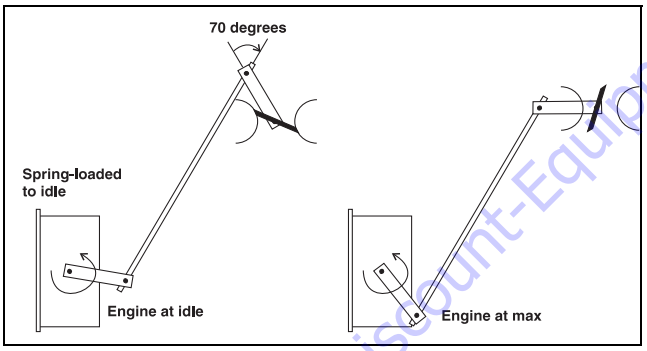


Note that the angle between the carburetor arm and the rod is 70 degrees with the engine at idle. This is highly desirable! Note also that the Actuator arm travels equally on either side of a 90 degree angle with the rod. This angular arrangement will give the proper mechanical gain for good stability and performance. It may be necessary to rotate the carburetor arm relative to the butterfly to achieve this. This can usually be done, and is usually worth the effort! Below are some workable installations, with good linkages. Remember, the Actuator can be turned 180 degrees on its mounting to "reverse" the

spring-loaded direction. Also, the Actuator can be mounted in any attitude.

The needed travel of the carburetor determines how far out on the Actuator arm the rod is to be attached. In most cases, the carburetor should be moved from closed to above 10 degrees from full open as the Actuator is moved min. to max. THEN ALTER THE LENGTH OF THE ROD SLIGHTLY (PERHAPS.030"), SO THAT THE ACTUATOR IS JUST OFF ITS INTERNAL STOP, AND IS PULLING THE BUTTERFLY AGAINST ITS STOP. This insures that the carburetor can fully close to idle on load dumps, minimizing overspeeds.





Examine the system for springs, such as carburetor return springs. These should be removed. Some automotive carburetors (as opposed to industrial carburetors) contain internal springs for accelerator pumps, etc. These may make good governing difficult, or even impossible. For this, and other reasons, industrial carburetors are much to be preferred.

Move the linkage slowly through its travel, and look for any binding or unexplained forces. Correct any before going further.

Many "governing" problems are really caused by binding of the butterfly and its shaft in the carburetor. This is caused by loading due to vacuum under the butterfly and atmospheric pressure above when the engine is running. These forces cannot be felt when the engine is not running. Therefore, start the engine while carefully controlling the speed by hand, and feel for binding or airload forces. Needle bearings on the butterfly shaft are available on many industrial carburetors to deal with this problem. Any tendency on the butterfly stick must be corrected.

Mounting-Controller

Select a reasonably cool, dry, and vibration free location.

The rear cover will probably need to be removed during set-up in order to make adjustments for speed setting and gain. You may wish to defer final installation until this is done.

After completing these adjustments, replace cover. Mount so that water cannot pool on this cover. Always mount the controller with the strain relief down. This will prevent water from entering thru the cable, also place the vent hole in the bottom of the controller down.

Wiring

See wiring diagram for details of hook-up.

Use #16 wire minimum.

Keep all wiring to the Governor as short as is practical.

Go directly from the controller ground terminal (B of the 8 pin connector) by dedicated wire, to the battery "minus" terminal. If this cannot be done, for some reason, go by dedicated wire to a very good engine ground.

A properly functioning engine electrical system will supply 13.5 - 14.8 VDC when the engine is running. If wiring size is adequate, with good connections and proper grounds, you will get this reading between the wires terminals A & B of the 8 pin connector when the Governor is controlling engine speed. Verify this. Improper hook-up can damage electronics. Recheck wiring before applying power.

Power Distribution

8 Pin Connector

Pin:

- **a.** 12 VDC from the make before break oil pressure switch. This switch provides power to pin A when the ignition is on and the engine is not running (no oil pressure), or when the ignition is turned off when the engine is running (has oil pressure).
- **b.** Ground.
- **c.** Tach signal from the engine ignition system.
- **d.** Tach signal from the engine ignition system.
- **e.** Control signal to operate the Actuator.
- **f.** Control signal to operate the Actuator.
- **g.** Removes ground from the start lock out relay when the engine is running above the start lock out set point. A 20 turn pot is provided to adjust this set point. (usually around 500 RPM)

h. Removes ground from the overspeed relay if this point is exceeded. A 20 turn pot is provided to adjust this set point.(usually around 5000 RPM)

4 Pin Connector

Pin:

a. Input from the elevation limit switches to allow high engine to operate.

b. Input from the high engine switch.

c. Input for mid engine from one of the following: The engine low coolant temperature switch, platform footswitch, or a ground control directional switch.

d. Provides ground to lockout start when the engine RPMS exceed the set point.

Check-Out and Initial Start-Up Procedures

Before proceeding, familiarize yourself with the locations of the various adjustment pots.

Adjustments

High engine
Mid engine
Start lockout
Over speed lockout
Factory adjust
Gain

High Engine:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the high engine pot is 25 turns, each turn will change engine speed by about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However the governor will not function when the pot is past full travel. If you suspect that you may have over-adjusted the high engine pot, or have lost track of where you are, turn the pot 25 to 30 turns out (CCW), then turn in (CW) 10 turns. This will get you back into the range you should be in. Make the high engine adjustment first, then gain, then reset high engine.

Gain:
This adjustment is made by turning the plastic screw clockwise (CW to increase governor sensitivity, counterclockwise (CCW) to decrease sensitivity. The adjustment range of the Factory pot is about 3/4 of a turn, AND OVERTURNING WILL BREAK THE INTERNAL STOPS, making further adjustments impossible. Too much gain will cause instability and the engine will pulsate, Not enough gain will make the engine slow to respond to load requirements, and at first appears to be a good setting when operating directional functions other than drive. The engine will accelerate right up to the set RPMS and stop at that point.The problem with this type of gain setting is that when a large load is applied (usually thru drive) and then suddenly unloaded, the engine will be slow to respond in decreasing RPMS. This will cause the engine to over rev and then at times, will activate the over speed cutout and shut the engine off. The ideal gain setting will provide a compromise between quick response and good stability. This will usually show up as 1 to 3 engine pulsation's before leveling out at the set RPMS when going from idle to high engine.

Mid engine:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the Mid engine pot is about 25 turns, each turn will change engine speed by about 100 to 200 RPMS. THE pot is protected by an slip clutch at each end and will not be harmed by moderate over adjustment. However, the governor will not function when the pot is past full travel. If you suspect that you have over adjusted the Mid engine pot, or have lost track of where you are, turn the pot 25 turns out (CCW), then turn in (CW), 15 turns. This will get you back into the range you should be in. Make all adjustments before setting the mid engine.

Start lockout:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed and counterclockwise (CCW) to decrease speed. The adjustment range of the Start lockout pot is about 25 turns, each turn will change engine speed by about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However, the governor will not function when the pot is past full travel. If you suspect that you may have over-adjusted the Start lockout pot, or have lost track of where you are, turn the pot to 25 to 30 turns in (CW), Then turn out (CCW) 8 1/2 turns. This will get you back into the range you should be in. Start lockout should normally not have to be adjusted. Normally startout should occur at around 500 RPM. If while cranking the engine seems to stop momentarily then reengages the starter, turn the adjustment in (CW) 1/4 to 1/2 turn at a time until the engine will crank with out locking out start. If the starter engages while the engine is running, check the idle RPMS before adjusting the governor. On the 800 series, this should be 1000 RPMS. Do not set the RPMS above 1100 RPMS as this will cause engine shut down problems that will be similar to dieseling.

Over speed:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the Over speed pot is about 25 turns, each turn will change engine speed about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However the governor will not function when the pot is past full travel. If you suspect that you have over-adjusted the Over speed pot, or have lost track of where you are, turn the pot 25 turns in (CW), then turn out (CCW) 5 1/2 turns. This will get you back into the range you should be in. Over speed should normally not have to be adjusted. When adjusting Over speed make sure other adjustments have been made correct.

Factory:
This adjustment is made by turning the plastic screw clockwise (CW) to increase governor sensitivity, counterclockwise (CCW) to decrease sensitivity. The adjustment range of the Factory range of the pot is about 3/4 of a turn, AND OVERTURNING WILL BREAK THE INTERNAL STOPS, making further adjustments impossible. The Factory setting normally will not have to be adjusted.

NOTE: *These settings are factory set, Start Lockout, Factory Adjust and Overspeed. They are conformally coated by P.G. and should not need to be reset.*

Assuming that the Actuator and Controller are mounted, the wiring is run and checked, and that the linkage is properly installed, proceed as follows:

1. Use multimeter to check battery voltage at battery terminals, and record. Now check voltage at the machine connection points for terminals A & B of the 8 pin connector on the E-331 (A is +, B is -). Voltage reading should be the same as at battery. If not, shut down, and correct wiring.
2. Hold the linkage back by hand, so as to control engine speed manually. Start engine, set vehicle controls to obtain High Engine speed, gradually release the linkage, and adjust the speed-set as needed to set the speed as desired. If engine speed surges, reduce Gain a little, as required (CCW).
3. Re-check voltage between terminal A & B as in step 2. Voltage reading should be between 13.5 - 14.6 VDC.

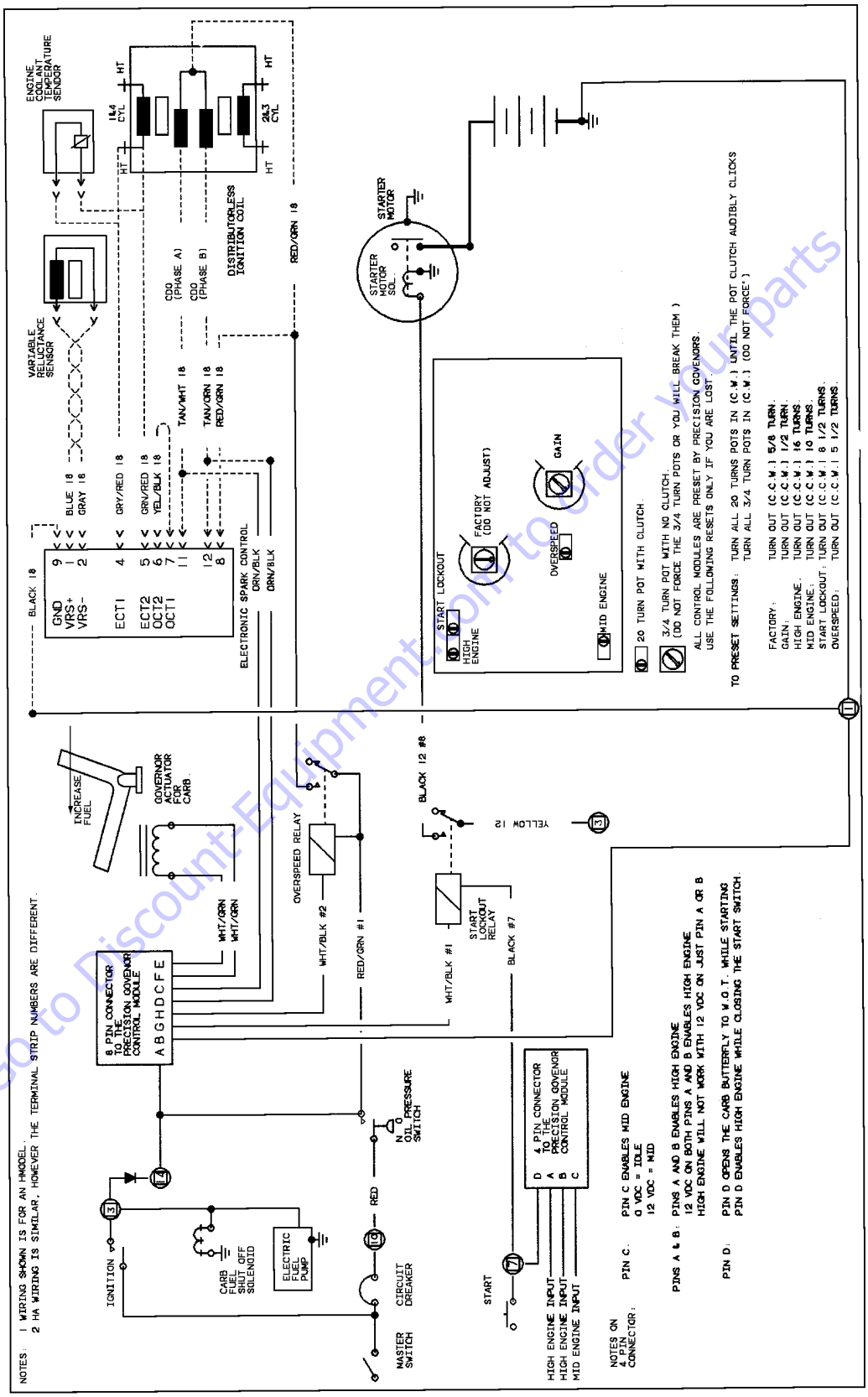


Figure 3-58. Check-Out and Initial Start-Up Procedures