JLG®

An Oshkosh Corporation Company

Service and Maintenance Manual

Model
800A
800AJ

Prior to S/N 0300183033

P/N - 3120740

December 18, 2015

ANSI

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.

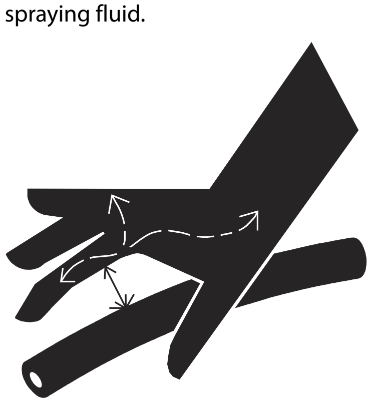
⚠ WARNING

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 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Table 1-1. Operating Specifications

Travel Speed 2WD 4WD	 3.0 MPH (4.83 Km/hr.) 3.0 MPH (4.83 Km/hr.)
Gradeability 2WD 4WD	 30% 45%
Turning Radius (Outside) 2WS 4WS	 22 ft. 6 in. (6.86 m) 14 ft. 6 in. (4.42 m)
Turning Radius (Inside) 2WS 4WS	 12 ft. 0 in. (3.66 m) 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 800AJ	 36 ft. 9 in. (11.25 m) 36 ft. 6 in. (11.13 m)
Wheel base	10 ft. 0 in. (3.05 m)
Boom Elevation - 800A Above Grade Below Grade	 +80 ft.3 in. (24.46 m) -15 ft. 7 in. (4.75 m)
Boom Elevation - 800AJ Above Grade Below Grade	 +80 ft. 3 in. (24.46 m) -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 Reverse	 42 - 48 seconds for 200 ft 42 - 48 seconds for 200 ft
Drive Speed (4WD) Forward Reverse	 42 - 48 seconds for 200 ft 42 - 48 seconds for 200 ft
Machine Weight approximately IN 385/65D 19.5 Pneumatic 15 X 19.5 Pneumatic IN 445/55D 19.5 18 X 19.5 Pneumatic Tires IN 385/65D 19.5 15 X 19.5 Foam Filled Tires IN 445/55D 19.5 18 X 19.5 Foam Filled Tires	 34,200 lbs.(15520 kg) 34,200 lbs.(15520 kg) 34,270 lbs. (15550 kg) 34,270 lbs. (15550 kg) 33,100 lbs. (15020 kg) 33,100 lbs. (15020 kg) 33,550 lbs. (15220 kg) 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 Deutz Cooling System Crankcase Total Capacity Caterpillar Isuzu GM	 4.5 Quarts (4.25 L) w/Filter 5 Quarts (4.73 L) 11 Quarts (10.4 L) w/Filter 16 Quarts (15.14 L) 10.6 Quarts (10 L) 8.5 Quarts (8.0 L) 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 High RPM	 3.45 GPH (13.06 lph) 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

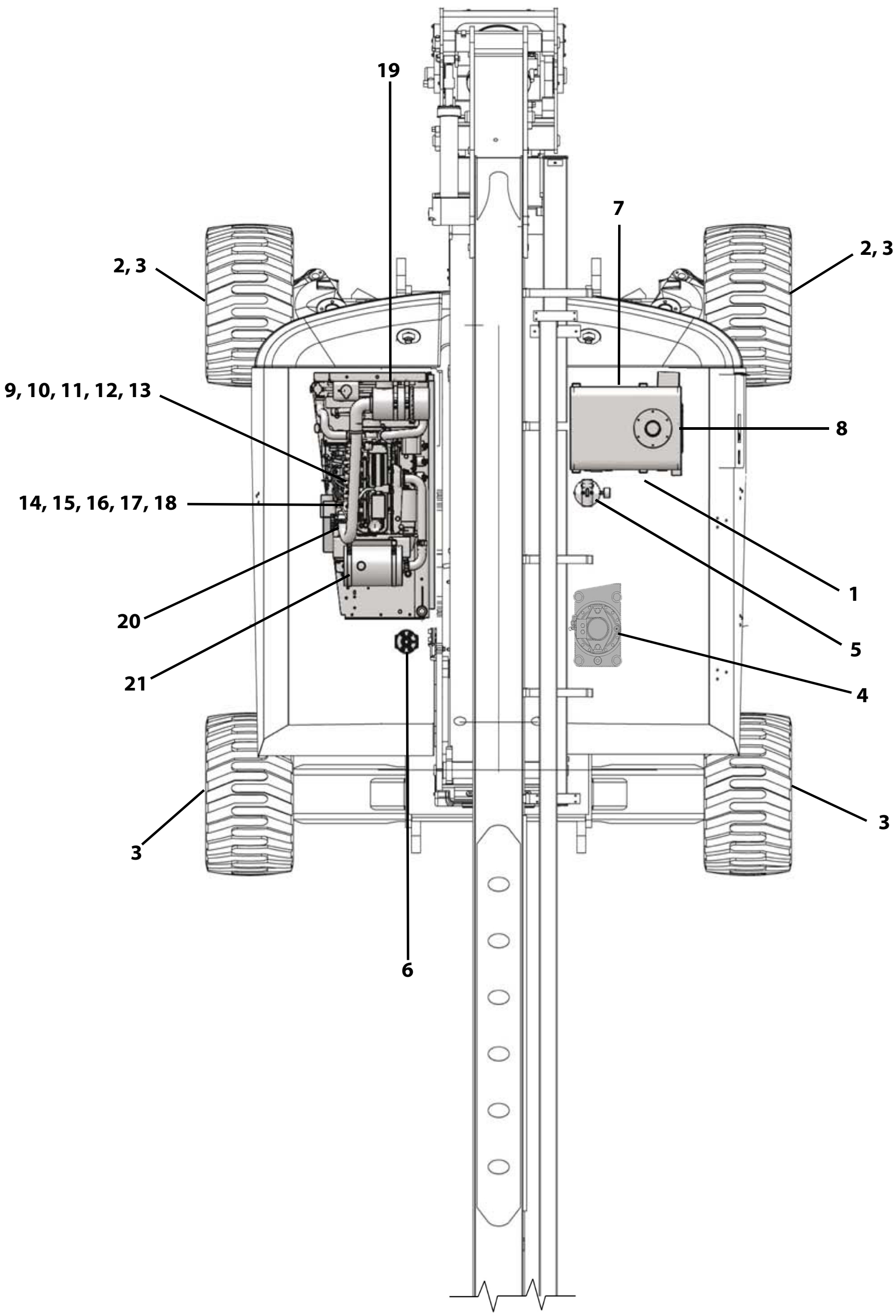


Figure 1-1. Maintenance and Lubrication Diagram

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

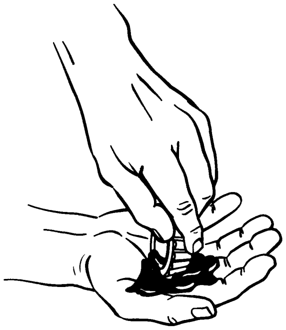
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

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

1. Swing Bearing - Internal Ball Bearing

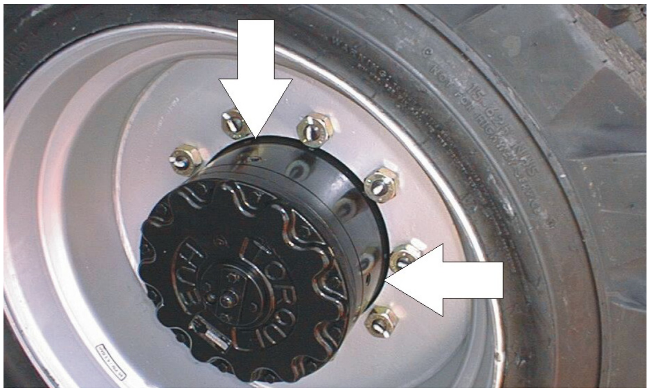
Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Access

2. Wheel Bearings



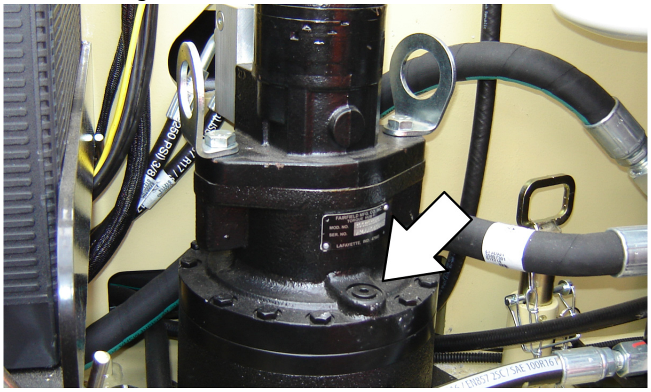
Lube Point(s) - Repack
Capacity - A/R
Lube - MPG
Interval - Every 2 years or 1200 hours of operation

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

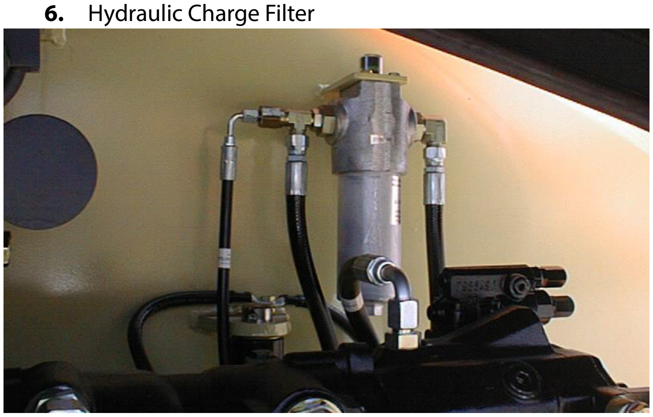


Lube Point(s) - Level/Fill Plug
Capacity - 43 oz. (1.3 L)
Lube - 90w80 Gear oil
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation

5. Hydraulic Return Filter

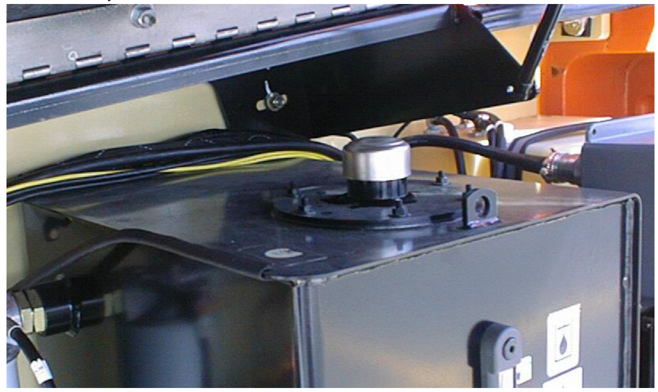
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

6. Hydraulic Charge Filter



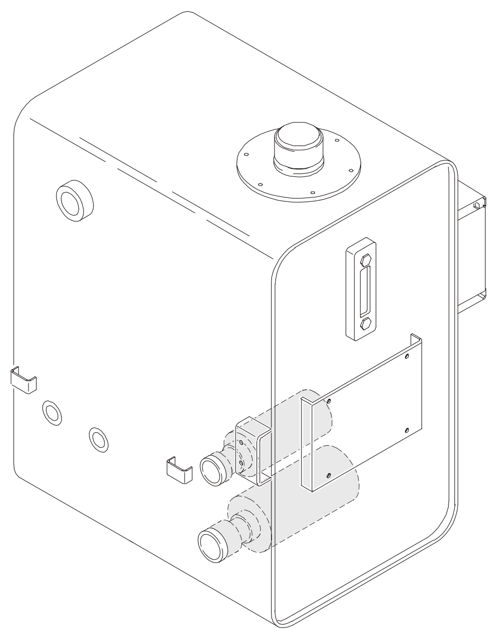
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter or as indicated by Condition Indicator.

7. Hydraulic Tank



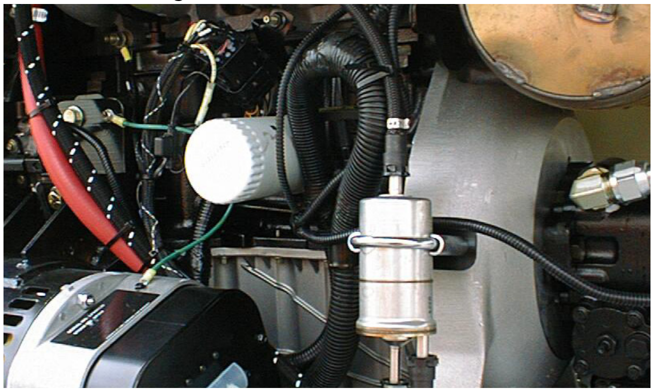
Lube Point(s) - Fill Cap
Capacity - 40 gallons (151 L) Tank; 77 gallons (291.4 L) System
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.

8. Suction Strainers



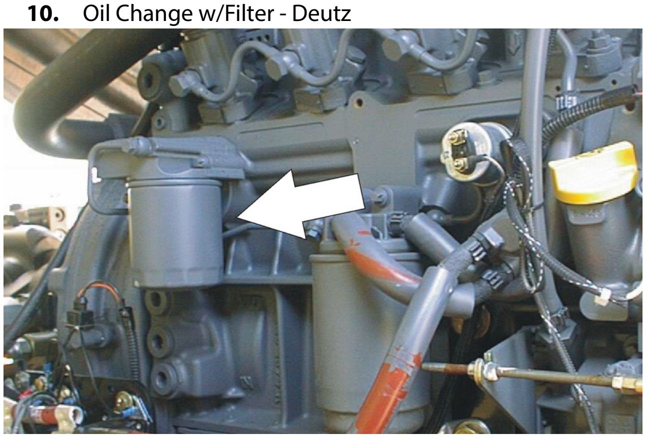
Lube Point(s) - 2
Interval - Every 2 years or 1200 hours of operation, remove and clean at time of hydraulic oil change.

9. Oil Change w/Filter - Ford

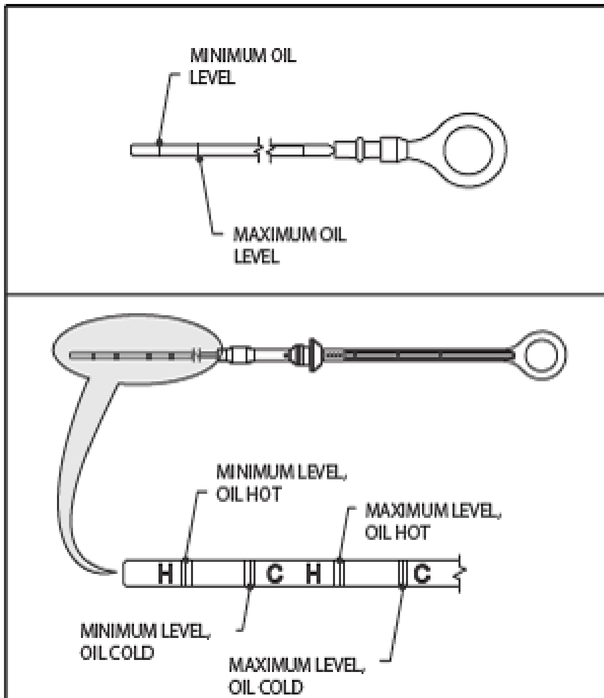


Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 4.5 Quarts
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

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

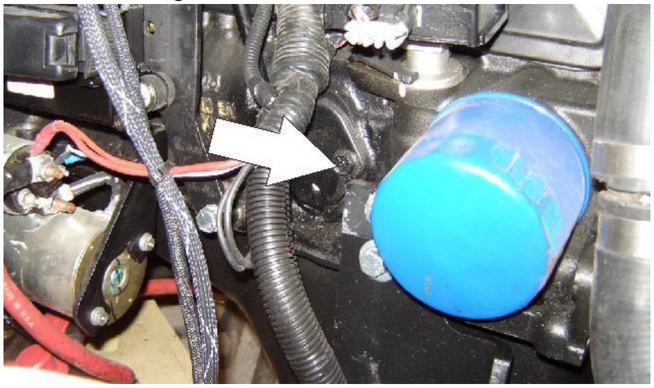
11. Oil Change w/Filter - Isuzu

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

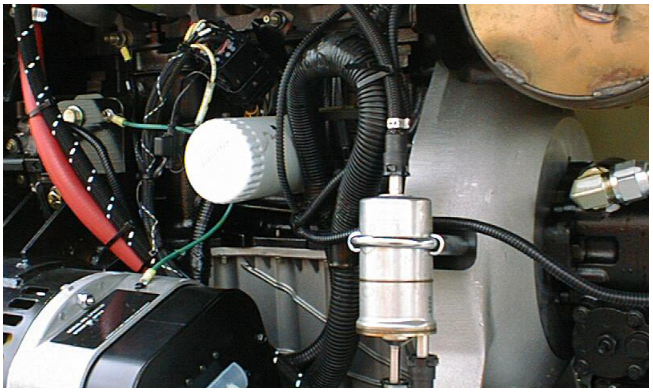
Lube Point(s) - Fill Cap/Spin-on Element
Capacity - 10.6 Quarts
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

13. Oil Change w/Filter - GM



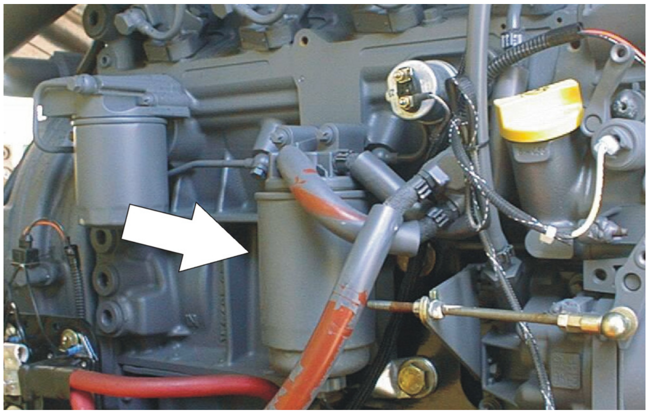
Lube Point(s) - Fill Cap/Spin-on Element (JLG P/N 7027965)
Capacity - 4.5 qt. (4.25 L) w/filter
Lube - EO
Interval - 3 Months or 150 hours of operation
Comments - Check level daily/Change in accordance with engine manual.

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

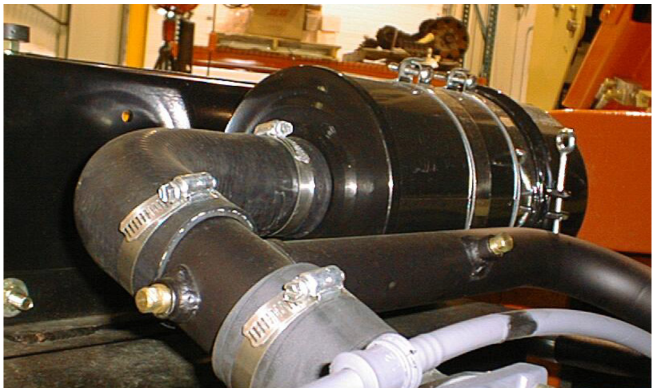
17. Fuel Filter - Caterpillar

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

18. Fuel Filter (Gasoline) - GM

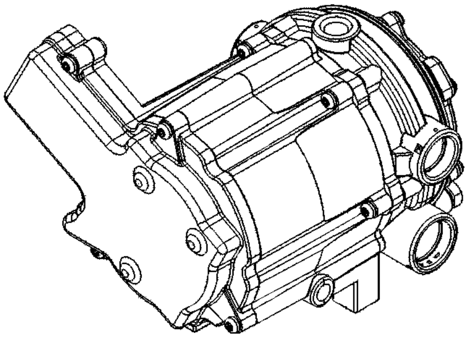
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation

19. Air Filter



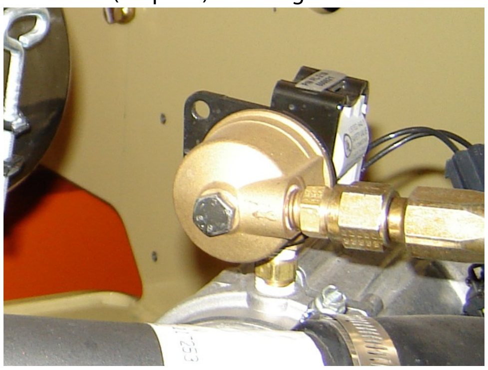
Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator

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

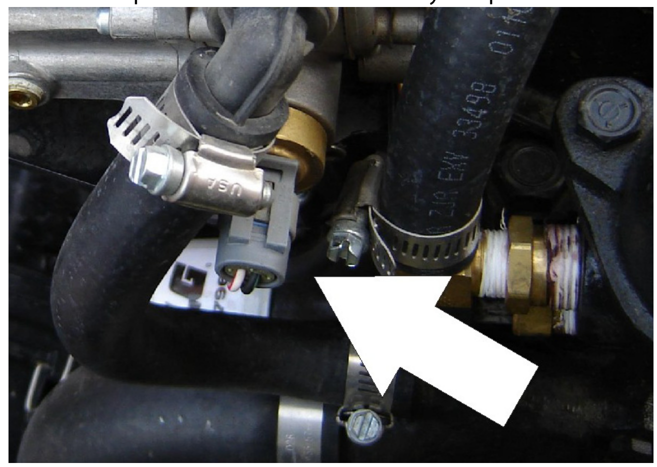
Draining Oil Build Up From The Propane Regulator (Prior to S/N 0300134626)

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.

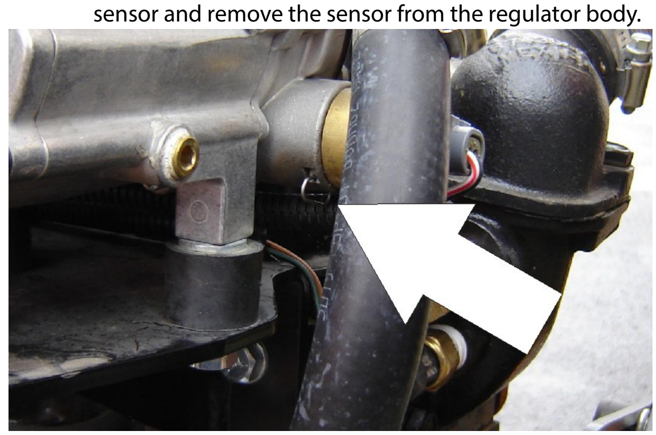
NOTICE

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.



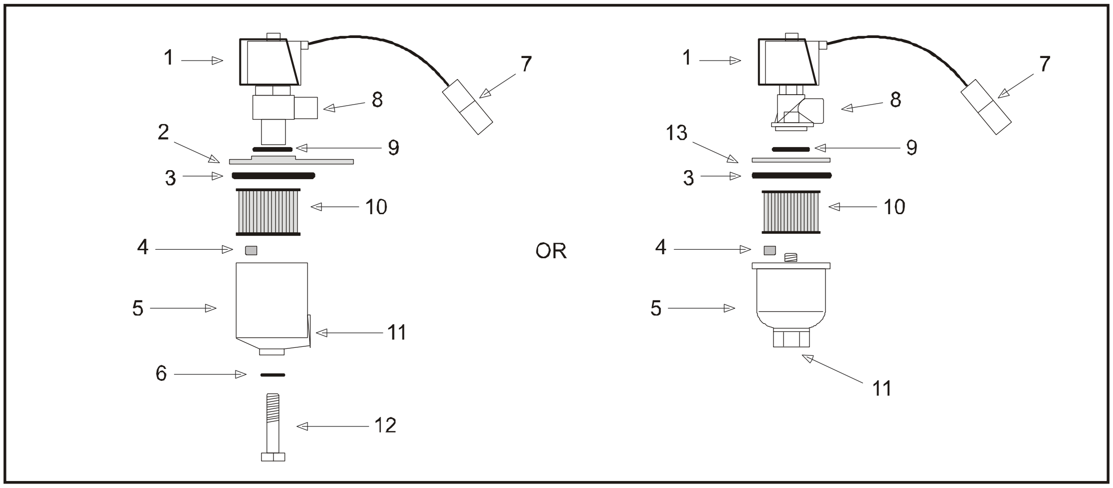
6. Remove the retainer clip for the LPG fuel temperature sensor and remove the sensor from the regulator body.



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

NO. 5000059 REV. K

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)

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

				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

NO. 5000059 REV. K

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)

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

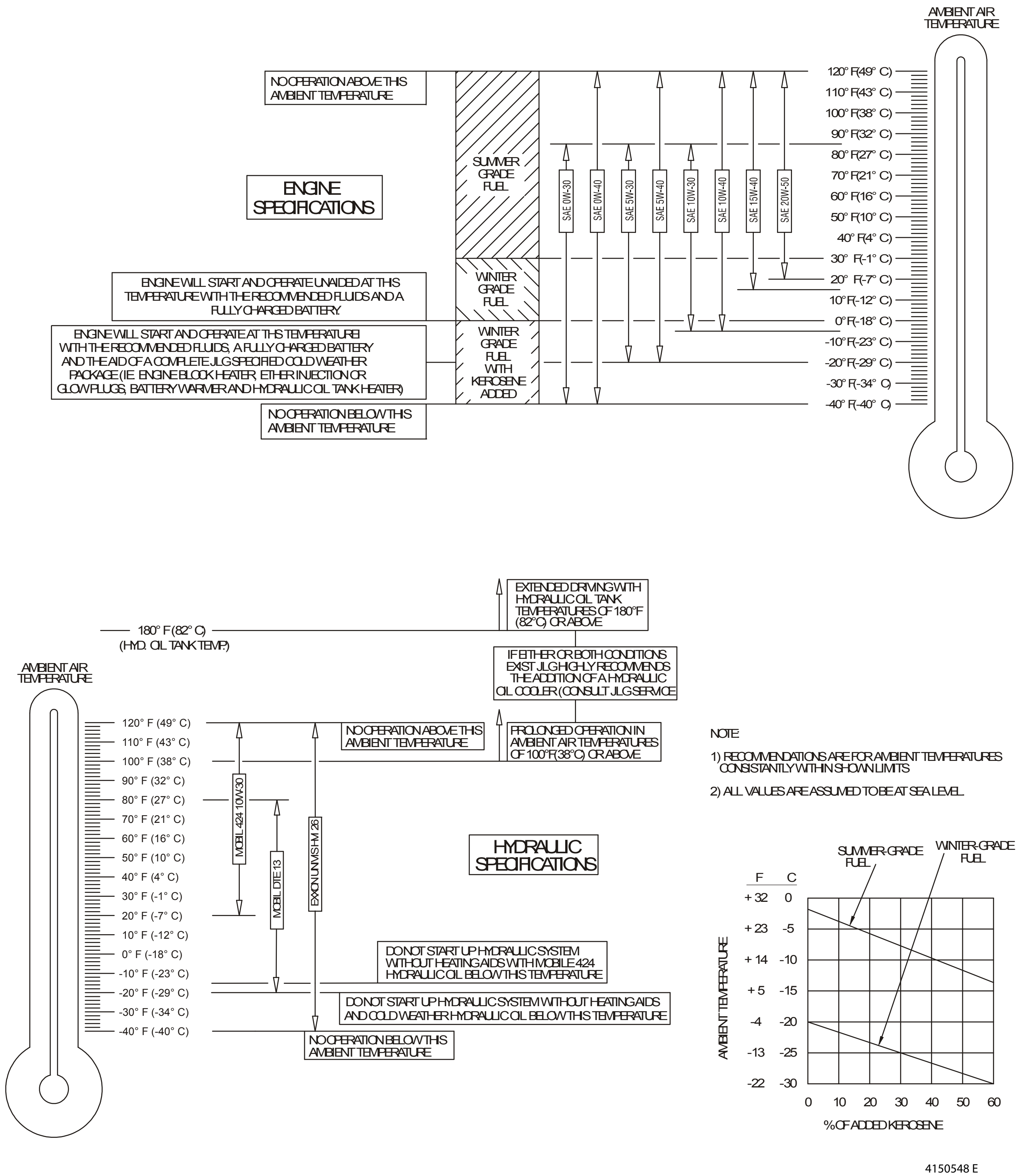


Figure 2-1. Engine Operating Temperature Specifications - Deutz

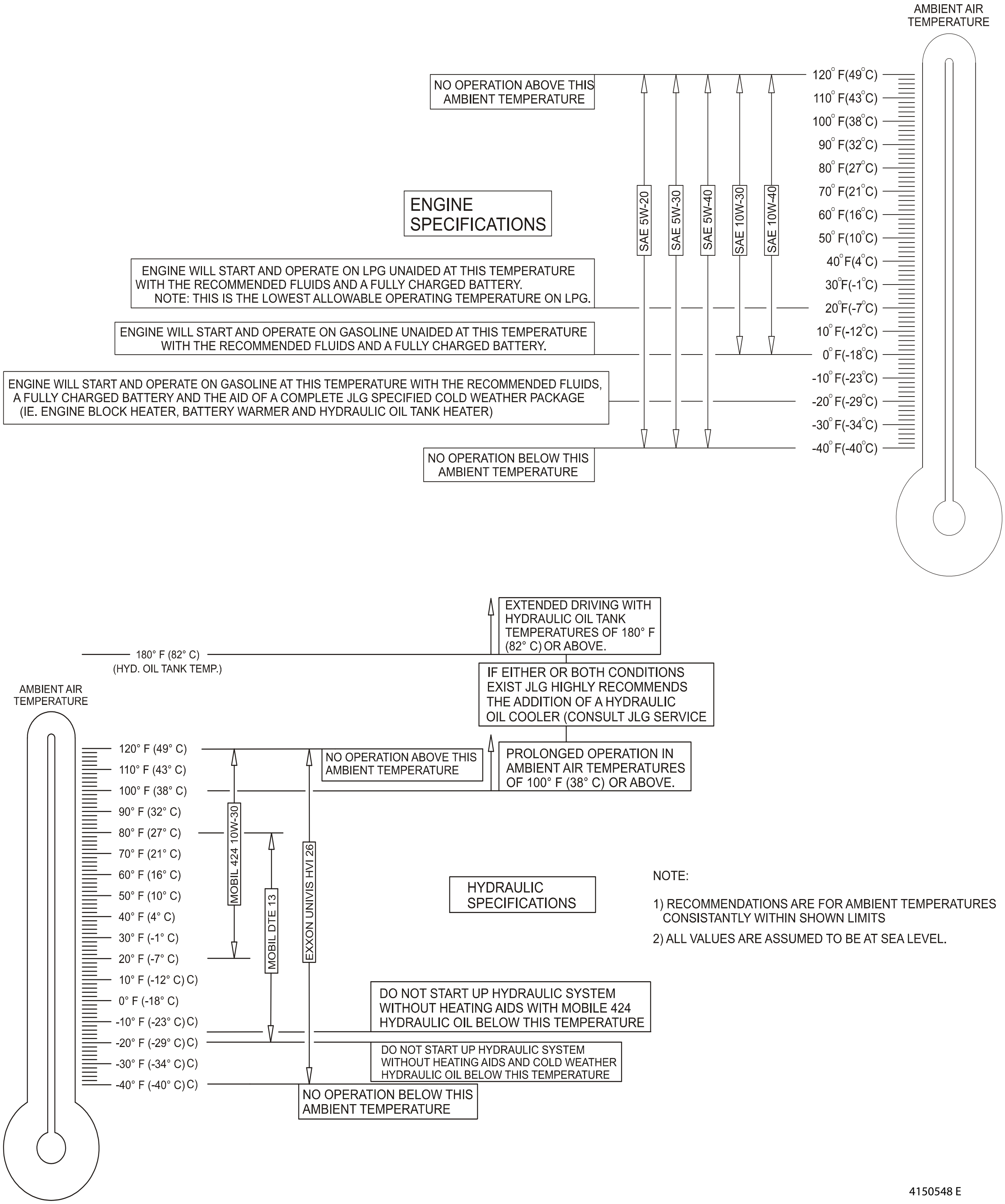


Figure 2-2. Engine Operating Temperature Specifications - Ford

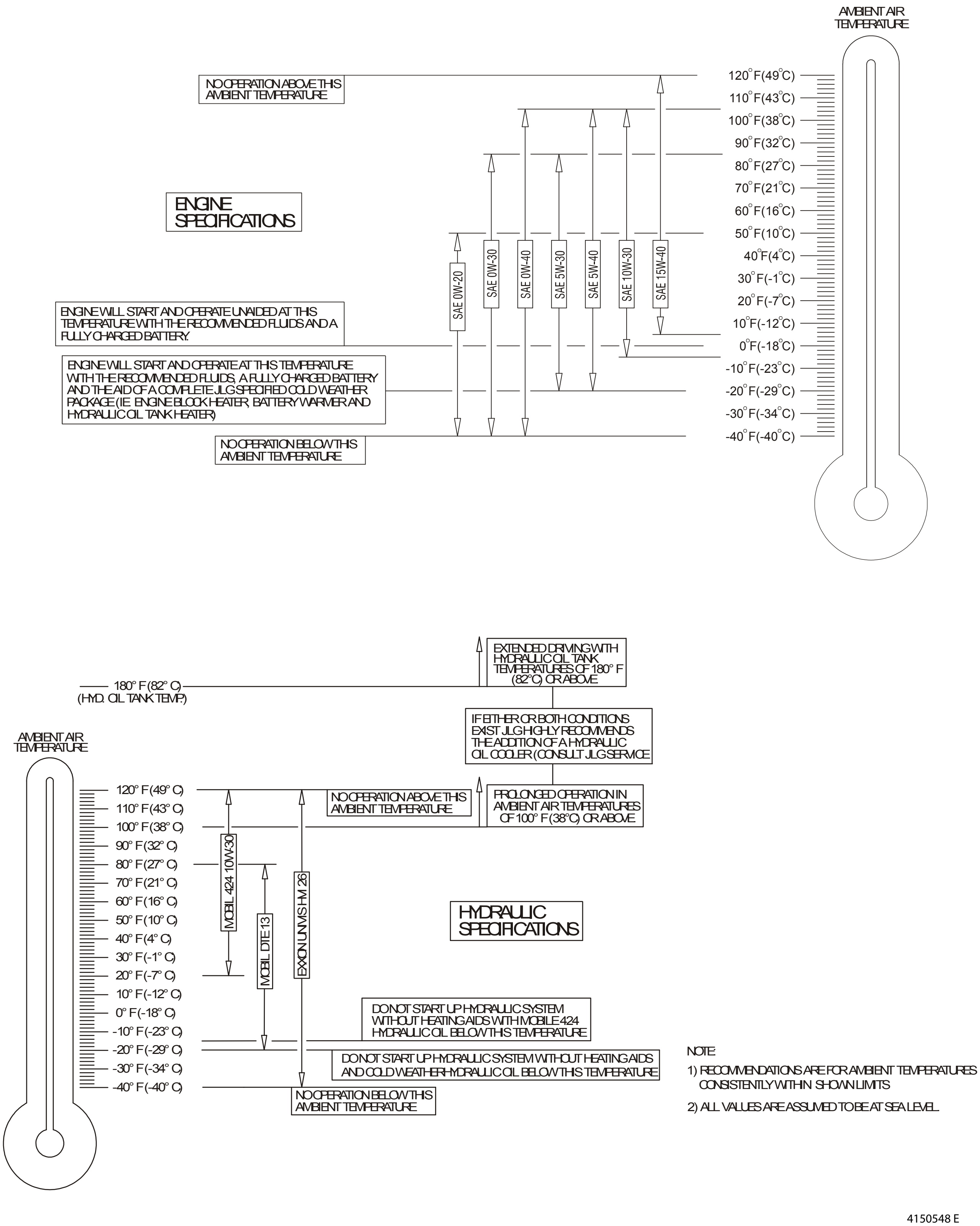


Figure 2-3. Engine Operating Temperature Specifications - Caterpillar

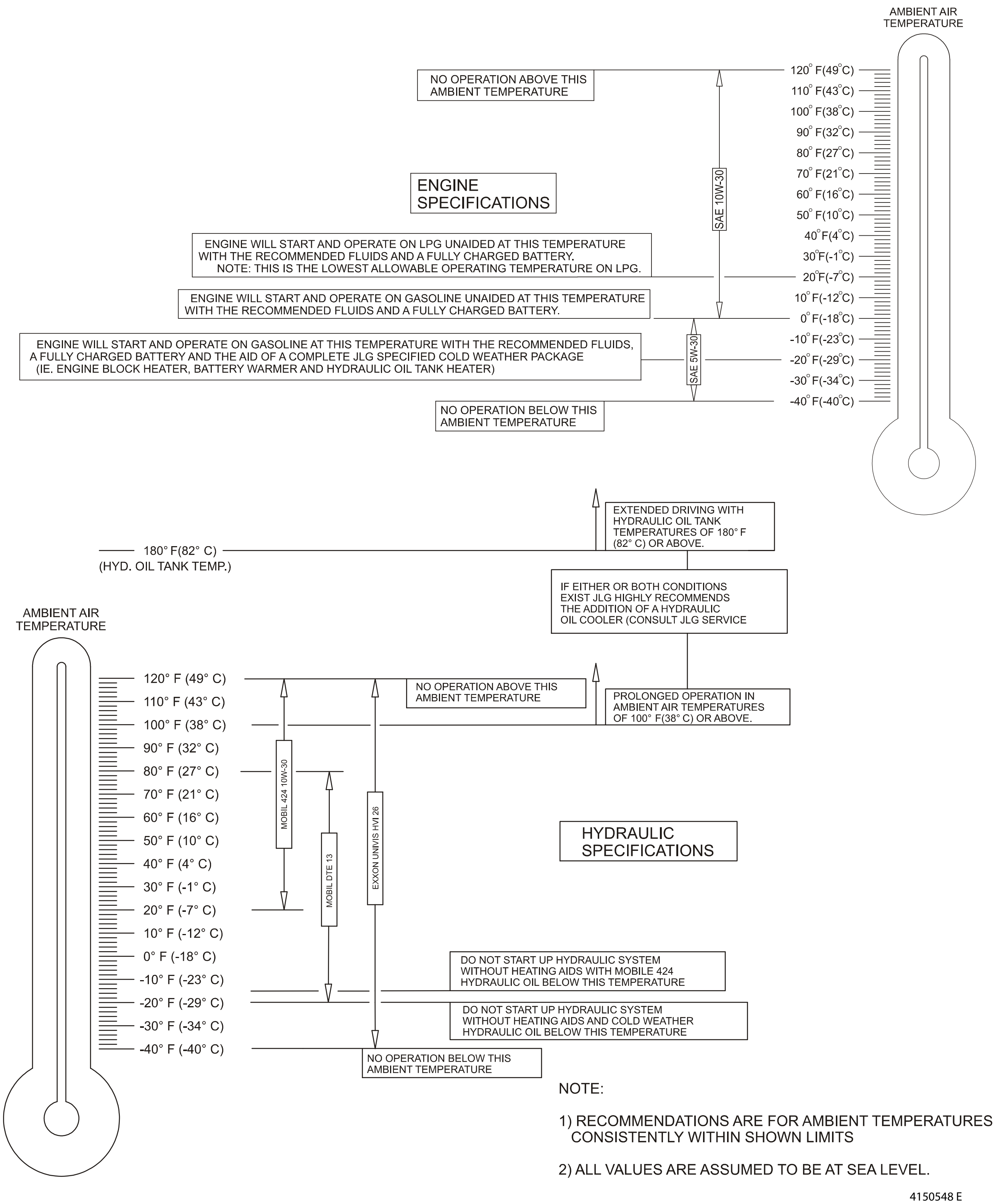


Figure 2-4. Engine Operating Temperature Specifications - GM

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

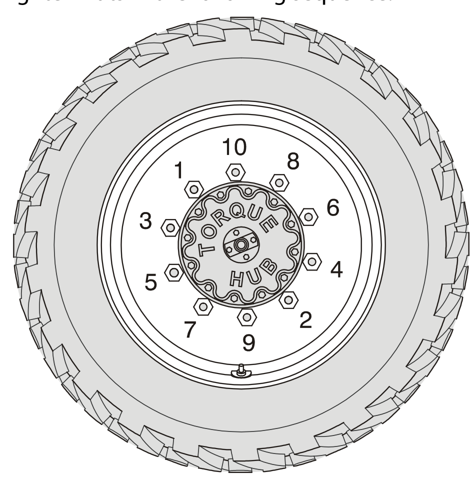
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ 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.*

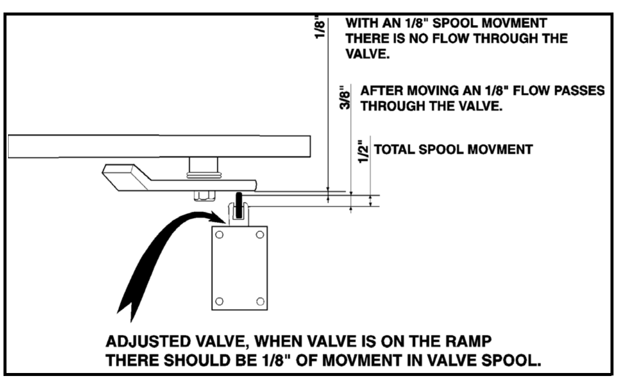


Figure 3-1. Oscillating Valve Adjustment

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.

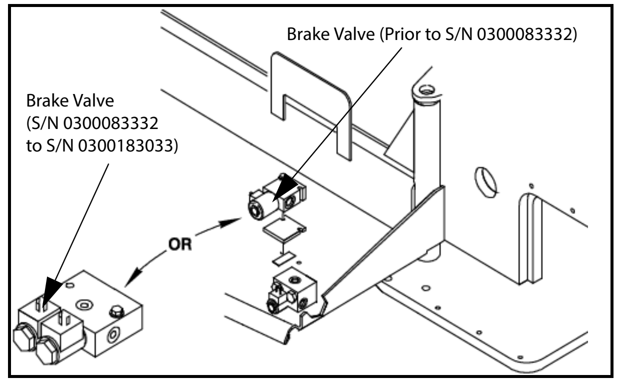


Figure 3-2. Brake Valve Wiring Connection

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.

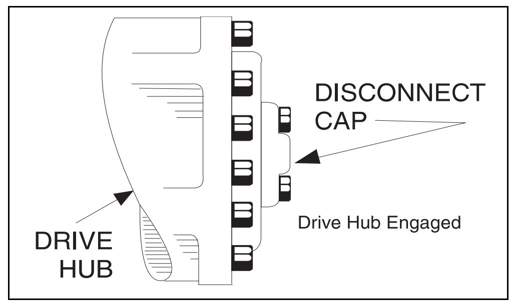
NOTE: *Ensure boom is fully retracted, lowered, and centered between drive wheels prior to beginning lockout cylinder test.*

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

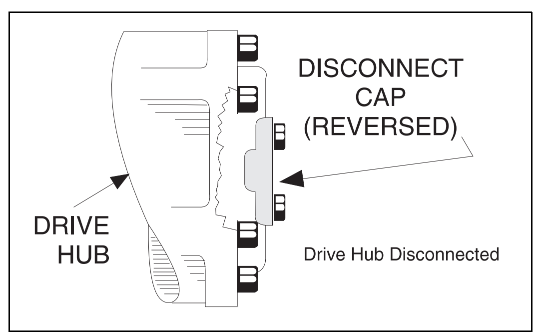
To Disengage Drive Motors and Brakes (Free Wheel) for Emergency Towing

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.

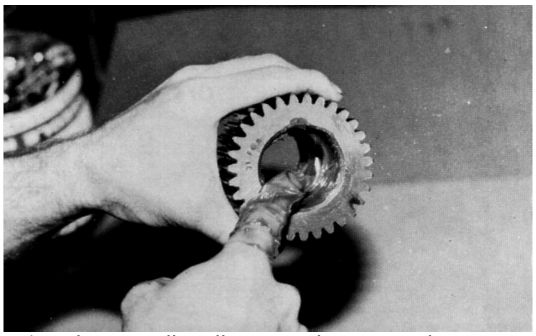
Repair

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).

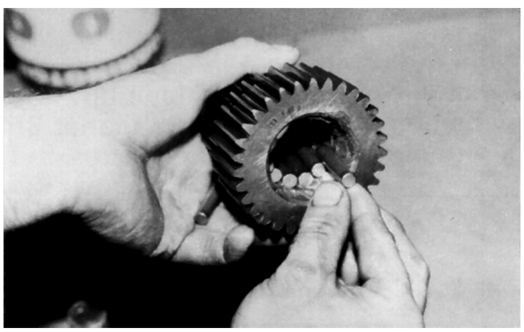
f. Repeat steps (a) through (e) for remaining two cluster gears.

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.

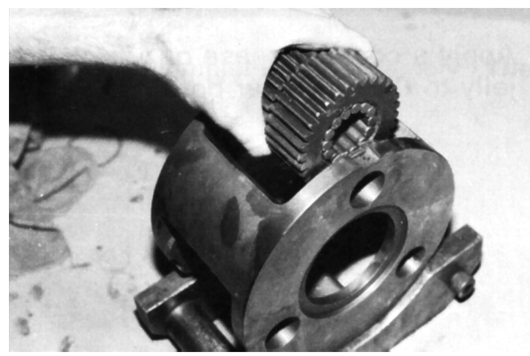


j. Place spacer into opposite side of cluster gear and against needle rollers.

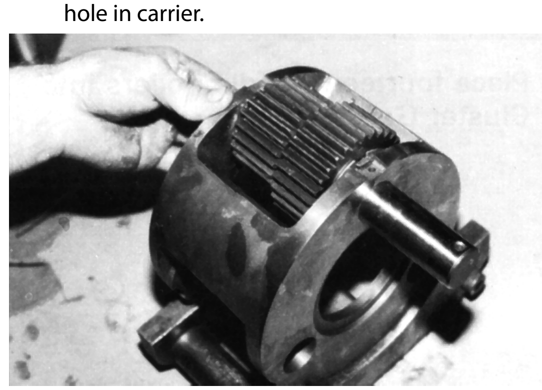
k. Place second set of needle rollers into cluster gear.

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.

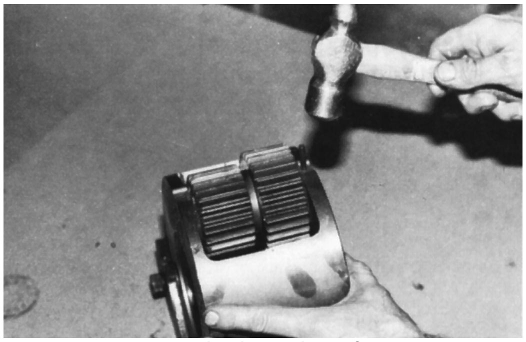
m. While keeping thrust washers in place, slide cluster gear into carrier with larger gear on side with small pin hole.



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.

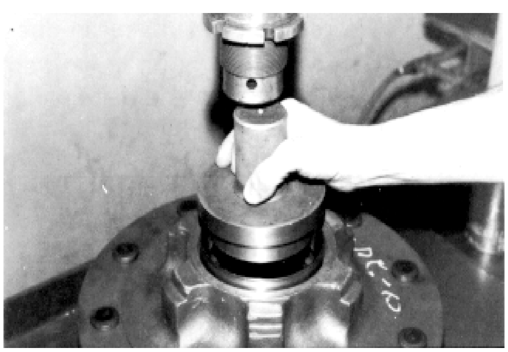
b. Remove two washers (31) and spring (32) from input shaft.

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

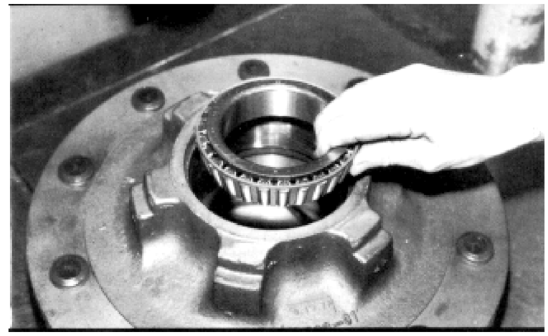
d. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.

Assembly

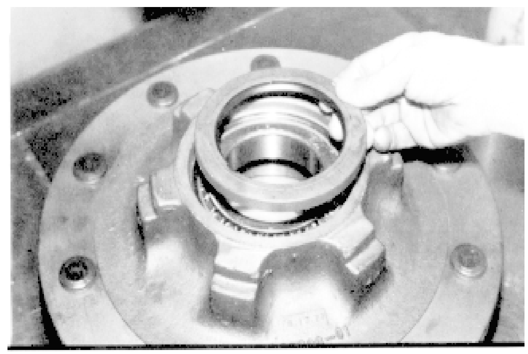
1. Using a suitable press, press new bearing cups (3, 5), with large inside diameters facing out, into hub (7) counterbores.



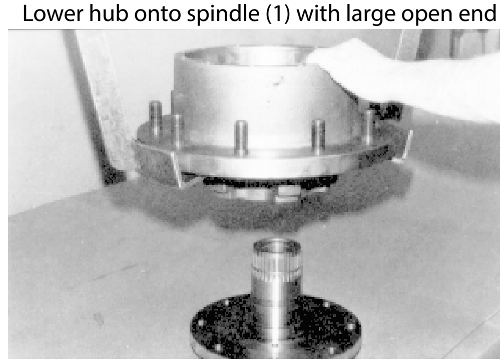
2. Place bearing cone (4) into bearing cup (3) in small end of hub.



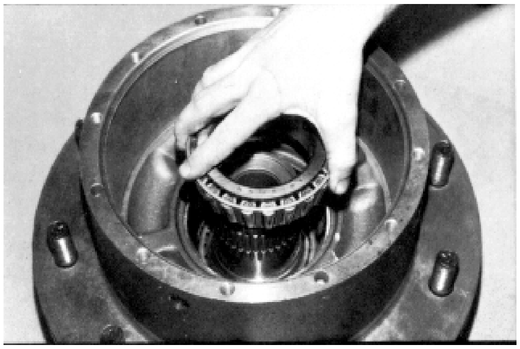
3. Press new seal (2) into hub counterbore with flat metal side facing in. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.



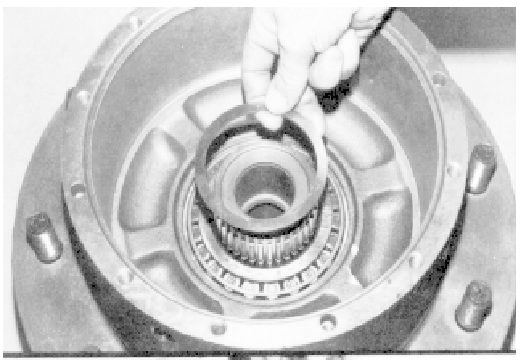
4. Lower hub onto spindle (1) with large open end up.



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



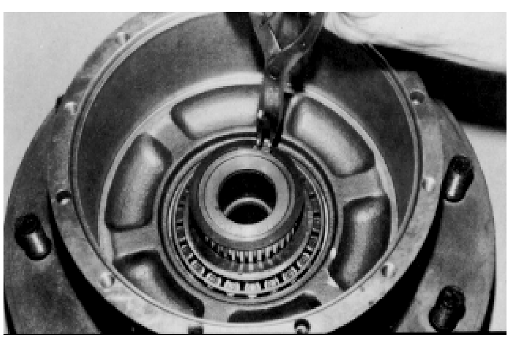
6. Place bearing shim (8) over end of spindle and against bearing cone.



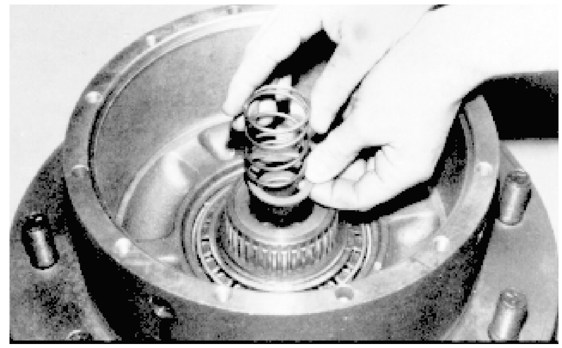
CAUTION

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.

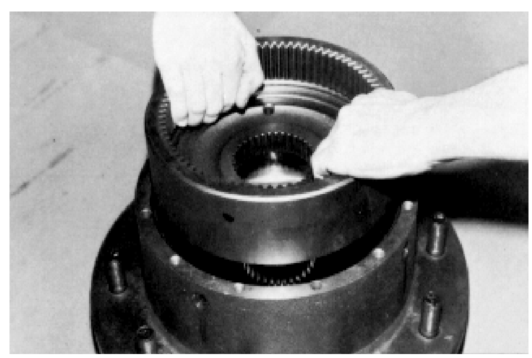


8. The disengage spacer and spring are installed into the counterbore of the spindle.

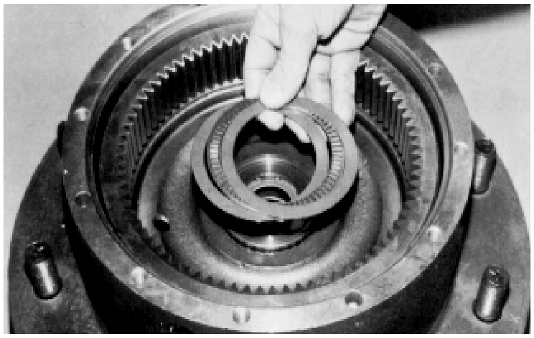


9. Install retaining ring into input shaft groove to secure spacers and spring to shaft.

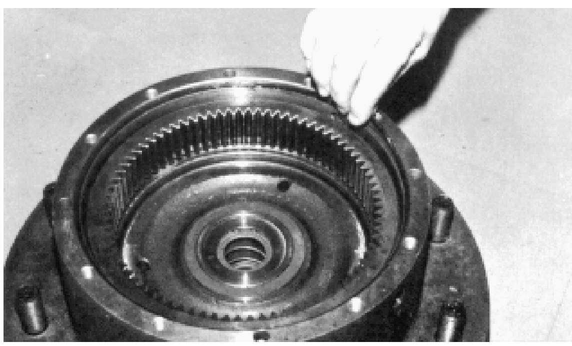
10. Place the internal gear (12) onto end of spindle by matching the bore spline, the spindle spline.



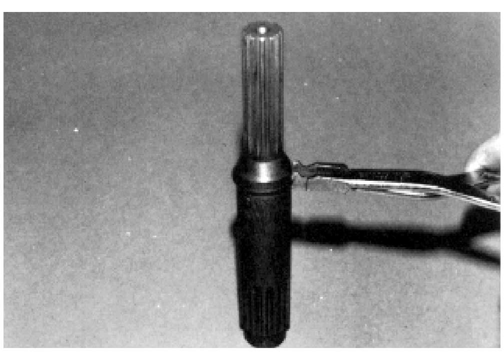
11. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.



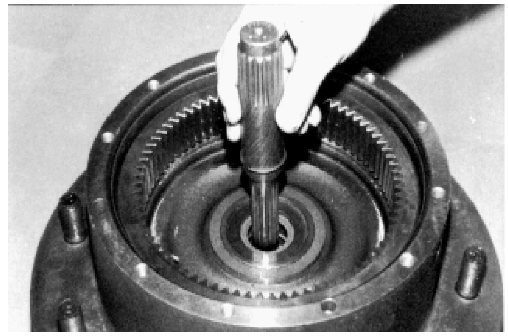
12. The o-ring is placed into the counterbore provided in the hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.



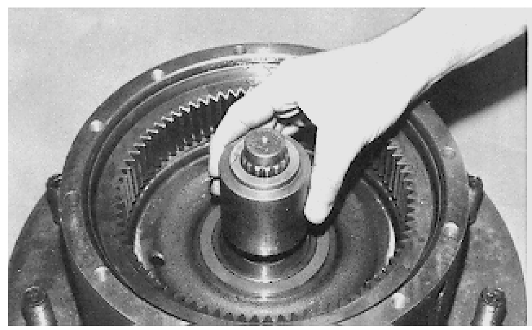
13. Install retaining ring (34) into input shaft retaining ring groove.



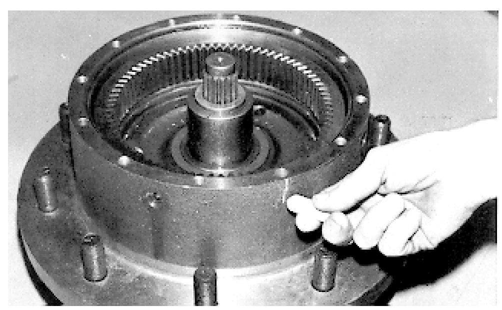
14. Place input shaft assembly (35) into spindle bore with unsplined end facing out.
The action of the spring should be checked at this point.



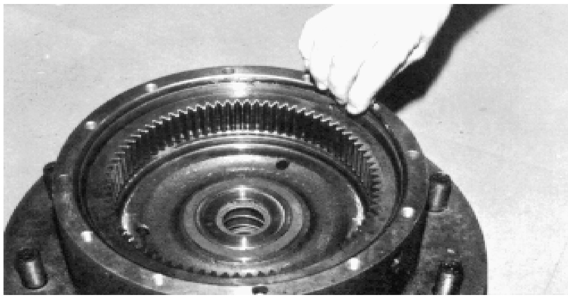
15. Place thrust spacer (36) over input shaft (35) with counterbore side facing spindle.



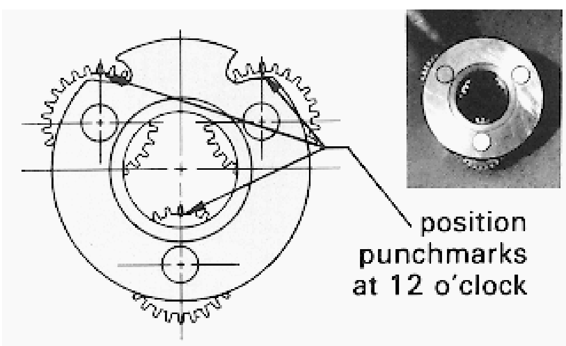
16. Locate the four counter reamed holes in the face of the hub, mark them for later identification.



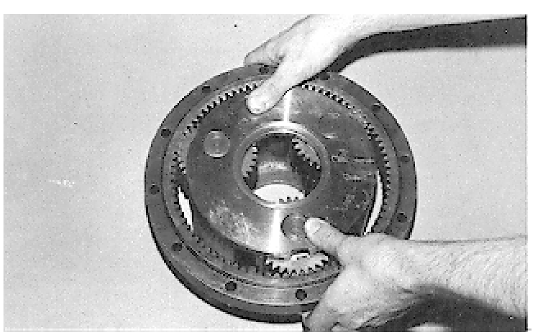
17. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.



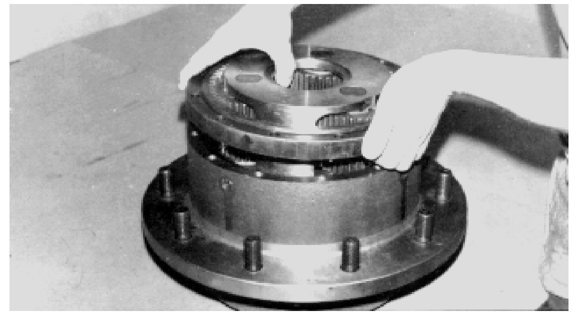
18. Place carrier assembly on a flat surface with large gears up and positioned as shown. Find punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin. Marked tooth will be located just under carrier on upper two gears.



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.

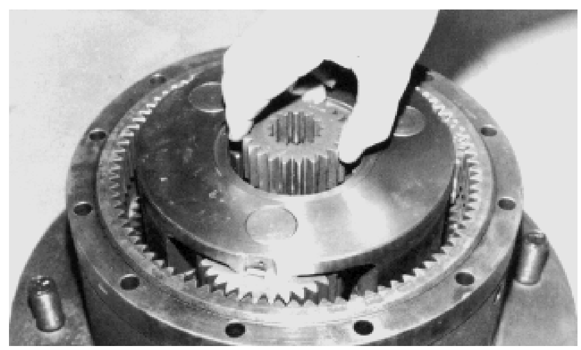


20. While holding ring gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked 'X' over one of the marked counterbored holes in hub.

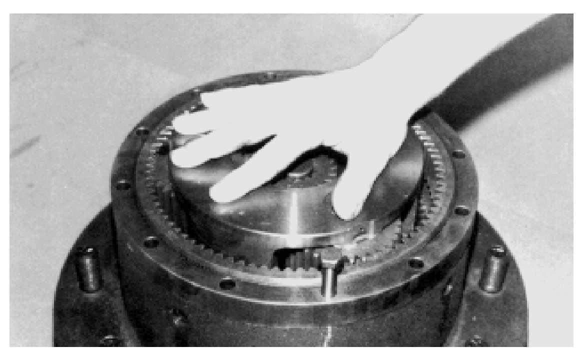


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster gear timing.*

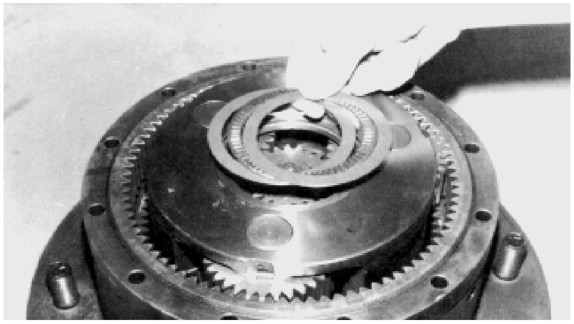
21. Install input gear (37) into the carrier assembly, meshing with large diameter cluster gears (18). Counterbore in bore of input gear must be to outside of carrier assembly.



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.

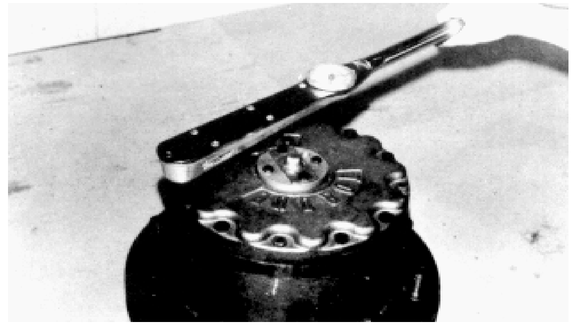


24. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place.

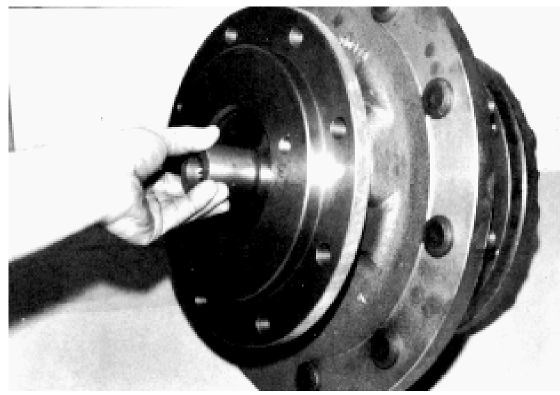
25. Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.

26. Locate four bolts (42), 90 degrees apart into counter-bored 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

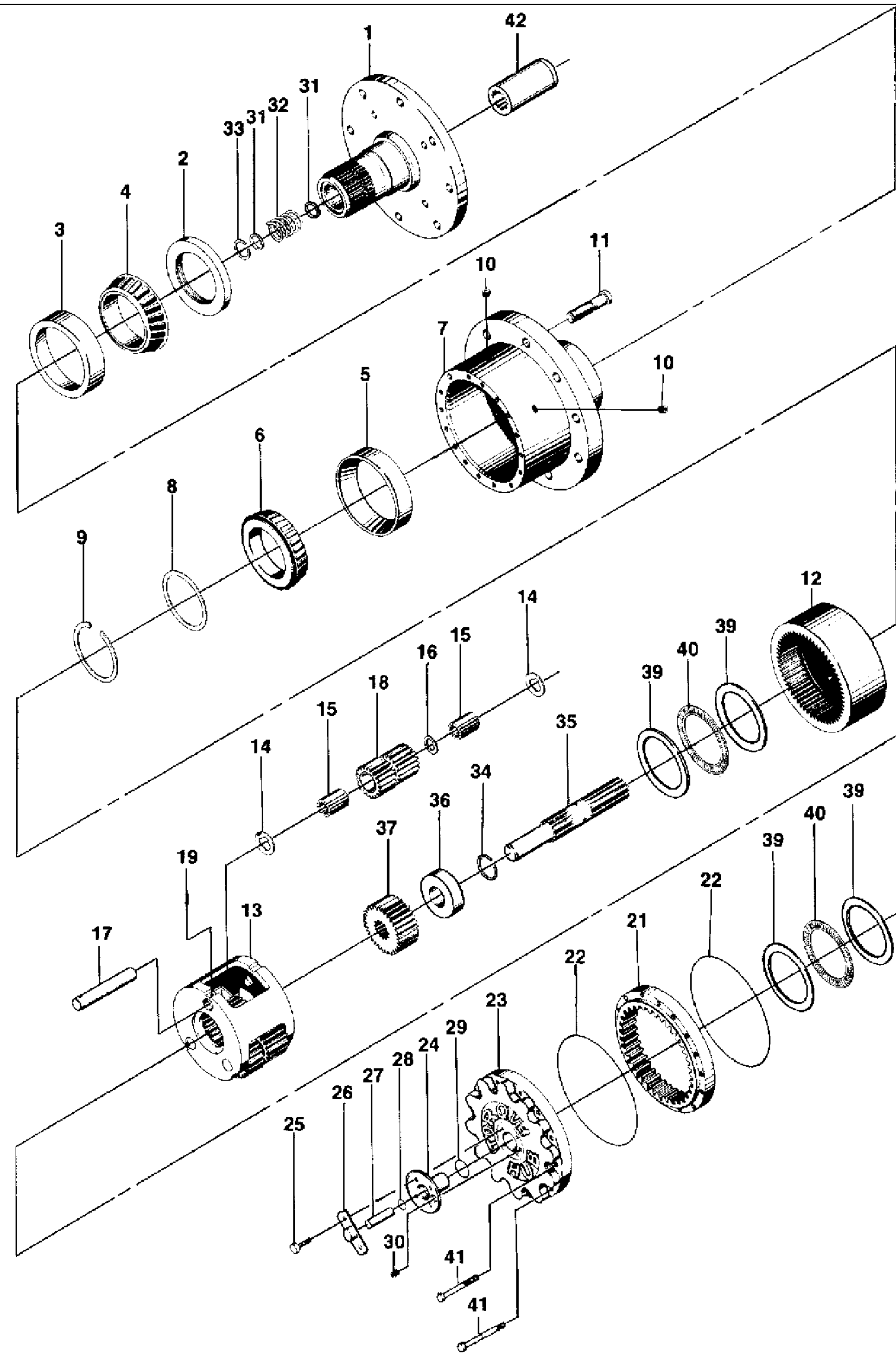


Figure 3-3. Torque Hub Drive (Fairfield)

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

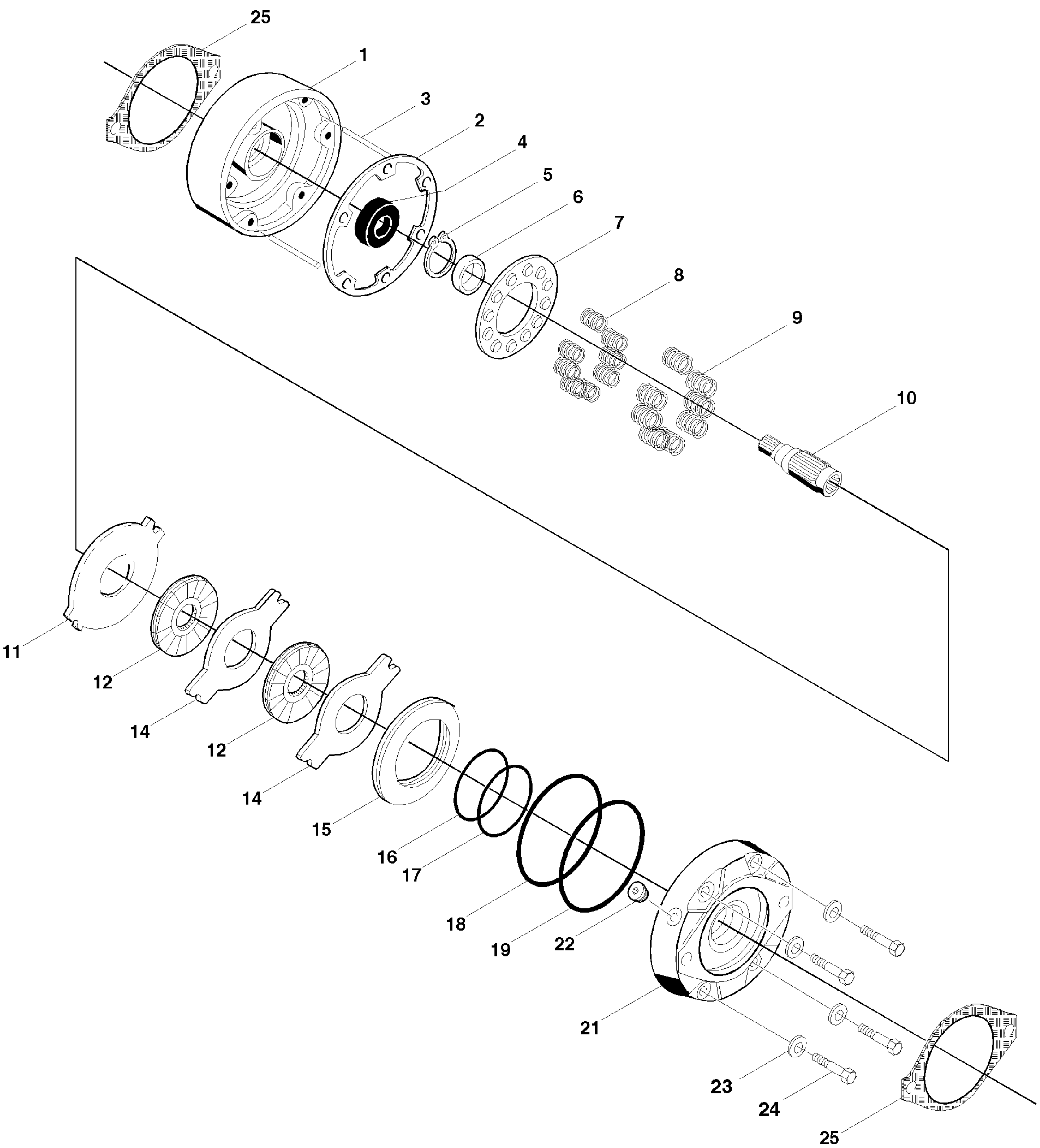
THERE MAY BE MORE PARTS IN A SERVICE KIT THAN YOUR BRAKE REQUIRES. CHECK THE PARTS LIST CAREFULLY FOR THE EXACT QUANTITY. IN THE CASE OF SPRINGS, SPACE THE SPRINGS AS SHOWN IN FIGURE 3-4.

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.

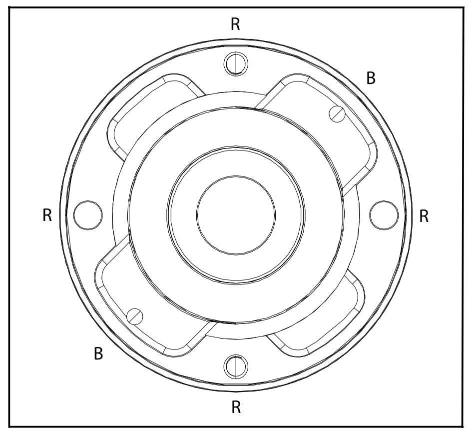
NOTE: *Cover plate (16) must be supported as indicated in Figure 3-5.*

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).

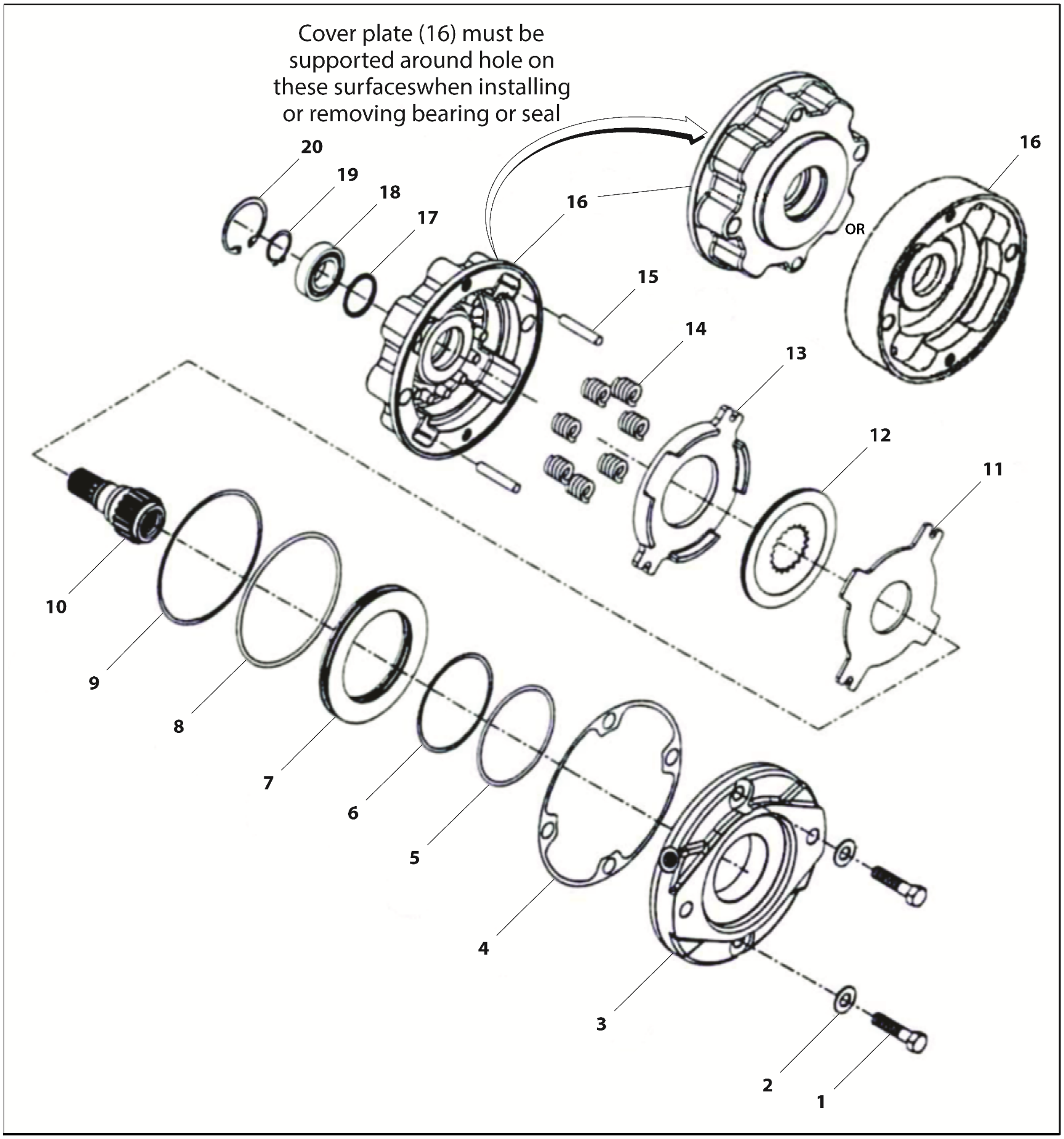
NOTE: *Be careful not to shear o-rings or back-up rings. Be careful not to scratch or mar piston.*

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.

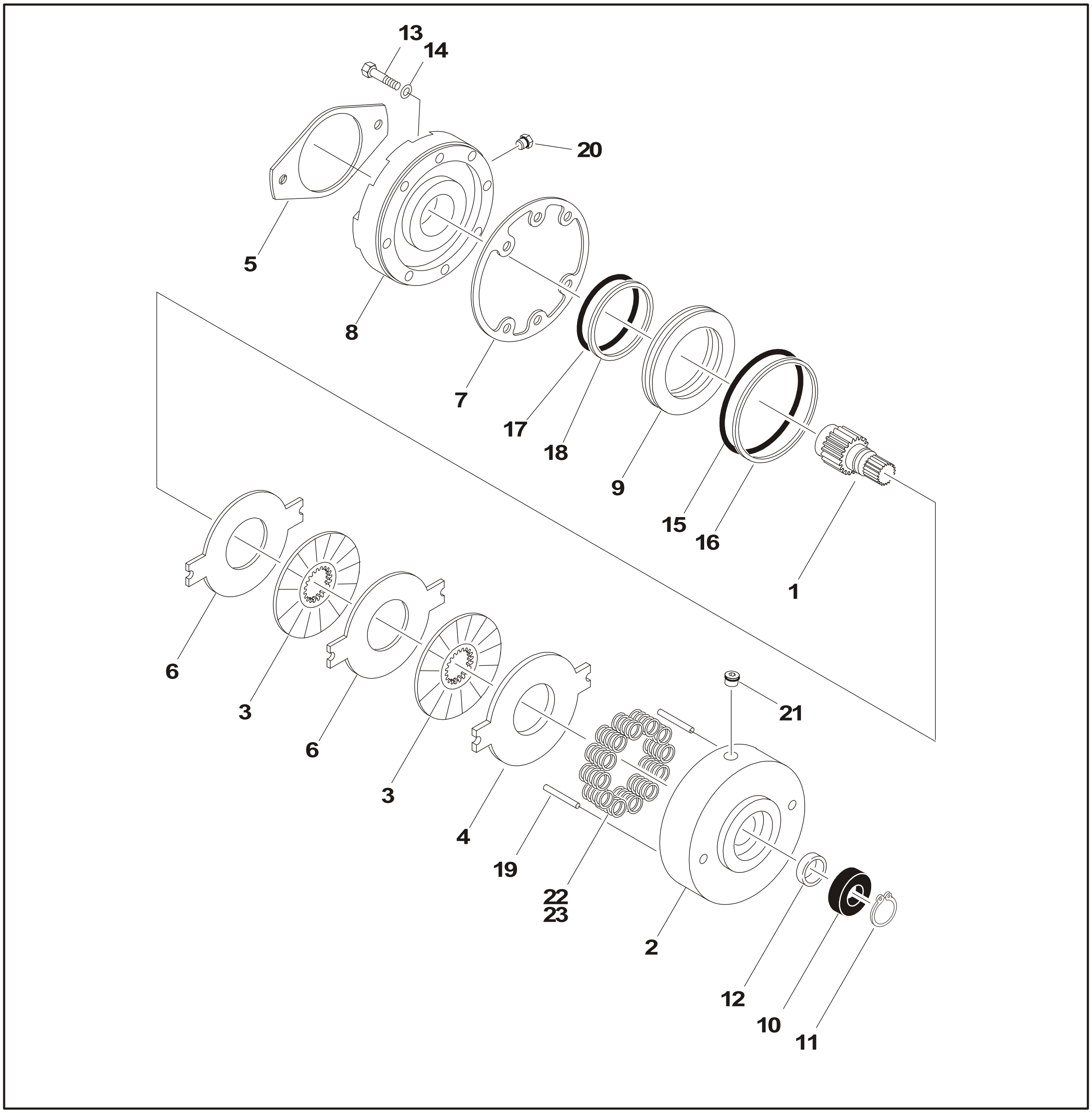
Assembly

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).*



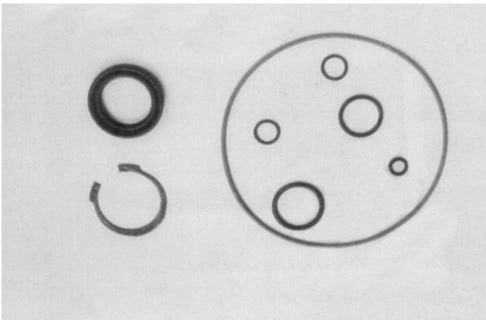
1. Shaft	6. Outer Plate	11. Retaining Ring	16. Backup Ring	21. Plug
2. Housing	7. Gasket	12. Shaft Seal	17. O-ring	22. Spring (Natural)
3. Friction Plate	8. Cylinder	13. Capscrew	18. Backup Ring	23. Spring (Blue)
4. Pressure Plate	9. Piston	14. Lockwasher	19. Dowel Pin	
5. Gasket	10. Ball Bearing	15.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

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

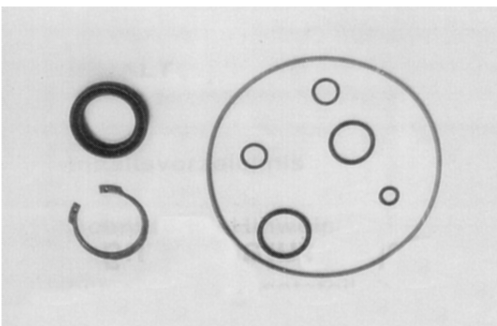
3.8 DRIVE MOTOR (PRIOR TO S/N 0300083332)

Spare Parts Kits

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

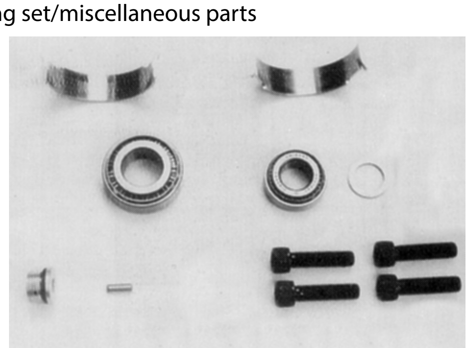


Same sealing kit like shown above only seal material changed to Viton

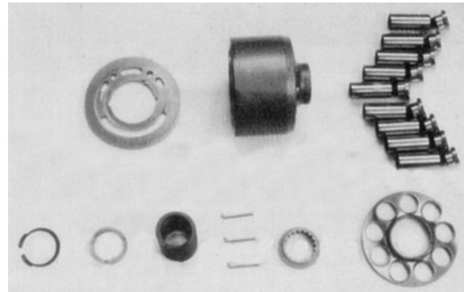


Drive shaft

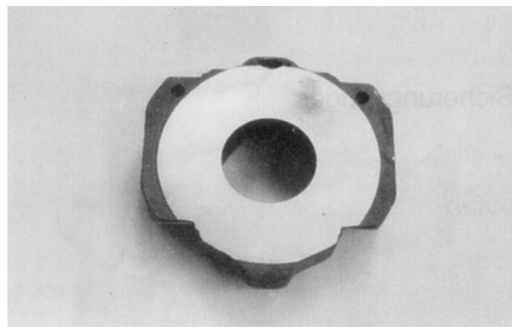
Bearing set/miscellaneous parts



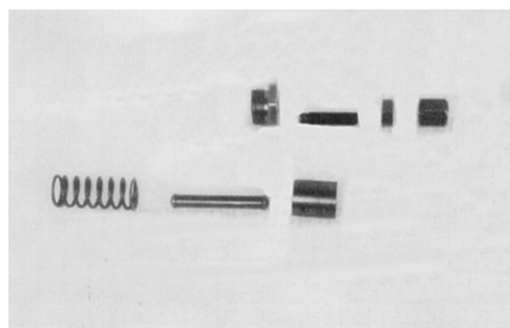
Rotary group complete 9 pistons, cylinder sub-assembly, valve plate (cw or ccw corresponding to the order) retaining plate and retaining ball.



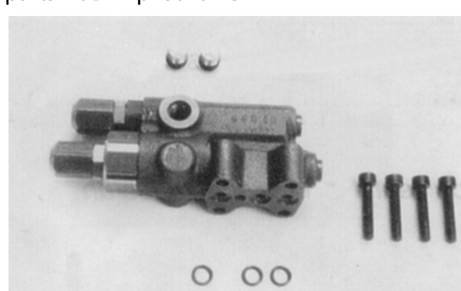
Swash Plate



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



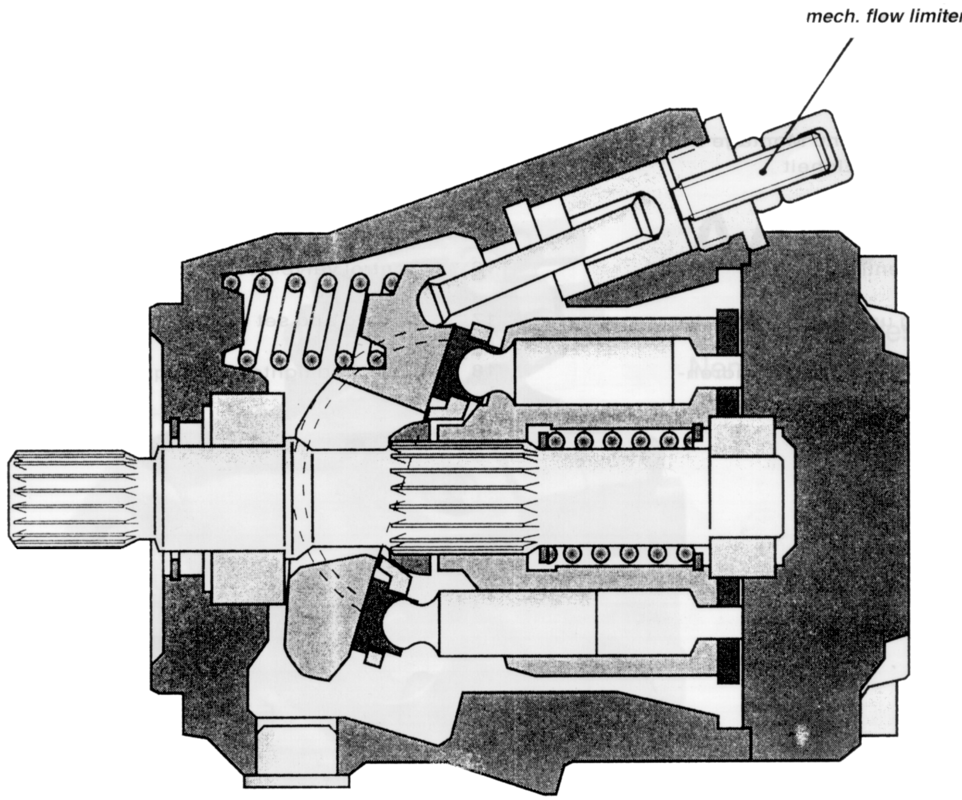
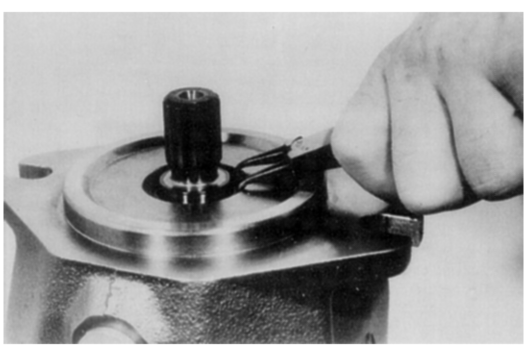


Figure 3-7. Drive Motor Cutaway

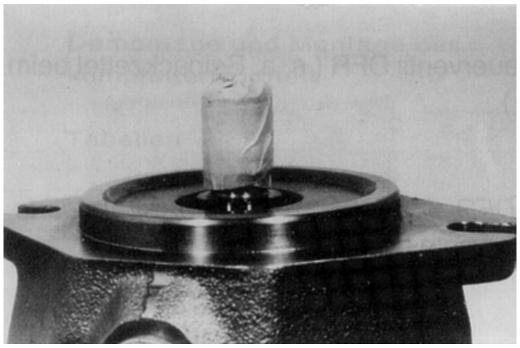
Replacing the Drive Shaft Seal

1. Remove the snap ring

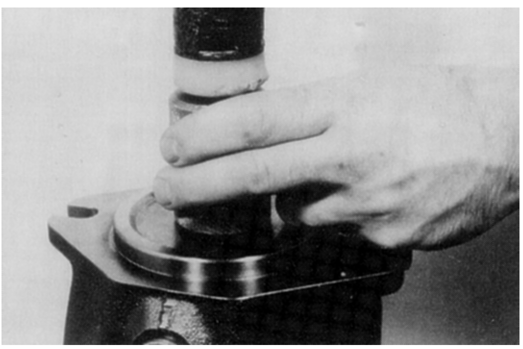


2. Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.

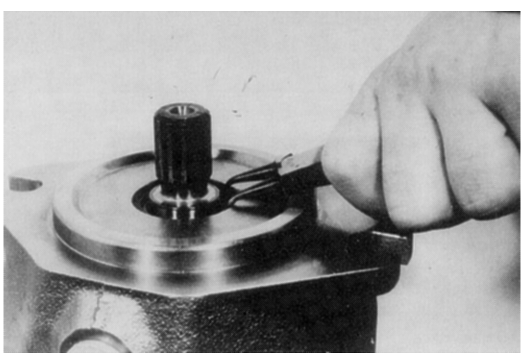
3. Be careful while you seal the drive shaft, use an adhesive tape to protect the splines.



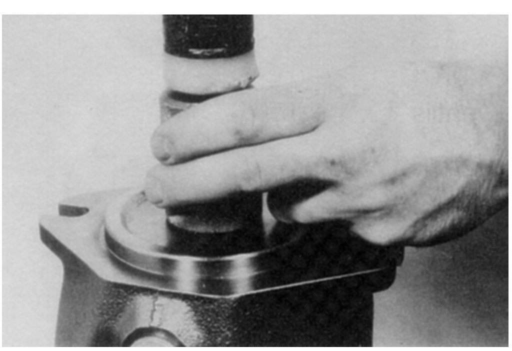
4. Assemble the sealing ring. The fitting tool will hold the sealing ring in the correct position in the pump housing.



5. Assemble the snap ring.

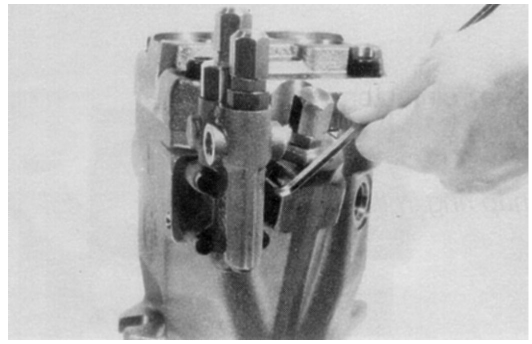


6. Assemble the snap ring in the correct position.

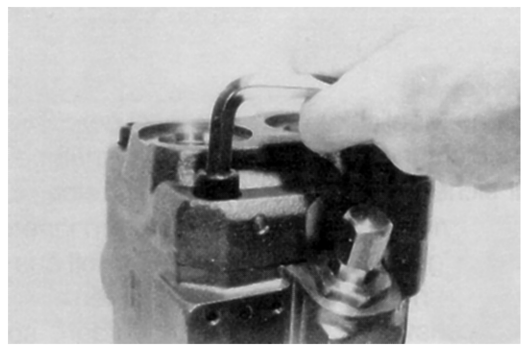


Disassembly and Assembly

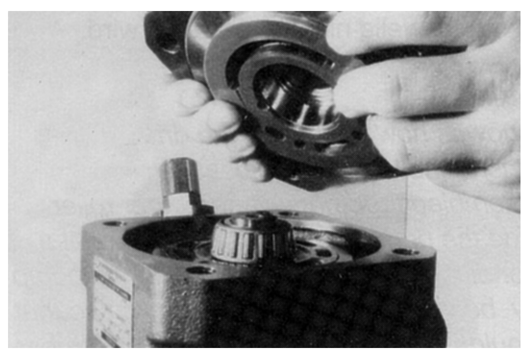
1. Disassemble the pilot valve.



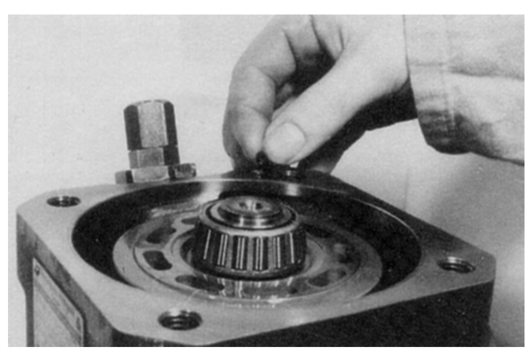
2. Mark the position of the port plate and remove the socket screw from the port plate.



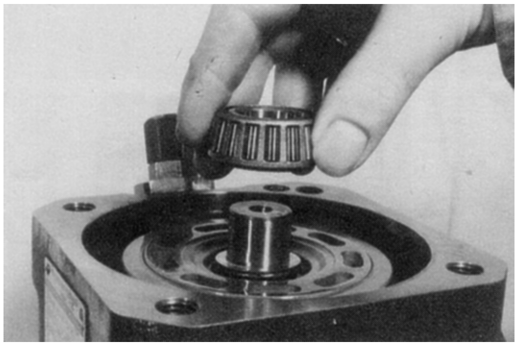
3. Remove the port plate together with the valve plate (hold the valve plate so that the plate can't fall down).



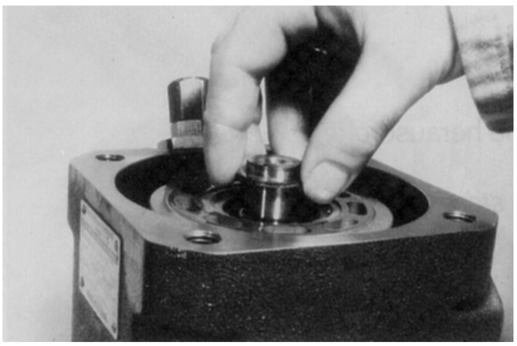
4. Remove the O-ring.



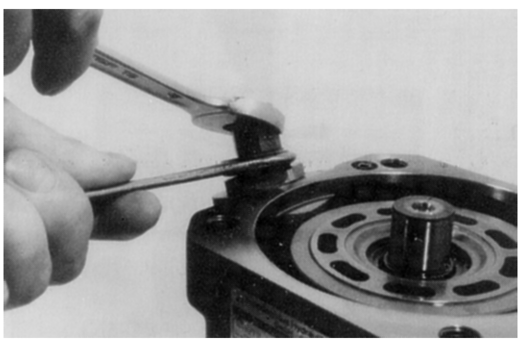
5. Disassemble the taper roller bearing.



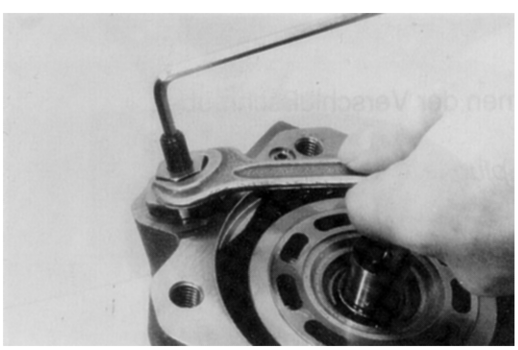
6. Remove the adjustment shim.



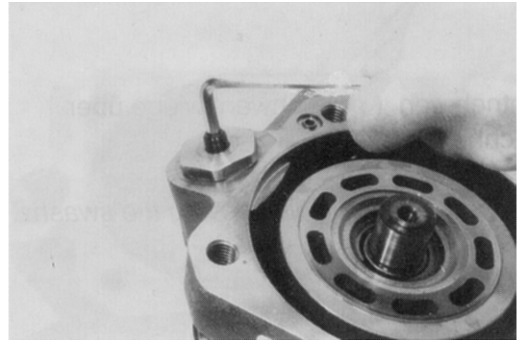
7. Unscrew the cap nut and remove it.



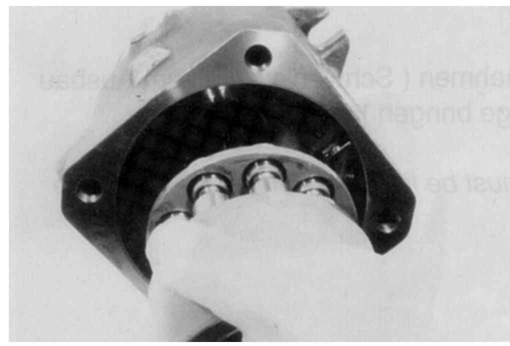
8. Loosen the retaining nut of the stopper max flow and remove it.



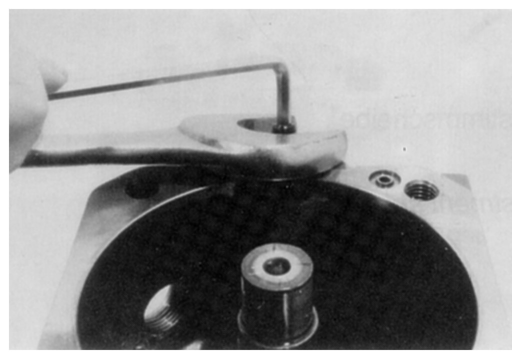
9. Turn in the stopper max flow to get swivel angle zero.



10. Disassemble the rotary group in horizontal position.



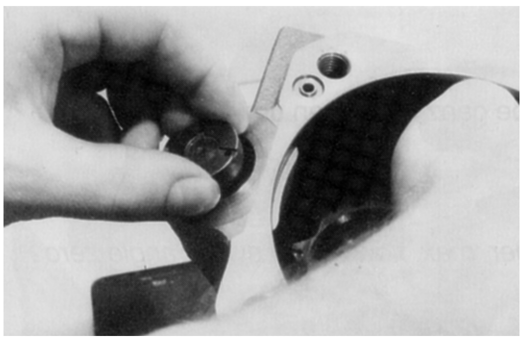
11. Disassemble the stopper - max. flow.



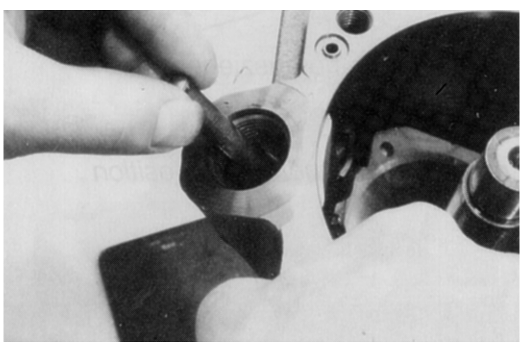
12. Remove the threaded pin (stopper - max.flow)

13. Disassemble the plug.

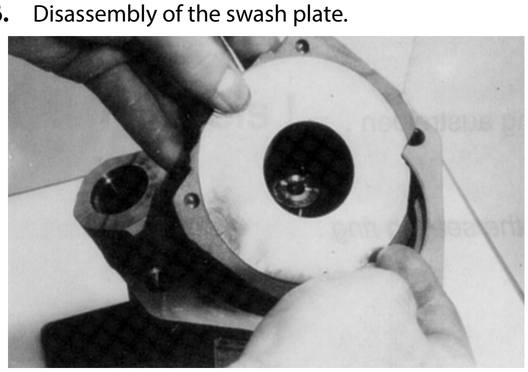
14. Disassemble the control piston while moving the swash plate.



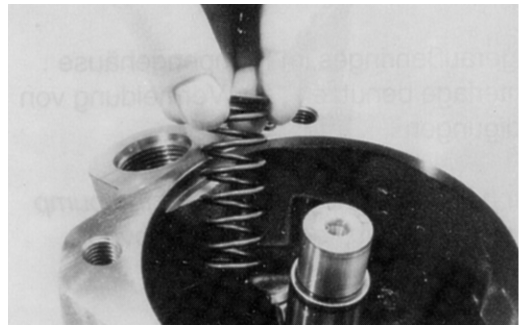
15. The swash plate must be lifted a little bit to disassemble the piston rod.



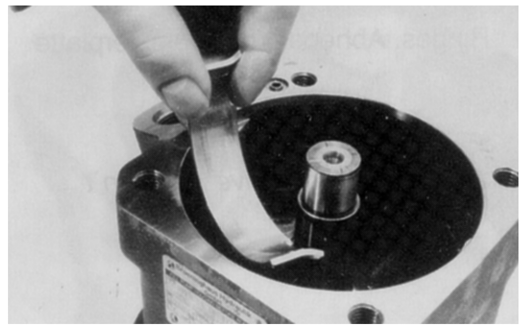
16. Disassembly of the swash plate.



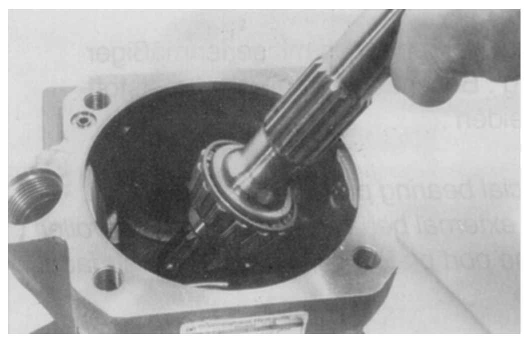
17. Remove the spring.



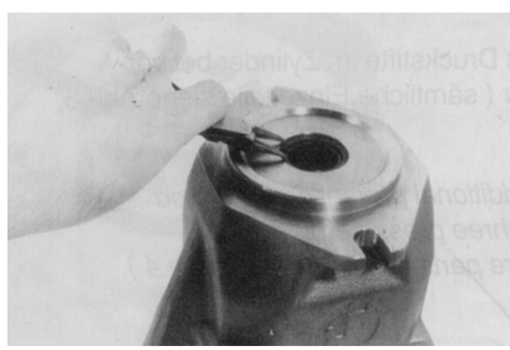
18. Remove both bearing shells.



19. Remove the drive shaft.

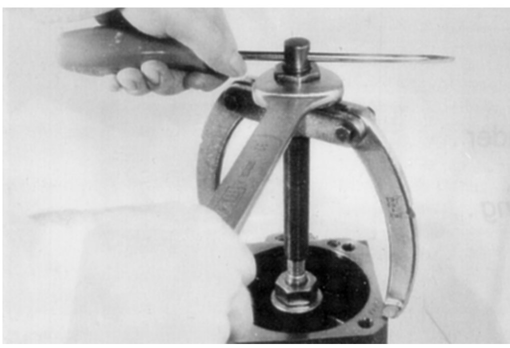


20. Remove the snap ring.

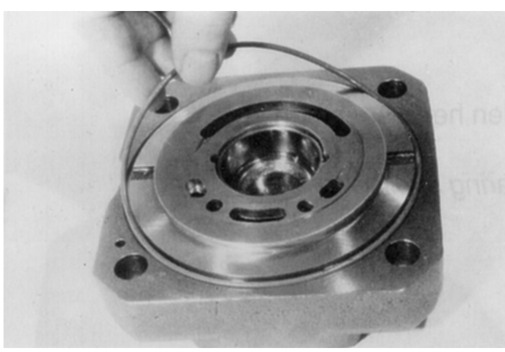


21. Disassemble the sealing ring.

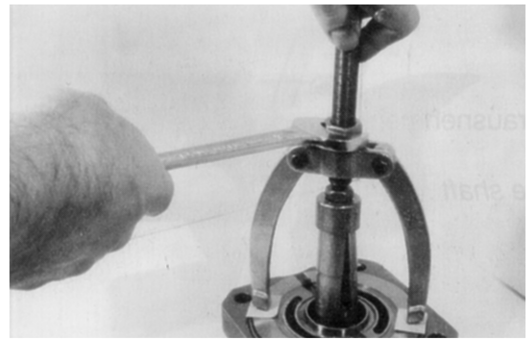
22. The external front bearing ring is pulled out of the pump housing.



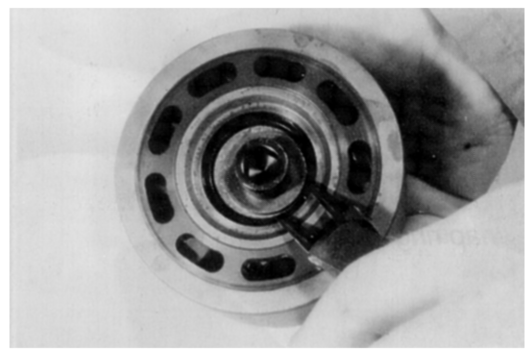
23. Remove the O-ring. Lifting of the valve plate isn't shown.



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.

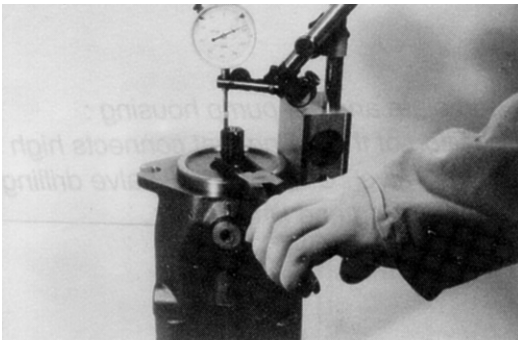


25. The spring has additional pretension while you disassemble the three pressure pins inside the cylinder.

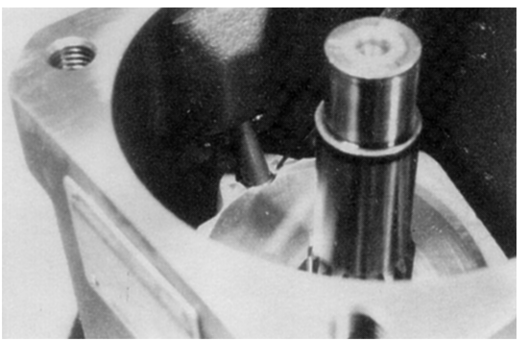


Assembly Notes

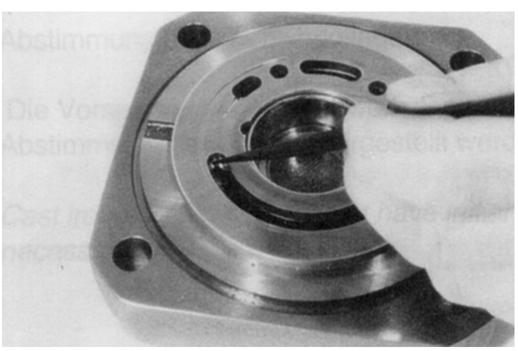
1. Measurement of the taper roller bearing pretension.



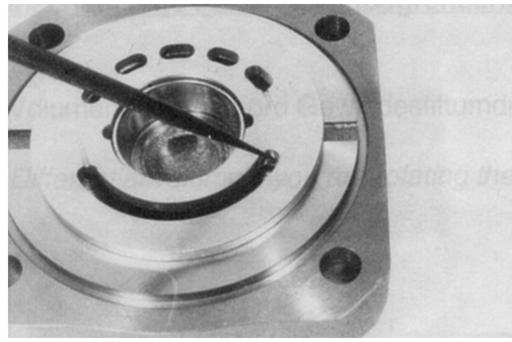
2. Note that there is a correct connection of the piston rod and the swash plate.



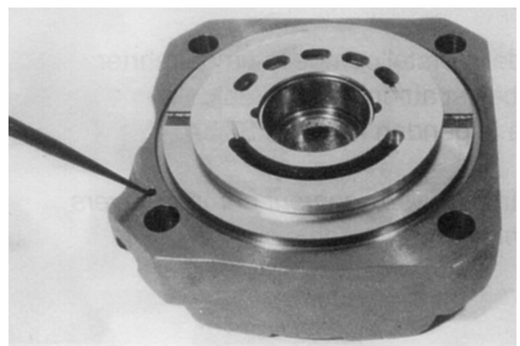
3. Pumps clockwise driven must have a position to the valve plate 4 degrees out of center in the same direction de-centered like drive direction. (Note spare parts exist as cw and ccw valve plates.)



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

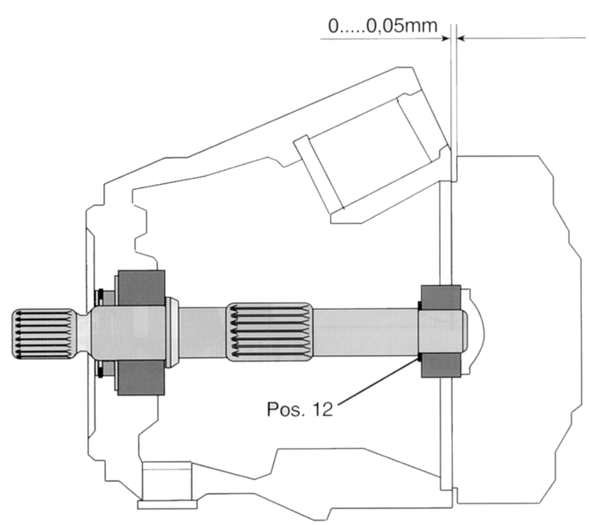


5. Assembly of the port plate and the pump housing: Note the correct position of the drilling that connects high pressure to the control valve. Check control valve drill position at the pump housing and fit together.

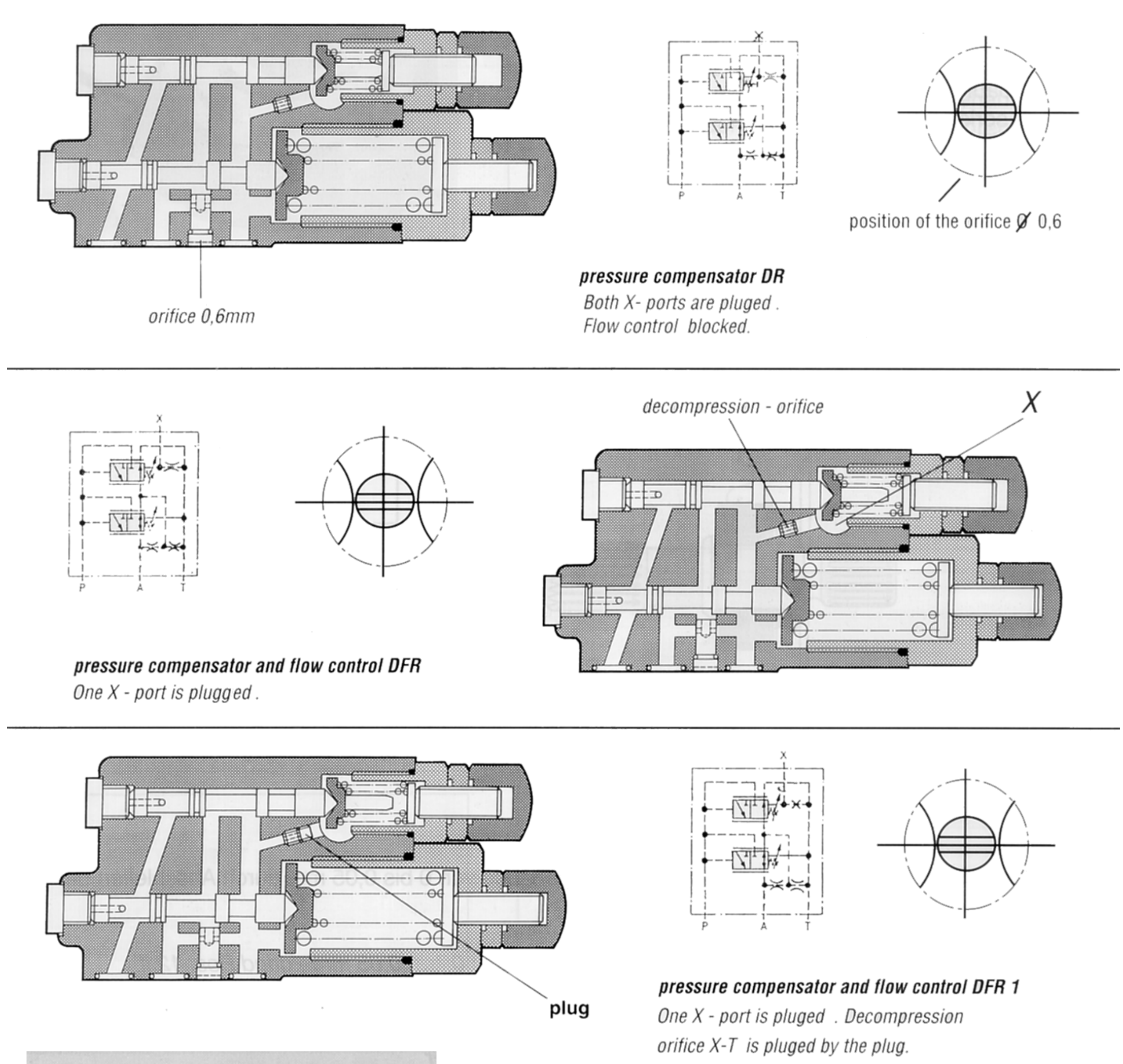


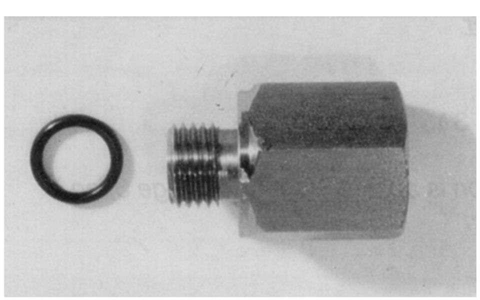
Taper Roller Bearing Initial Tension

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").





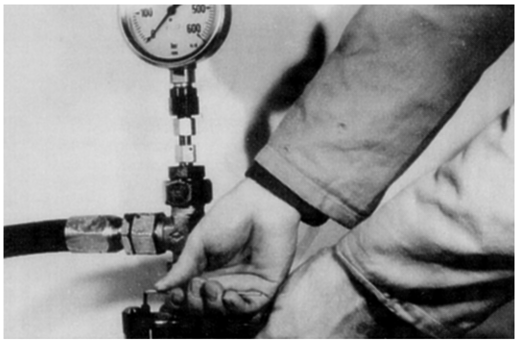
Adapter without orifice of the DFR-pilot valve , if you use a metric pilot pipe connection X .

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

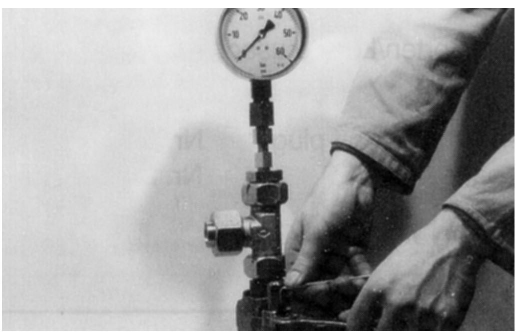
Figure 3-8. Flow Control Pilot Valves

Testing and Setup

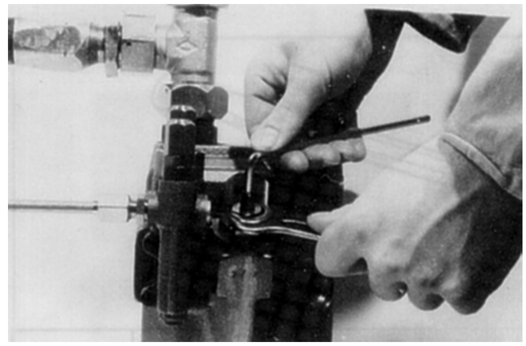
DR: When pressure line is closed adjust the pressure of the controller (if it's DFR design then open the adjustable orifice and increase force of the spring - FR -).



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



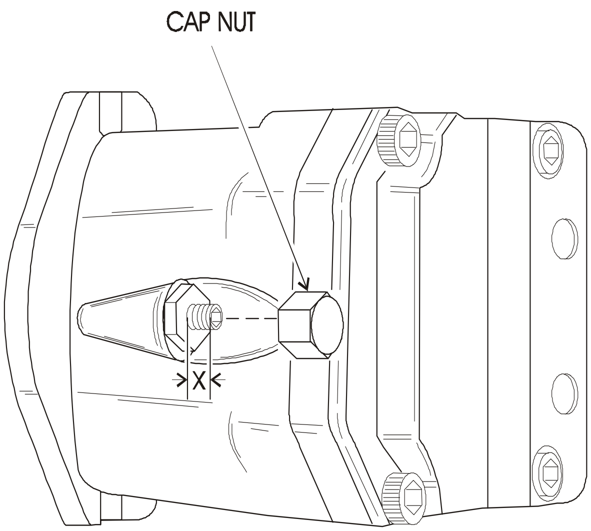
Mechanical flow limiter: While screwing in the threaded pin you will be able to reduce the flow from Vg max to 50% of Vg max.



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.

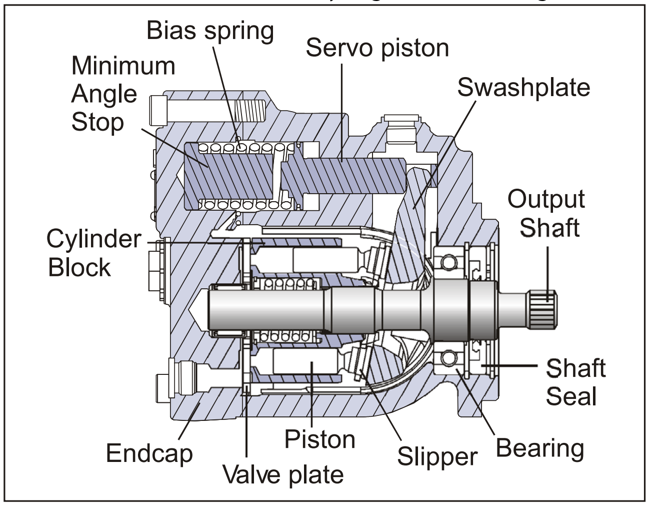
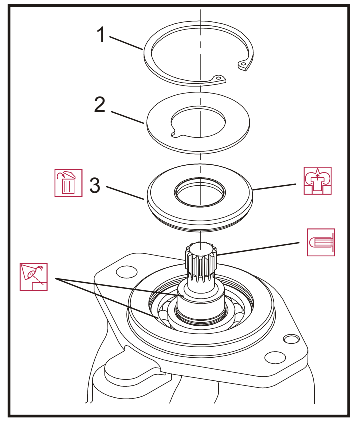


Figure 3-10. Drive Motor Cross Section

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.

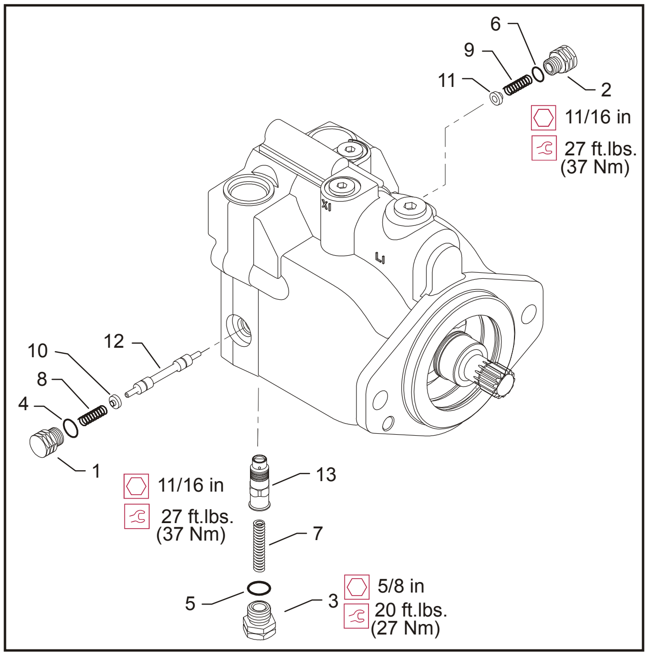
INSTALLATION

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
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 3-12. 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.

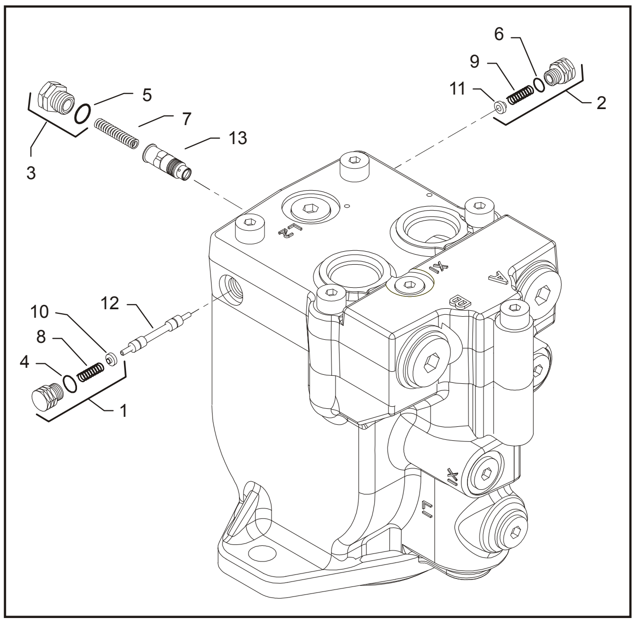
Disassembly

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.

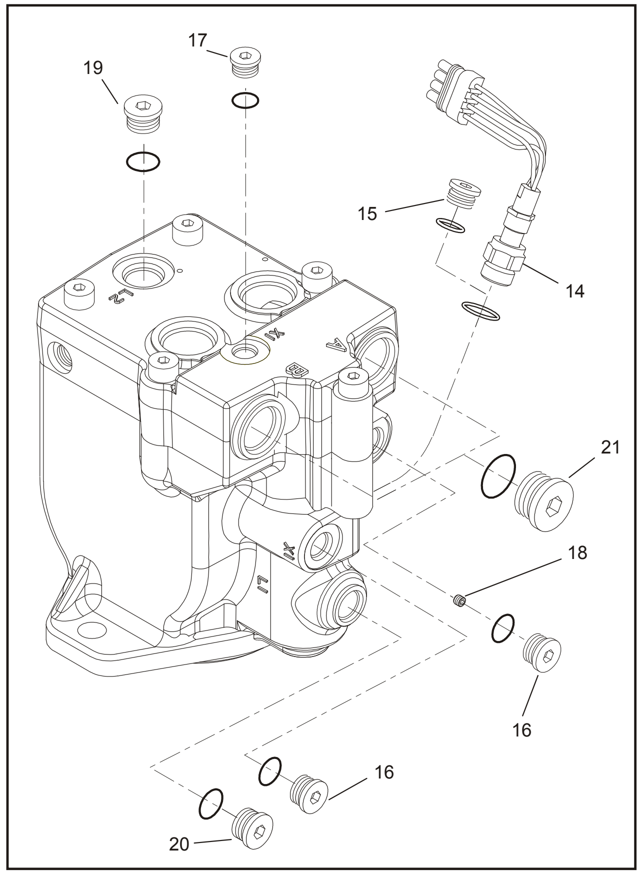
It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.



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

Figure 3-13. Loop Flushing Spool

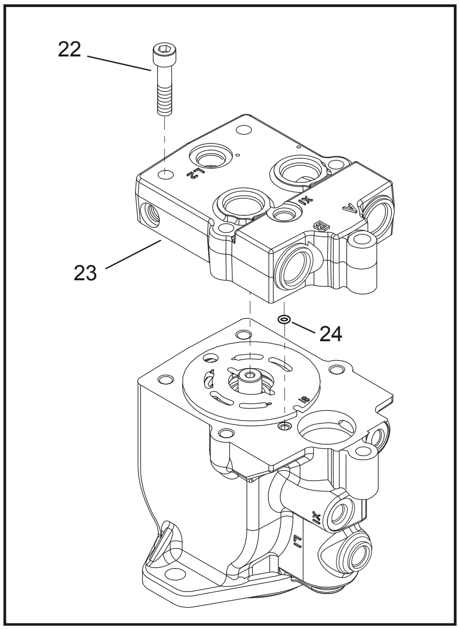
1. Using a 11/16 in wrench remove plug (1) and (2).
2. Using a 5/8 in hex wrench remove plug (3).
3. Remove O-rings (4, 5, and 6).
4. Using pliers, remove centering springs (7, 8, and 9).
5. Remove spring retaining washers (10 and 11).
6. Remove shift spool (12).
7. Remove orifice poppet (13).



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



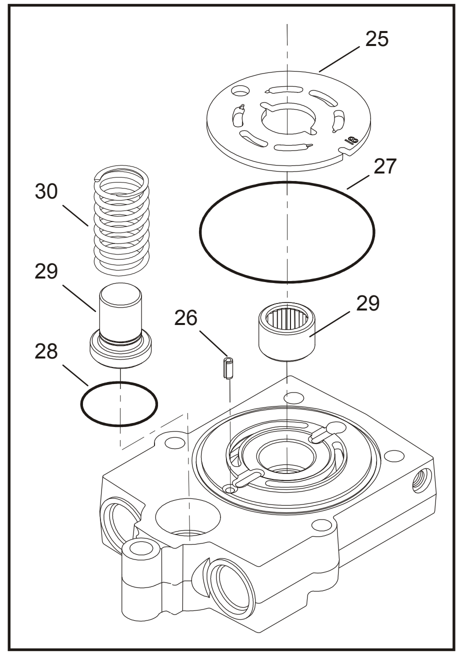
22. Screw
23. End Cap
24. O-ring

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.

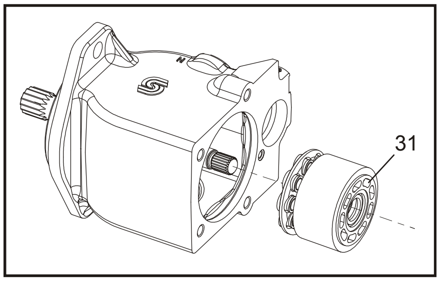
Each displacement has a unique valve plate. For identification, the last two digits of the valve plate part number are stamped on its surface.

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

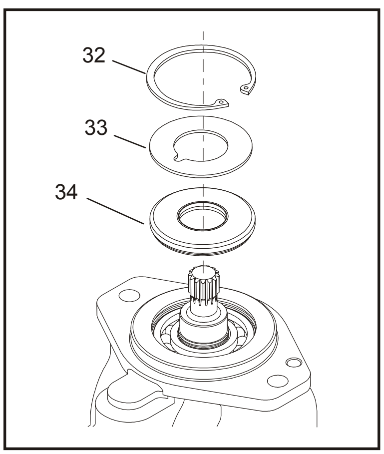
Figure 3-17. Cylinder Kit

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	--

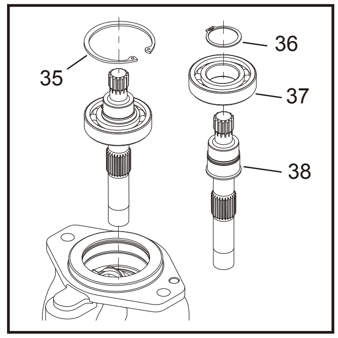


32. Snap Ring
33. Support Washer
34. Shaft Seal

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.

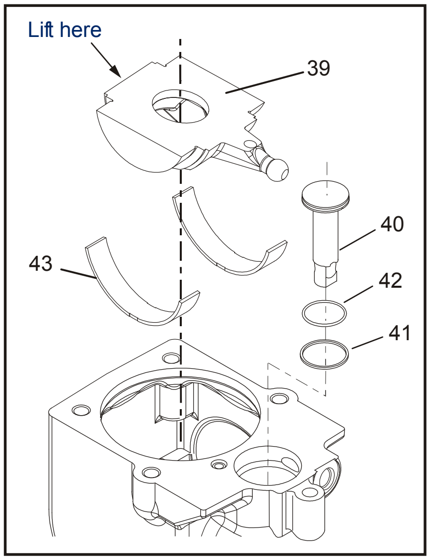


35. Inner Snap Ring
36. Snap Ring
37. Bearing
38. Shaft

Figure 3-19. Shaft & Front Bearing

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

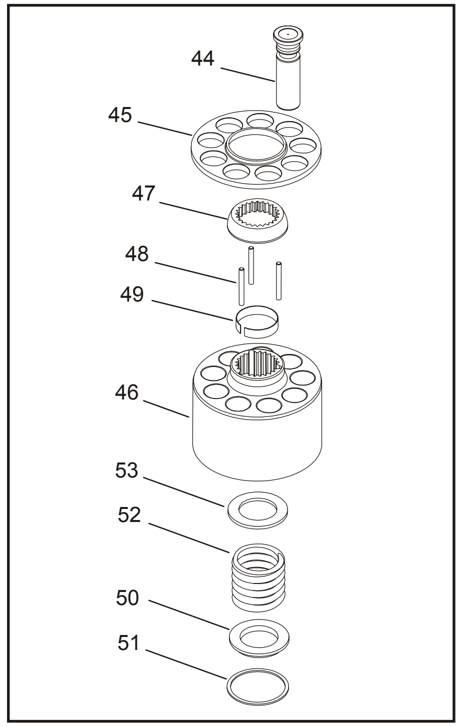
22. Remove the snap-ring (36) retaining the shaft front bearing. Pull the bearing (37) off of the shaft (38).



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.

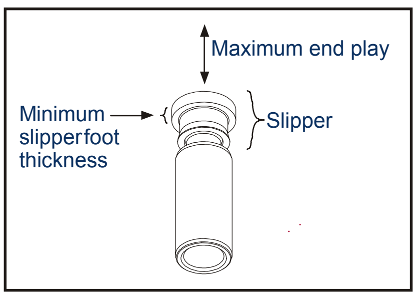
28. Turn the block over. Using a press, apply pressure on the block spring washer (50) to compress the block spring. Compress the spring enough to safely remove the spiral retaining ring (51). While maintaining pressure, unwind the spiral retaining ring (51). Carefully release the pressure and remove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

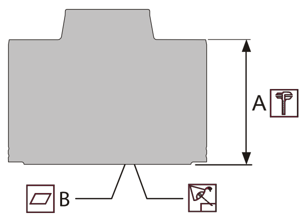
Measurement		L Frame	K Frame
Slipper Foot Thickness	mm (in.)	2.71 (0.11)	4.07 (0.16)
Piston/Slipper End Play		0.15 (0.006)	

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.

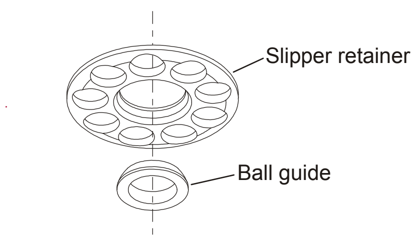
Table 3-8. Cylinder Block Measurements

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)



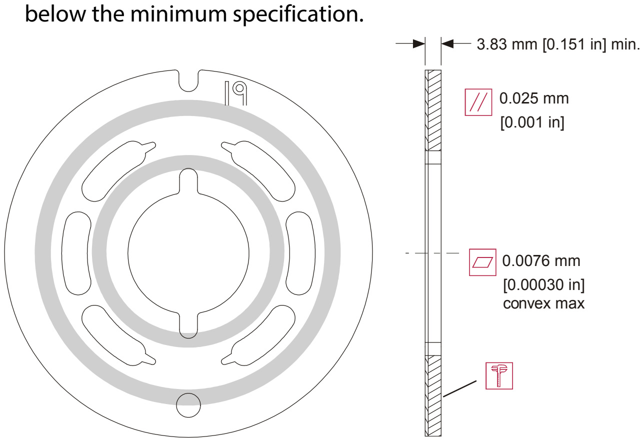
BALL GUIDE AND SLIPPER RETAINER

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.



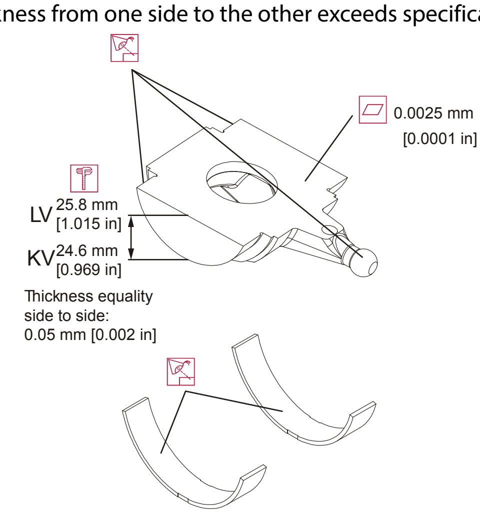
VALVE PLATE

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

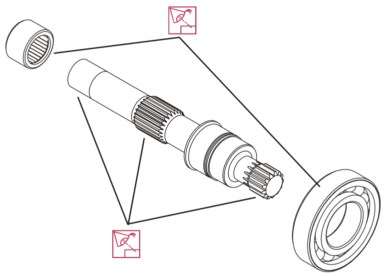
Inspect the running face, servo ball-joint, and swashplate journal surfaces for damage or excessive wear. Some material transfer may appear on these surfaces and is acceptable providing the surface condition meets specifications shown. Measure the swashplate thickness from the journals to the running 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.

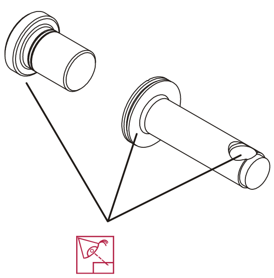


SHAFT

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.

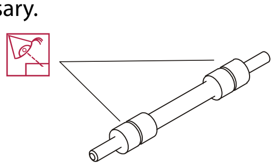
SERVO PISTON AND MINIMUM ANGLE STOP

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



LOOP FLUSHING SPOOL

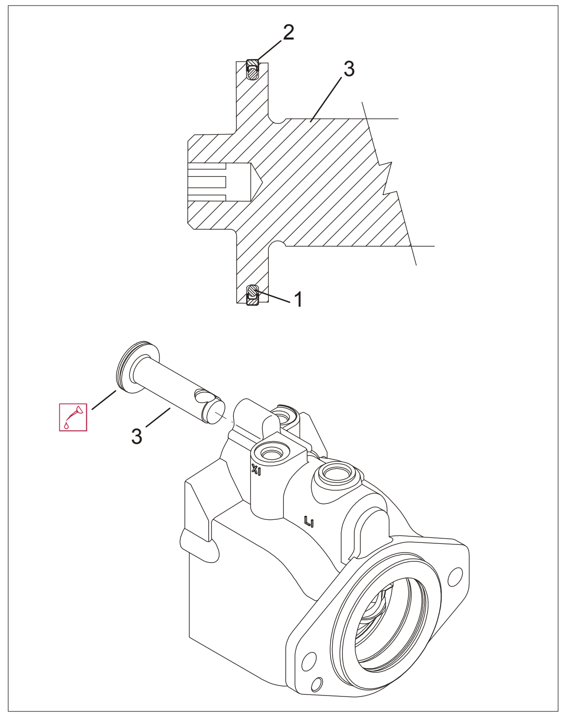
Inspect the loop flushing spool. Check for cracks or damage. Replace if necessary.



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

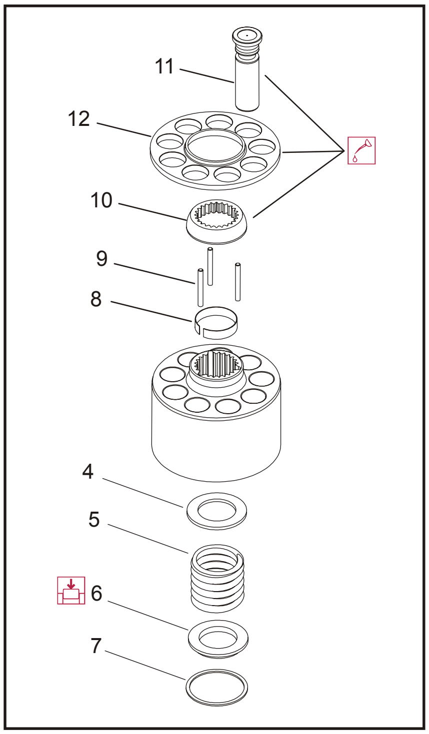
Figure 3-22. Servo Piston

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.



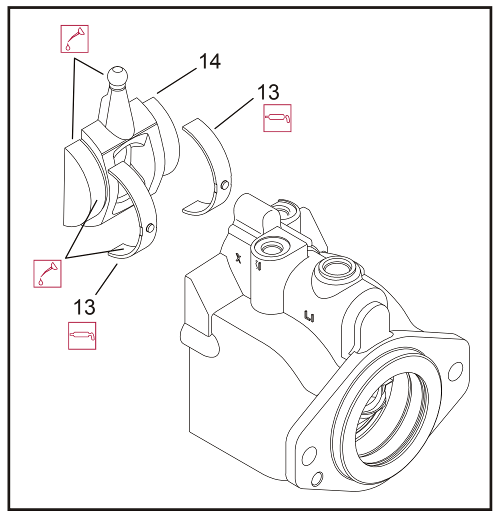
4. Block Spring Washer
5. Block Spring
6. Outer Washer
7. Spiral Retaining Ring
8. Retaining Ring
9. Holddown Pins
10. Ball Guide
11. Piston
12. Slipper Retainer

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.

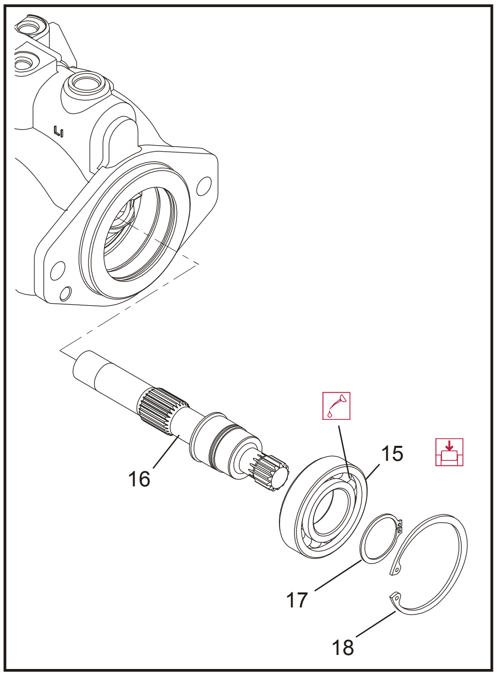


13. Journal Bearings
14. Swash Plate

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.

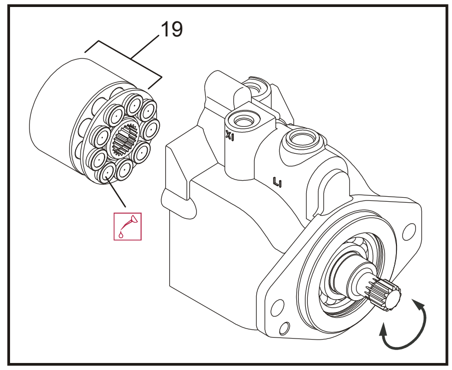


15. Front Shaft Bearing
16. Shaft
17. Snap Ring
18. Snap Ring

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).

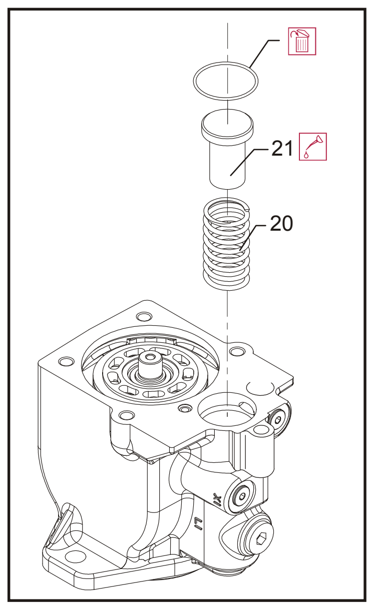
10. Verify swashplate and bearings are properly seated. Install the cylinder kit (19) onto the shaft. Install with the slippers facing the swashplate. Rock the shaft to align the block splines and slide the cylinder kit into place. Orient the motor with the shaft pointing downward and verify the cylinder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



19. Cylinder Kit

Figure 3-26. Cylinder Kit Installation

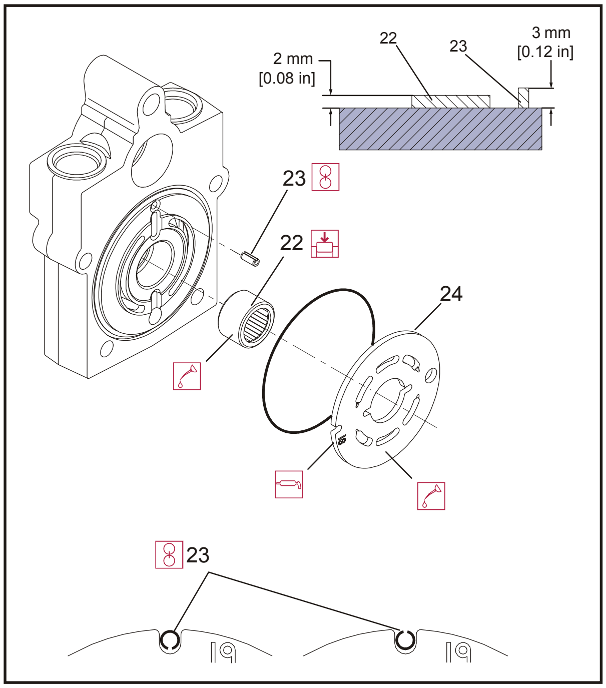
11. Lubricate and install the servo spring (20), and minimum angle stop (21) into the housing bore.



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.



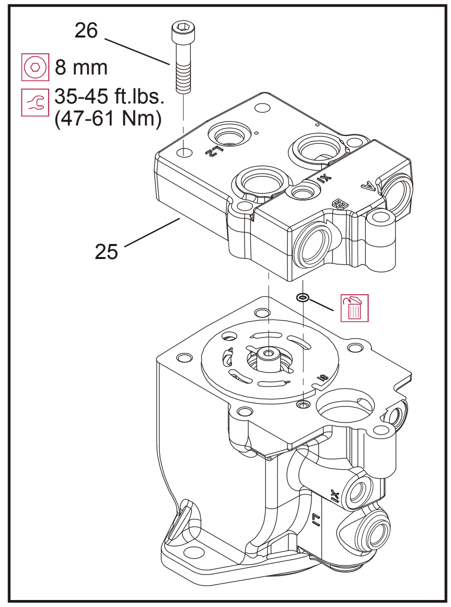
22. Rear Shaft Bearing
23. Timing Pin
24. Valve Plate

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.



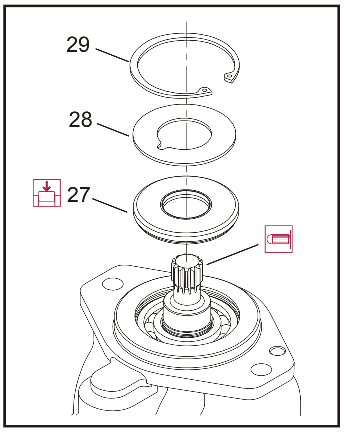
25. End Cap
26. Screw

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.

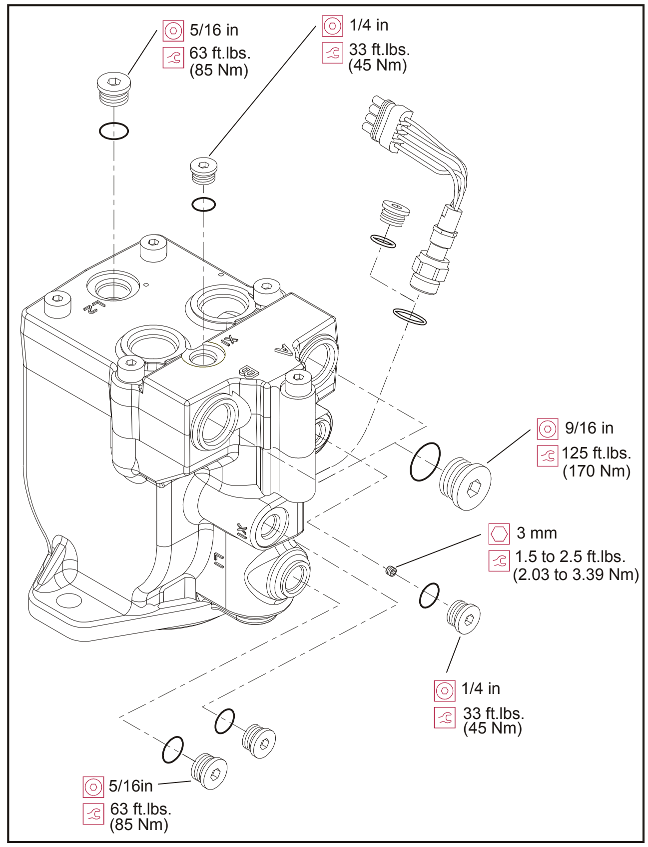
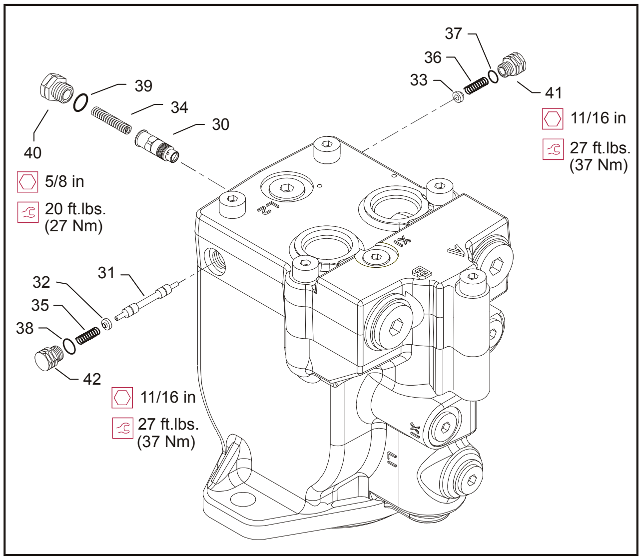


Figure 3-31. Plugs and Fittings Installation

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.

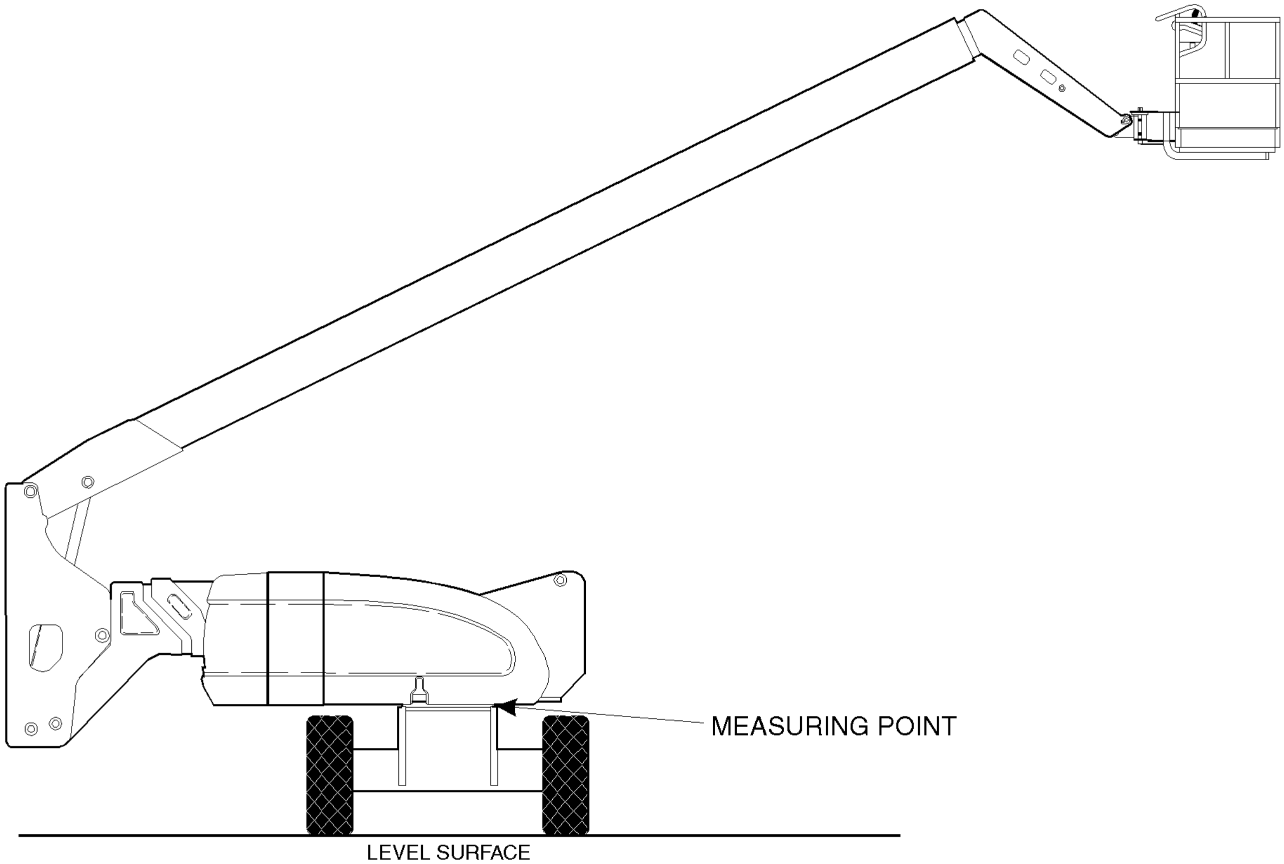


Figure 3-33. Swing Bearing Tolerance Boom Placement (Sheet 1 of 2)

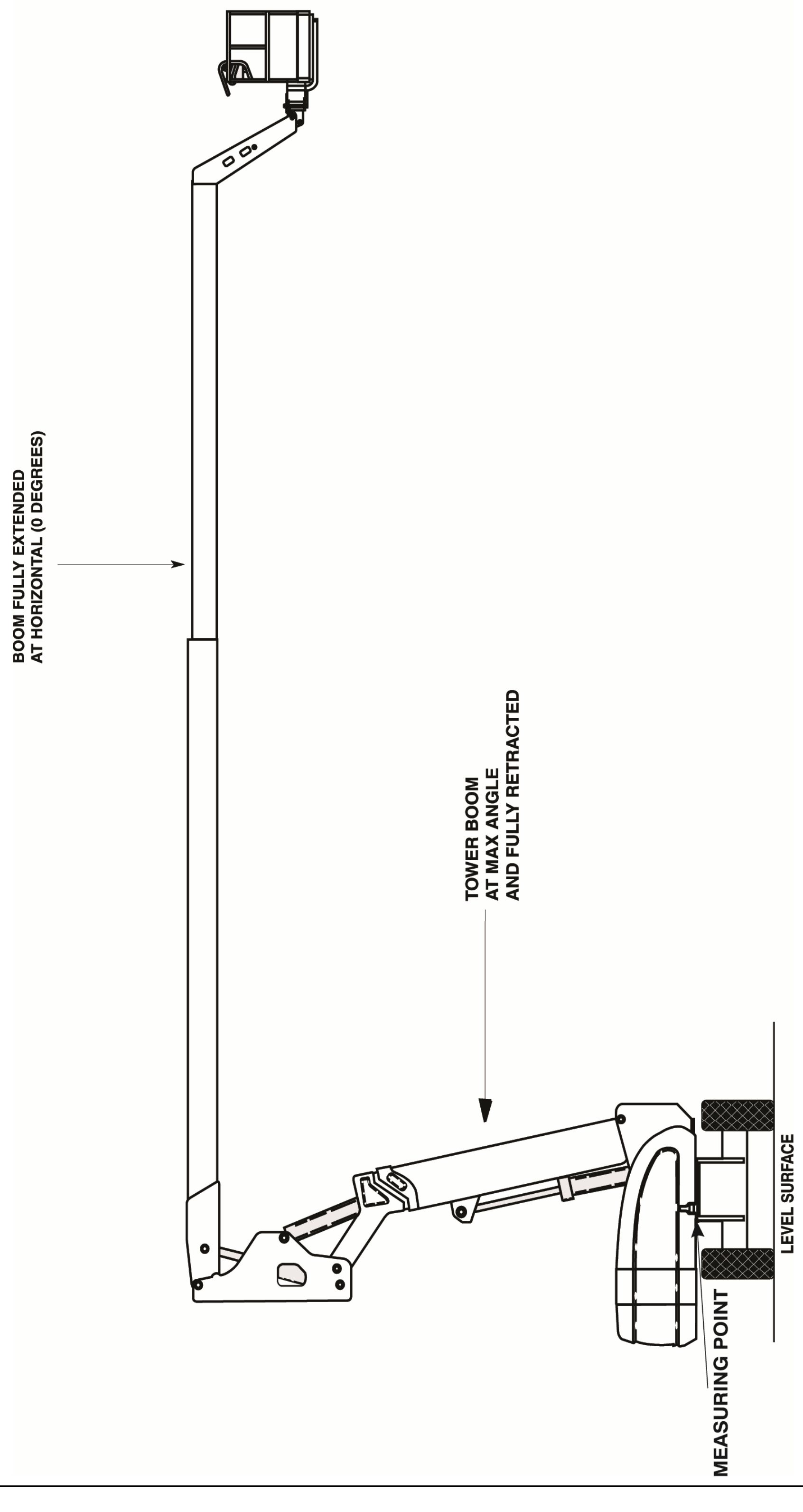


Figure 3-34. Swing Bearing Tolerance Boom Placement (Sheet 2 of 2)

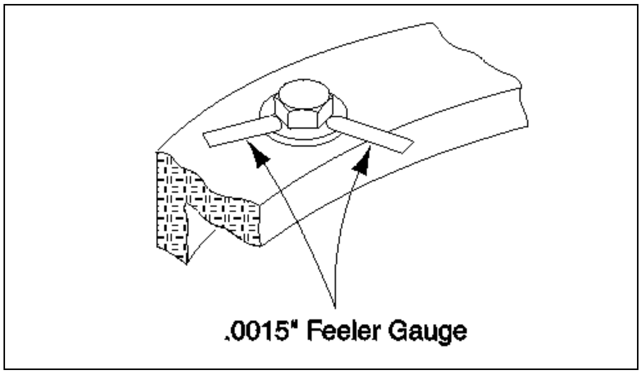


Figure 3-35. Swing Bolt Feeler Gauge Check

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.

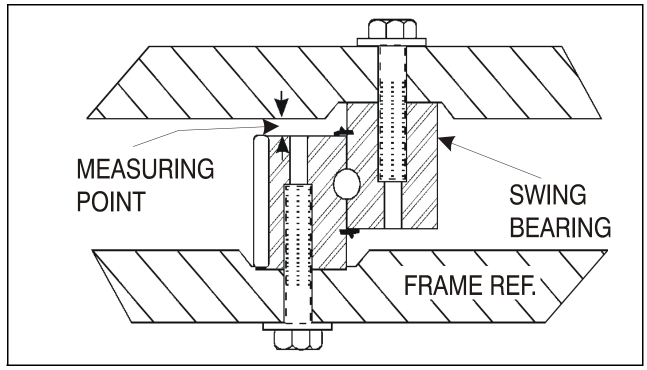


Figure 3-36. Swing Bearing Tolerance Measuring Point

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.

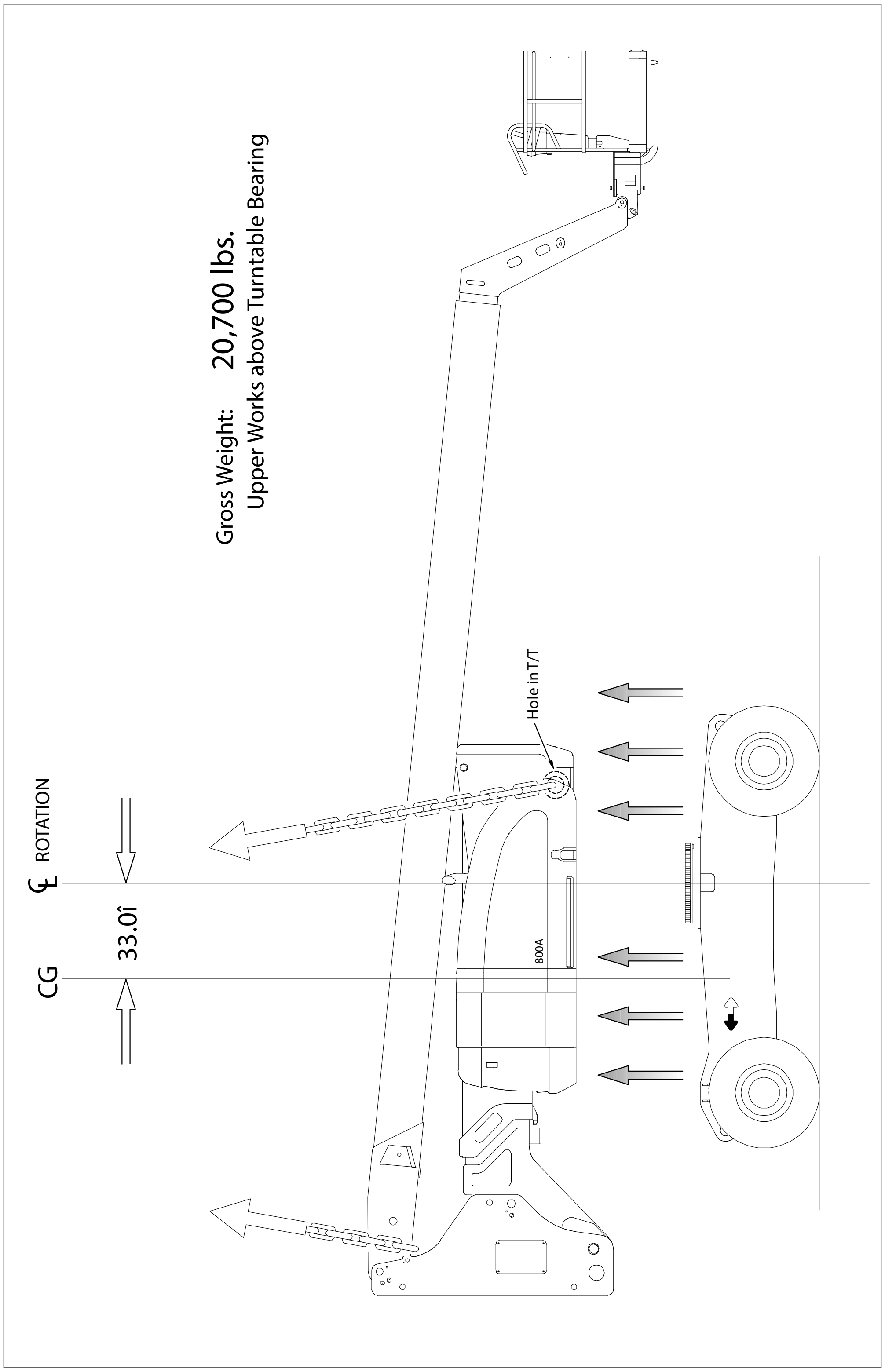


Figure 3-37. Swing Bearing Removal (800A)

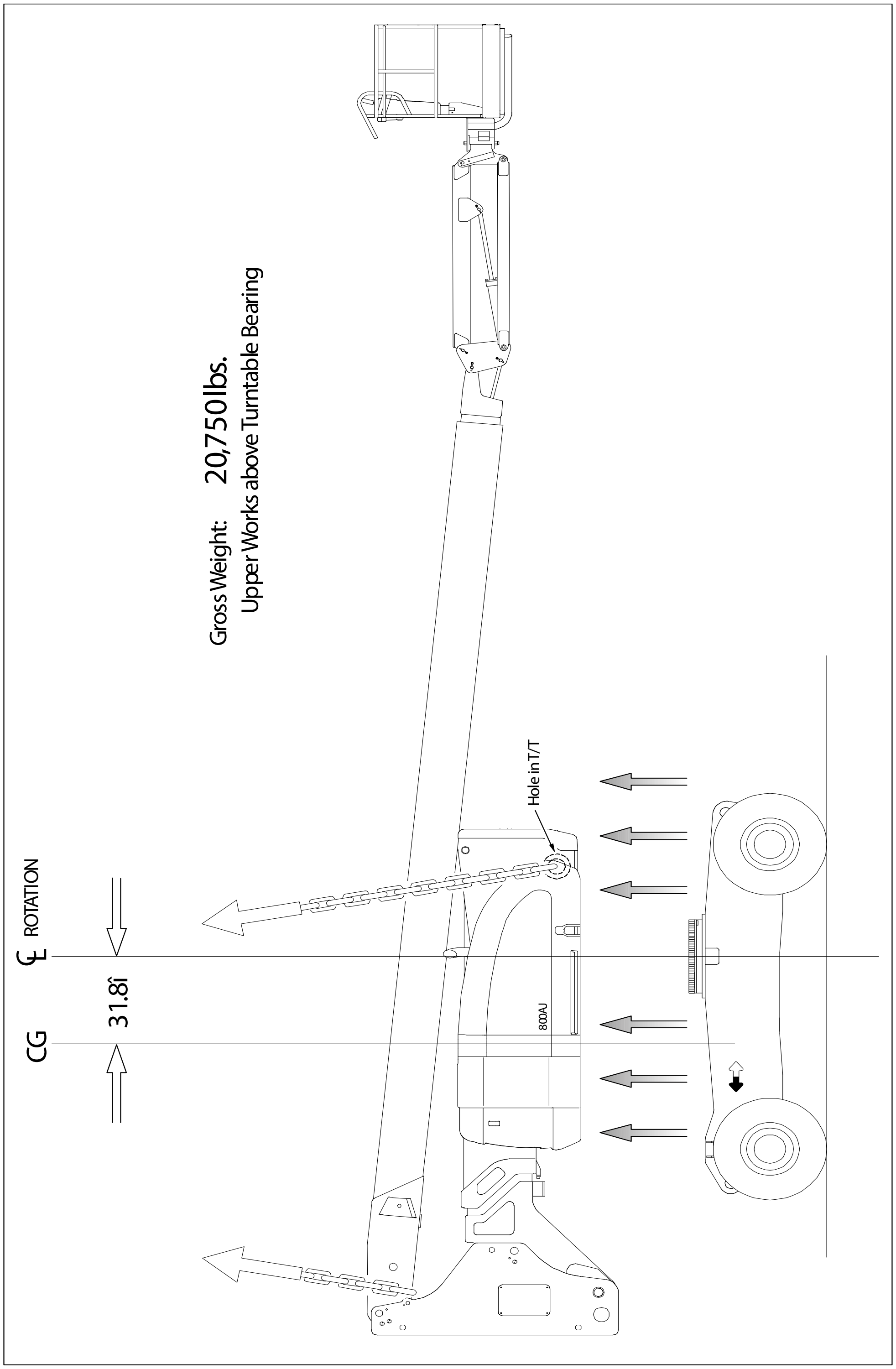
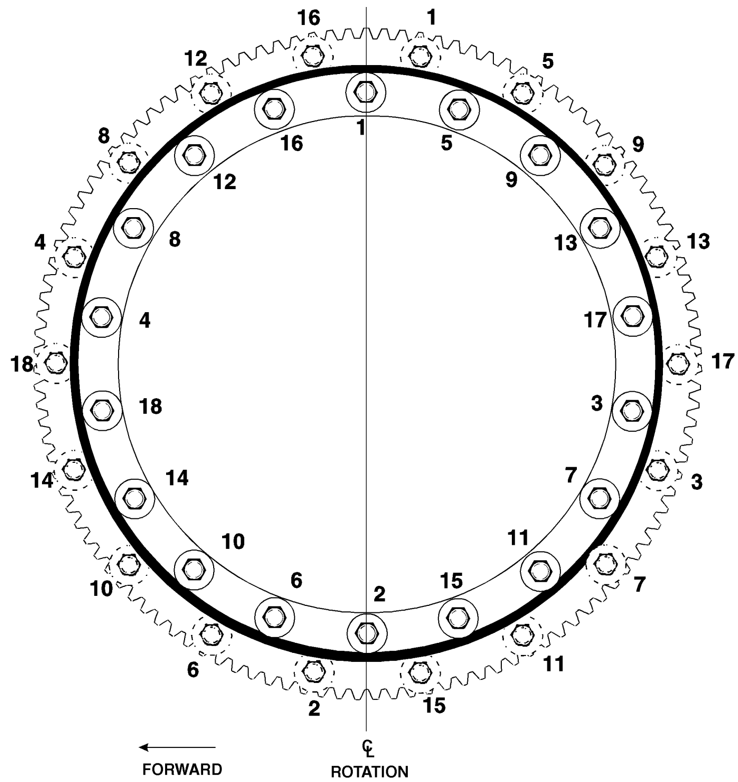
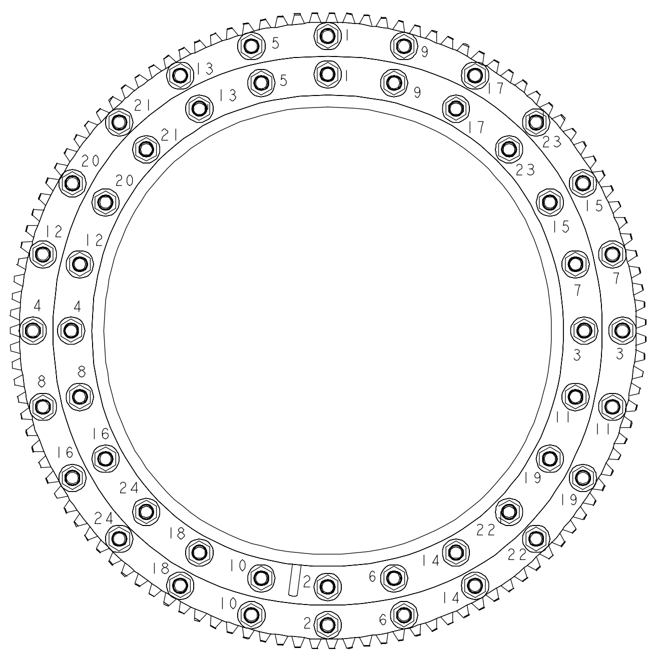


Figure 3-38. Swing Bearing Removal (800AJ)



Machines built prior to S/N 0300068040



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

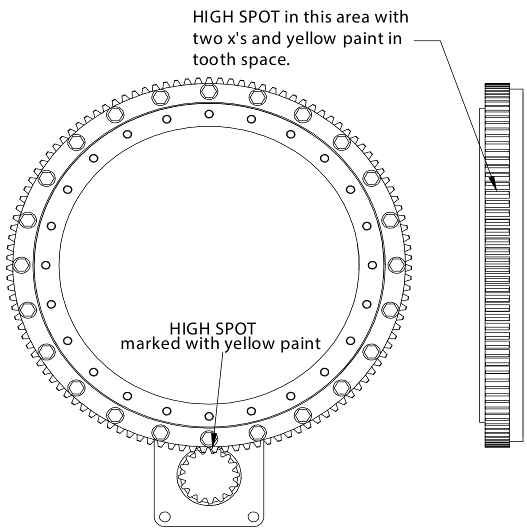
Machines built S/N 0300068040 to S/N 0300183033

Figure 3-39. Swing Bearing Torque Sequence

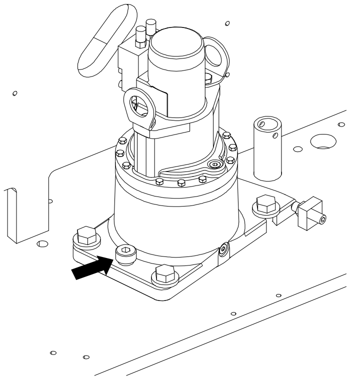
3.12 PROCEDURE FOR SETTING SWING GEAR BACKLASH

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.

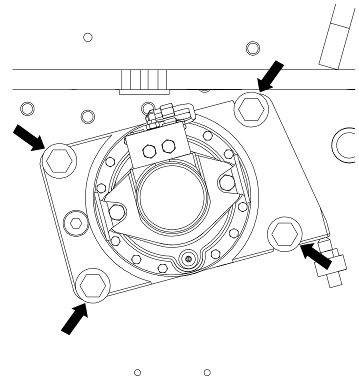


3. Apply JLG Threadlocker P/N 0100019 and torque shoulder screw to 420 ft. lbs. (569 Nm).

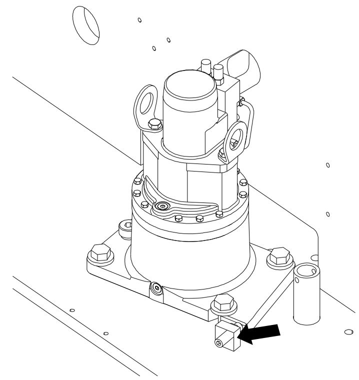


NOTE: *Make sure the turntable is properly supported during the following step. The turntable can swing a few degrees when the turntable lock is removed if the turntable is not balanced properly.*

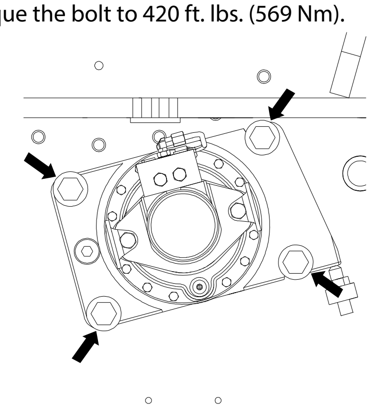
4. Remove turntable lock pin.
5. Apply JLG Threadlocker P/N 0100019 and pre-torque bolt to 30 ft. lbs. (42 Nm).



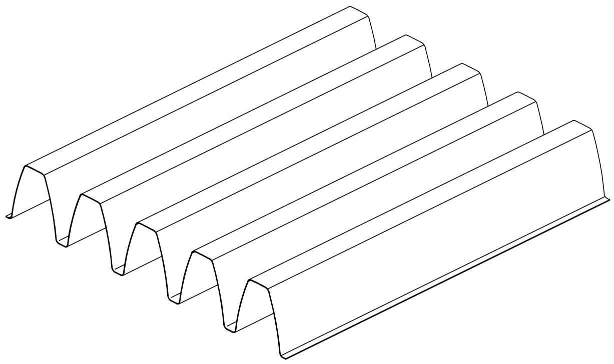
6. Tighten setscrew until pinion is completely snug against shim and bearing then back off setscrew.



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.*

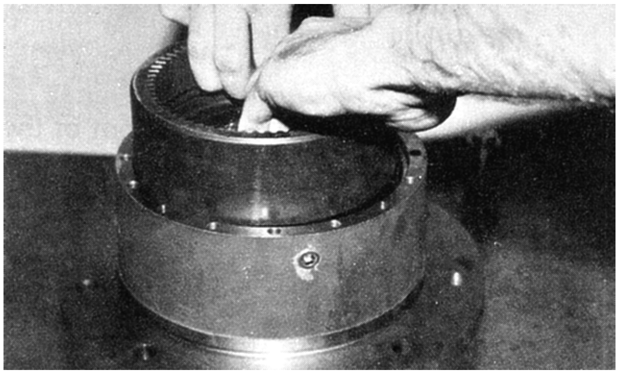
11. To remove the Cluster Gears (3F) from the Carrier (3A), drive the Anti-roll Pin (3G) into the Planet Shaft (3E). The Planet Shaft (3E) may now be tapped out of the Carrier. After Planet Shaft (3E) has been removed the Roll Pin (3G) can be driven out.
12. The Cluster Gear (3F) can now be removed from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

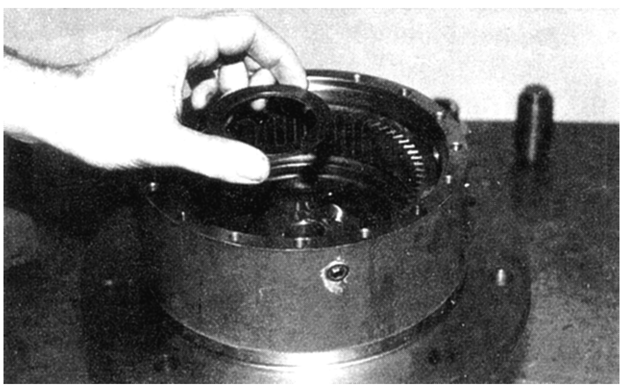
WHEN REBUILDING OR REPAIRING THE UNIT, THE RETAINING RING (1I), O-RINGS (5) AND SEAL (1B) SHOULD ALWAYS BE REPLACED.

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.

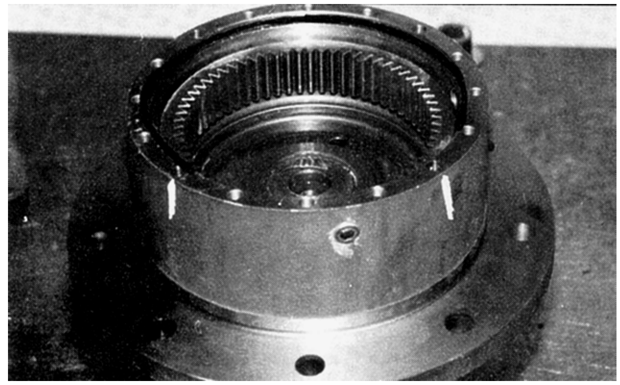


3. Place o-ring (5) into Hub counterbore. Use petroleum jelly to hold o-ring in place.

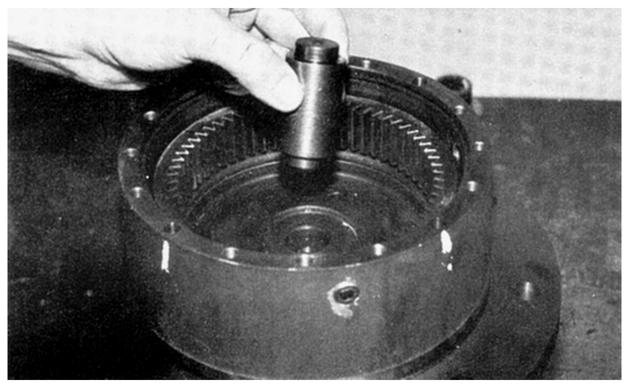
CAUTION

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

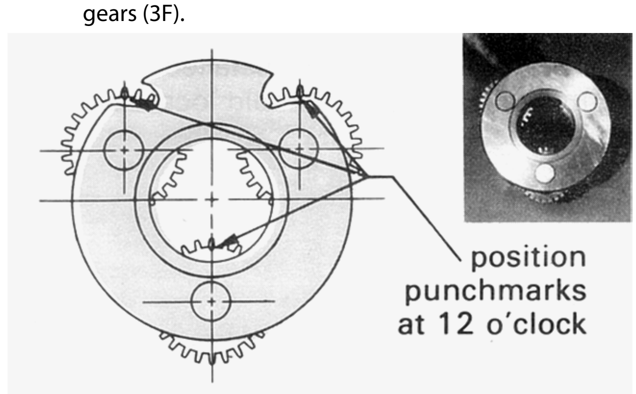
Also at this time locate and mark the 4 counter beamed holes in the face of the Hub (1G). This is for identification later in the assembly.



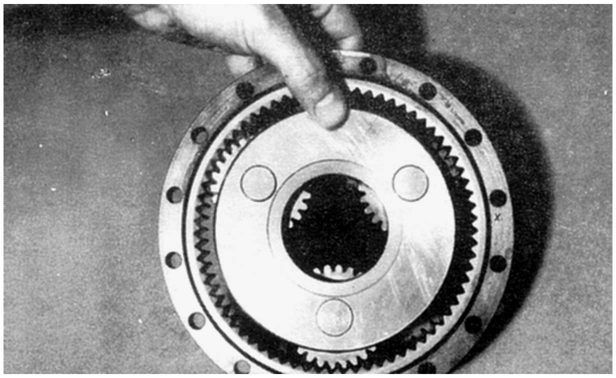
4. Thrust Spacer (9) is installed into the bore of the Output Shaft (1A). This should be a slip fit and the Thrust Spaces should rotate in this location.



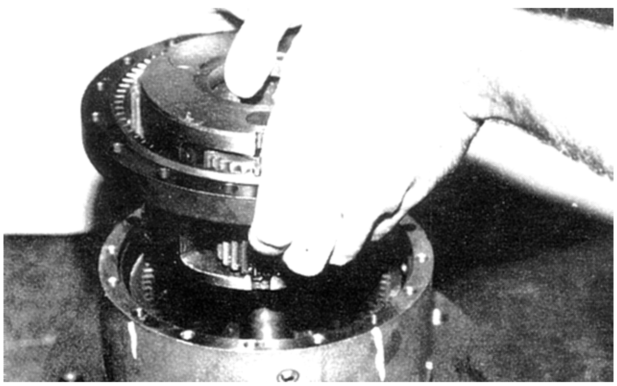
5. Place Carrier Assembly (3) on a flat surface with the large gears (3F) up and positioned as shown. Find the punch marked tooth on each large gear (3F) and locate at 12 o'clock (straight-up) from each planet pin. Marked tooth will be located just under the Carrier (3A) on upper two gears (3F).



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.

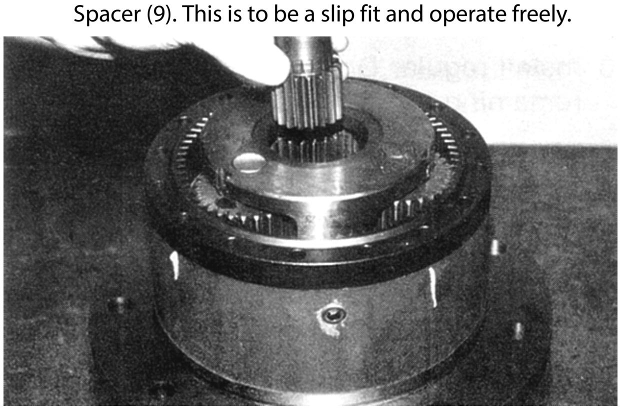


7. While holding Ring Gear (4) and Cluster Gears (3F) in mesh, place small side of Cluster Gears (3F) into mesh with the Internal Gear (2) and Input Gear (13). On the Ring Gear locate the hole marked X over one of the marked counterbored holes (Step 3) in Hub (1G).

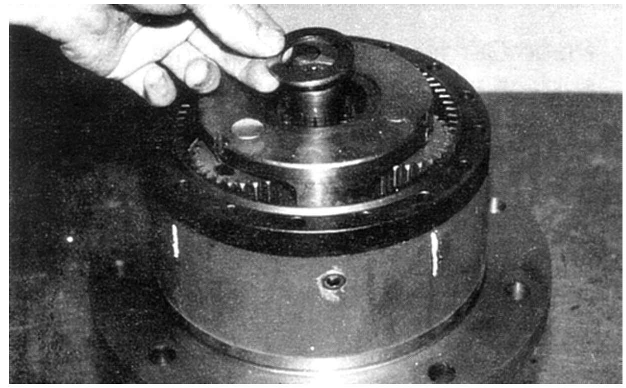


NOTE: *If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.*

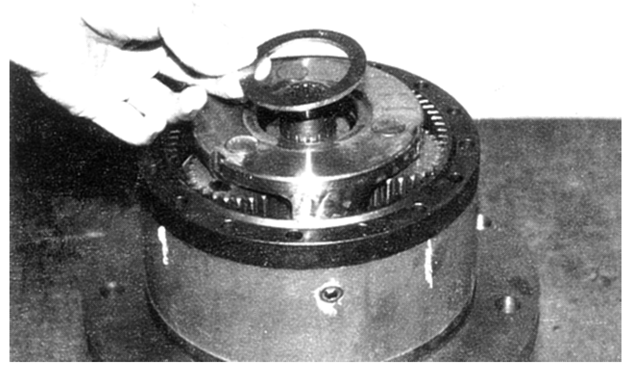
8. Input Gear (8) is installed, meshing with the teeth of the large diameter Cluster Gear (3F). The counterbore on the Input Gear (8) locates on the shoulder of the Thrust Spacer (9). This is to be a slip fit and operate freely.



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).



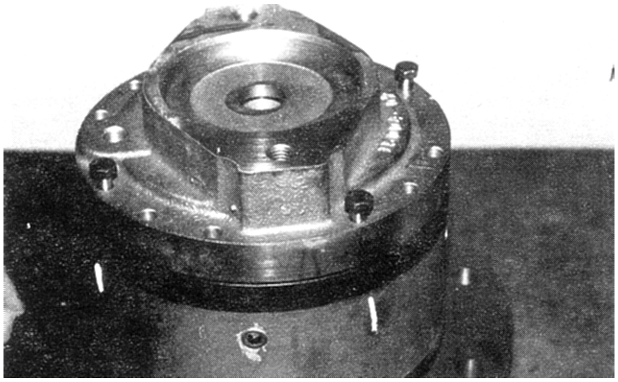
11. Place o-ring (5) into Cover (6) counterbore. Use petroleum jelly to hold o-ring in place.

WARNING

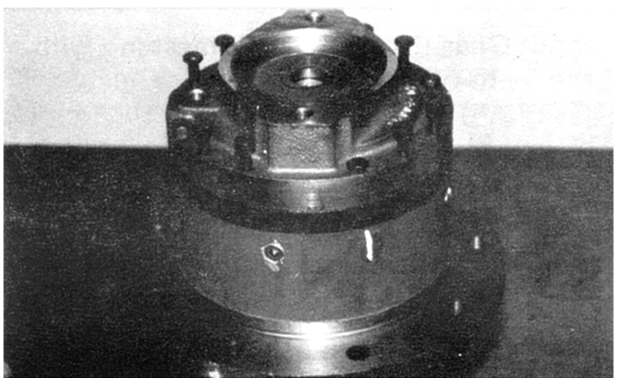
BEWARE OF SHARP EDGES OF THE COUNTERBORE WHILE SEATING THIS O-RING.

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.

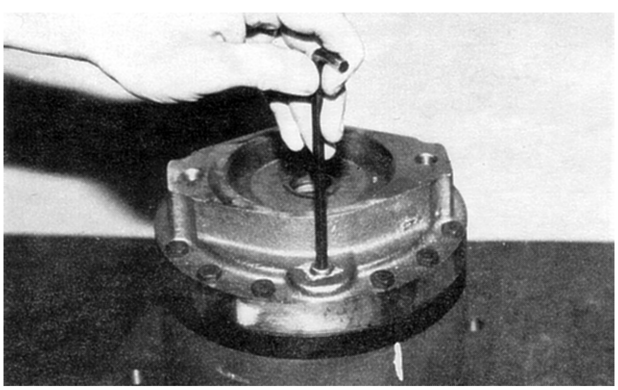
    Locate the 4 counterbore holes in Hub (1G) [marked in Step 3] and install 4 Shoulder Bolts (13). A slight tap with a hammer may be necessary to align Shoulder Bolt with Hub (1G) counterbore.



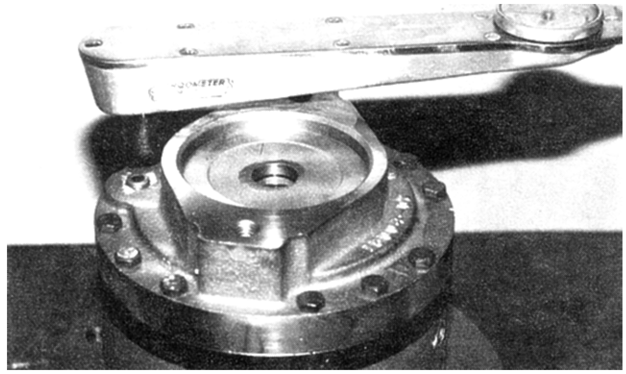
13. Install regular Grade 8 Bolts (12) into remaining holes.



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



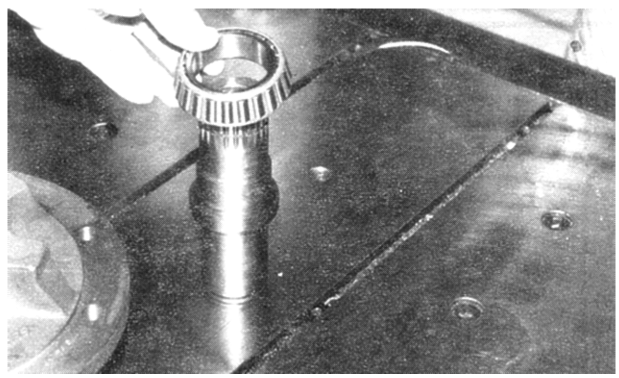
15. Torque Shoulder Bolts (13) to 23-27 ft.-lbs. and regular Grade 8 Bolts (12) to 23-27 ft.– lbs.



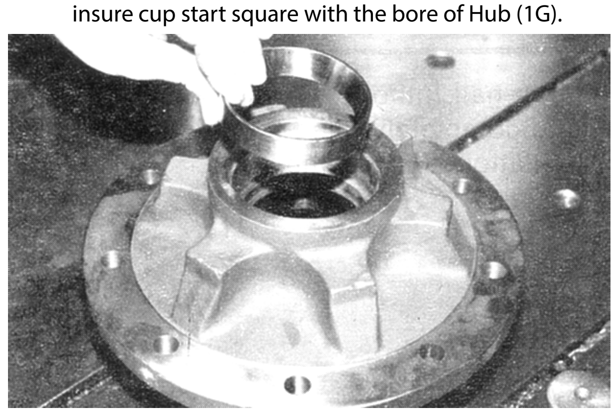
16. The unit must be completely filled with EP 90 lubricant before operation.

Hub Shaft Sub-Assembly

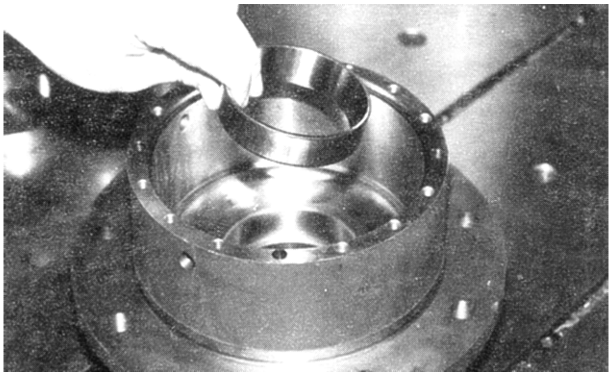
1. Press Bearing Cone (1D) onto Shaft (1A).



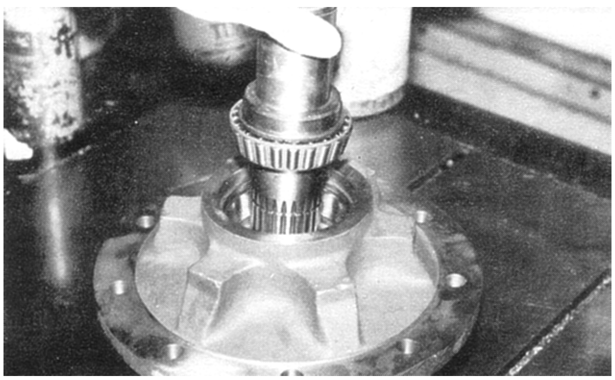
2. Press Bearing Cup (1C) into Hub (1G) taking care to insure cup start square with the bore of Hub (1G).



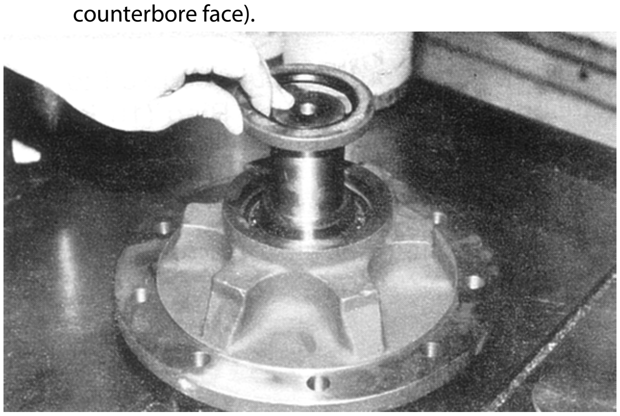
3. Invert Hub (1G) and press Bearing Cup (1E) into inter-counterbore of housing (1G).



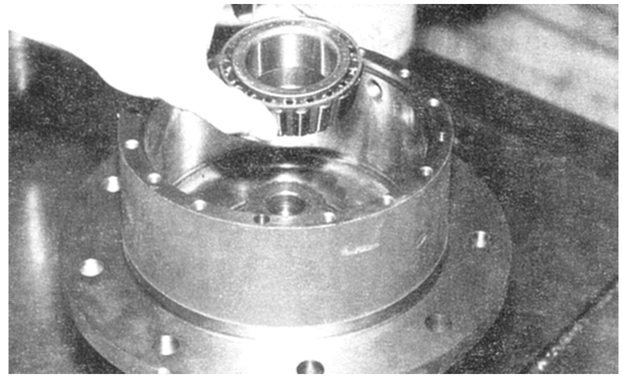
4. Returning the Hub (1G) to locate on the large diameter end, the Output Shaft (1A) is carefully installed into the Hub (1G).



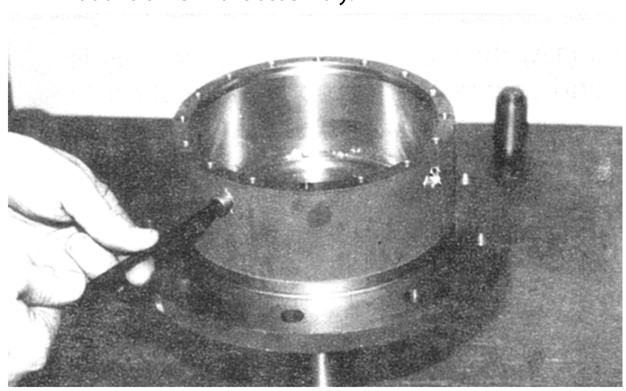
5. The Shaft Seal (1B) is installed over the Output Shaft (1A) and into the counterbore of the Hub (1G). Care should be taken to insure the Seal (1B) is being correctly installed (smooth face UP and located just flush with the counterbore face).



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

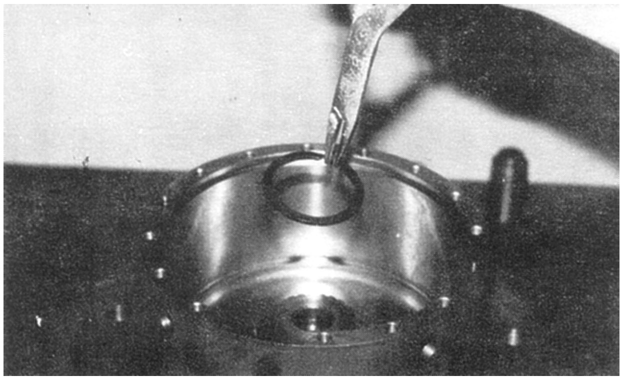


7. Pipe Plugs (1J & 1K) should be checked and/or installed at this time in the assembly.



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 (1l) should never be reused in a repair or rebuild.



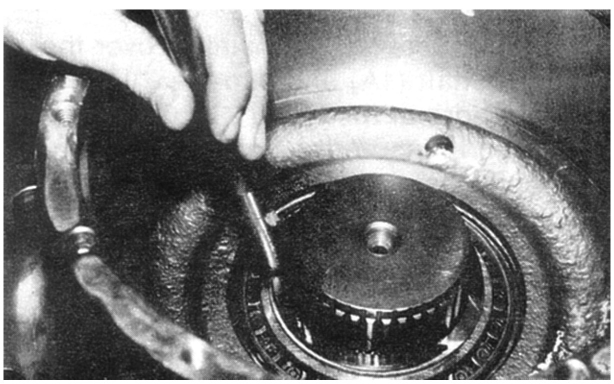
⚠ WARNING

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).

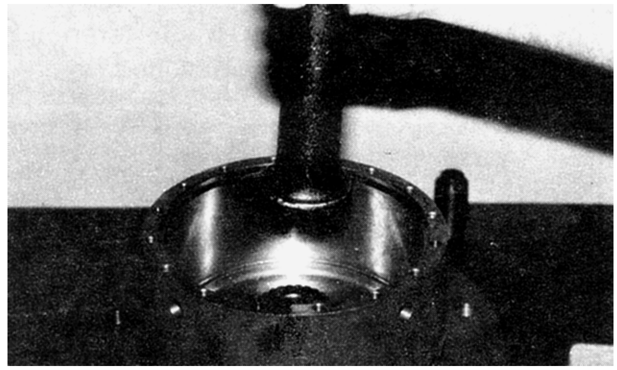
⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.



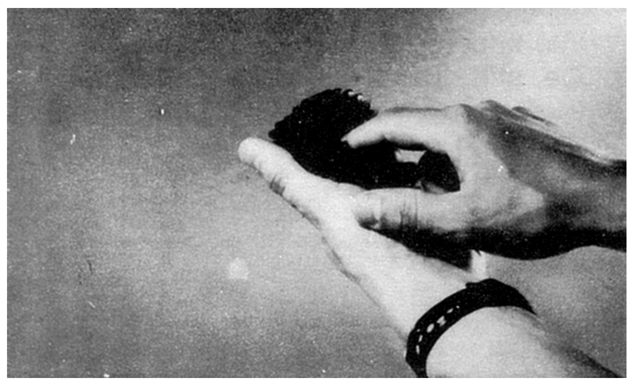
11. Upon completion of Step 10, rap the internal end of the Output Shaft (1A) twice with a piece of soft metal rod. This will release the preload which was on the Bearings.

12. If the assembly is not going to be used right away, it should be oiled and covered to help prevent rusting.

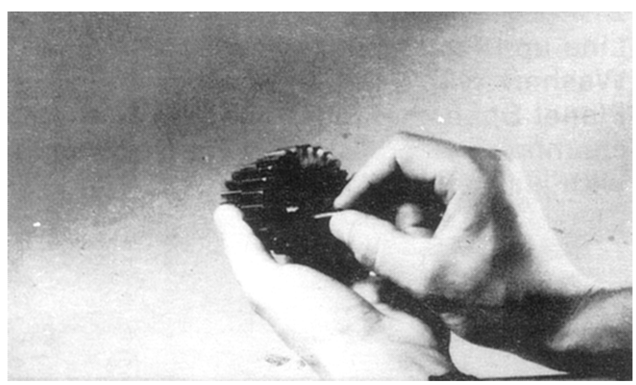


Carrier Sub-Assembly

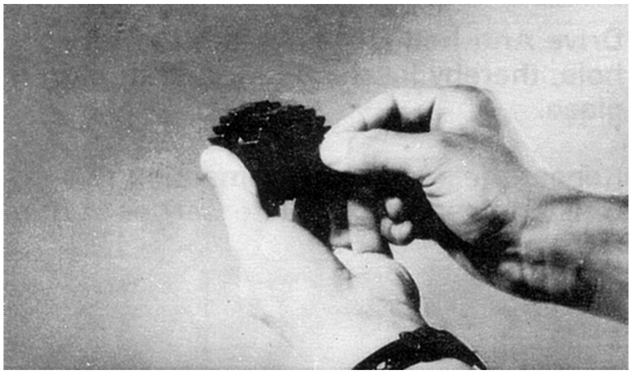
1. Apply a coat of grease or petroleum jelly to Cluster Gear bore.



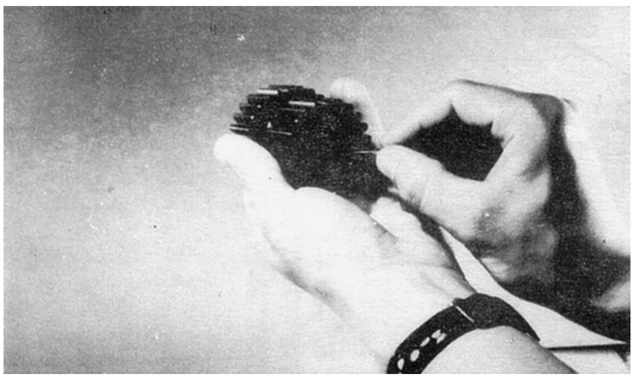
2. Place Needle Rollers into Cluster Gear bore.



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

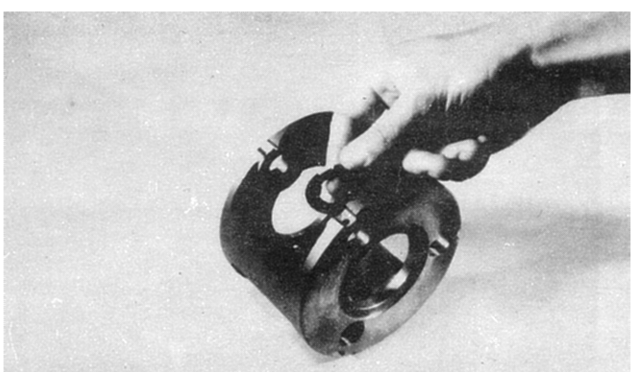


4. Place second set of Needle Rollers into Cluster Gear.

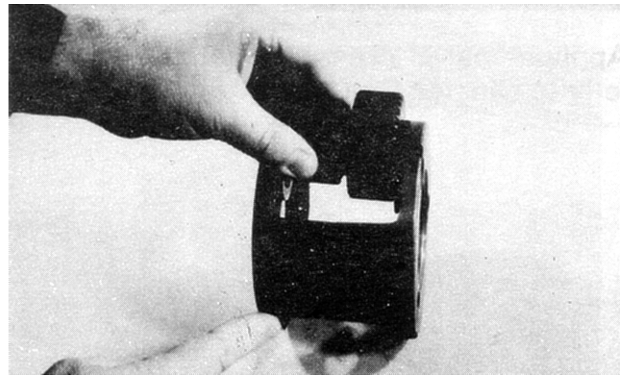


5. Apply grease or petroleum jelly to the tang side of two Thrust Washers. Place Thrust Washers against bosses in Carrier with washer tang fitting into slot in Carrier outside diameter.

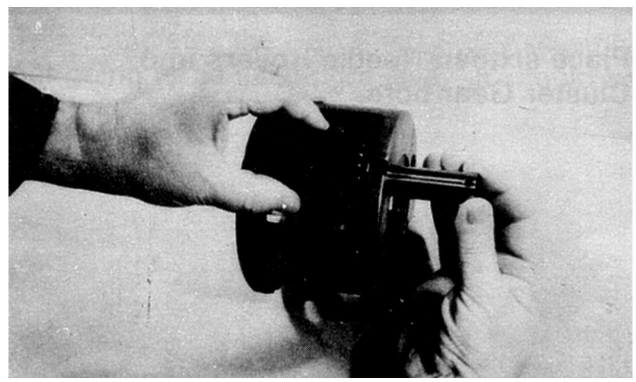
NOTE: *Some old style Carriers will not have slots and tangs should be located inside boss relief.*



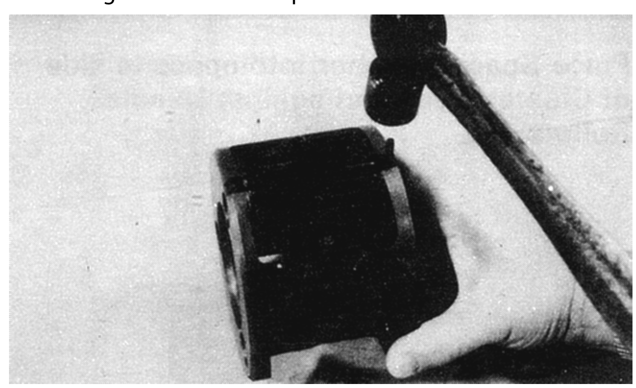
6. While keeping Thrust Washers in place, slide Cluster Gear into Carrier with the larger gear on the side with the small pin hole.



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.

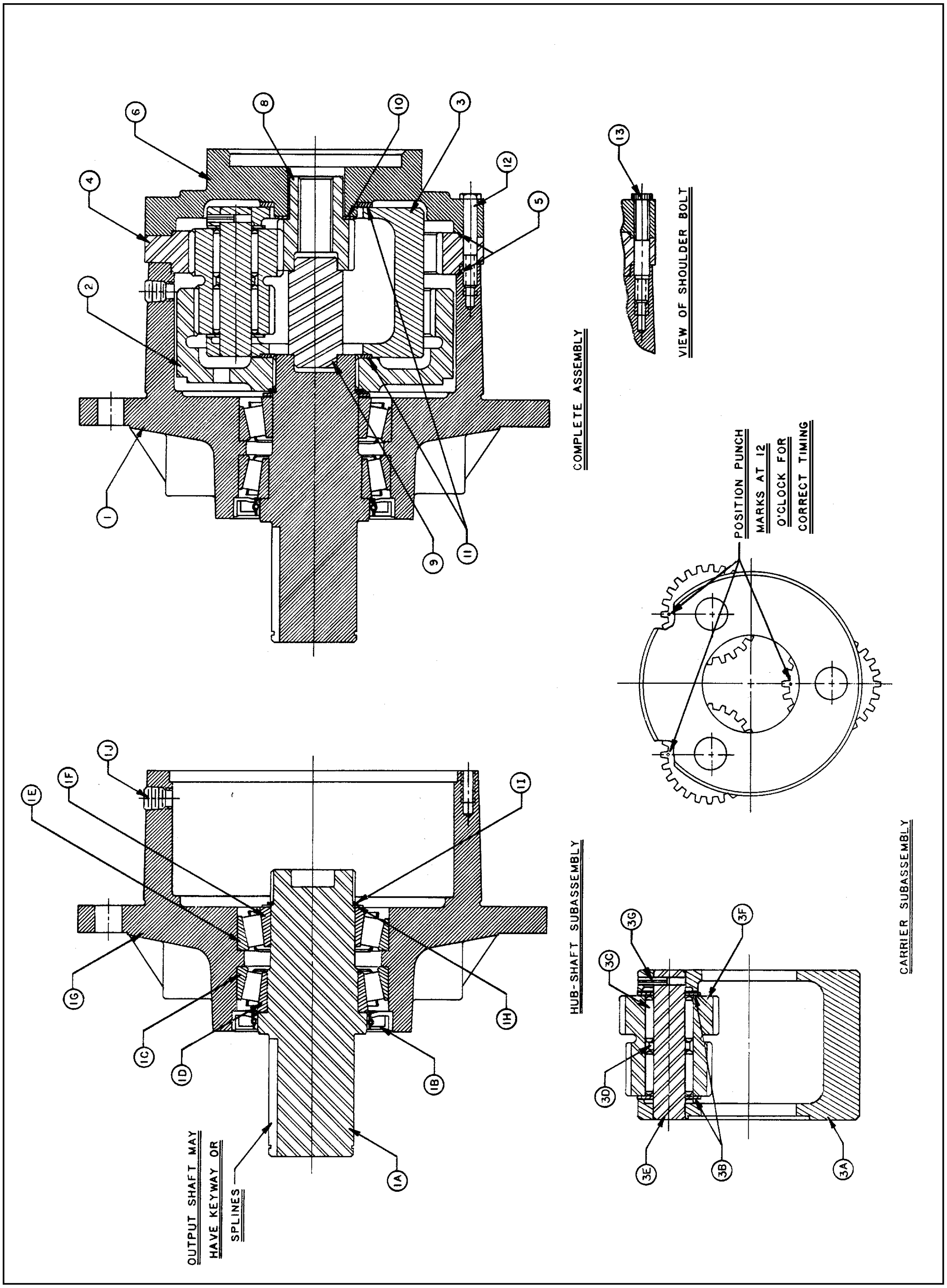


Figure 3-40. Swing Hub

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

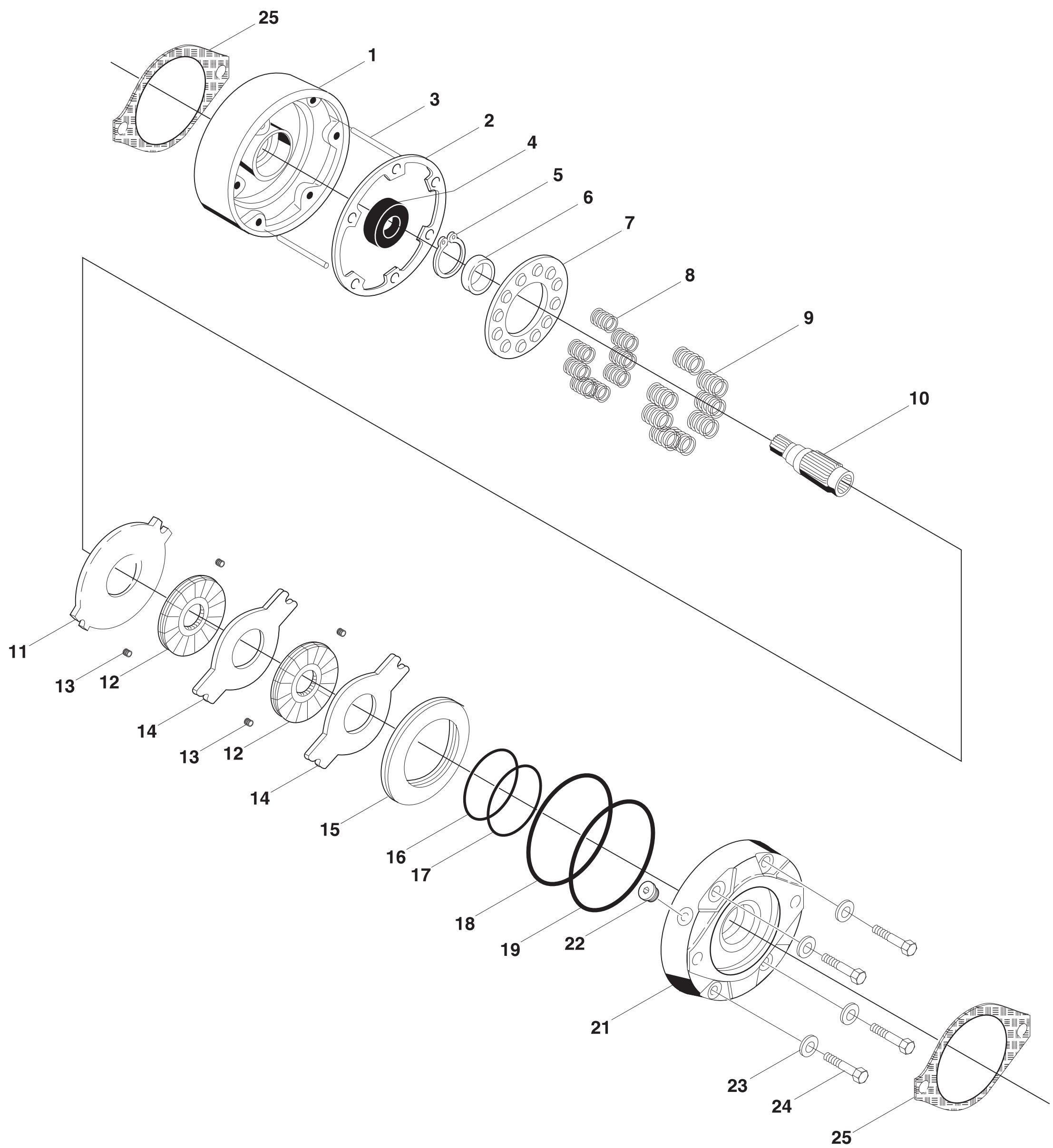
THERE MAY BE MORE PARTS IN A SERVICE KIT THAN YOUR BRAKE REQUIRES. CHECK THE PARTS LIST CAREFULLY FOR THE EXACT QUANTITY. IN THE CASE OF SPRINGS, SPACE THE SPRINGS AS SHOWN IN FIGURE 3-41.

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

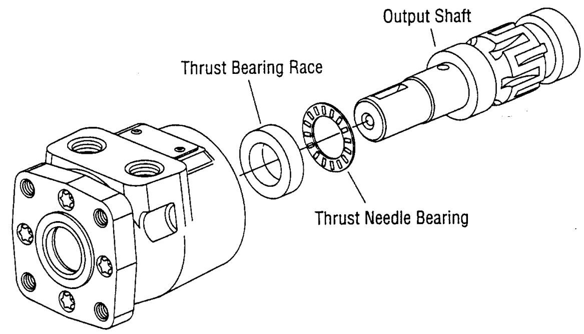
Figure 3-41. Swing Brake Assembly (Ausco) (Prior to S/N 0300064566)

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.

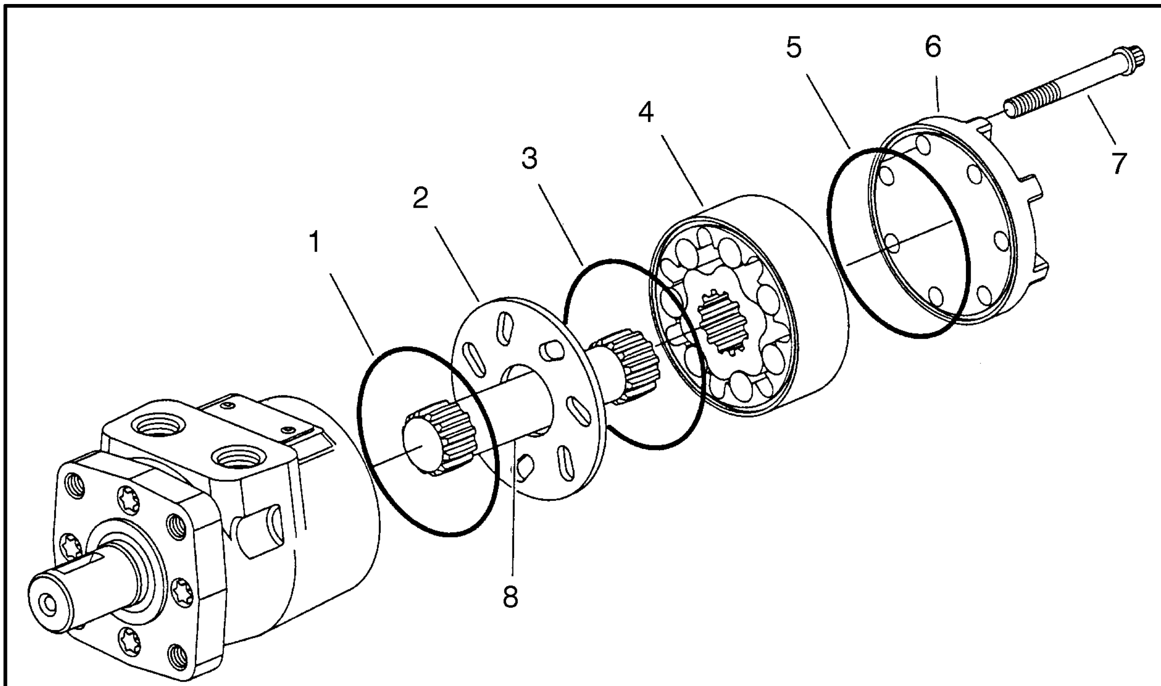


5. Remove the four cap screws that hold the mounting flange to the motor housing.

NOTICE

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

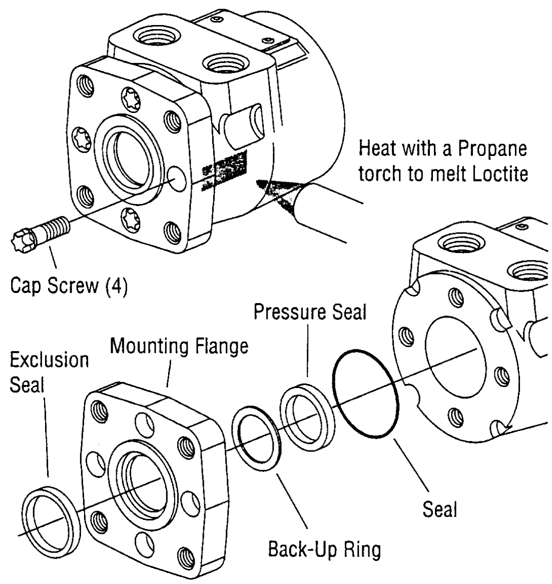
If the Loctite is holding the screws too tightly, heat the motor housing, with a propane torch, while turning screw. Apply heat to where the screw threads into the motor housing.



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.

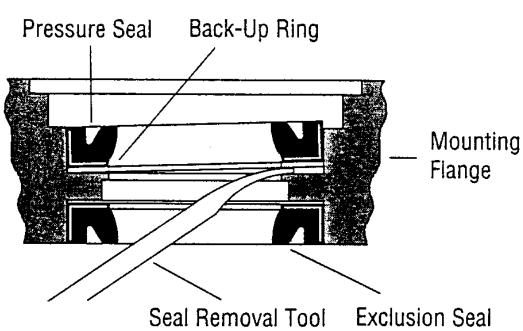


6. Remove the mounting flange from the motor housing. The exclusion seal, pressure seal, and back - up ring will come off with the mounting flange.

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

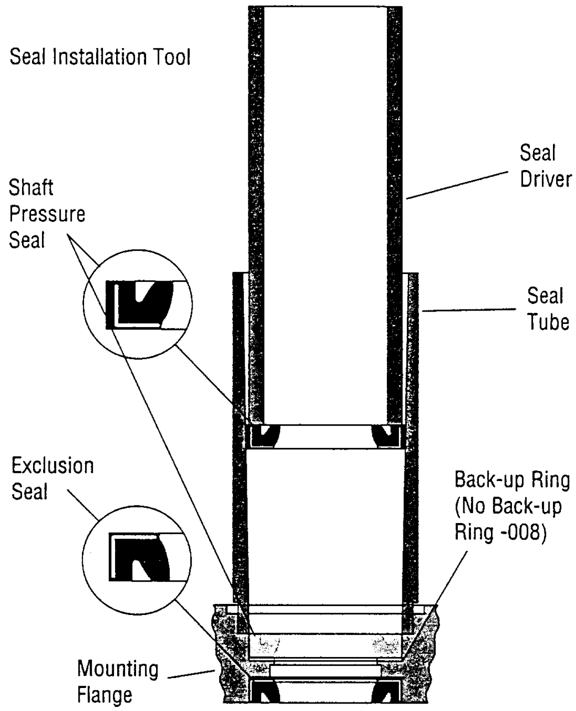
DURING REASSEMBLY LUBRICATE THE NEW SEALS WITH A PETROLEUM JELLY LIKE VASELINE. ALSO LUBRICATE MACHINED SURFACES AND BEARINGS WITH CLEAN HYDRAULIC FLUID.

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.

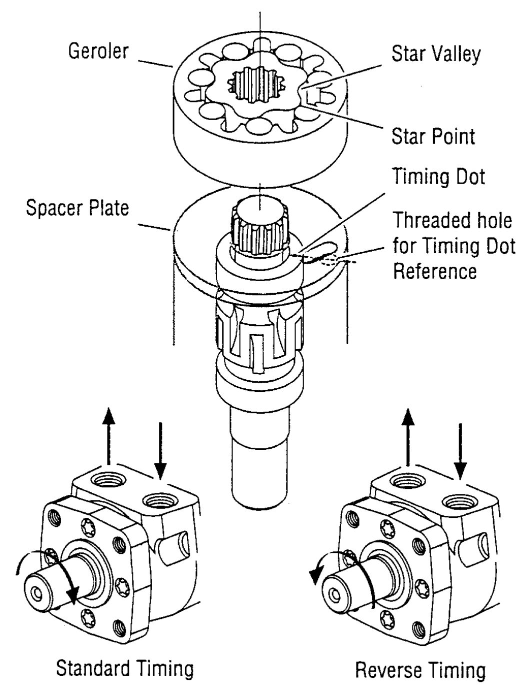
NOTICE

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.

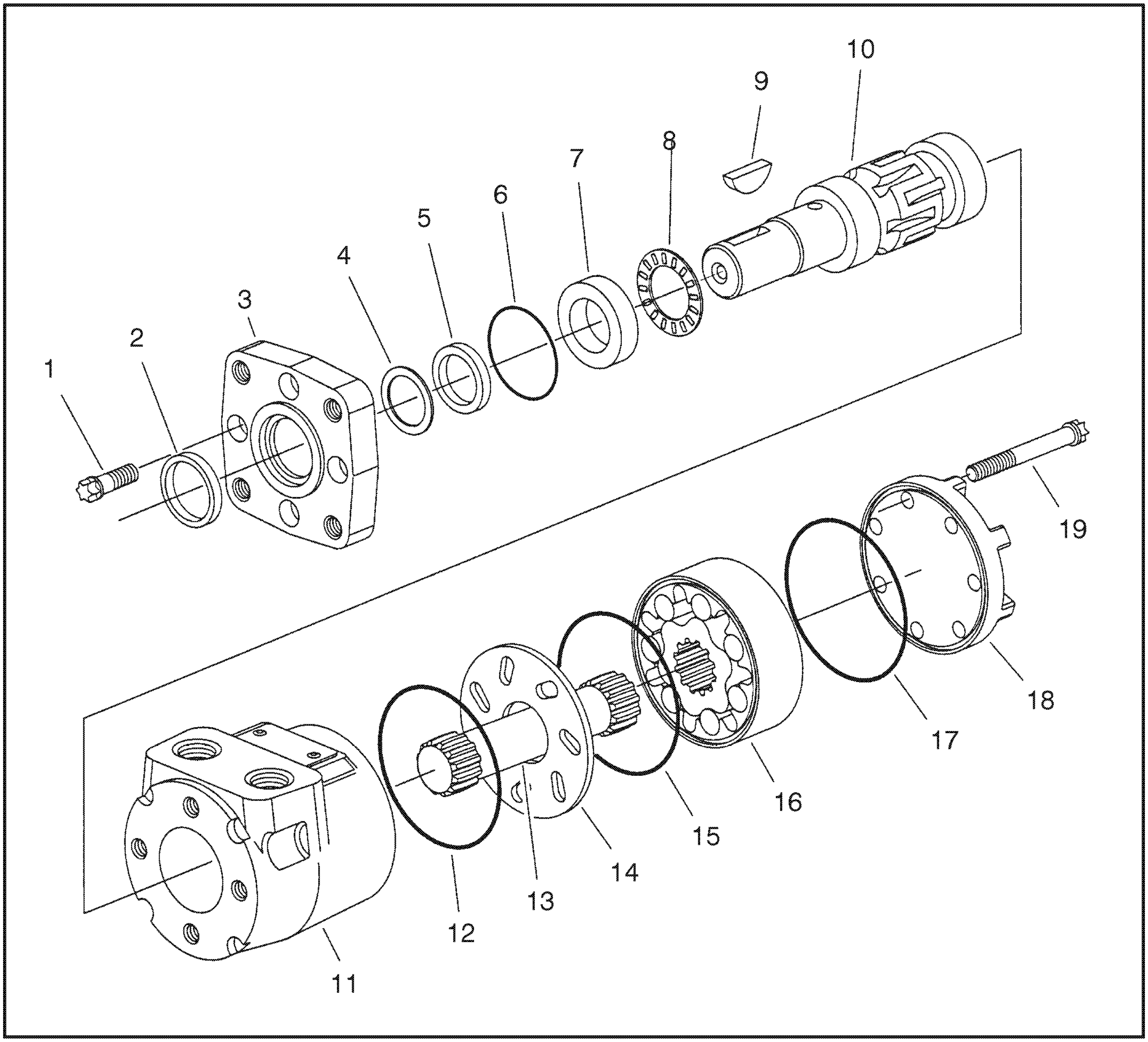
3. Lightly stretch, lubricate and install the second of the three larger diameter seals in the groove in the Geroler.

   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.*

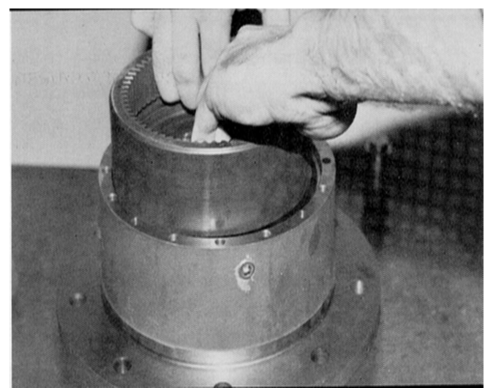
11. To remove the cluster gears (3F) from the carrier (3A), drive the anti-roll pin (3G) into the planet shaft (3E) may now be tapped out of the carrier. After planet shaft (3E) has been removed the roll pin (3G) can be driven out.
12. The cluster gear (3F) can now be removed from the carrier (3A). THe 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.

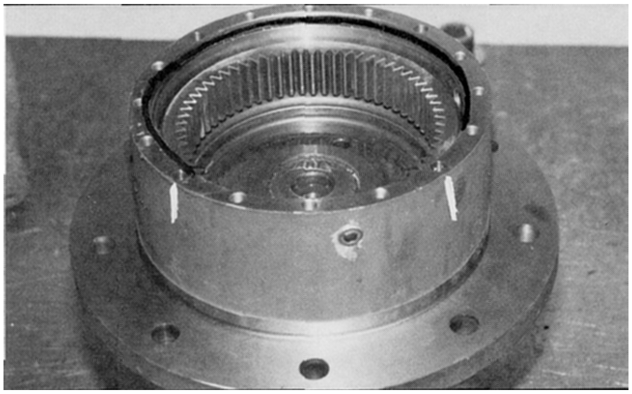
Main Assembly Procedure

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).

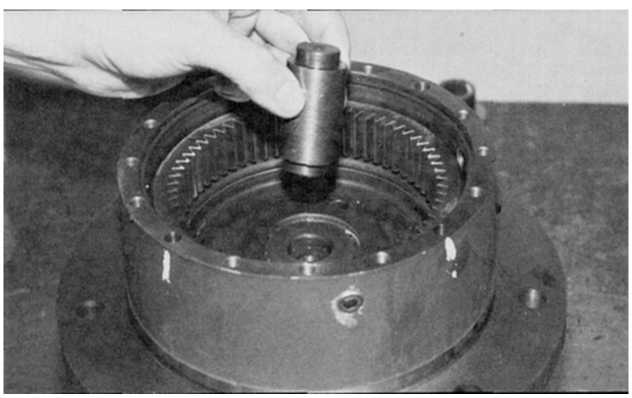


2. Thrust washer (11) is installed on the face of the output shaft (1A). Sufficient grease or petroleum jelly should be used to hold thrust washer in place.

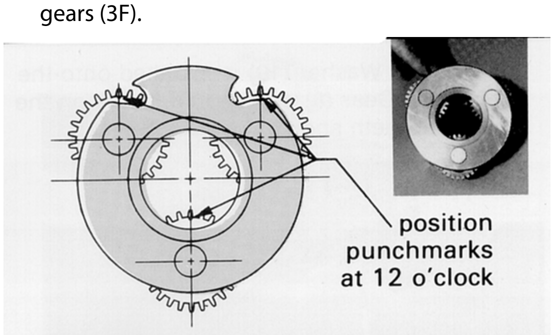
3. Place O-ring (5) into hub counterbore. Use petroleum jelly to hold O-ring in place. Also at this time locate and mark the 4 counter beamed holes in the face of the hub (1G). This is for identification later in the assembly.



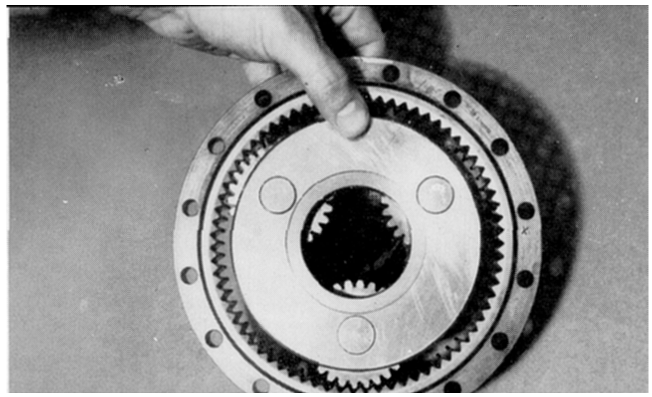
4. Thrust spacer (9) is installed into the bore of the output shaft (1A). This should be a slip fit and thrust spaces should rotate in this location.



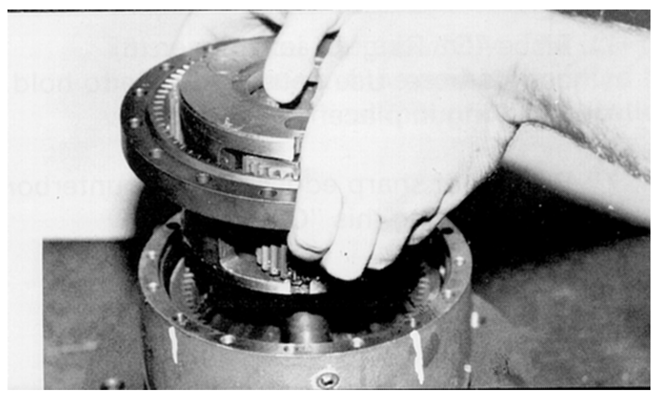
5. Place carrier assembly (3) on a flat surface with the large gears (3F) up and positioned as shown. Find the punch marked tooth on each large gear (3F) and locate at 12 0'clock (straight-up) from each planet pin. Marked tooth will be located just under the carrier (3A) on upper two gears (3F).



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.

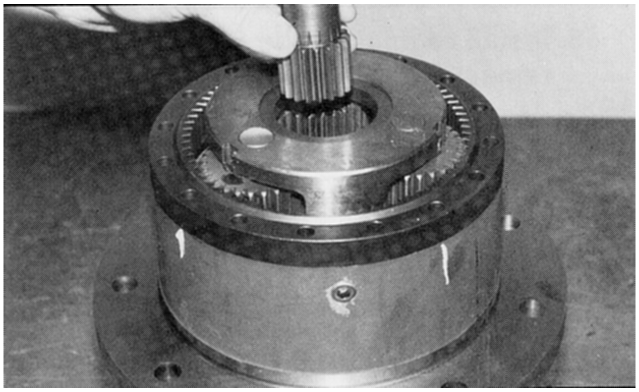


7. While holding ring gear (4) and cluster gears (3F) in mesh, place small side of cluster gears (3F) into mesh with the internal gear (2) and input gear (13). On the ring gear locate the hole marked "x" over one of the marked counterbore holes (step 3) in hub (1G).

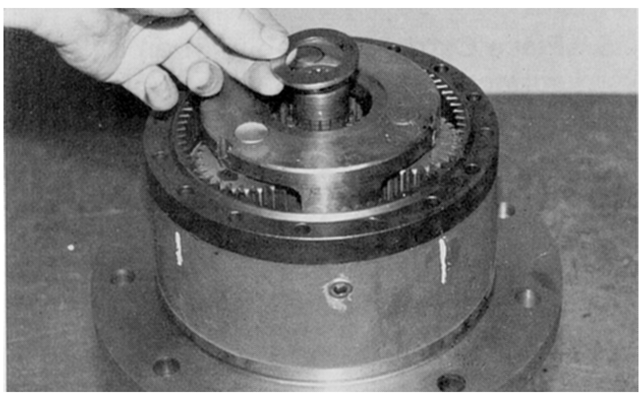


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove the carrier and ring gear and check the cluster gear timing.*

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.

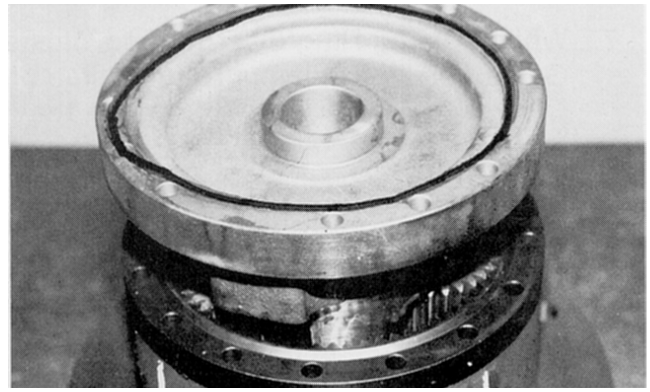


10. Thrust washer (11) is installed into the counterbore of the carrier (3).

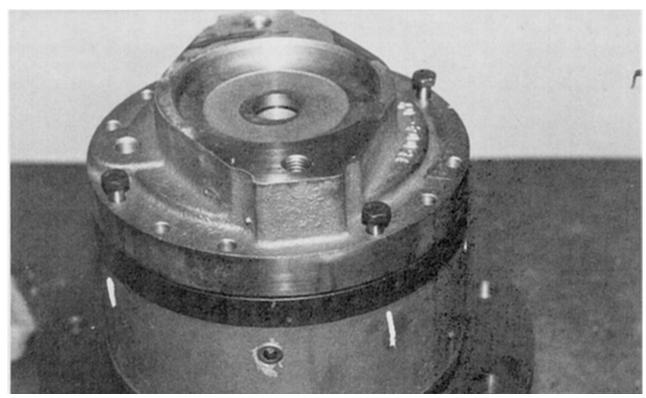
11. Place O-ring (5) into cover (6) counterbore. Use petroleum jelly to hold O-ring in place.

CAUTION

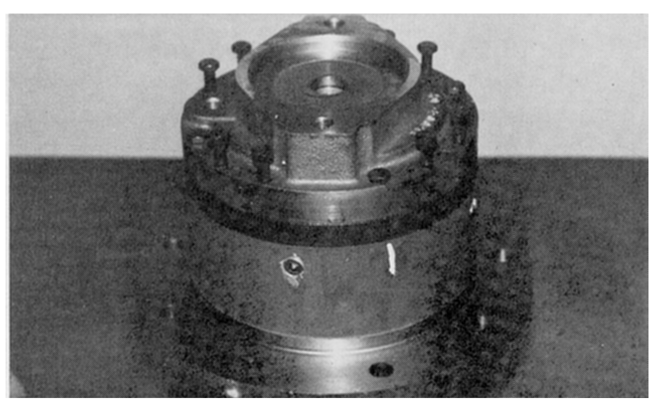
BEWARE OF SHARP EDGES OF THE COUNTERBORE WHILE SEATING THIS O-RING.



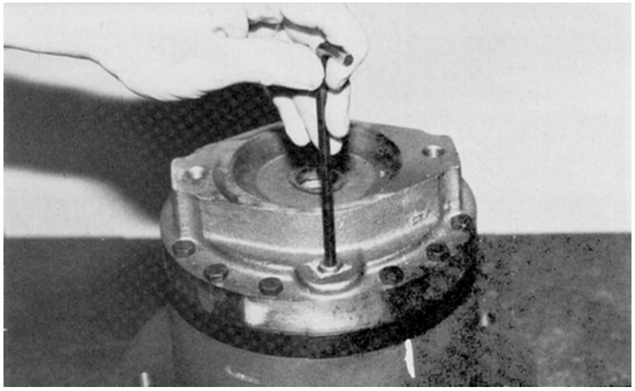
12. The cover (6) is now installed on this assembly. Taking care to correctly align pipe plug hole (20) with those in the hub (1J), usually 90° to one another.
Locate the 4 counterbore holes in hub (1G) (marked in step 3) and install 4 shoulder bolts (13). A slight tap with a hammer may be necessary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



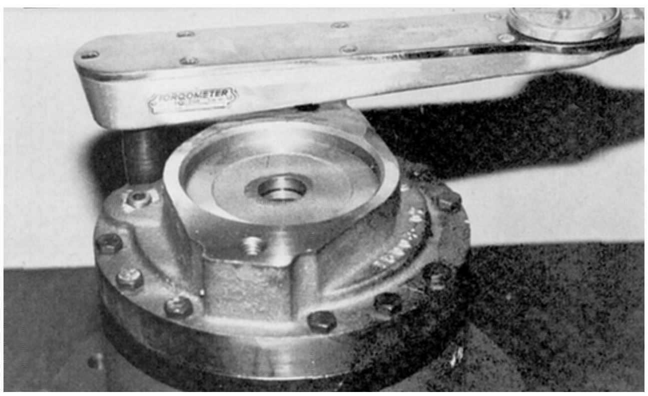
13. Install regular grade 8 bolts (12) into remaining holes.



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



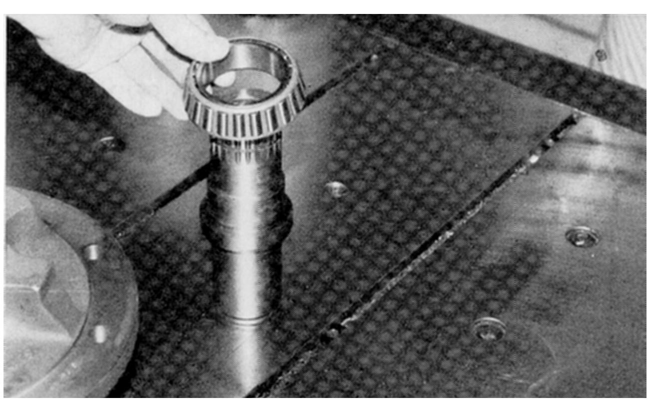
15. Torque shoulder bolts (13) to 23-27 ft. lbs. and regular grade 8 bolts (12) to 23-27 ft. lbs.



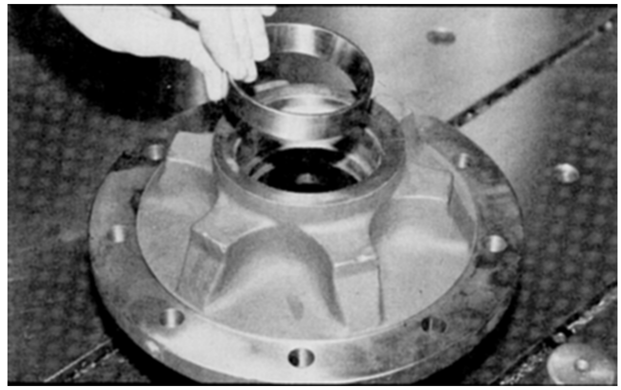
This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation if the unit is mounted horizontally, and completely filled if mounted vertically. In vertical mounting application case oil circulation is recommended.

Hub Shaft Sub-Assembly

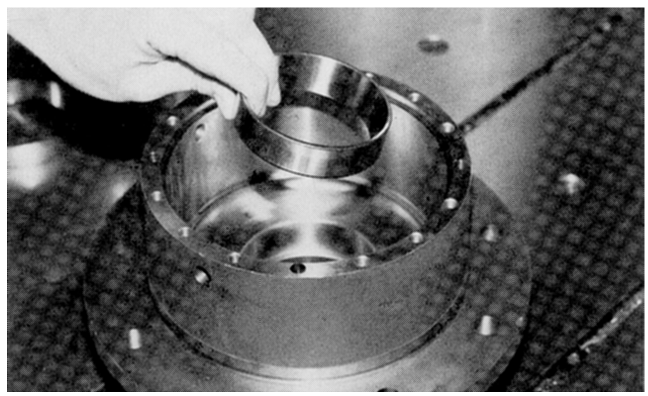
1. Press bearing cone (1D) onto shaft (1A).



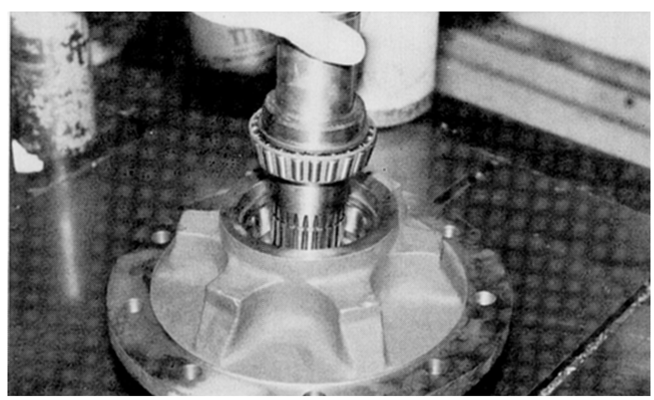
2. Press bearing cup (1C) into hub (1G) taking care to insure cup start square with the bore of the hub.



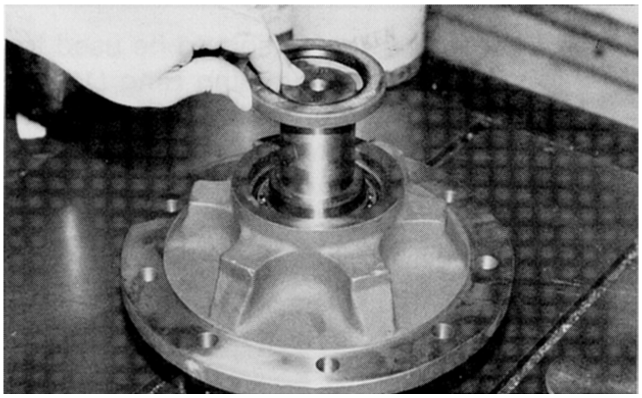
3. Invert hub (1G) and press bearing cup (1E) into inter counterbore of hub (1G).



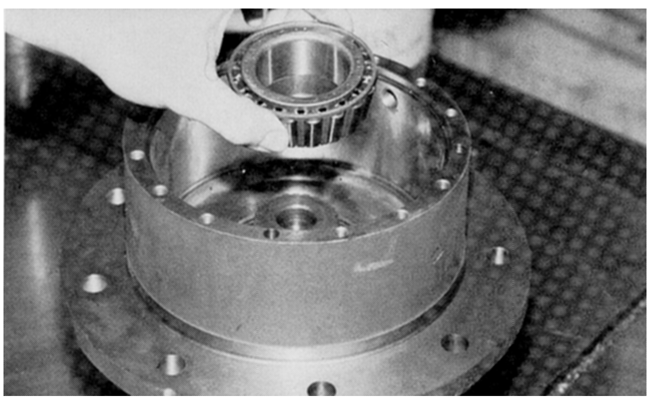
4. Returning the hub (1G) to locate on the large diameter end, the output shaft (1A) is carefully installed into the hub (1G).



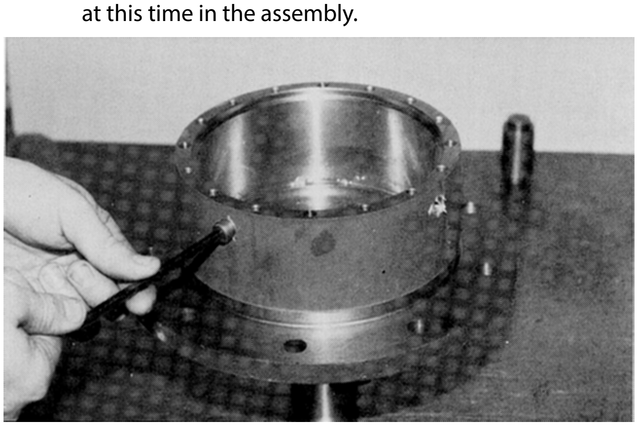
5. The shaft seal (1B) is installed over the output shaft (1A) and into the counterbore of the hub (1G). Care should be taken to insure the seal (1B) is being correctly installed (smooth face up and located just flush with the counterbore face).



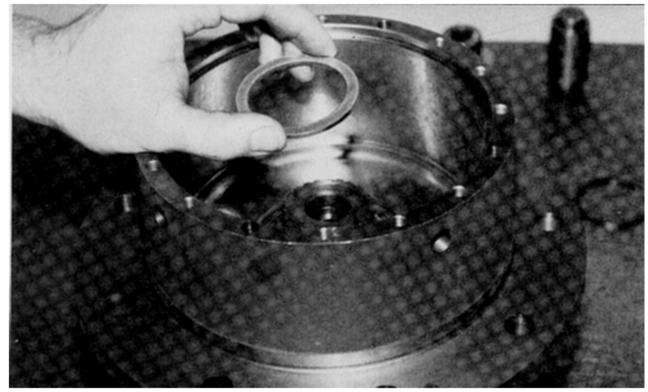
6. The bearing cone (1F) is an interference fit and has to be pressed or tapped on.



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



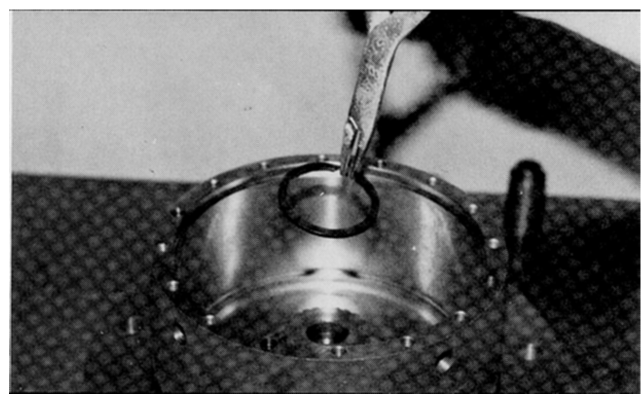
8. Bearing spacer (1H) is installed around the output shaft (1A) and locates on bearing cone (1F).



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

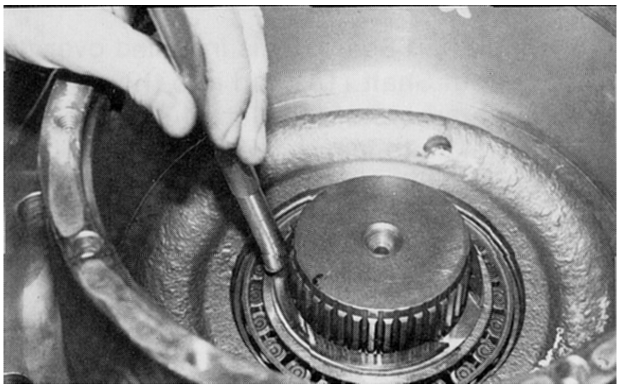
EYE PROTECTION SHOULD BE WORN DURING THIS PROCEDURE.



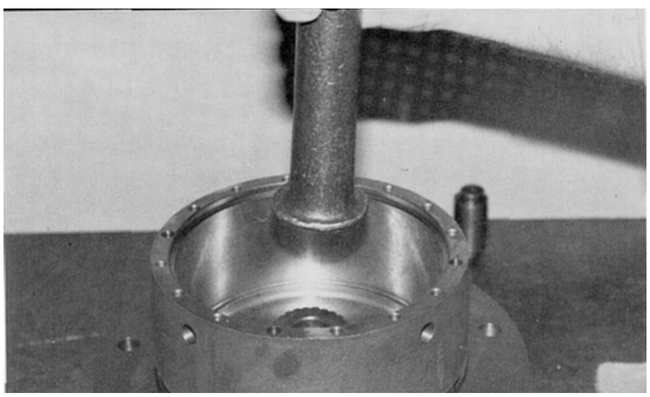
10. A soft metal punch should be used to insure that this retaining ring (1I) is completely seated in the groove of the output shaft (1A).

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.

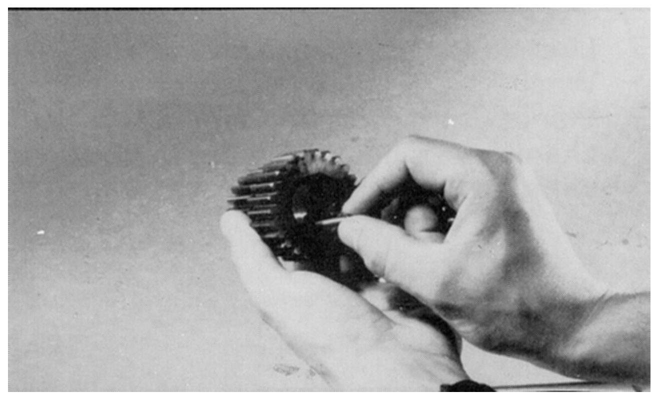


This completes the hub shaft sub-assembly —items (1A) through (1J). If this assembly is not going to be used right away, it should be oiled and covered to help prevent rusting,

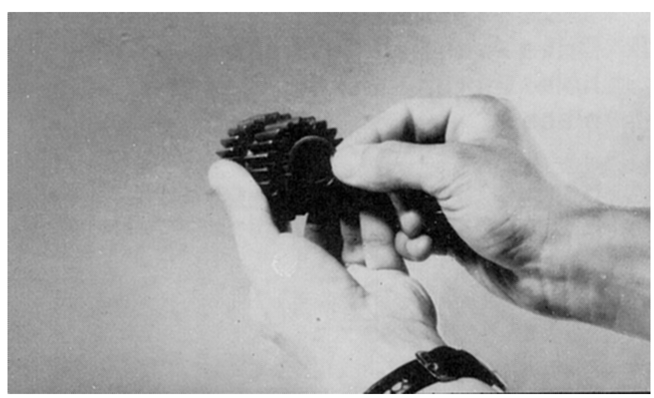
Carrier Sub-Assembly

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

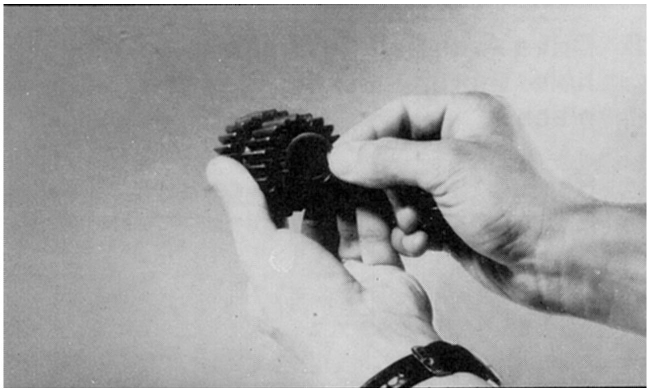
2. Place needle rollers into cluster gear bore.



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

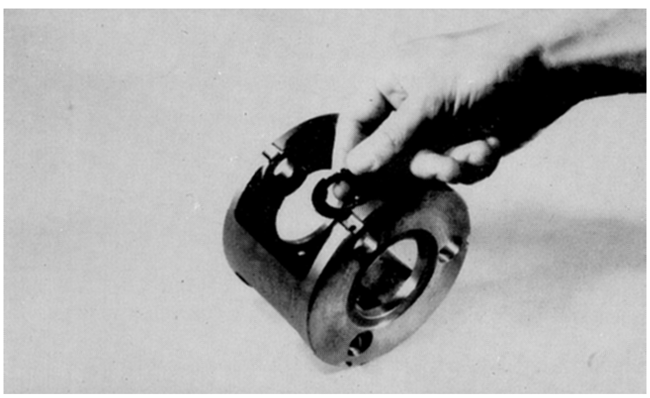


4. Place second set of needle rollers into cluster gear.

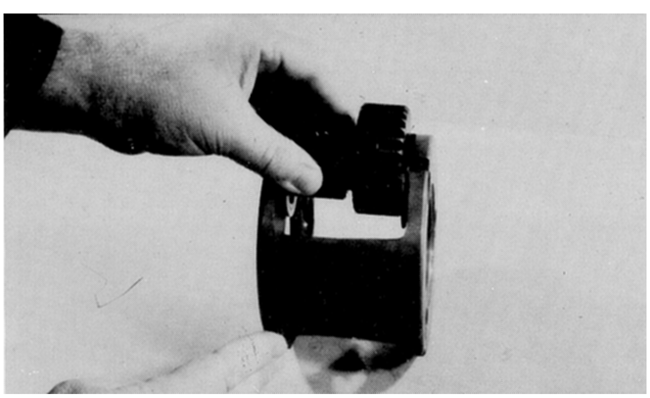


5. Apply grease or petroleum jelly to the tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.

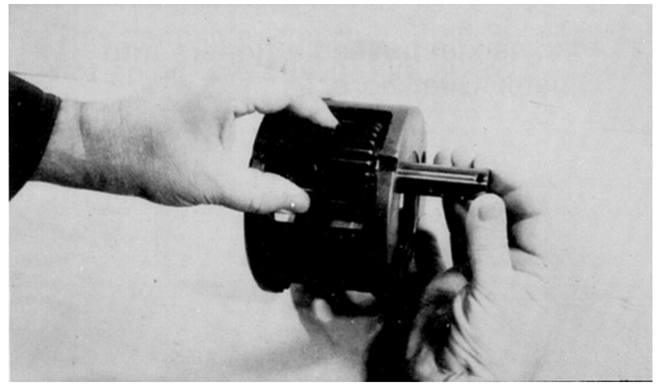
NOTE: *Some old style carriers will not have slots and tangs should be located inside boss relief.*



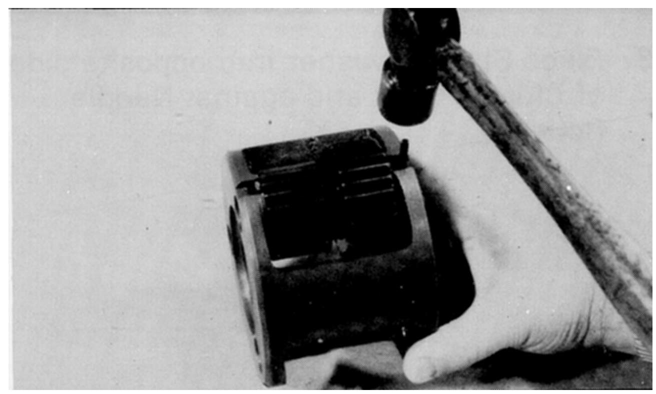
6. While keeping thrust washers in place, slide cluster gear into carrier with the larger gear on the side with the small pin hole.

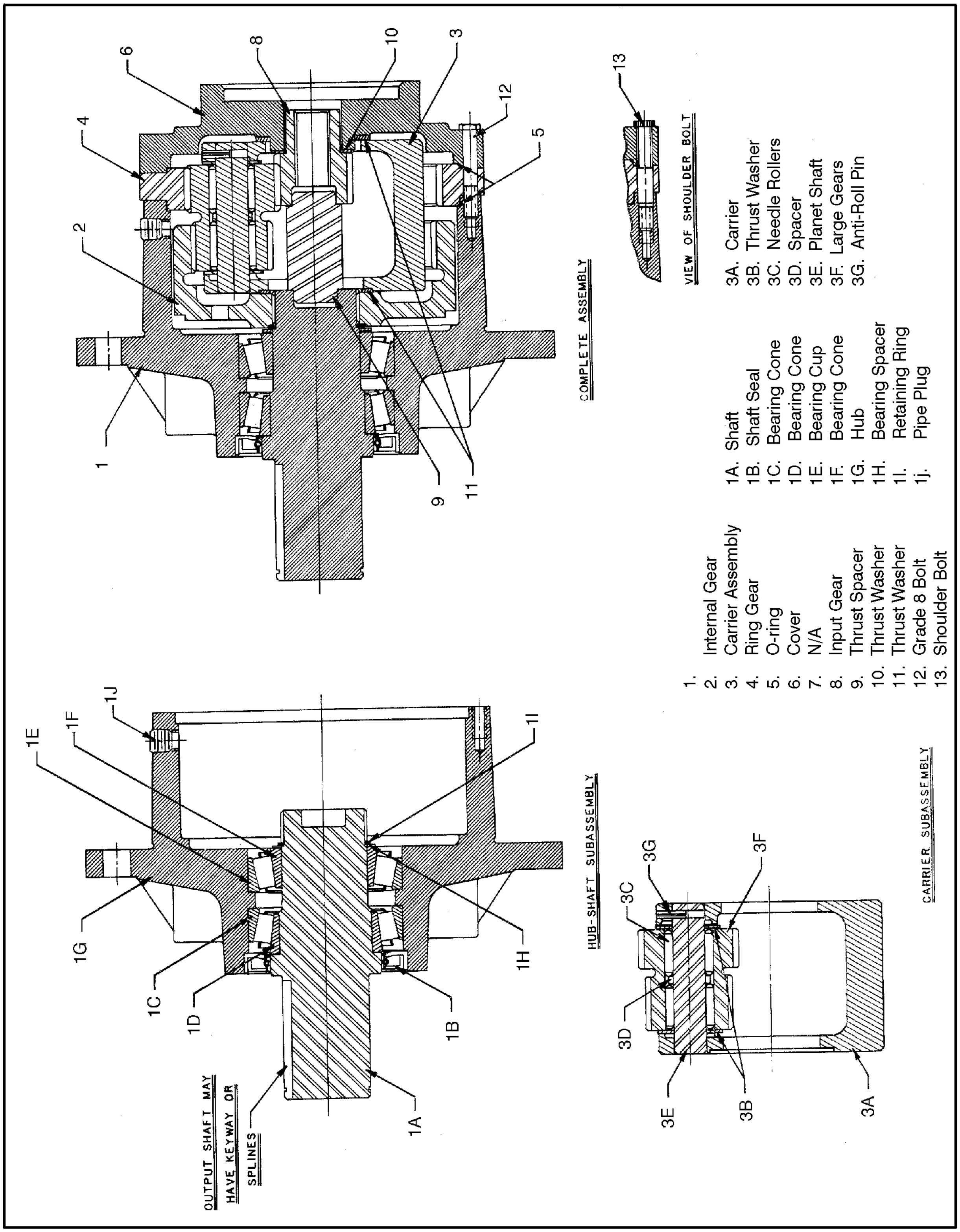


7. Line up cluster gear and thrust washer with hole in carrier and slide planet shaft through. Line up chamfered side of hole in planet shaft with pin hole in carrier.



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.





1. Internal Gear
2. Carrier Assembly
3. Ring Gear
4. O-ring
5. Cover
6. N/A
7. Input Gear
8. Thrust Spacer
9. Thrust Washer
10. Thrust Washer
11. Grade 8 Bolt
12. Shoulder Bolt
13. Shoulder Bolt

- 1A. Shaft
- 1B. Shaft Seal
- 1C. Bearing Cone
- 1D. Bearing Cone
- 1E. Bearing Cup
- 1F. Bearing Cone
- 1G. Hub
- 1H. Bearing Spacer
- 1I. Retaining Ring
- 1j. Pipe Plug

- 3A. Carrier
- 3B. Thrust Washer
- 3C. Needle Rollers
- 3D. Spacer
- 3E. Planet Shaft
- 3F. Large Gears
- 3G. Anti-Roll Pin

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).

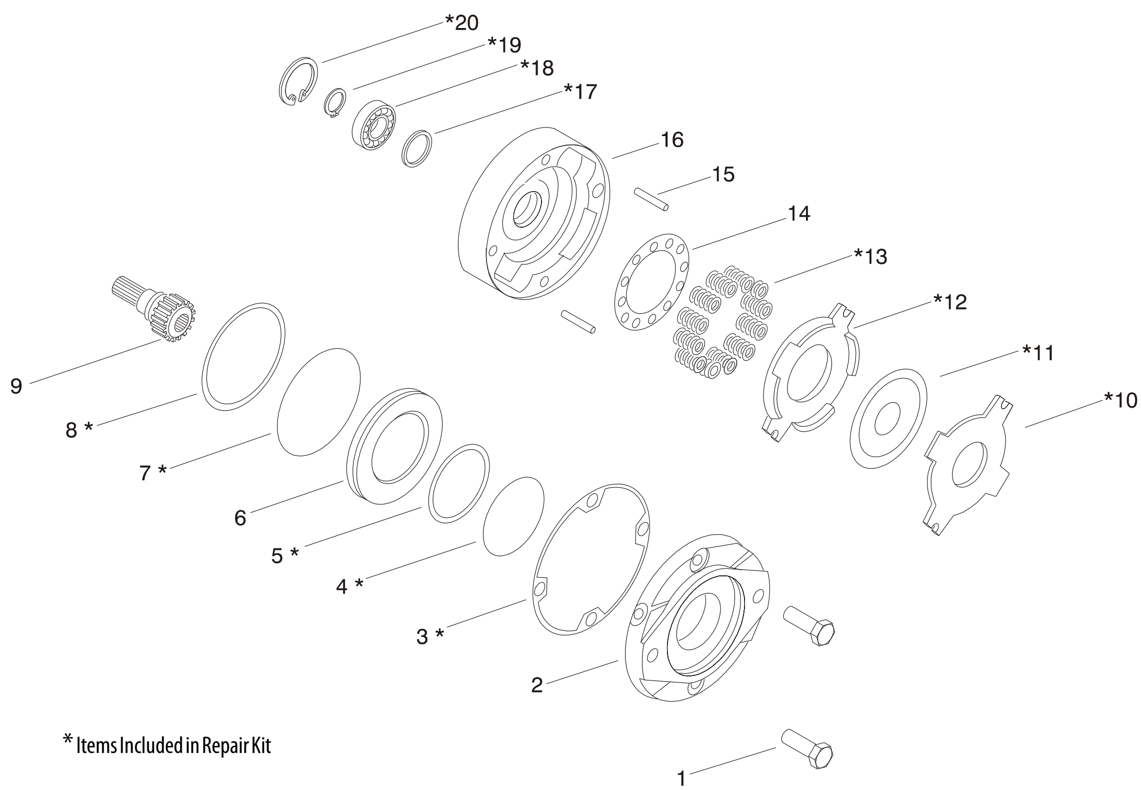
NOTE: *Be careful not to shear o-rings or back-up rings. Be careful not to scratch or mar piston.*

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

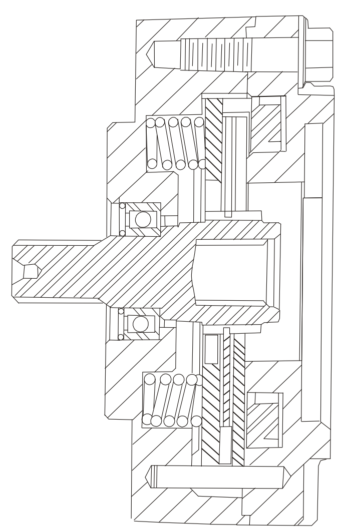


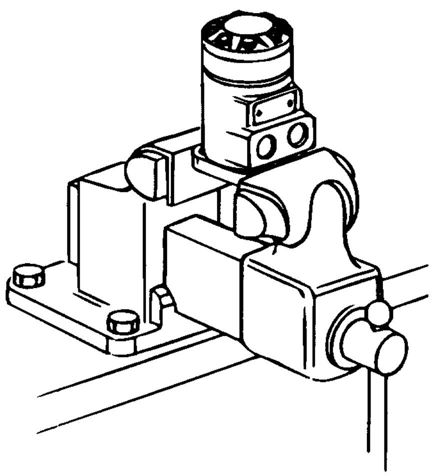
Figure 3-45. Swing Brake (S/N 0300068040 to S/N 0300183033)

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

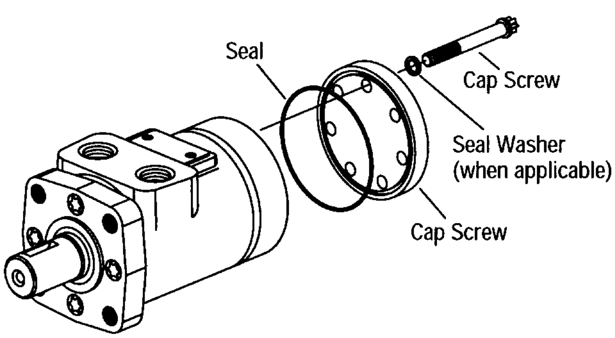
Disassembly

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.

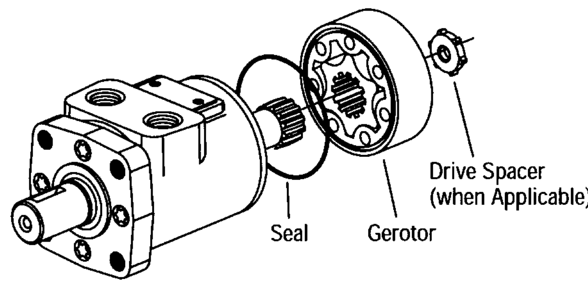
Although not all drawings show motor in a vise, we recommend that you keep the motor in a vise during disassembly. Follow the clamping procedures explained throughout the manual.



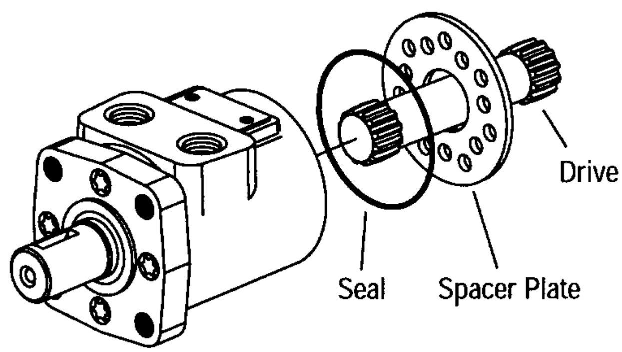
1. Place motor in vice and clamp across edge of flange with output shaft down. When clamping, use protective device on vice such as special soft jaws, pieces of hard rubber or board.



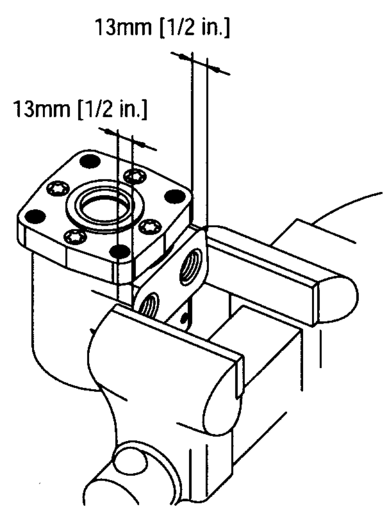
2. remove cap screws and seal washers.
3. Remove end cap.
4. Remove seal from end cap.



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.

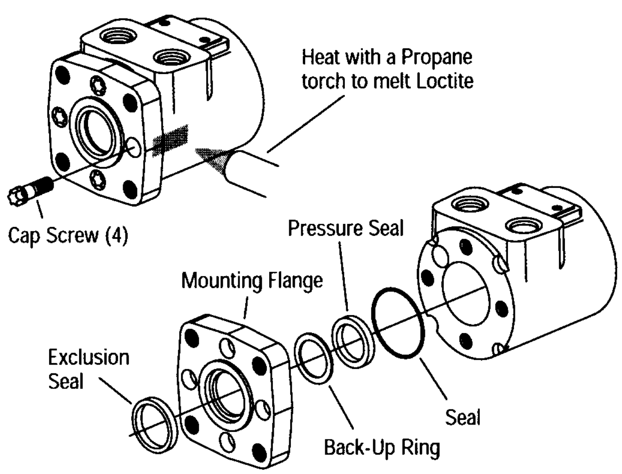


13. Reposition motor in vise. Clamp across ports as shown above. Do not clamp side of housing. Excessive clamping pressure on side of housing causes distortion.
14. Remove cap screws from mounting flange. These screws are assembled with Loctite to hold them in place.

    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.*

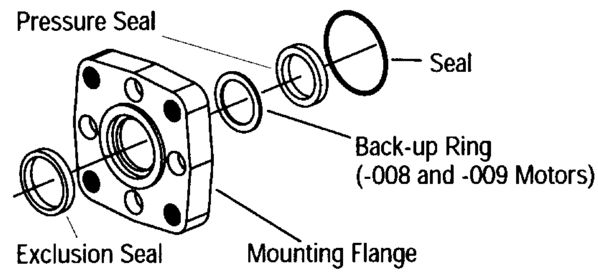
When heated, Loctite partially melts. This reduces the torque required to remove screw. Use small flame propane torch to heat small area of housing where screw enters (see figure below). Be careful not to overheat housing and damage motor. Gradually apply torque to screw with socket wrench as heat is 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

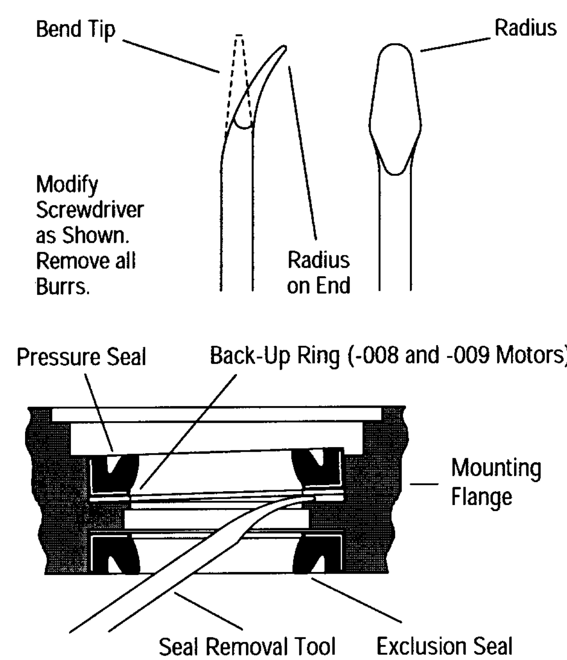
SOME MOTORS MAY HAVE A QUAD SEAL AND BACK-UP RING IN PLACE OF THE PRESSURE SEAL. THE QUAD SEAL AND BACK-UP RING ARE NO LONGER AVAILABLE AND ARE REPLACED BY THE PRESSURE SEAL. THEY ARE INTERCHANGEABLE, BUT SOME PRECAUTIONS MUST BE TAKEN TO INSURE PROPER INSTALLATION. FOLLOW THE REASSEMBLY INSTRUCTIONS.



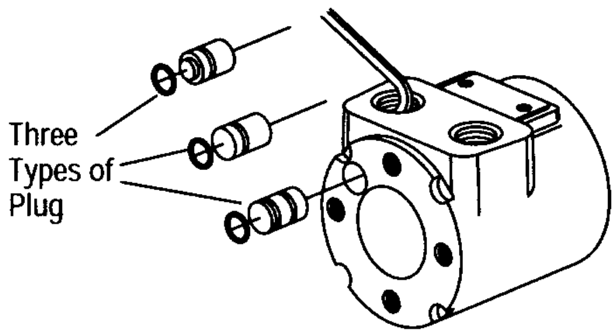
16. Exclusion seal, back-up ring, pressure seal and seal will come off with flange. Use seal removal tool as shown to remove exclusion and pressure seals.

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:

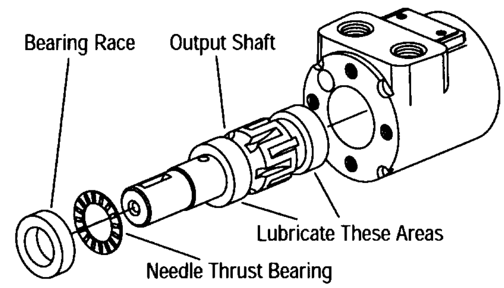
NOTE: *Fully cured Loctite resists most solvents, oils, gasoline and kerosene and is not affected by cleaning operations. It is not necessary to remove cured Loctite that is securely bonded in tapped holes; however, any loose particles of cured Loctite should be removed.*

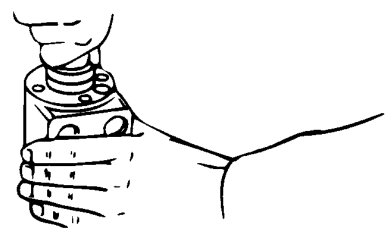
a. Wash the housing with solvent to remove oil, grease and debris. Pay particular attention to four tapped holes on flanged end.
b. Blow dry with compressed air. Clean and dry tapped holes.
c. Wire brush screw threads to remove cured Loctite and other debris. Discard any screws that have damaged threads 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.



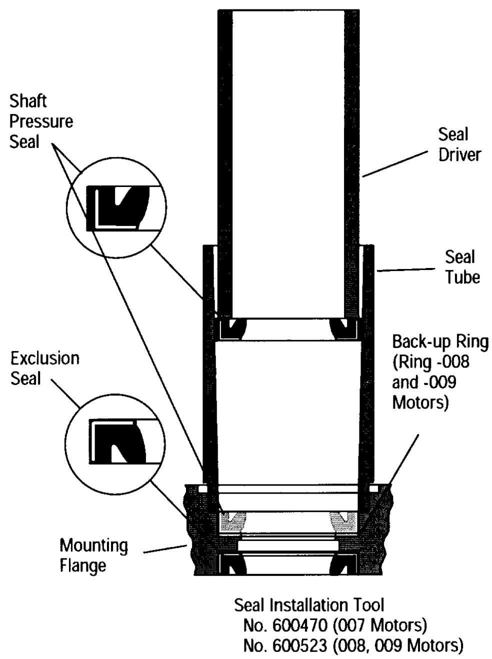


2. Lubricate output shaft with hydraulic oil, then install shaft in housing.

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.



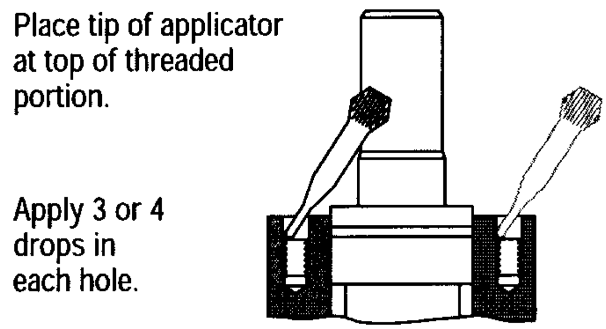
4. Install exclusion seal in flange. Carefully press exclusion seal into place.
5. Visually check seal seat in mounting flange for scratches or other marks that might damage the pressure seal. Check for cracks in flange that could cause leakage.
6. Lubricate I.D. of seal tube and O.D. of shaft pressure 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.

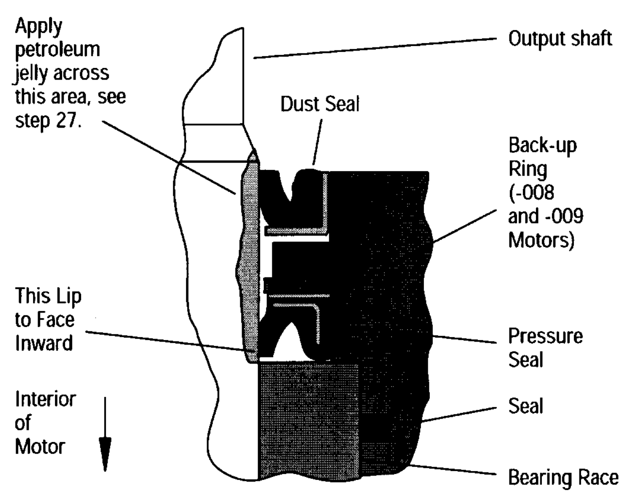
7. Install 49 mm (1.937 in.) I.D. seal in flange.
8. It is recommended to apply a light coat of Loctite Primer NF in tapped holes of housing. Allow primer to dry for at least 1 minute. Do not force dry with air jet; the primer will blow away.

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



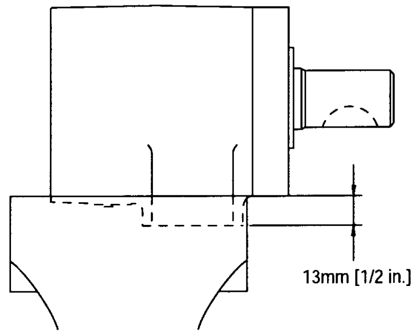
9. Apply 3 or 4 drops of Loctite sealant at top of threads for each of the four holes in housing. Do not allow parts with Loctite applied to come on contact with metal parts other than those for assembly.Wipe off excess Loctite from housing face, using a non petroleum base solvent.

   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.

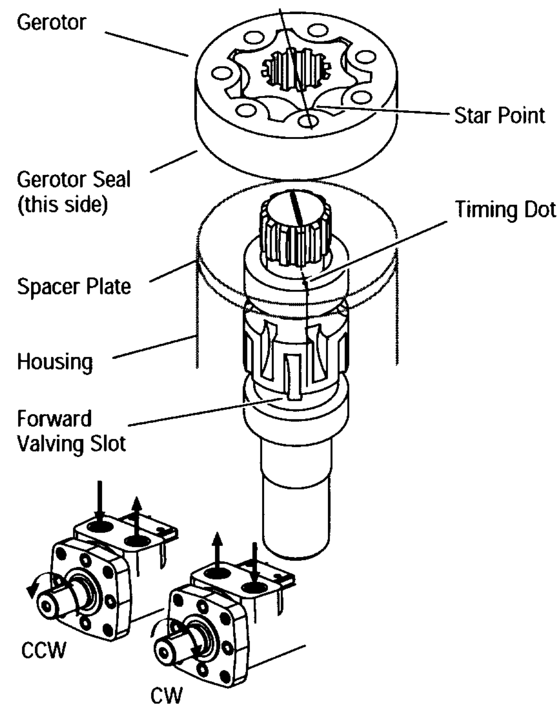
Timing Procedure

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

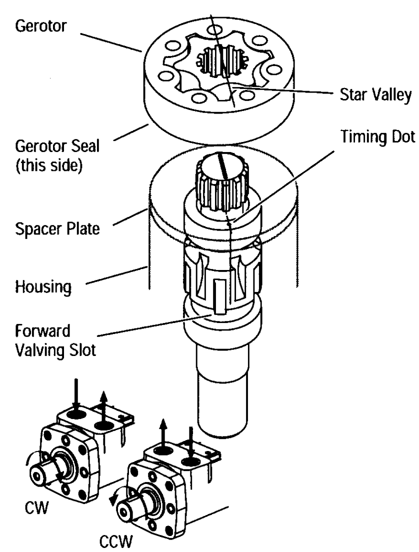
NOTE: *If drive is not symmetrical, install larger splined end into shaft.*

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.

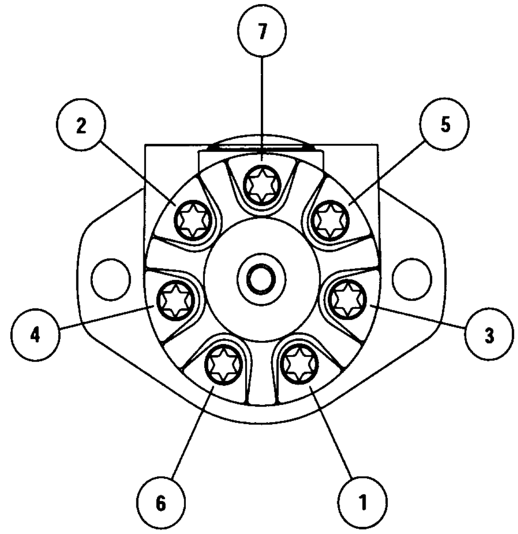
Standard rotation align any star point with tooth marked on drive (see figure below).



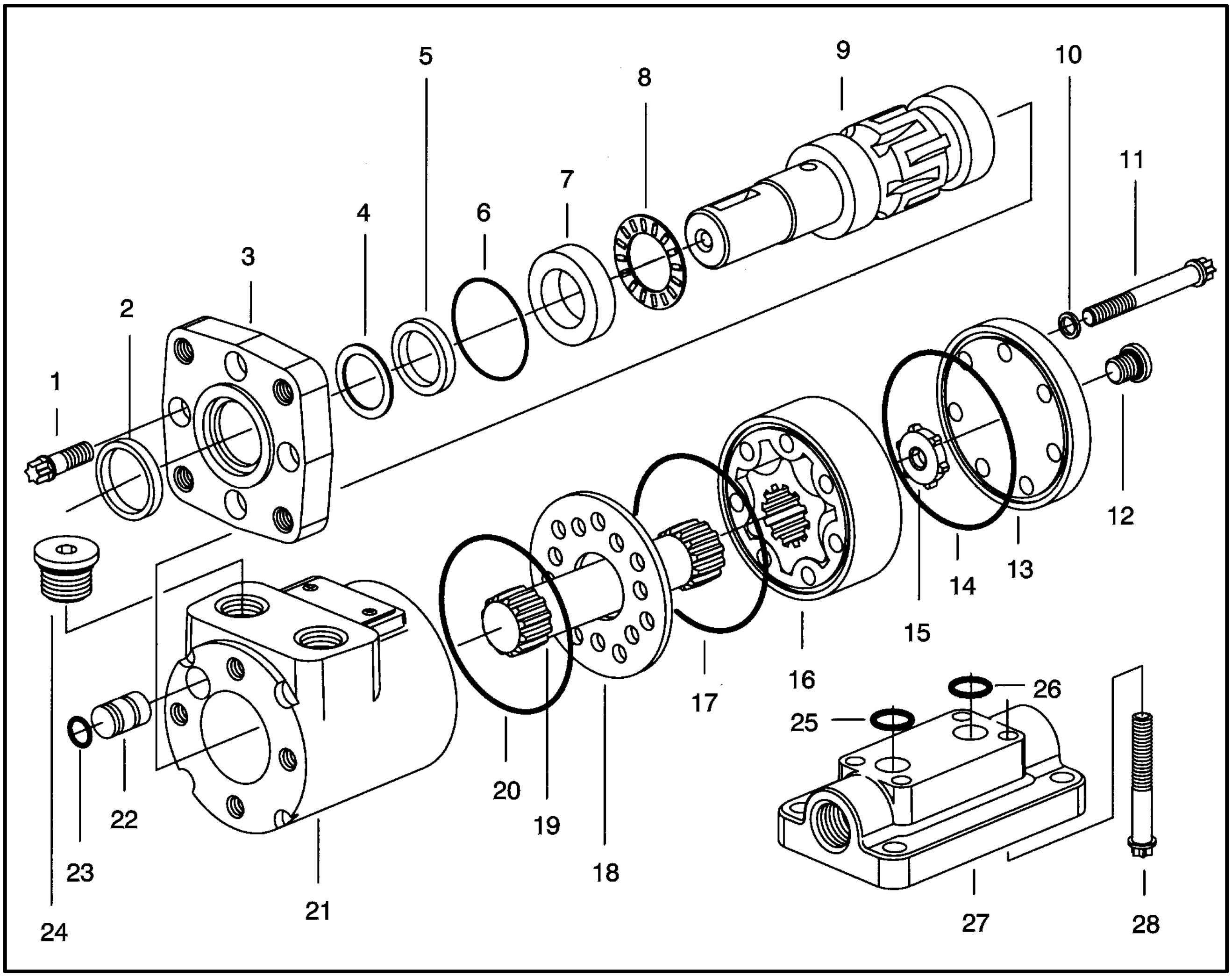
Reverse rotation align any star valley with marked tooth (see figure below).



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.

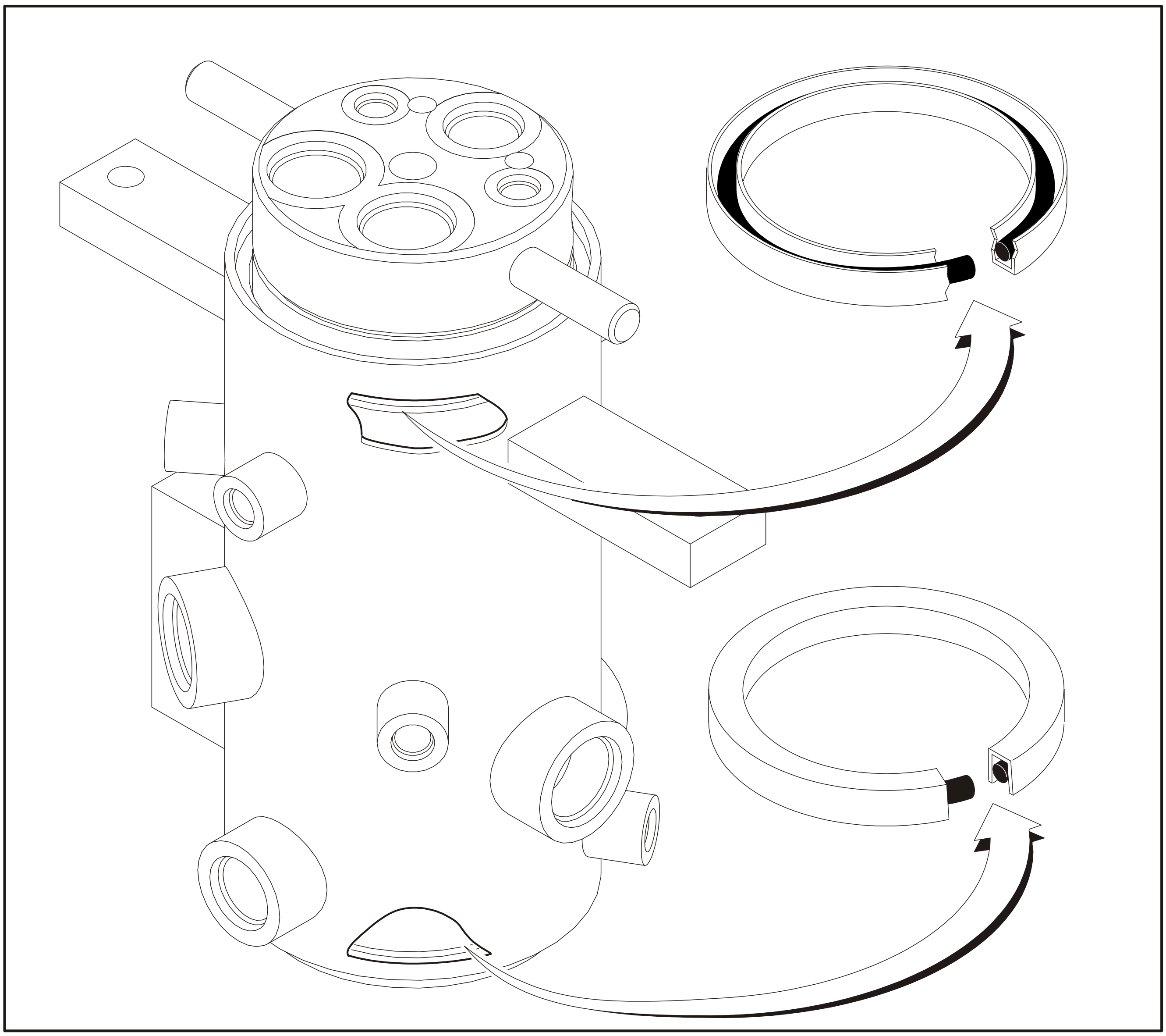
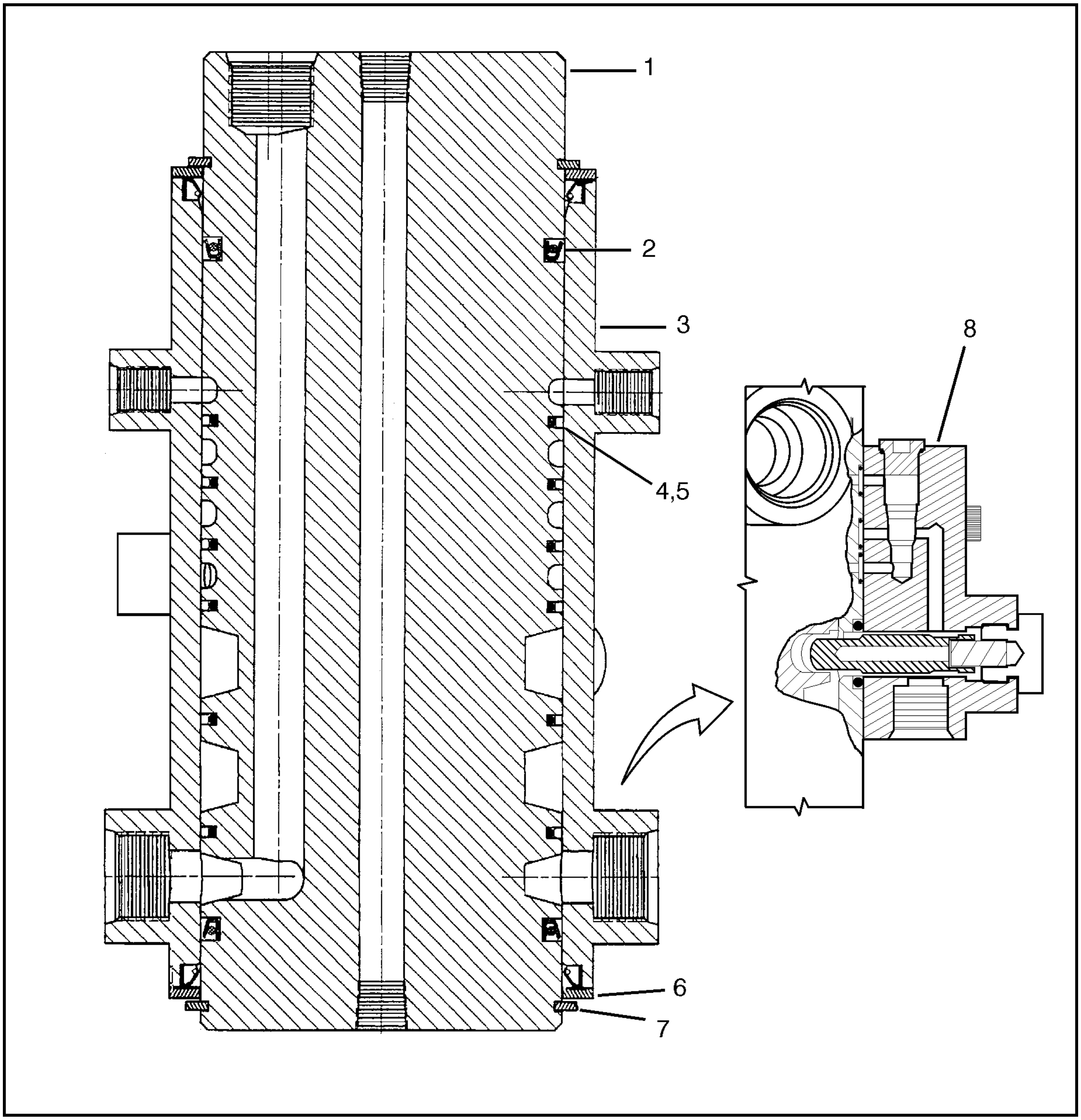


Figure 3-47. Rotary Coupling Seal Installation



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

Figure 3-48. Rotary Coupling Cutaway

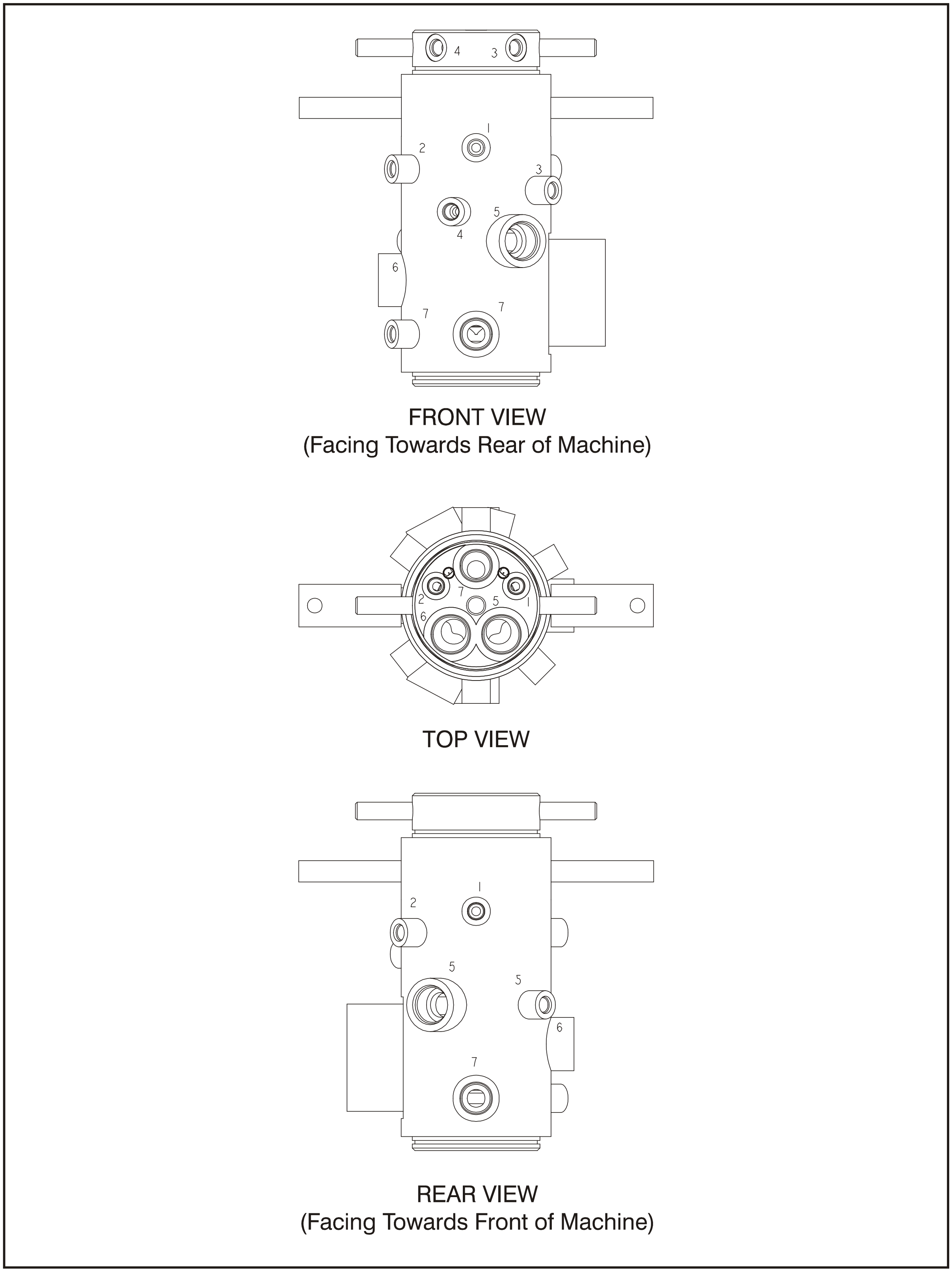


Figure 3-49. Rotary Coupling Port Location (7 Port)

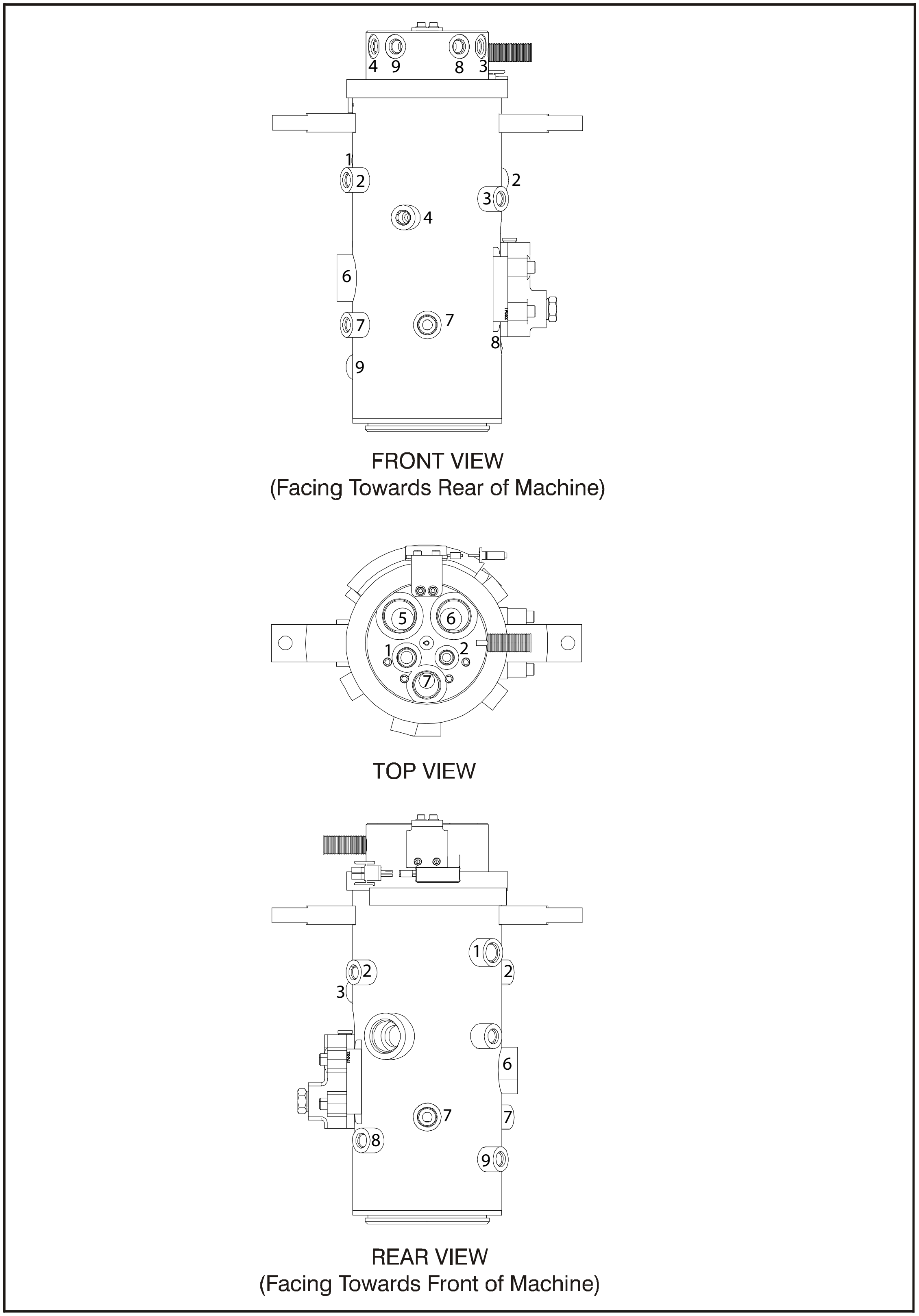
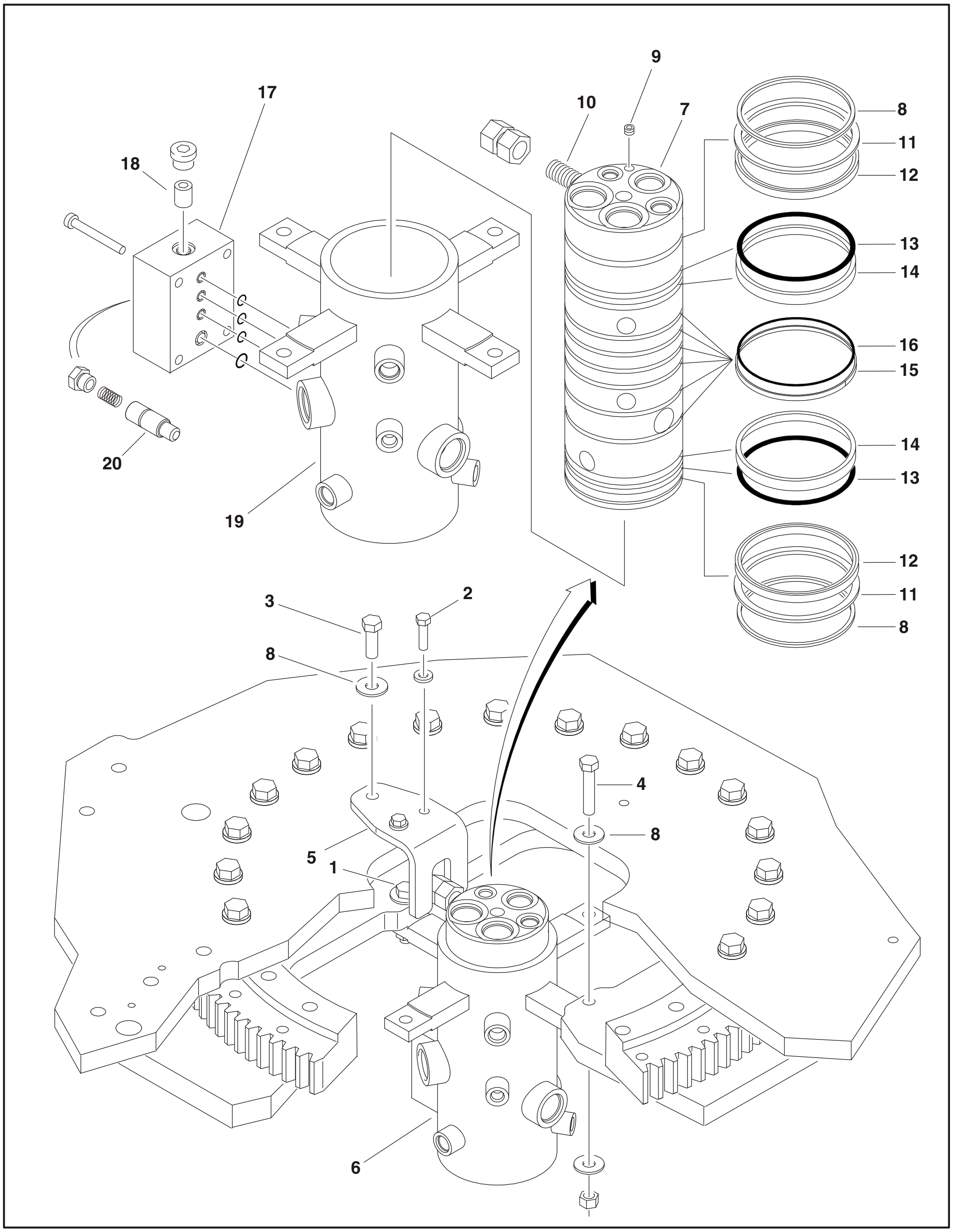


Figure 3-50. Rotary Coupling Port Location (9 Port)



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.

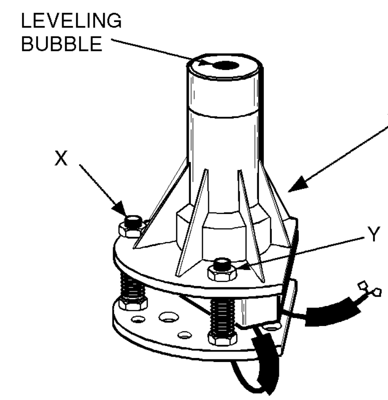


Figure 3-52. Tilt Switch Adjustment

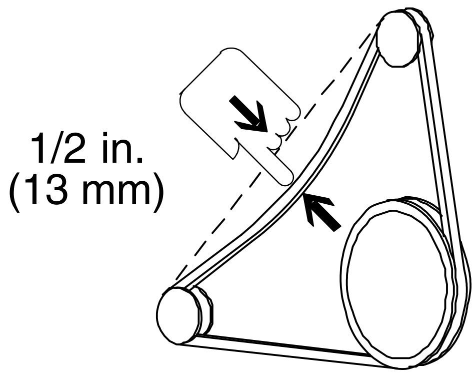
3.21 SPARK ARRESTER CLEANING INSTRUCTIONS

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

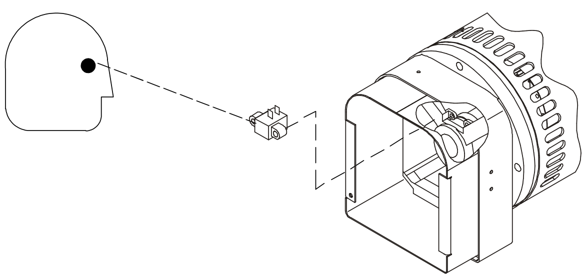
Every 250 hours

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

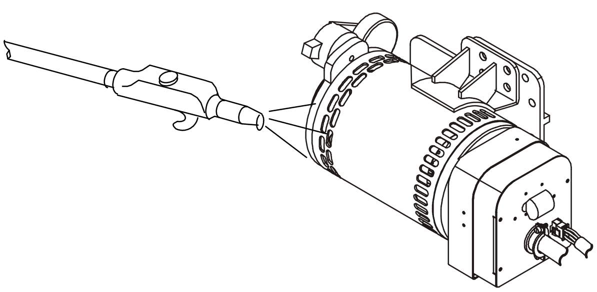


Every 500 hours

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.

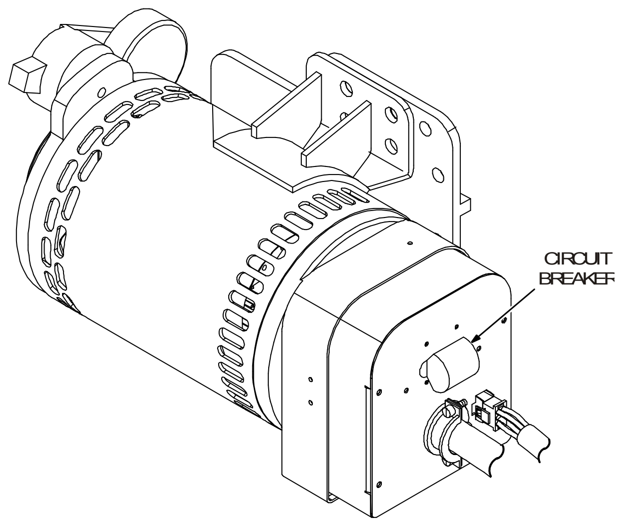


Overload Protection

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.

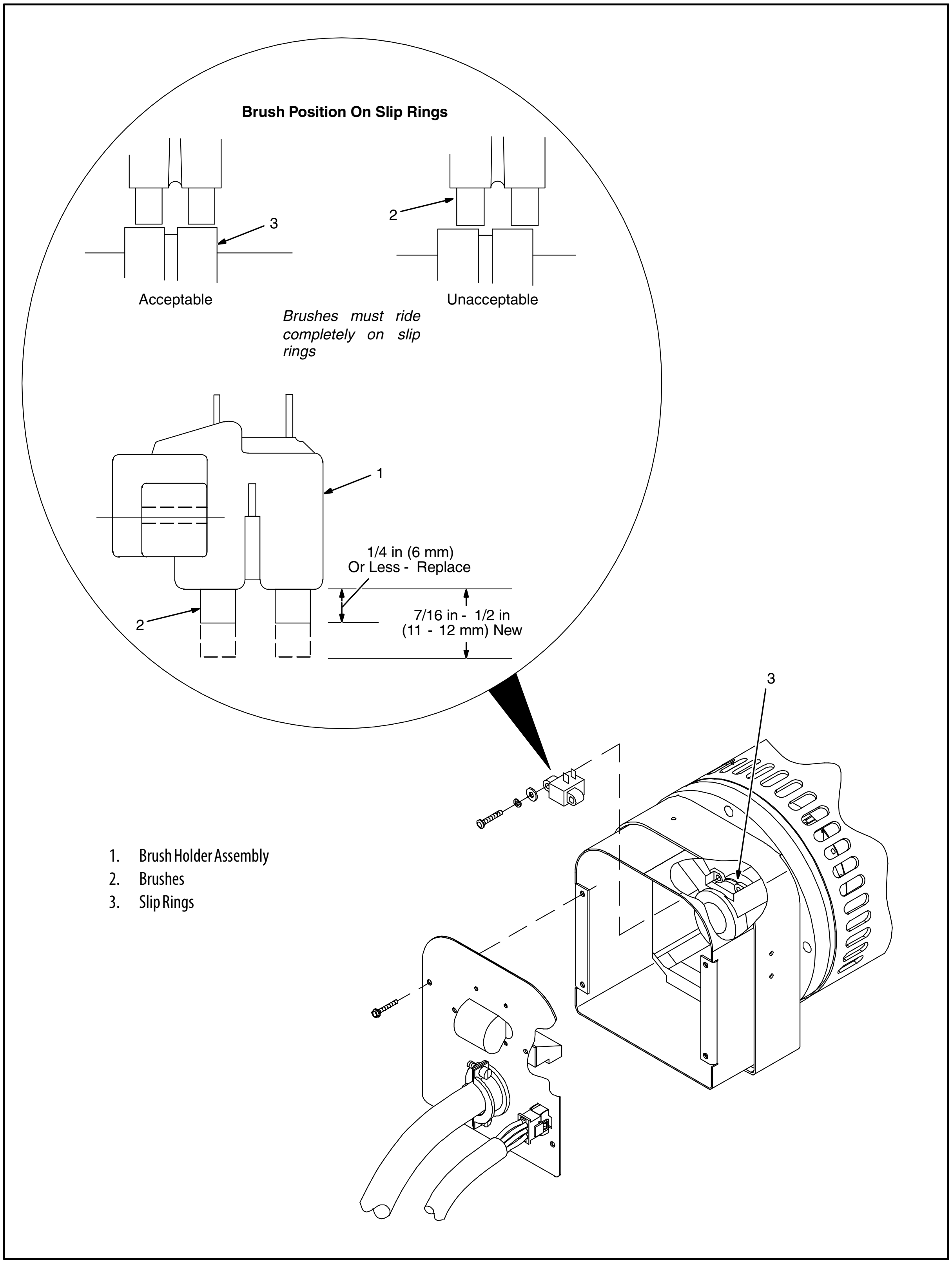


Figure 3-53. Inspecting Generator Brushes, Replacing Brushes, and Cleaning Slip Rings

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 re-installed 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.

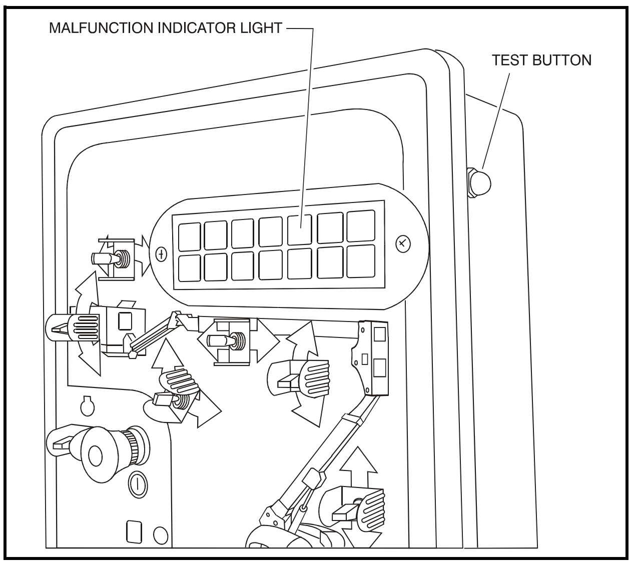


Figure 3-54. Malfunction Indicator and Test Button

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.

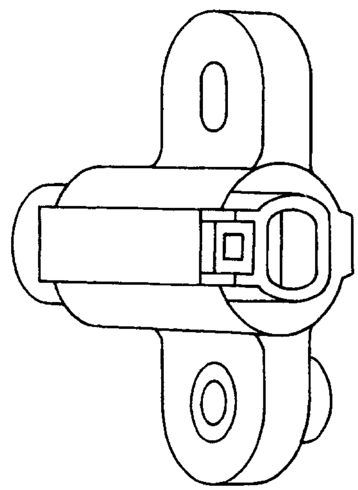


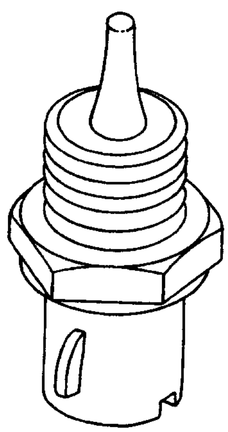
Table 3-11. ECM Diagnostic Trouble Codes

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

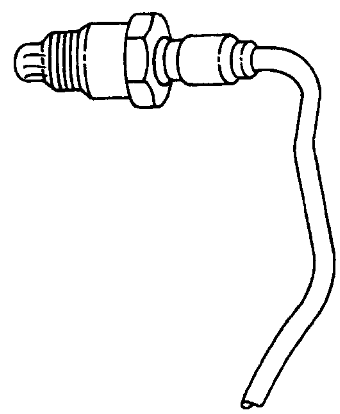
The heated oxygen sensor is mounted in the exhaust stream where it can monitor the oxygen content of the exhaust gas. The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100 mV to 900 mV. The heated oxygen 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).



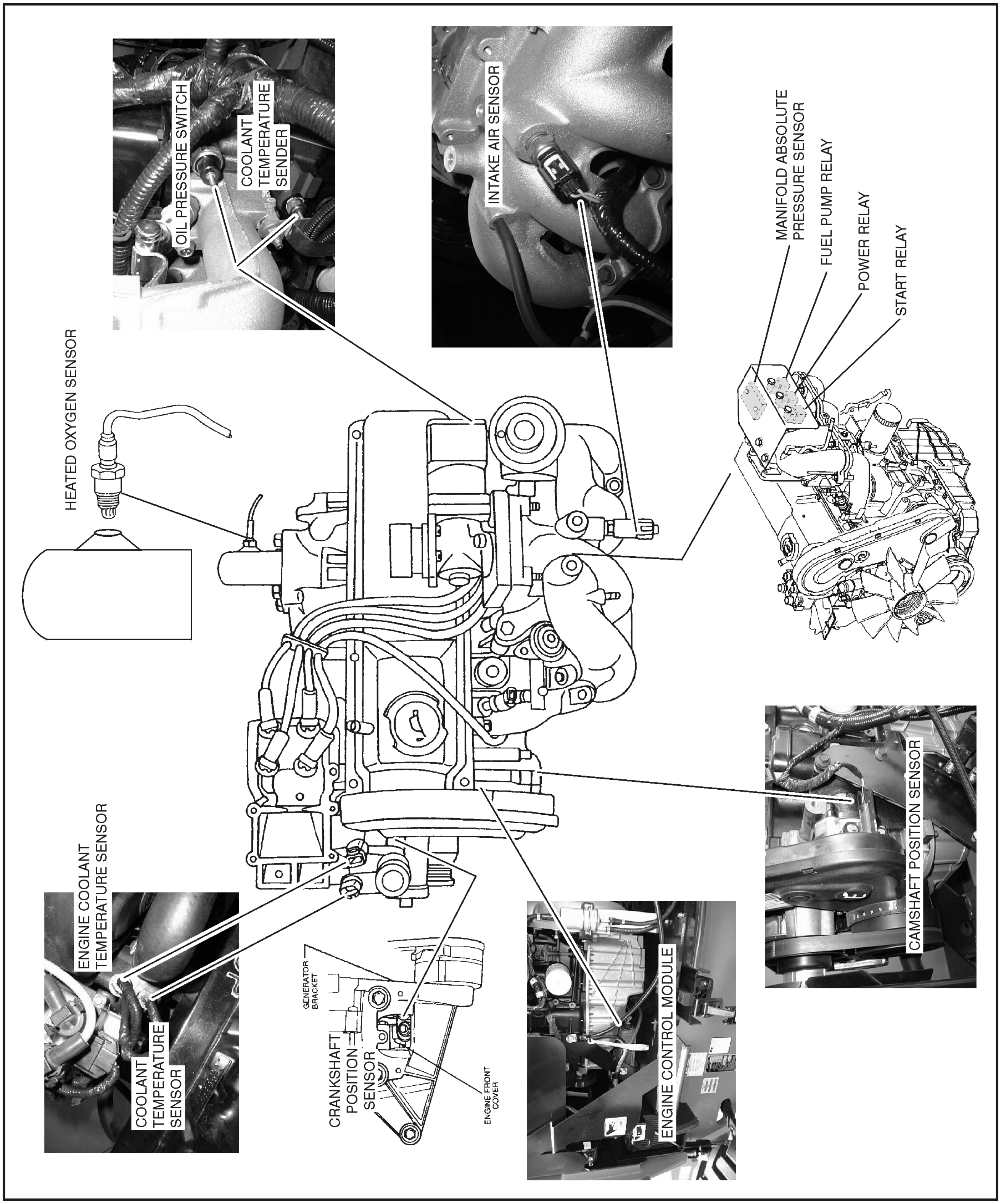
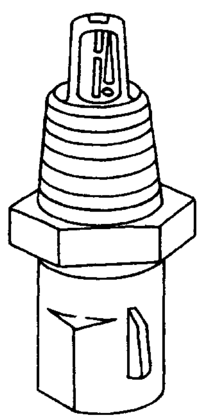


Figure 3-55. EFI Component Location

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.



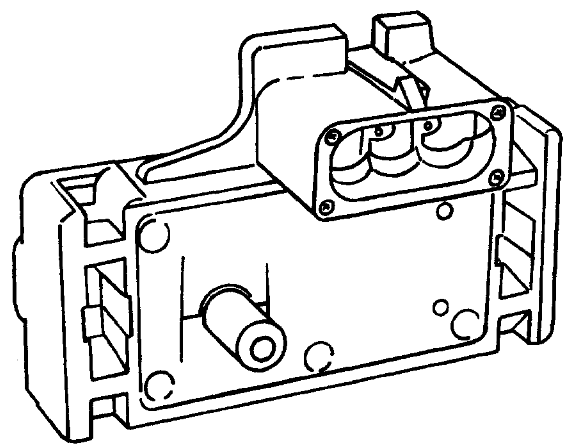
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

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)

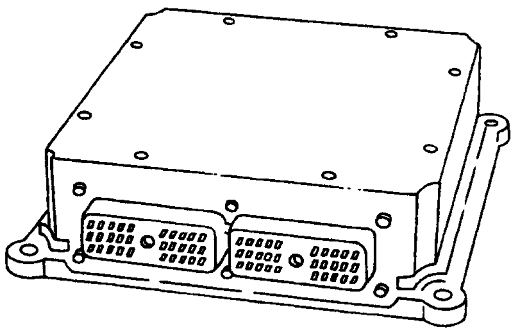
The ECM controls the following:

- 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

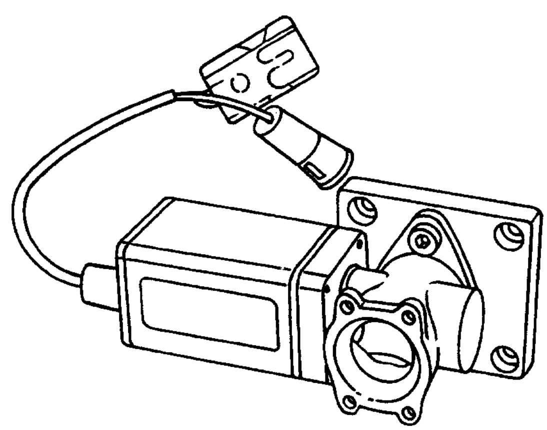
The ECM is designed to withstand normal current draws associated with engine operation. When servicing the ECM, observe the following guidelines:

- 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

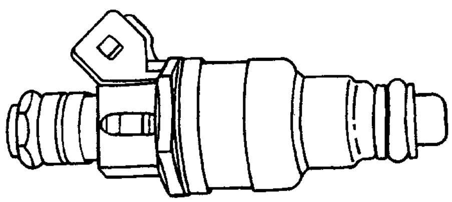
Fuel System

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.

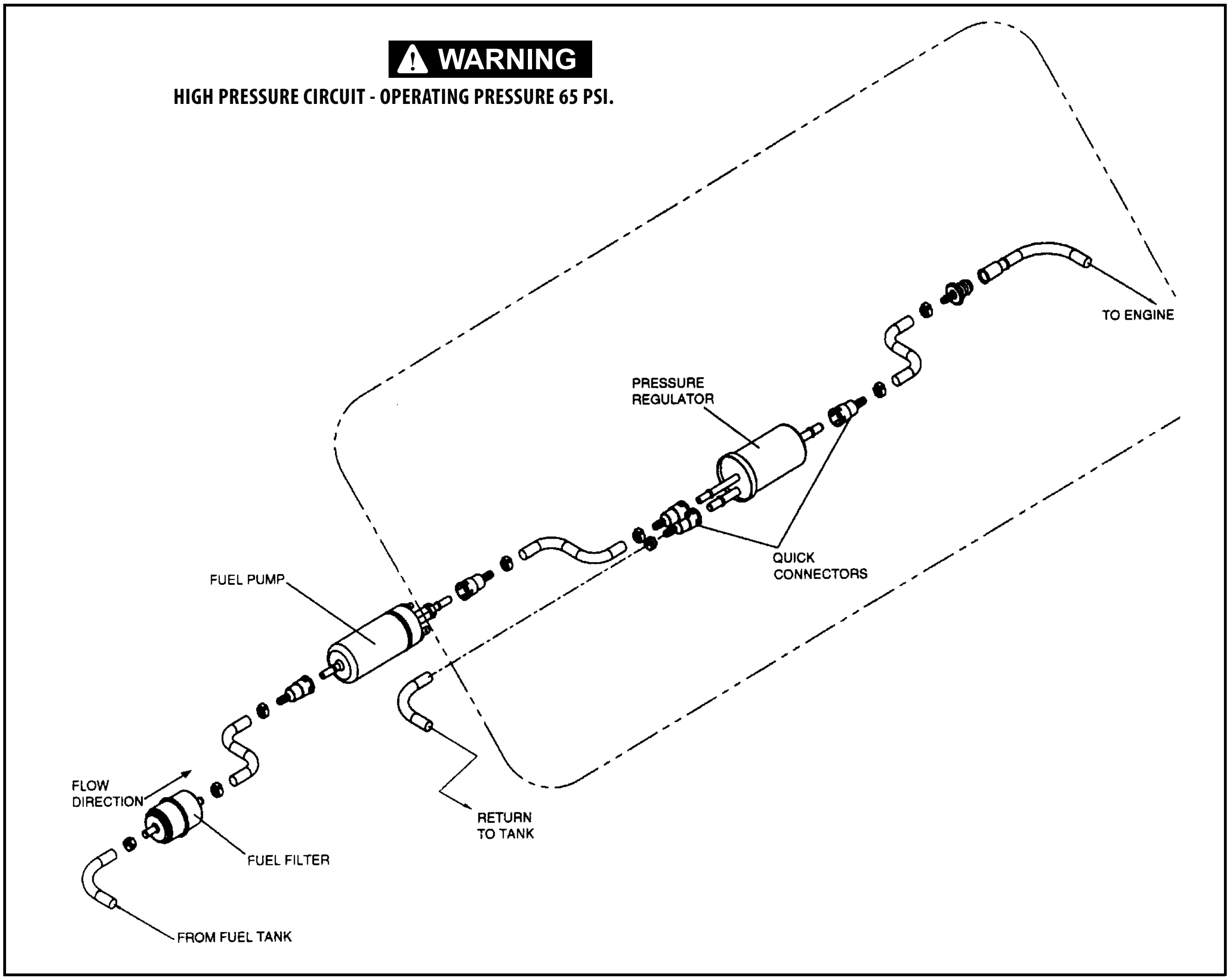


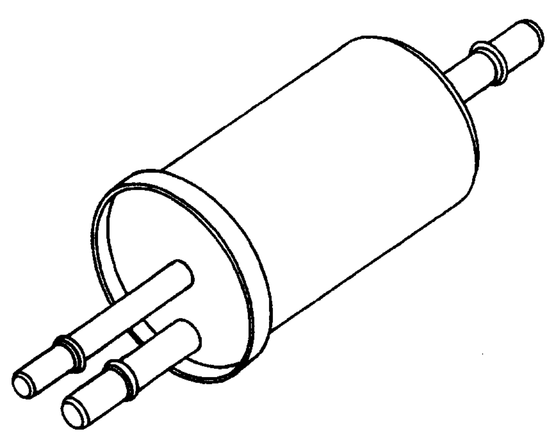
Figure 3-56. Typical Fuel System

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.



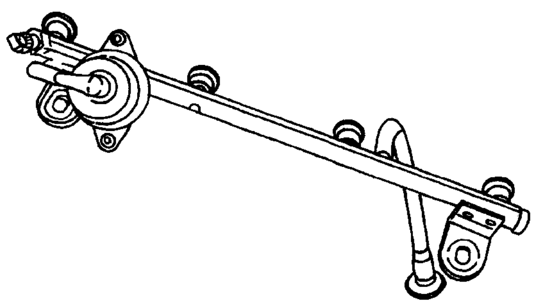
FUEL PUMP ELECTRICAL CIRCUIT

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.

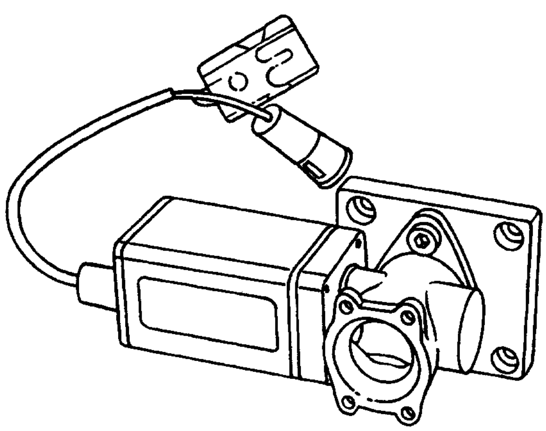
FUEL RAIL

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.

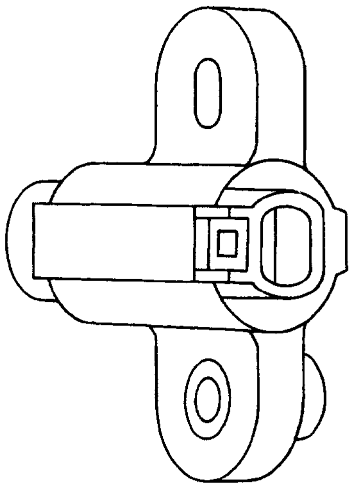
The system remains in open loop until the following conditions are met:

- 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.

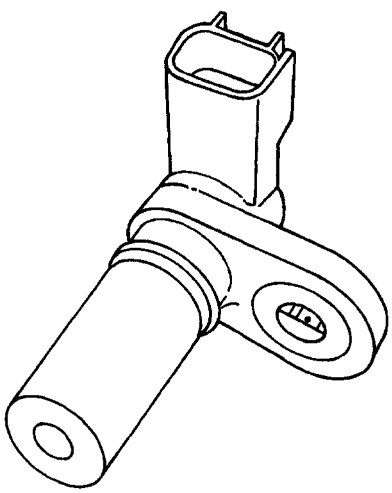
CAMSHAFT POSITION (CMP) SENSOR

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

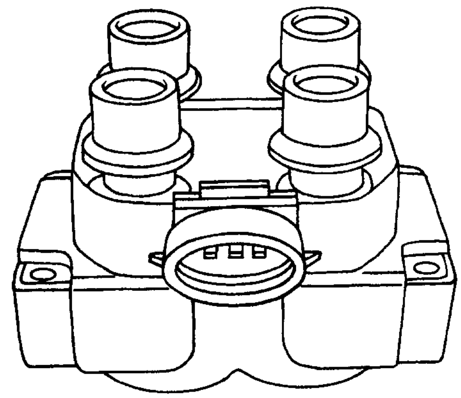
The electronic ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel w mixture at the correct time. To provide optimum engine performance, fuel economy, and control of exhaust emissions, the ECM controls the spark advance of the ignition system. Electronic ignition 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."

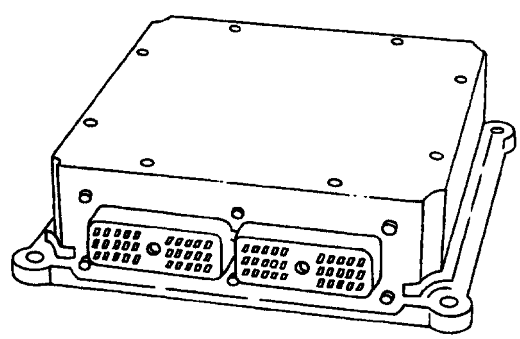
The primary coils in the coil pack are triggered by the "Ignition Coil Feed #1" and "Ignition Coil Feed #2" Signals from the ECM.



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.

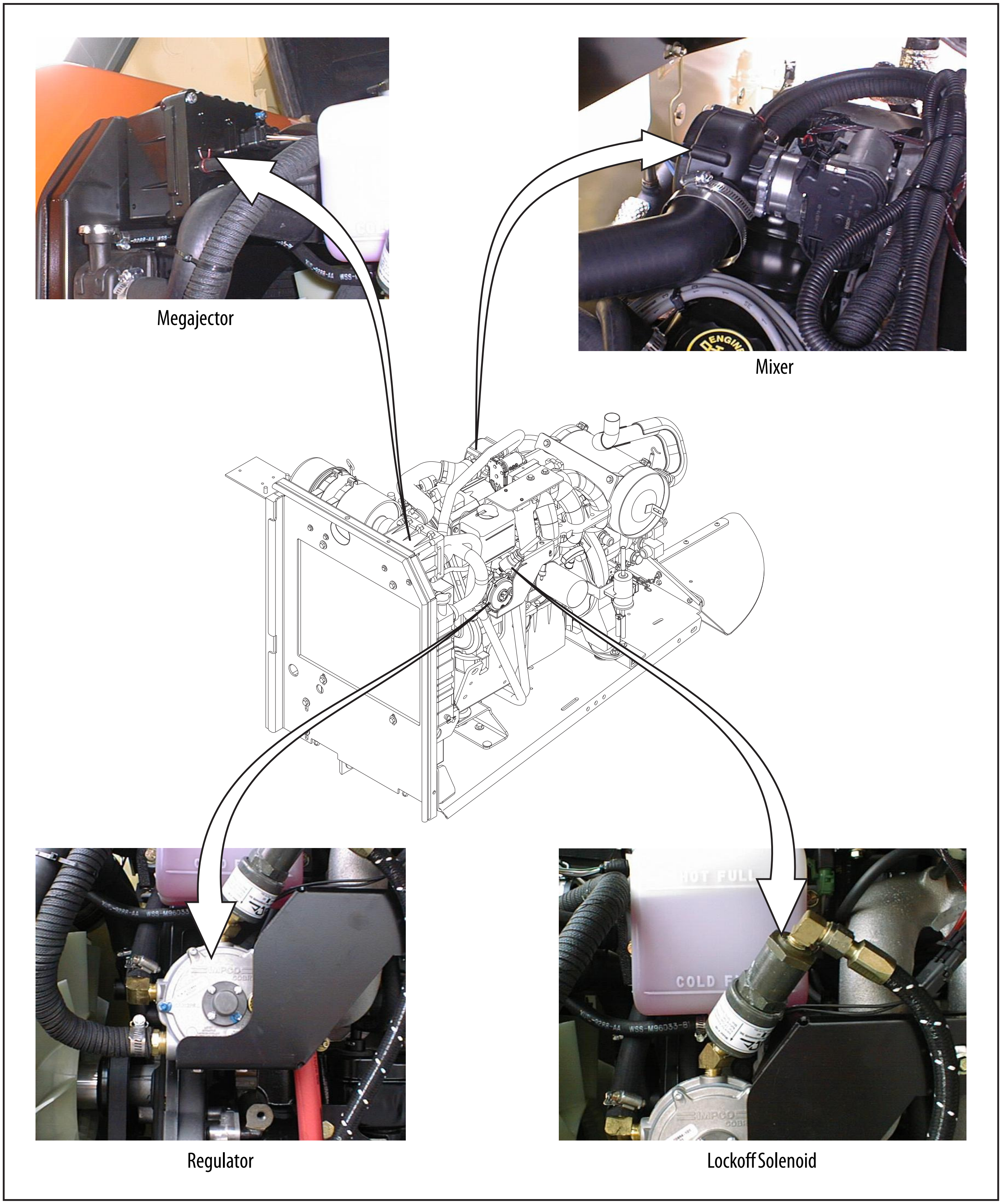


Figure 3-57. LPG System Components (S/N 0300077500 to S/N 03000140000)

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.

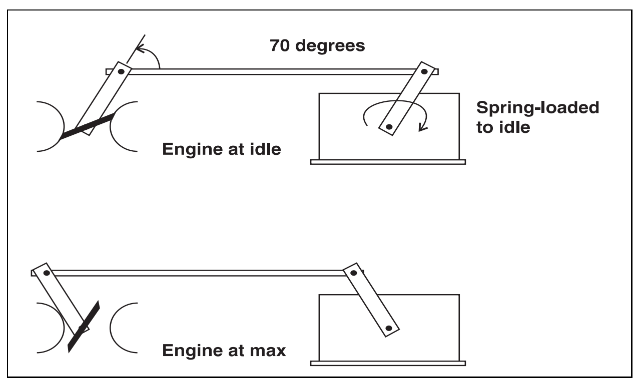
Linkage

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.

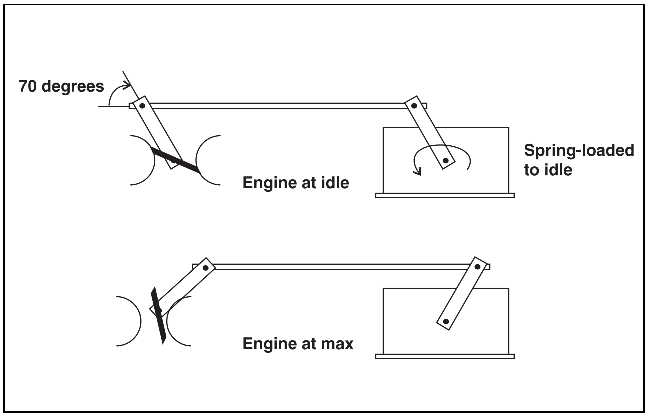
The linkage must not rub against the engine, brackets, hoses, etc. The linkage must be free of friction and lost motion or "slop".

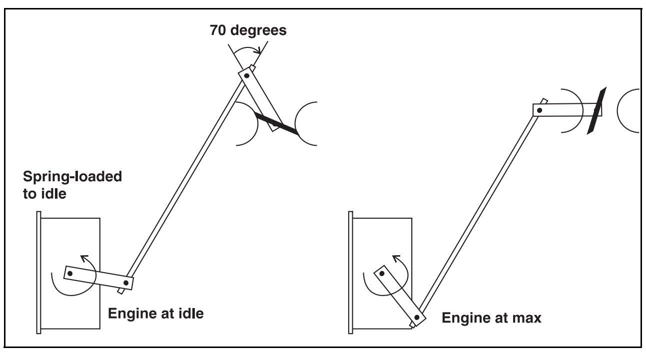
The following sketch indicates the proper linkage geometry for most installations.



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.

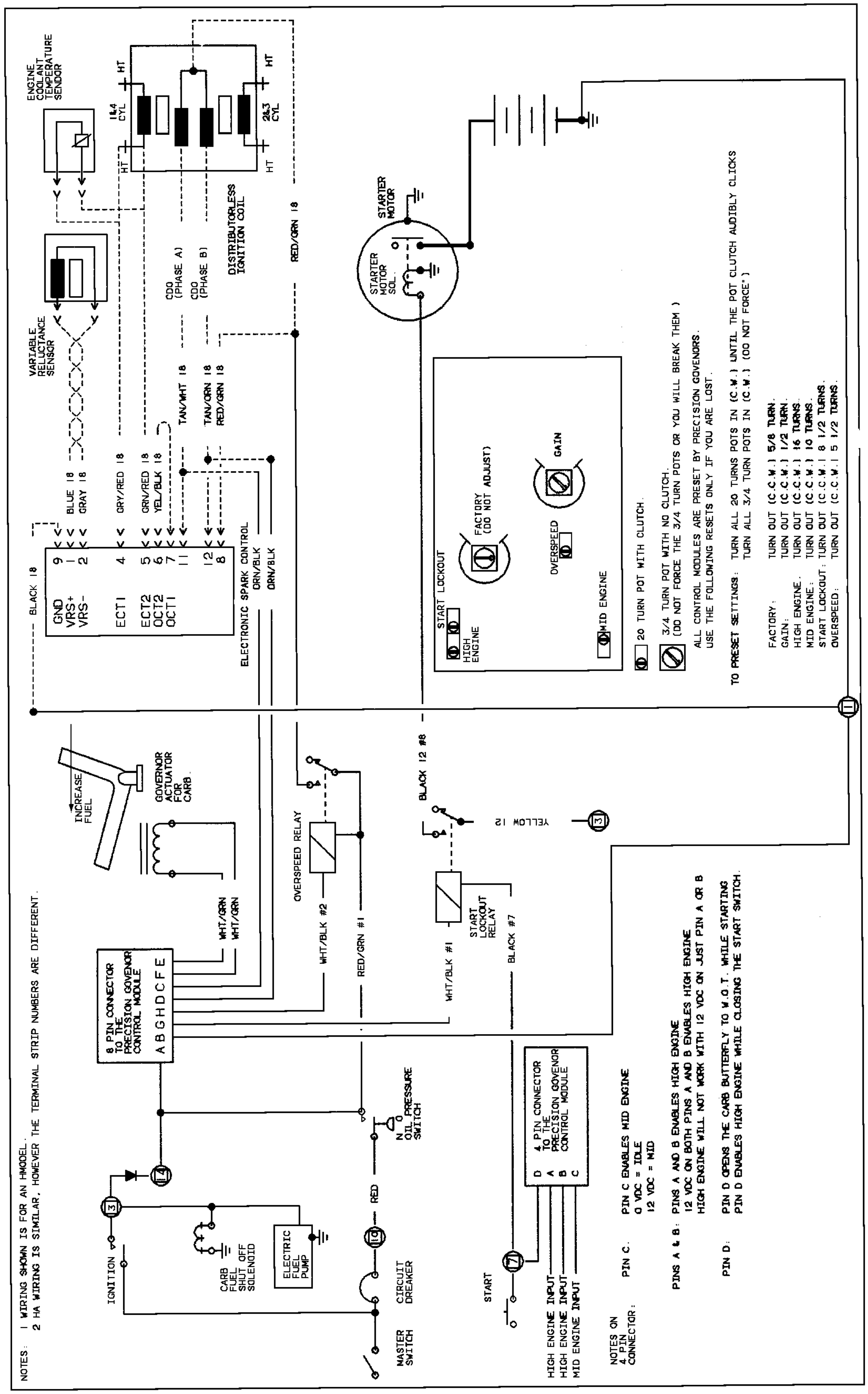
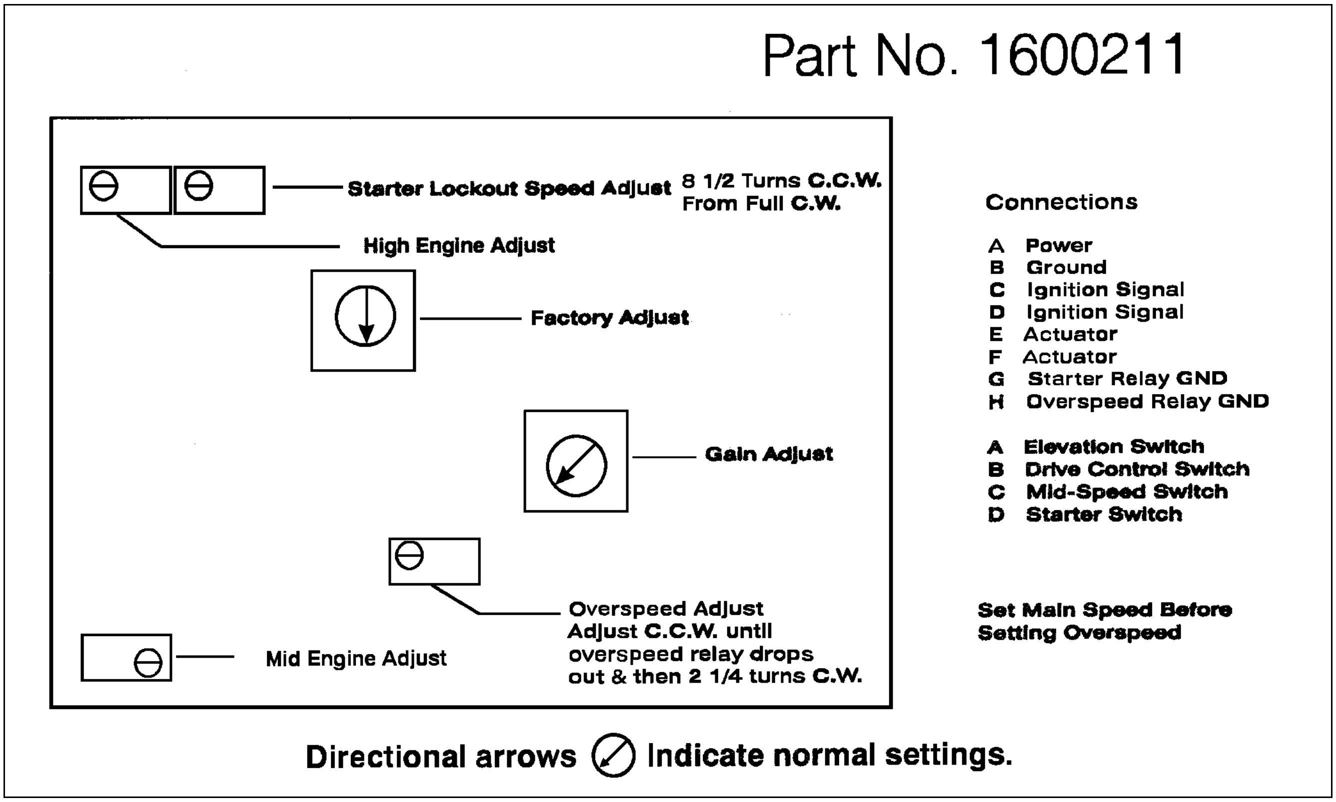


Figure 3-58. Check-Out and Initial Start-Up Procedures



4. Carefully adjust Gain. You are looking for the best compromise between quick response and good stability. Make very small adjustments, then load and unload engine, or pull linkage back slightly and release. Usually, a good set-up is one that makes 1 to 3 small bounces and then steadies down after a large change. Too much Gain shows up as a rapid (bounce per second) instability, most commonly at light loads. Too little Gain shows up in large over-shoots on start-up or large load changes, and generally sluggish operation.
5. Make final adjustment to the High Engine Pot.
6. Set machine controls to obtain the mid-engine speed. Adjust the mid-engine pot as needed to obtain the speed desired.
7. The start lockout adjustment is factory set. If necessary, he starter lockout pot may be adjusted to obtain drop-out of the starter as the engine attains running speed. Normally this is around 500 RPM.
8. The overspeed adjustment is factory set. If necessary, it may be readjusted to shut off ignition power at a different engine speed by means of the overspeed adjustment pot. The overspeed is simply to shut down an over revving engine.

NOTE: *Overspeed to be set at 4000 - 4500 RPM's. This is not a function we test for correct settings. The High Engine speed must be set before setting the overspeed.*

9. Re-install the back cover on the E-331. Final mount the controller.

Troubleshooting

We will discuss Troubleshooting in two general categories:

- **Governor won't work.**
- **Governor works, but can't be set up to give satisfactory performance.**

There is, of course, some overlap between these categories. Read both sections and apply the fixes that seem appropriate.

NOTE: *During troubleshooting, be prepared to control the engine manually to prevent overspeeds, etc.*

- **Governor won't work.**

No reaction from Governor. Actuator output arm never moved, engine off or engine running. Can be caused by:

1. No power.
2. Incorrect linkage, preventing movement.
3. Incorrect electrical hook-up.
4. No speed signal to Governor.
5. Damaged Controller or Actuator.

(1.) No power - Use a multimeter to check for 12-15 VDC between terminals A & B on the controller. Check during engine off and engine running conditions. If voltage is absent or low, check for:

- **a.** Wiring error.
- **b.** Hook-up on wrong side of ballast resistor.
- **c.** Low battery.
- **d.** Bad voltage regulator.
- **e.** Bad ground connection.
- **f.** corroded terminals.
- **g.** Undersized wiring.

(2.) Incorrect Linkage - Re-check linkage. The freedom of movement and lack of play are important.

(3.) Incorrect Electrical Hook-up - Re-check all wiring and connections to the Actuator and Controller against the supplied schematic.

(4.) No speed signal to Controller.

- **a.** Check the voltage between terminals C and ground and D and ground of the 8 pin connector with the engine running. You should see 5 - 30 VDC.
- **b.** The above checks do not guarantee a good speed signal, but their absence proves that there is a problem.

(5.) Incorrect Electrical Hook-up - If steps 1 - 4 above have not revealed the problem, the governor may have been damaged, either in shipping or during hook-up and test.

- **Governor reacts, but can't be set up to give proper performance.**

This kind of trouble usually falls into three main categories:

1. Actual Governor malfunction.
2. Governor installation problems and improper adjustment.
3. Governor not tuned or adjusted for engine/application.

NOTE: *Assure the engine is operating properly by running engine manually. The Governor will not control any poor running engine.*

(1.) Actual Governor Malfunction - The Governor was engine-tested for proper operation just prior to being shipped. Unless damaged in shipment or by improper handing, it should be serviceable. To check for proper operation proceed as follows:

- **a.** Once again, disconnect fuel system linkage from Governor output arm and control engine manually.
- **b.** Start engine, hold at a low speed, Governor arm should move to full-fuel position.
- **c.** Increase engine speed carefully. At some engine speed, Governor arm should move to low-fuel position.
- **d.** By carefully varying engine speed, you should be able to cause the Governor arm to pause momentarily near the middle of its travel. This engine speed is the speed for which the Governor is adjusted. If grossly incorrect, reset High Engine Pot.
- **e.** With the engine running at low speed, move the Governor arm throughout its stroke by hand. You should feel a constant smooth force in the on direction. No binding or rubbing should be felt within the Governor.

If steps 1a. thru 1e. can be accomplished as described, the Governor is probably OK. It recognizes underspeed, overspeed, onspeed and is not binding internally.

If the above steps cannot be accomplished satisfactorily, there is probably an actual Governor malfunction.

- **a.** Governor is unable to move fuel system freely (not enough Actuator force available). If Governor doesn't move fuel system to on far enough to provide sufficient fuel but Governor arm moves far enough when disconnected look for:

  1. Linkage binding or misadjusted.
  2. Low voltage at Governor during operation.

NOTE: **Measure the voltage as discussed previously and observe voltage during operation. If Governor fails to move full on and voltage dips over 1 volt, check for undersize wire (should be #16 minimum).*

  3. Excessive force at Governor during engine running, particularly on carburetor engines.

NOTE: **Carburetor butterfly valves are loaded by engine vacuum during running, which can add considerable force not present when engine isn't running.*

NOTE: **Springs in the system; carburetor return springs, acceleration pump springs, etc., are not usually needed and can cause governing problems.*

- **b.** Governor is unstable at light-load or no-load. See "Linkage" for carbureted engines.
- **c.** Governor experiences sudden, momentary spikes toward max. at random intervals, then recovers.

  1. Look for loose wiring or momentary shorts in wiring. Noise or occasionally missing speed signal.

- **d.** Speed seems to slowly wander (5-15 second periods) around at speed, particularly at higher loads. See item 2a. 3 concerning excessive on Governor.

(3.) Governor not tuned or adjusted for engine/application.

The basic adjustment to set sensitivity/stability is the Gain pot. A good starting point for many engines is full CCW, then CW 1/3 turn. (See "Governor adjustment" section). To increase stability, turn CCW. If satisfactory governing cannot be achieved with this one adjustment, the factory adjustment may be needed. Normal starting point for this adjustment is fully CCW, then CW 1/4 turn. (Before changing this pot, mark the original position).

NOTE: *If problems occurs with the Governor overshooting when a large load is released from the engine, such as driving up a hill and stopping. There is usually one of two things:*

a. Gain adjustment is to far CCW.

b. Mechanical preload between the carburetor and actuator is to large, this should be no greater than 1/2 to 1 ball dia. (Ref. to page 43 par. 1).

Automatic Choke Adjustment Procedure

(For all JLG 1.IL and 2.3L Ford carbureted engines)

1. At 70°F the choke plate should be open 1/3" (not touching the choke bore).
2. If the ambient temperature is not 7o°F, an additional adjustment is required:

   a. Loosen the three cover plate screws.

   b. Adjust the cover to open the choke plate 1/32".

   c. Readjust for ambient temperature by rotating the cover one (1) mark per 5°F from 70°. Rotate CCW (lean) if warmer than 70°, CW (rich) if colder than 70°.
   (If actual temperature is 80°, set at 1/32" and rotate two (2) marks CCW (lean) direction.)

   d. Tighten the three cover plate screws and check for free rotation (no sticking or binding) of the choke shaft.

3.27 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE (PRIOR TO S/N 0300065534)

General

The throttle control system on the Deutz engine includes the positional controller and the actuator.

Four LEDs are incorporated in the controller. They are as follows:

- Red - failure: signals a problem with the system - needs service or adjustment
- Green - clutch engaged; operation normal while system is powered.
- Amber - motor extend
- Amber - motor retract

The controller is designed so that when the system voltage reaches 10.5 volts, the actuator clutch will be released and the motor drive turned off in order to prevent unpredictable operation from occurring.

When a failure condition occurs (i.e. position time-out) the controller will release the clutch and turn off the actuator motor. This will prevent unnecessary motor wear.

Table 3-13.Position Controller Truth Table

Control Wiring				Actuator Position
Black	Red	White	Green	
GND	OFF	X	X	OFF POSITION (Freewheel)
GND	+12 VDC	OFF	OFF	POSITION 1 (See Adjustments)
GND	+12 VDC	+12 VDC	OFF	POSITION 2 (See Adjustments)
GND	+12 VDC	OFF	+12 VDC	POSITION 3 (See Adjustments)
GND	+12 VDC	+12 VDC	+12 VDC	POSITION 4 (See Adjustments)

GND = POWER SUPPLY OR BATTERY GROUND
OFF = GROUND OR OPEN CIRCUIT
X = DON'T CARE
+12 VDC = +12 VOLT POWER SUPPLY OR BATTERY SYSTEM, VIA A 5 AMP FUSE OR CIRCUIT BREAKER

TRIMMER ADJUSTMENTS	LED INDICATORS
1 - POSITION 1 CW=RETRACT	R - RETRACT INDICATOR (AMBER)
2 - POSITION 2 CW=RETRACT	E - EXTEND INDICATOR (AMBER)
3 - POSITION 3 CW=RETRACT	C - CLUTCH INDICATOR (GREEN)
4 - POSITION 4 CW=RETRACT	F - FAILURE INDICATOR (RED)

Procedure

NOTE: *Never run fuel tank dry. Diesel engines cannot be restarted after running out of fuel until fuel system has been air-vented or bled of air. See Deutz Instruction Manual for procedure.*

1. Power the ignition switch at the ground control panel. Set the mid rpm.
2. Supply 12 volts of power to the white wire on the controller. Set the high engine rpm.

NOTE: *Actuator rod travel must stop slightly before lever makes contact with throttle lever stop. Failure to do so will burn out actuator.*

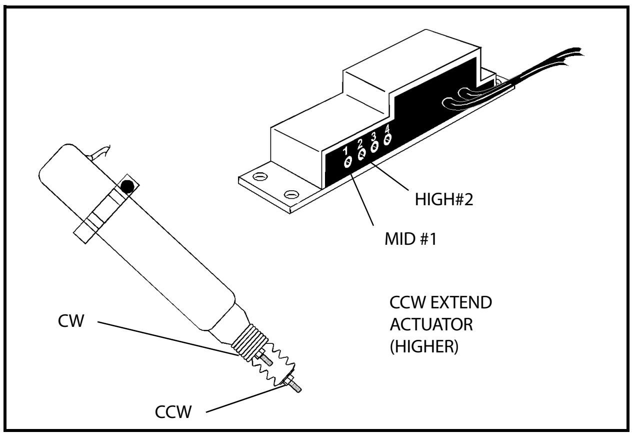
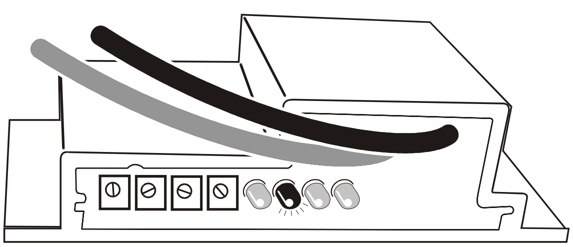


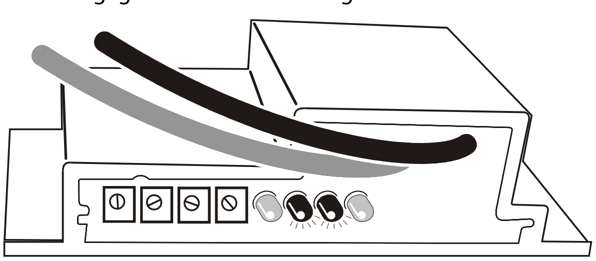
Figure 3-59. Addco Adjustments - Deutz

Controller Status

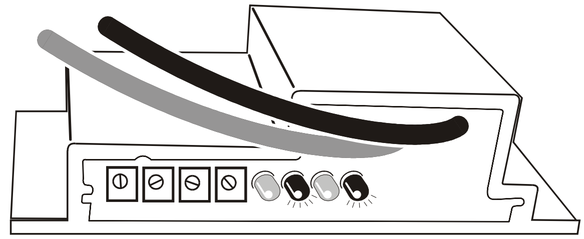
Clutch engaged no actuator movement



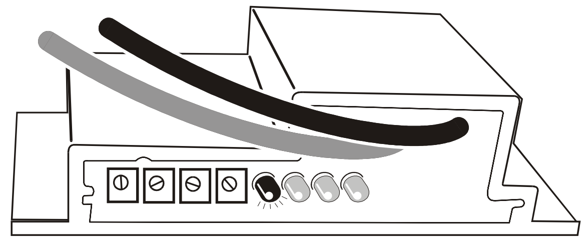
Clutch engaged actuator extending



Clutch engaged actuator retracting

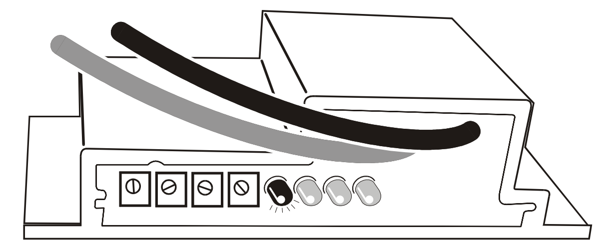


Controller fault - clutch disengaged and no actuator movement



Failure Modes

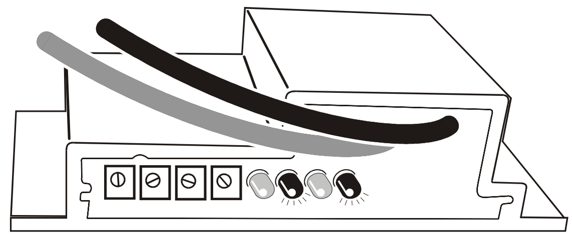
Immediate Red Light



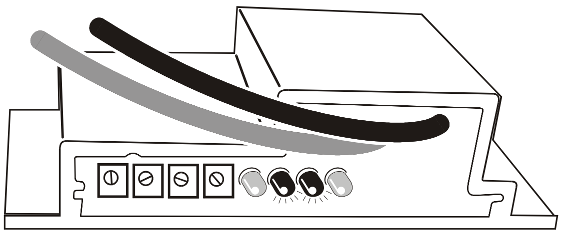
Action:

1. Recycle power to determine if the problem is intermittent.
2. The input voltage must be greater than 10.5 Vdc.
3. Check wiring for any damage and correct.
4. Disconnect engine harness and actuator connnections.
5. If problem reoccurs return unit.

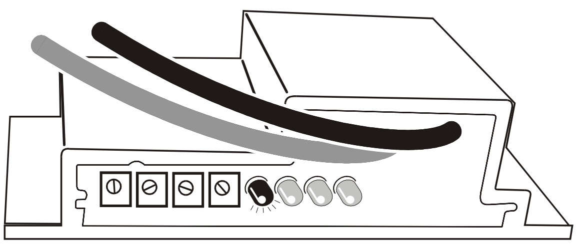
Green and either Amber light followed by a red light



or



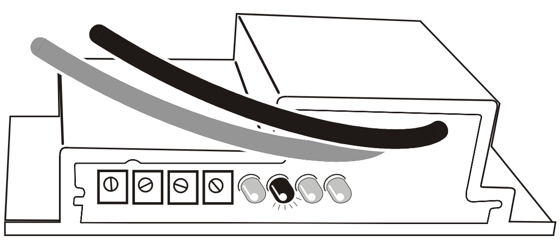
then



Action:

1. Inspect and clean wiring connections.
2. Examine throttle linkage for any damage or bent components and correct.
3. With linkage disconnected, check each potentiometer for operation.
4. Reconnect linkage and reset each potentiometer for correct operation.
5. If failure continues to occur, replace unit.

Only green light on and no actuator movement



Action:

1. Adjust trim potentiometers.
2. If problem continues, replace unit.

3.28 DEUTZ EMR 2 (S/N 0300085331 TO S/N 0300183034)

The EMR2 consists of the sensors, the control unit and the actuator. Engine-side controls as well as the JLG Control System are connected by means of separate cable harnesses to the EMR control unit.

The sensors attached to the engine provide the electronics in the control unit with all the relevant physical parameters In accordance with the information of the current condition of the engine and the preconditions (throttle position etc.), the EMR2 controls an actuator that operates the control rod of the injection pump and thus doses the fuel quantity in accordance with the performance requirements.

The exact position of the regulating rod is reported back and, if necessary, is corrected, by means of the control rod travel sensor, situated together with the rotation magnets in a housing of the actuator.

The EMR2 is equipped with safety devices and measures in the hardware and software in order to ensure emergency running (Limp home) functions.

In order to switch the engine off, the EMR2 is switched in a de-energized fashion over the ignition switch. A strong spring in the actuator presses the control rod in the de-energized condition into the zero position. As a redundancy measure, an additional solenoid serves for switching off and this, independently of the actuator, also moves the control rod in the de-energized condition into the zero position.

After the programming, that is carried out over the ISO9141 interface, the EMR2 possesses a motor-specific data set and this is then fixedly assigned to the engine. Included in this are the various application cases as well as the customer's wishes regarding a particular scope of function.

Each EMR2 module is matched by serial number to the engine. Modules cannot be swapped between engines.

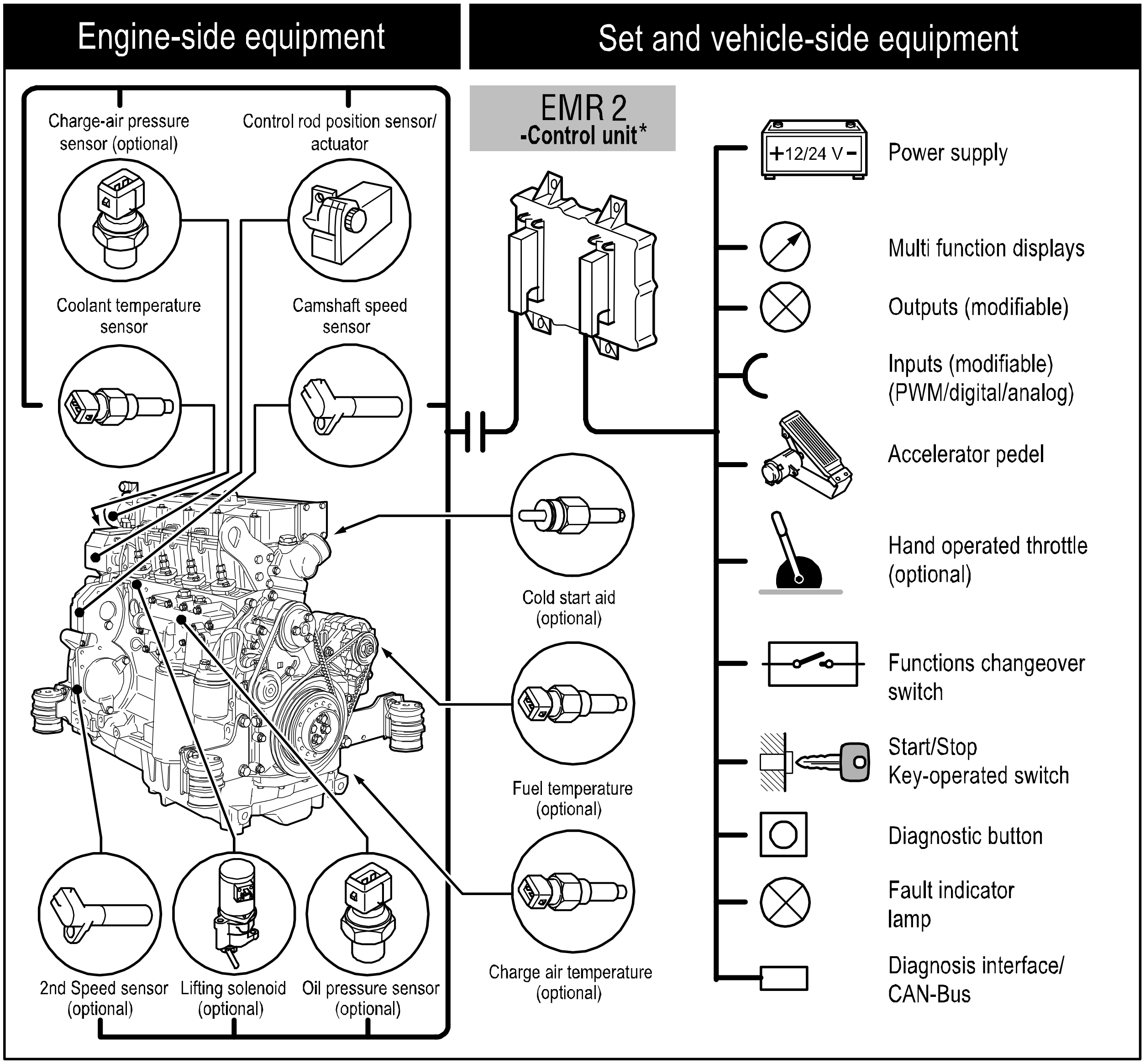


Figure 3-60. EMR 2 Engine Side Equipment

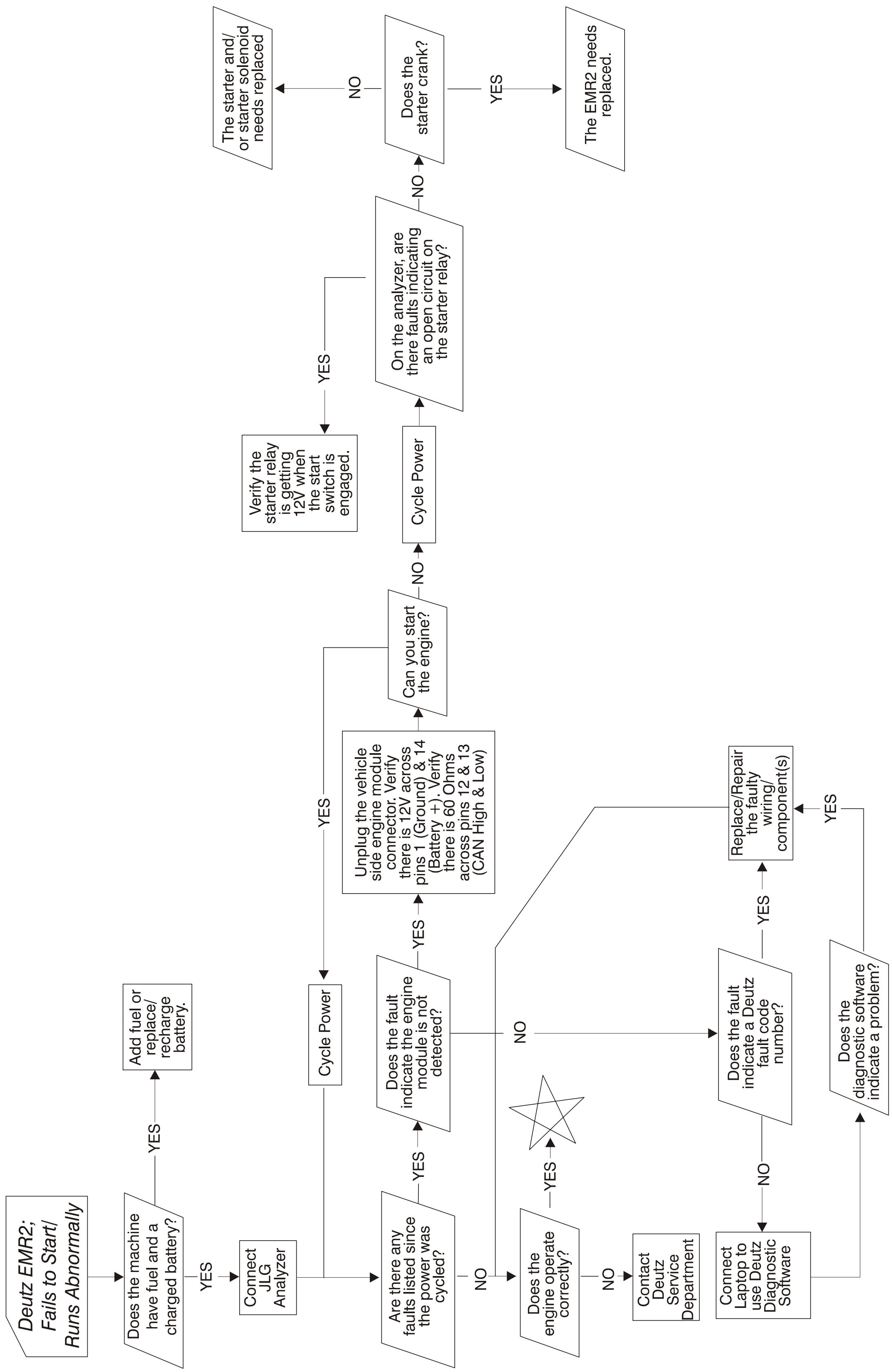


Figure 3-61. Deutz EMR 2 Troubleshooting Flow Chart

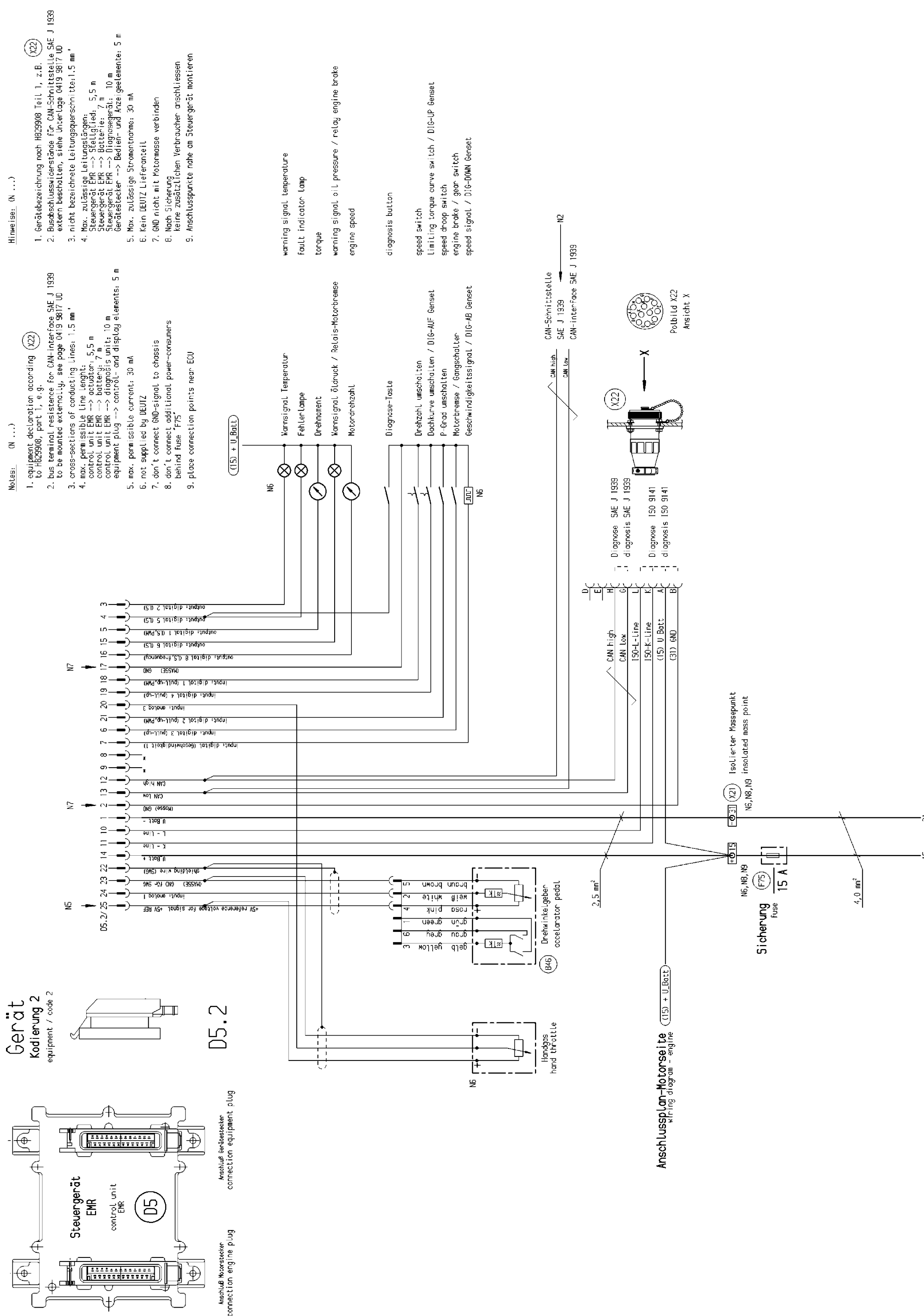


Figure 3-62. Deutz EMR 2 Vehicle Side Connection Diagram

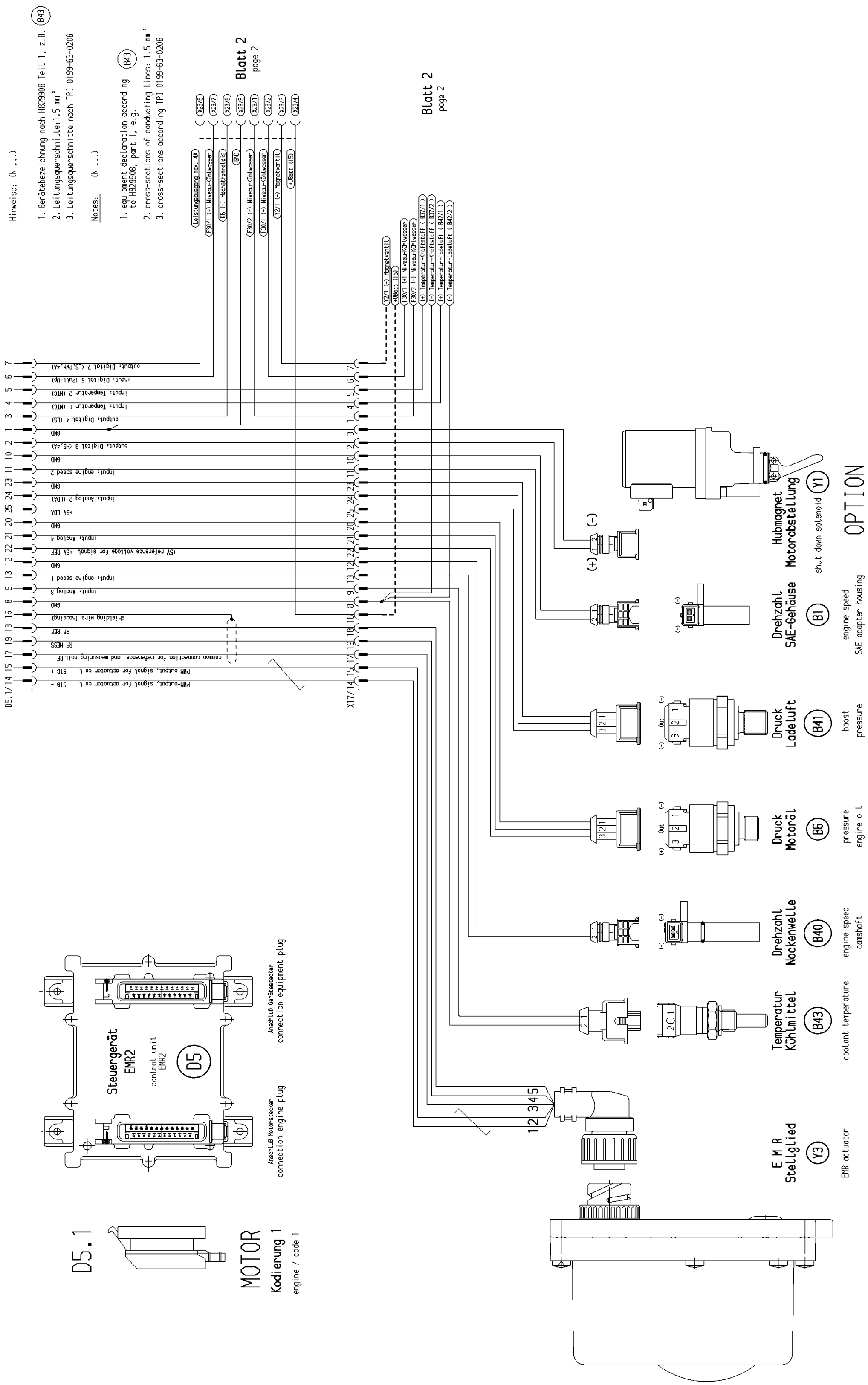


Figure 3-63. Deutz EMR 2 Engine Side Connection Diagram - Sheet 1 of 2

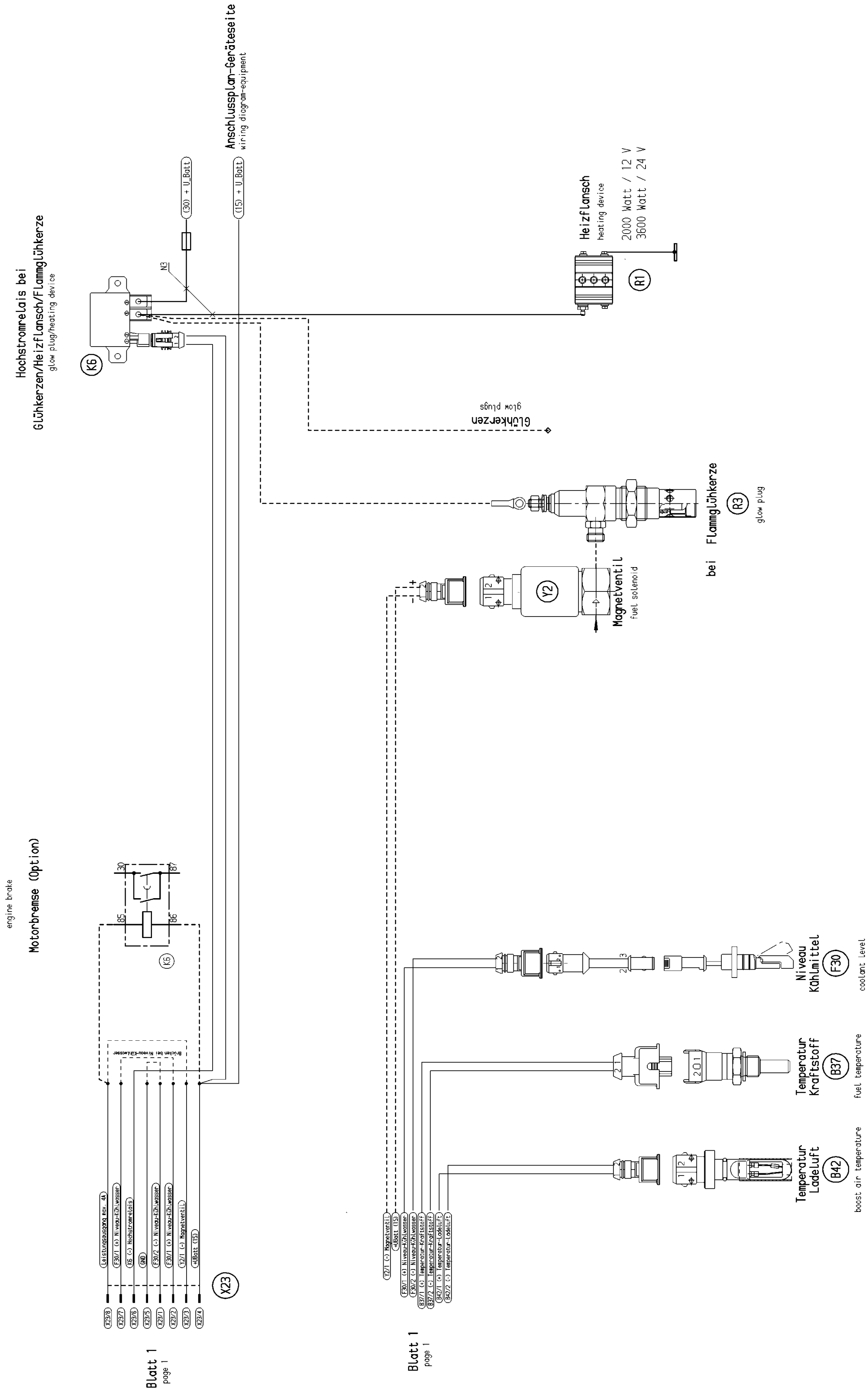
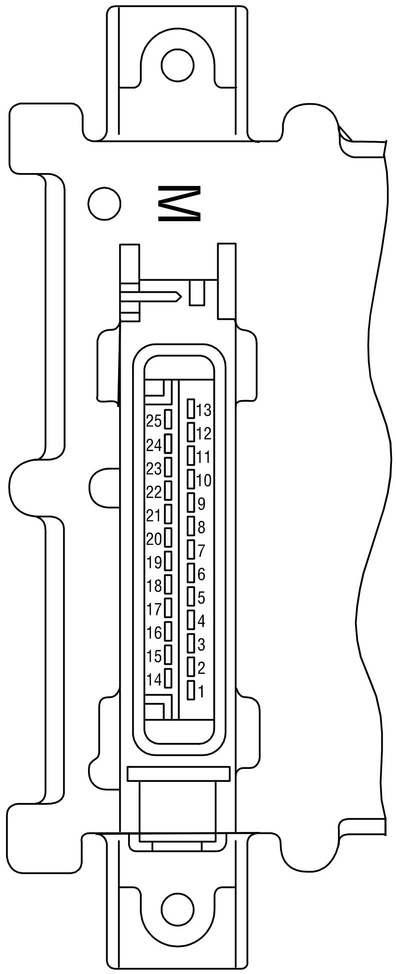


Figure 3-64. Deutz EMR 2 Engine Side Connection Diagram - Sheet 2 of 2

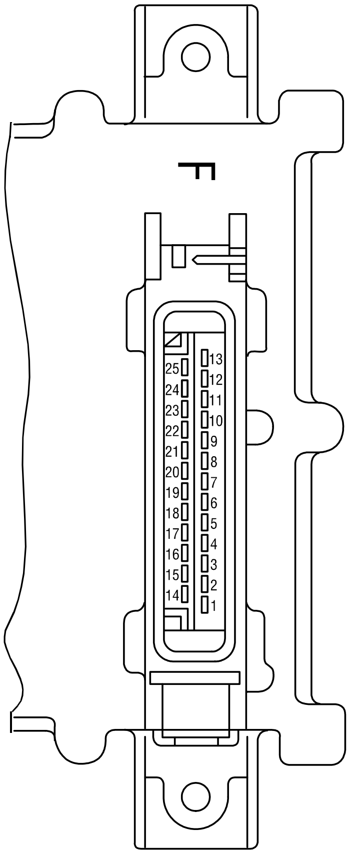


Pin No.	Designation	Description
1	Reserve	Reserve
2	Output: digital 3	Digital output for solenoid 1)
3	Output: digital 4	For heating flange (optional)/ glow plug (optional)
4	Input (optional) Temp 1	Fuel temperature 2)
5	Input (optional) Temp 2	Charge air temperature
6	Input (optional) DigIn 5	Coolant level / oil level
7	Output: PWM2/digital 6	
8	GND	Reference potential for analog signal at pin 9
9	Input: analog 7	Analog input for Coolant temperature sensor (NTC)
10	GND	Reference potential for analog signal at pin 11
11	Multi-function input: speed 2/DigIn 2	Digital input second engine speed (crankshaft) (optional) and speed signal (optional)
12	GND	Reference potential for analog signal at pin 13
13	Input: speed 1	Digital input first engine speed (camshaft)
14	STG -	PWM output, signal for actuator coil
15	STG +	PWM output, signal for actuator coil
16	Screen	Screening regulating rod travel sensor (for lines 17, 18, 19)
17	RF -	General connection for reference and measuring coil
18	RF REF	Analog input, reference signal of the reference coil
19	RF MESS	Analog input, measuring signal of the measuring coil
20	GND	Reference potential for signal at pin 21
21	Input: analog 4/digital 9	Analog input 4 (sensor signal oil pressure sensor) or digital input 9
22	+5 V REF	+5 V Reference voltage for signal at pin 21 (max. 15 mA)
23	GND	Reference potential for signal at pin 24
24	Input: analog 2/digital 7	Analog input 2 (sensor signal charge air) or digital input 7
25	+5 V LDA	+5 V Reference potential for signal at pin 24 (max. 15 mA)

1) For continuous power: < 4 A

2) Corresponds to special function"fuel temperature compensation at the EMR (0211 2571)

Figure 3-65. EMR 2 Engine Plug Pin Identification



Pin-No.	Designation	Description
1	U Batt -	Negative pole at battery (clamp 31)
2	GND	Reference potential for signal
3	Output: digital 2	PWM or digital output, various functions
4	Input / output: DigInOut	Fault lamp and diagnostic button
5	Output: PWM 1/Dig 1	PWM or digital output, various functions
6	Multi-function input: DigIn 3	Genset applications/gear shift/motor brake
7	Input: digital 10/velocity	Speed signal (tacho input)
8	NC	Not occupied
9	NC	Not occupied
10	L-line	Serial ISO 9141 interface
11	K-line	Serial ISO 9141 interface
12	CAN high	Interface for CAN-Bus
13	CAN low	Interface for CAN-Bus
14	U Batt +	Positive pole for battery (clamp 15)
15	Output: digital 5	Digital output, various functions
16	Output: digital 7/Frequency	Frequency, PWM or digital output, various functions
17	Ground	Reference potential for signal at pins 18, 19 and 21
18	Input: digital 1 / PWM 1	PWM 1 or digital input 1, various functions
19	Multi-function input: DigIn 4	Performance curve switching/genset applications
20	Multi-function input: digital 8 / analog 3	Hand hand throttle/genset applications, Digital (8) or analog input (3)
21	Input: digital 2 / PWM 2	PWM 2 or digital input 2, various functions
22	Screen	Screening (e.g. for lines hand throttle or PWG)
23	GND	Reference potential for signal at pin 24
24	Input: analog 1 / digital 6	Analog input 1 (pedal value sensor, PWG) or digital input 6
25	+5 V REF	+5 V Reference voltage for signal at pin 24

Figure 3-66. EMR 2 Vehicle Plug Pin Identification

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Zero error display	-	No faults	524287	31	No **active** faults present		
Revolutions / speed acquisition	01	Speed sensor 1	190	8	Sensor failure. Distance from gear too far. Additional fault impulses. Cable joint interrupted.	Governor in emergency operation (if sensor 2 available). Emergency switch-off (if sensor 2 not available or failed).	Check distance. Check cable connection. Check sensor and replace if required.
						Governor in emergency operation (with sensor 1) Emergency switch-off (if sensor 1 not available or failed).	
	03	Speed sensor	84	8	Tacho failed. Additional fault impulses. Cable connection interrupted.	Governor in emergency operation.	Check cable connection and Tacho. Replace if required.
	04	Excess speed switch-off	190	0	Speed was/is in excess of limit.e.	Engine stop.	Check parameter (21). Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator (impulse on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
Sensors	07	Charge air pressure	102	2	Fault at corresponding sensor entry (e.g. short circuit or cable break).	With failure of the sensor, the associated monitoring function is de-activated.	Check sensor cable. Check sensor and replace if required. Check fault limits for sensor.
	08	Oil pressure	100	2			
	09	Coolant temperature	110	2			
	10	Charge air temperature	105	2			
	11	Fuel temperature	174	2			

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-67. EMR2 Fault Codes - Sheet 1 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Functional fault warning	30	Oil pressure warning	100	1	Oil pressure below speed-dependent warning line characteristic	Fault message (disappears when oil pressure is again above recovery limit). After a delay time - fill limitation.	Check engine (oil level, oil pump). Check oil pressure sensor and cable. Check oil pressure warning line characteristic.
	31	Coolant temperature warning	110	0	Coolant temperature has exceeded warning level.	Fault message (disappears when coolant temperature again drops below recovery level). After a delay time - fill limitation.	Check coolant. Check coolant temperature sensor and cable.
	32	Charge air temperature warning	105	0	Charge air temperature has exceeded warning level.	Fault message (disappears when charge air temperature gain drops below recovery level). After a delay time - fill limitation.	Check charge air. Check charge air-temperature sensor and cable.
	34	Coolant level warning	111	1	Switch input “Low coolant level” is active.	Fault message.	Check coolant level. Check coolant level sensor and cable.
	35	Speed warning (with thrust mode operation).	SID 190	14	revolutions was/is above (top) revolution speed limit. “Thrust mode” function is active.		Check parameters. Check speed settings.
					Check PID setting. Check rods. Check actuator and replace if required. Check cable to actuator. Check speed sensor (impulses on incorrect speed). Check No. of teeth. For vehicles check for possible thrust mode.		
	36	Fuel temperature warning	174	0	Fuel-temperature has exceeded warning level.	Fault message (disappears when fuel temperature again drops below recovery level).	Check fuel. Check fuel temperature sensor and cable.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-68. EMR2 Fault Codes - Sheet 2 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Functional fault, switch-off	42	Charge air temperature switch-off	105	0	Charge air temperature has exceeded switch-off limit.	Emergency stop	Check charge air. Check charge air-temperature sensor and cable. Check switch-off limit.
	44	Coolant level switch-off	111	1	Switch input “Low coolant level” is active.	Emergency stop. Start lock.	Check coolant level. Check coolant level sensor and cable.
Actuator	50	Feedback	SID 24	12	Actuator not connected. Fault in actuator confirmation.	Emergency switch-off. Actuator cannot be operated.	Check actuator, replace if required. Check cable, check fault limits for “Confirmation”.
	52	Reference feedback	SID 24	13			Check actuator, replace if required. Check cable, check fault limits for “Rifeness confirmation”.
	53	Control travel difference	SID 23	7	Injection pump/actuator jammed or not connected. Difference between nominal/actual control travel is > 10 % of the overall control path.	Fault message (disappears when difference is < 10 %).	Check actuator/actuator rods / injection pump, replace if required. Check actuator cable.
	59	Auto calibration BOSCH-EDC pumps faulty operation	SID 23	13	No automatic actuator equalization possible. Incorrect input of the actuator reference values.	Engine stop / start lock. Governor cannot be taken into use. EDC actuator calibration required.	Check actuator and replaced if required. Check feedback cable. Check fault limits and reference values of the feedback. Program the fault limits for feedback, save values. Switch ignition off and on again.Check again. If faulty, inform DEUTZ-Service and carry out automatic equalization again. Set fault limits again.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-69. EMR2 Fault Codes - Sheet 3 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Hardware inputs/ outputs	60	Digital output 3 (Switch-off solenoid, pin M 2)	SID 51	2	Fault (short circuit / cable break) at digital output.	Driver level is switched off.	Check cable of digital output (cable break or short circuit).
	62	Digital output 6, pin M 7	SID 60	2		Fault message.	
	63	Excess voltage switch-off solenoid	SID 51	6			
	67	Error Hand Setp1	91	11			
	68	Error CAN Setp1	898	2			
Communi-cation	70	CAN-Bus controller	SID 231	12	CAN-controller for CAN-bus is faulty. Fault removal despite re-initialising continuously not possible	Application-dependent.	Check CAN connection, terminating resistor (see Chapter 12.4), Check control unit.
	71	CAN interface SAE J 1939	SID 231	9	Overflow in input buffer or a transmission cannot be placed on the bus.		
	74	Cable break, short circuit or bus-error	SID 231	14			Check CAN connection, cable connection. Check sensor and replace if required.
Memory	76	Parameter programming (write EEPROM)	SID 253	12	Fault in parameter programming in the governor fixed value memory.	Emergency switch-off. engine cannot be started.	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service
	77	Cyclic program test	SID 240	12	Constant monitoring of program memory shows error (so-called "Flash-test").		
	78	Cyclic RAM test	SID 254	2	Constant monitoring of working memory shows error.		Note values of parameters (3895 and 3896). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-70. EMR2 Fault Codes - Sheet 4 of 5

Fault group	Fault no. (in SERDIA)	Fault locality/ Fault description	SPN	FMI	Cause	Remarks	Help
Control unit hardware	80	Power supply (Actuator)	SID 254	2	Power supply for actuator not in the permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	83	Reference voltage 1	SID 254	2	Reference voltage for actuator not in the permissible range.	Fault message (disappears when power again in the normal range). Auxiliary value 5 V	Check voltage supply. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	84	Reference voltage 2	SID 254	2			
	85	Reference voltage 4	SID 254	2			
	86	Internal temperature	171	12	Internal temperature for control unit not in permissible range.	Fault message (disappears when power again in the normal range).	Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	87	Atmospheric pressure	108	12	Atmospheric pressure not in permissible range.	Fault message (disappears when power again in normal range). Atmospheric pressure monitoring function de-activated.	
Program logic	90	Parameter fault (EEPROM retrieval or checksum faulty).	SID 253	2	No data found or checksum of data is faulty (note: fault only occurs during setting of parameter / saving or reset.).	Engine cannot be started.	Check data for correct settings. Save parameters. Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	93	Stack overflow	SID 240	2	Internal calculation fault (so-called "Stack overflow" fault).	Emergency switch-off. Engine cannot be started.	Note parameters (3897 and 3898). Switch ignition off and on again. Check again. If faulty inform DEUTZ Service.
	94	Internal fault	SID 254	2			

NOTE: SID is equal to 512. To get SPN #, add 512 + number. For example, SID 254 would be 512+254 or an SPN of 766.

Figure 3-71. EMR2 Fault Codes - Sheet 5 of 5

3.29 GM ENGINE GENERAL MAINTENANCE

Maintenance of the Drive Belt

The serpentine drive belt utilizes a spring loaded tensioner which keeps the belt properly adjusted. The drive belt is an integral part of the cooling and charging systems and should be inspected frequently.

When inspecting the belts check for:

- Cracks or breaks
- Chunking of the belt
- Splits
- Material hanging from the belt
- Glazing and hardening
- Damaged or improperly aligned pulleys
- Improperly performing tensioner

Check the belt tensioner by pressing down on the midway point of the longest stretch between pulleys. The belt should not depress beyond 1/2 inch (13mm). If the depression is more than allowable adjust the tension.

NOTICE

THE ENGINE MANUFACTURER DOES NOT RECOMMEND THE USE OF "BELT DRESSING" OR "ANTI SLIPPING AGENTS" ON THE DRIVE BELT.

Engine Electrical System Maintenance

The engine electrical system incorporates computers and microprocessors to control the engine ignition, fuel control, and emissions. Due to the sensitivity of the computers to good electrical connections periodic inspection of the electrical wiring is necessary. When inspecting the electrical system use the following:

- Check and clean the battery terminal connections and insure the connections are tight
- Check the battery for any cracks or damage to the case
- Check the Positive and Negative battery cables for any corrosion build up, rubbing or chafing, check connection on the chassis to insure they are tight
- Check the entire engine wire harness for rubbing chafing, cuts or damaged connections, repair if necessary
- Check all wire harness connectors to insure they are fully seated and locked
- Check ignition coil and spark plug cables for hardening, cracking, chafing, separation, split boot covers and proper fit
- Replace spark plugs at the proper intervals as prescribed in the engine manufacturer's manual
- Check to make sure all electrical components are fitted securely
- Check the ground and platform control stations to insure all warning indicator lights are functioning

Checking/Filling Engine Oil Level

NOTICE

AN OVERFILLED CRANKCASE (OIL LEVEL OVER THE SPECIFIED FULL MARK) CAN CAUSE AN OIL LEAK, A FLUCTUATION OR DROP IN THE OIL PRESSURE, AND ROCKER ARM "CLATTER" IN THE ENGINE.

NOTICE

CARE MUST BE TAKEN WHEN CHECKING THE ENGINE OIL LEVEL. OIL LEVEL MUST BE MAINTAINED BETWEEN THE "ADD" MARK AND "FULL" MARK ON THE DIPSTICK.

To ensure that you are not getting a false reading, make sure the following steps are taken to before check the oil level.

1. Stop the engine if in use.
2. Allow sufficient time (approximately 5 minutes) for the oil to drain back into the oil pan.
3. Remove the dipstick. Wipe with a clean cloth or paper towel and reinstall. Push the dipstick all the way into the dipstick tube.
4. Remove the dipstick and note the oil level.
5. Oil level must be between the "FULL" and "ADD" marks.

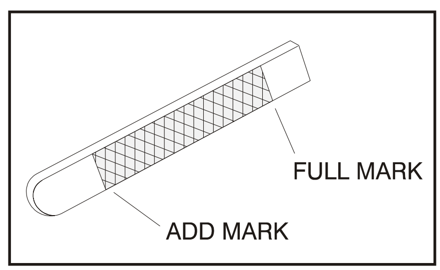


Figure 3-72. Engine Oil Dip Stick

6. If the oil level is below the "ADD" mark, proceed to Step 7 and 8 and reinstall the dipstick into the dipstick tube.
7. Remove the oil filter cap from the valve rocker arm cover.
8. Add the required amount of oil to bring the level up to but not over "FULL" mark on the dipstick.
9. Reinstall the oil fill cap to the valve rocker cover and wipe away any excess oil.

Changing The Engine Oil

NOTICE

WHEN CHANGING THE OIL, ALWAYS CHANGE THE OIL FILTER. CHANGE OIL WHEN THE ENGINE IS WARM FROM OPERATION AS THE OILS WILL FLOW FREELY AND CARRY AWAY MORE IMPURITIES.

To change the oil use the following steps:

1. Start the engine and run until it reaches normal operating temperature.
2. Stop the engine.
3. Remove the drain plug and allow the oil to drain.
4. Remove and discard the oil filter and its sealing ring.
5. Coat the sealing ring on the filter with clean engine oil and wipe the sealing surface on the filter mounting surface to remove any dust, dirt and debris. Tighten the filter securely (follow the filter manufacturers instructions). Do not over tighten.
6. Check the sealing ring on drain plug for any damage, replace if necessary, wipe the plug with a clean rag, and wipe the sealing surface on the pan and reinstall the pan plug. Do not over tighten.
7. Fill the crankcase with oil.
8. Start the engine and check for oil leaks.
9. Stop the engine and check the oil level to insure the oil level is at "FULL".
10. Dispose of the oil and filter in a safe manner.

Coolant Fill Procedure - Dual Fuel Engine

NOTICE

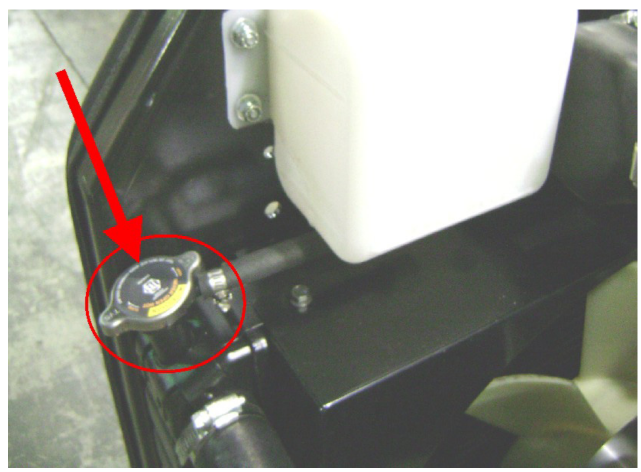
DAMAGE TO THE ENGINE COULD OCCUR IF NOT PROPERLY FILLED WITH COOLANT. LPG FUELED ENGINES ARE MOST PRONE TO CREATING AN AIR LOCK DURING A COOLANT FILL OPERATION DUE TO THE ELECTRONIC PRESSURE REGULATOR (EPR) BEING THE HIGHEST POINT IN THE COOLING SYSTEM. AN EPR THAT APPEARS TO HAVE FROST FORMING ON IT IS A SIGN THAT THE ENGINE COOLING SYSTEM CONTAINS AIR. THE APPEARANCE AND TEMPERATURE OF THE EPR SHOULD BE MONITORED DURING THE COOLANT FILL OPERATION. A WARM EPR IS AN INDICATION THAT THE COOLING SYSTEM IS PROPERLY FILLED AND FUNCTIONING.

⚠ CAUTION

MAKE SURE ENGINE IS COOL BEFORE PERFORMING ANY MAINTENANCE WORK.

1. Loosen the worm gear clamp on the coolant line running into the EPR as shown below and remove the hose from the EPR. Place a rag under the hose to prevent coolant from running onto the engine/machine.

2. Remove the radiator cap. Fill the radiator with coolant until coolant starts to appear from the previously removed hose at the EPR. Reinstall the hose back onto the EPR and continue to fill radiator with coolant.



3. With the radiator cap still removed, start the engine and run until the thermostat opens. The thermostat opens at 170° F (77° C), which can be checked using the JLG handheld analyzer.

NOTICE

WHILE ENGINE IS RUNNING, AIR AND/OR STEAM MAY BE PRESENT COMING FROM THE RADIATOR. THIS IS NORMAL.

4. After running the engine for 5 minutes after it has reached operating temperature, shut the engine off and continue to step 5.

CAUTION

WITH THE ENGINE RUNNING OR WHEN SHUTTING OFF THE ENGINE, SOME HEATED COOLANT MAY SPILL OUT DUE TO AIR "BURPING" OUT OF THE SYSTEM WITH THE RADIATOR CAP OFF.

5. Next, verify that the 2 coolant hoses on the EPR are warm. If they are not warm repeat step 3 and 4, otherwise continue to step 6.

NOTICE

A PROPERLY PURGED COOLING SYSTEM WILL YIELD A WARM UPPER RADIATOR HOSE AND A WARM EPR HOSE. IF THE UPPER RADIATOR HOSE AND/OR EPR HOSE ARE NOT WARM TO THE TOUCH AFTER THE ENGINE HAS RUN FOR 5-8 MINUTES AFTER REACHING OPERATING TEMPERATURE, THE SYSTEM MAY STILL CONTAIN AIR. IT MAY BE NECESSARY TO REPEAT THE ABOVE STEPS.

6. Fill radiator with coolant as needed and install the radiator cap. Next, remove the cap off the coolant recovery bottle and fill just below the HOT FULL line and reinstall the caps.

3.30 GM ENGINE DUAL FUEL SYSTEM

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.*

The Dual Fuel system allows the operator to operate the vehicle on either gasoline or LPG by positioning a selector switch in the operator's platform. When the operator places the selector switch in the gasoline mode the gasoline fuel pump is energized. While in the gasoline mode the LPG fuel lock-off is isolated and will not energize. In addition the gasoline injector circuit is enabled and injector pulses are provided to each injector and the ECM calibration for gasoline is also enabled. When the operator selects the LPG mode the Low Pressure LPG lock-off is energized and fuel from the LPG tank flows to the Electronic Pressure Regulator (EPR). The EPR receives an electronic signal to position the secondary lever for the start or run positions and when the engine begins to crank the mixer air valve will rise and fuel will begin flowing to engine. During this mode the gasoline fuel pump is isolated and will not be activated. The primary components of the gasoline dual fuel system are the gasoline tank, electric fuel pump and filter, fuel supply line, injector rail and injectors and the fuel pressure regulator. The primary components of the LPG dual fuel system are the LPG fuel tank, in-fuel filter, LPG Low Pressure lock-off, Electronic Pressure Regulator (EPR) and the fuel mixer module. The LPG fuel system operates at pressures which range from 14.0 inches (355.60 mm) of water column up to 312 psi (21.5 BAR).

Components which are shared by both systems include the Electronic Throttle Control and the ECM. The ECM contains a dual calibration; one controls the gasoline fuel system during gasoline operation and one controls the LPG fuel system during LPG operation.

Fuel Filter

Propane fuel like all other motor fuels is subject to contamination from outside sources. Refueling of the equipment's tank and removal of the tank from the equipment can inadvertently introduce dirt and other foreign matter into the fuel system. It is therefore necessary to filter the fuel prior to entering the fuel system components downstream of the tank. An inline fuel filter has been installed in the fuel system to remove the dirt and foreign matter from the fuel. The inline filter is replaceable as a unit only. Maintenance of the filter is critical to proper operation of the fuel system and should be replaced as Section 1. In severe operating condition more frequent replacement of the filter may be necessary.

Electric Lock Off

The Electric Lock Off device is an integrated assembly. When energized the solenoid opens the valve and allows the Propane fuel to flow through the device. The valve opens during cranking and run cycles of the engine. The lock off supply voltage is controlled by the engine control module (ECM).

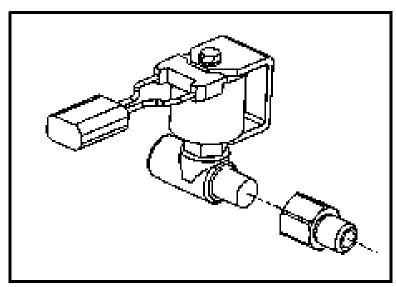
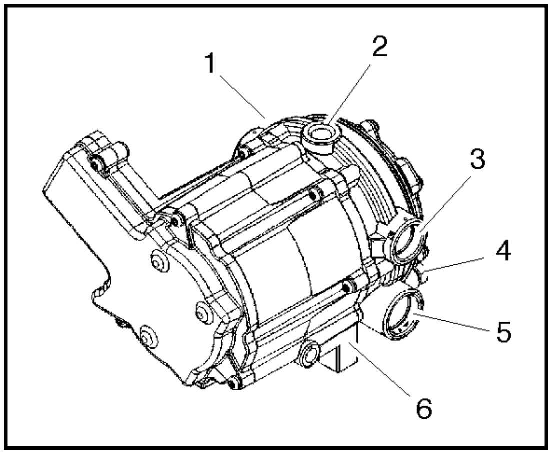


Figure 3-73. Electric Fuel Lock Off

EPR Assembly

The EPR assembly is a combination Low Pressure Regulator and a Voice Coil Assembly. The Voice coil is an electronic actuator which is controlled by an internal microprocessor. The microprocessor provides output data to the ECM and receives input data over a CAN BUS connection. The internal microprocessor receives electrical signals from the Fuel Pressure Sensor FPS and the Fuel Temperature Pressure FTP and communicates the data to the ECM. The ECM uses the FPS and FTP data to calculate the location of the secondary lever in the LPR and sends that data back to the EPR via the CAN BUS. The internal microprocessor in the EPR will then output a signal, which causes the voice coil to move and position the secondary lever to the correct location.



1. Pressure Regulator Section
2. Fuel Inlet
3. Coolant Passage
4. Primary Test Port
5. Secondary Test Port
6. Voice Coil Section

Figure 3-74. EPR Assembly

Low Pressure Regulator (LPR)

The LPR is a combination vaporizer, pressure regulating device. The LPR is a negative pressure, two stage regulator that is normally closed when the engine is not running. When the engine is cranking or running, a partial vacuum is created in the fuel line which connects the regulator to the mixer. This partial vacuum opens the regulator permitting fuel to flow to the mixer.

Propane fuel enters the primary port of the LPR and passes through the primary jet and into the primary/ exchanger chamber. As the propane passes through the heat exchanger the fuel expands and creates pressure inside the chamber. The pressure rises as the fuel expands when the pressure rises above 1.5 psi (10.34 kpa), sufficient pressure is exerted on the primary diaphragm to cause the diaphragm plate to pivot and press against the primary valve pin thus closing off the flow of fuel. This action causes the flow of fuel into the regulator to be regulated.

When the engine is cranking, sufficient vacuum will be introduced into the secondary chamber from the mixer drawing the secondary diaphragm down onto the spring loaded lever and opening the secondary valve allowing vaporized fuel to pass to the mixer. This mechanical action in conjunction with the EPR reactions causes the downward action on the secondary lever causing it to open wider allowing more fuel to flow to the mixer.

⚠ WARNING

THE VOICE COIL SECTION OF THE EPR ASSEMBLY IS AN EMISSIONS CONTROL DEVICE AND CANNOT BE REBUILT. IF THE COIL ASSEMBLY FAILS TO OPERATE PROPERLY, REPLACE IT WITH AN OEM REPLACEMENT PART ONLY.

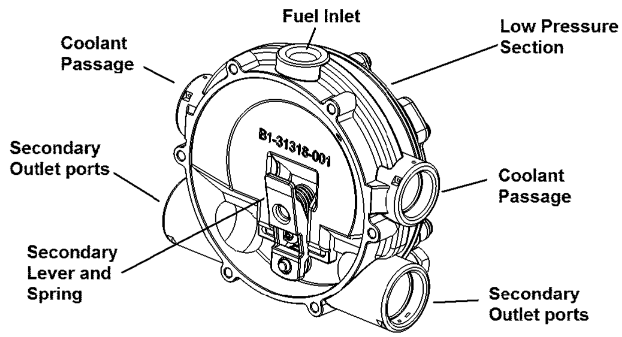


Figure 3-75. Low Pressure Regulators

Air Fuel Mixer

The air valve mixer is an air-fuel metering device and is completely self-contained. The mixer is an air valve design, utilizing a relatively constant pressure drop to draw fuel into the mixer from cranking to full load. The mixer is mounted in the air stream ahead of the throttle control device.

When the engine begins to crank, it draws in air with the air valve covering the inlet, negative pressure begins to build. This negative pressure signal is communicated to the top of the air valve chamber through 4 vacuum ports in the air valve assembly. A pressure/force imbalance begins to build across the air valve diaphragm between the air valve vacuum chamber and the atmospheric pressure below the diaphragm. The air valve vacuum spring is calibrated to generate from 4.0 inches (101.6 mm) of water column at start to as high as 14.0 inches (355.60 mm) of water column at full throttle. The vacuum being created is referred to as Air Valve Vacuum (AVV). As the air valve vacuum reaches 4.0 inches (101.6mm) of water column, the air valve begins to lift against the air valve spring. The amount of AVV generated is a direct result of the throttle position. At low engine speed the air valve vacuum is low and the air valve position is low thus creating a small venturi for the fuel to flow. As the engine speed increase the AVV increases and the air valve is lifted higher thus creating a much larger venturi. This air valve vacuum is communicated from the mixer venture to the LPR secondary chamber via the low pressure fuel supply hose. As the AVV increases in the secondary chamber the secondary diaphragm is drawn further down forcing the secondary valve lever to open wider.

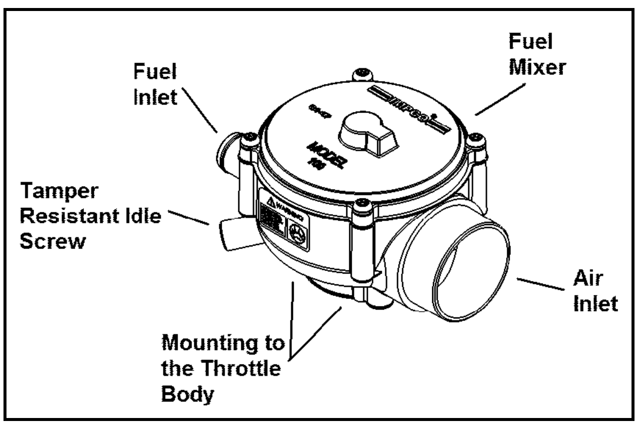


Figure 3-76. Air Fuel Mixer

Electronic Throttle Control (ETC)

Engine speed and load control is maintained by an ETC device. Speed and load control are determined by the ECM. Defaults programmed into the ECM software and throttle position sensors allow the ECM to maintain safe operating control over the engine. The Electronic Throttle Control device or "throttle body assembly" is connected to the intake manifold of the engine. The electronic throttle control device utilizes an electric motor connected to the throttle shaft. When the engine is running electrical signals are sent from the equipment controls to the engine ECM when the operator depresses an equipment function switch. The ECM then sends an electrical signal to the motor on the electronic throttle control to increase or decrease the angle of the throttle blade thus increasing or decreasing the air/fuel flow to the engine.

The electronic throttle control device also incorporates two internal Throttle Position Sensors (TPS) which provide output signals to the ECM as to the location of the throttle shaft and blade. The TPS information is used by the ECM to correct speed and load control as well as emission control.

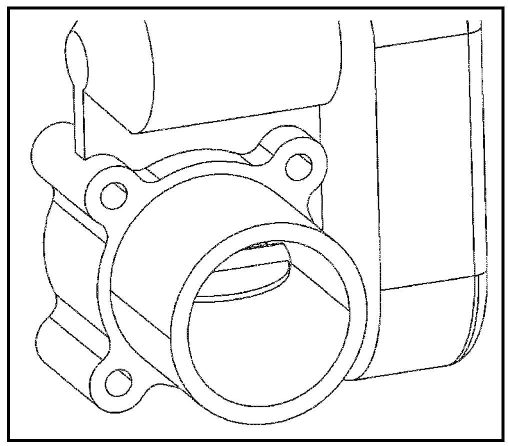


Figure 3-77. ETC throttle control device

Engine Control Module

To obtain maximum effect from the catalyst and accurate control of the air fuel ratio the emission certified engine is equipped with an onboard computer or Engine Control Unit (ECM). The ECM is a 32 bit controller which receives input data from sensors fitted to the engine and fuel system and then outputs various signals to control engine operation.

One specific function of the controller is to maintain "closed loop fuel control". Closed loop fuel control is accomplished when the exhaust gas oxygen sensor (HEGO) mounted in the exhaust system sends a voltage signal to the controller. The controller then calculates any correction that may need to be made to the air fuel ratio. The controller then outputs signals to the EPR to correct the amount of fuel being supplied to the mixer. At the same time the ECM may correct the throttle blade position to correct speed and load of the engine.

The controller also performs diagnostic functions on the fuel system and notifies the operator of malfunctions by turning on a Malfunction Indicator Light (MIL) mounted in the Ground Control Station and the Platform Control Station. Malfunctions in the system are identified by a Diagnostic Code number. In addition to notifying the operator of the malfunction in the system the controller also stores the information about the malfunction in its memory.

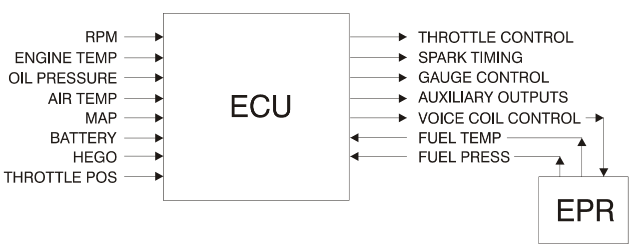


Figure 3-78. LPG Engine Control Unit (ECM)

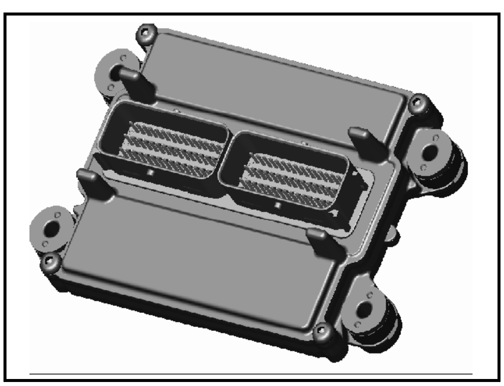


Figure 3-79. ECM Assembly

Heated Exhaust Gas Oxygen Sensor

There are two Heated Exhaust Gas Oxygen Sensors (HEGO). The first HEGO is mounted in the exhaust system downstream of the engine. It is used to measure the amount of oxygen present in the exhaust stream and communicate that to the ECM via an electrical signal. The amount of oxygen present in the exhaust stream indicates whether the fuel/air ratio is too rich or too lean. If the HEGO sensor signal indicates that the exhaust stream is too rich the ECM will decrease or lean the fuel mixture during engine operation, if the mixture is too lean the ECM will richen the mixture. The ECM continuously monitors the HEGO sensor output. If a rich or lean condition is present for an extended period of time, and the ECM cannot correct the condition, the ECM will set a diagnostic code and turn on the MIL light in control box.

The second HEGO is mounted in the exhaust system after the muffler. It measures the amount of oxygen in the exhaust system after the catalyst treatment has been completed in the muffler. If the ECM detects that the catalytic action in the muffler is not sufficient and fuel correction cannot correct the malfunction the MIL light is illuminated in the control box and a DTC code will stored in the computer.

NOTICE

THE HEATED EXHAUST GAS OXYGEN SENSOR IS AN EMISSION CONTROL DEVICE. IF THE HEGO FAILS TO OPERATE, REPLACE IT WITH AN OEM REPLACEMENT PART. THE HEGO SENSOR IS SENSITIVE TO SILICONE OR SILICONE BASED PRODUCTS AND CAN BECOME CONTAMINATED. AVOID USING SILICONE SEALERS OR HOSES TREATED WITH SILICONE LUBRICANTS IN THE AIR STREAM OR FUEL LINES.

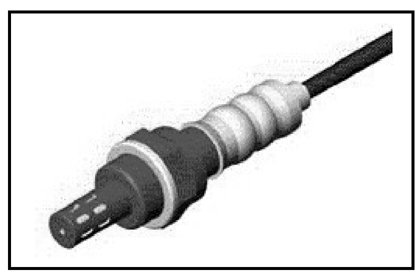


Figure 3-80. Heated Exhaust Gas Oxygen Sensor (HEGO)

Gasoline Multi Point Fuel Injection System (MPFI)

The primary components of the Gasoline Multi Point Fuel Injection (MPFI) fuel system are the fuel tank, electric fuel pump, fuel pressure and temperature sensor manifold, fuel filter and fuel rail.

Gasoline Fuel Pump

The Gasoline is stored as a liquid in the fuel tank and in drawn into the fuel system by an electric fuel pump. The fuel pump will receive a signal from the ECM to prime the fuel system for approximately 2 seconds prior to start. Priming of the fuel system provides for a quicker start, when the engine begins to crank.

Gasoline Pressure And Temperature Sensor Manifold

This engine is equipped with a fuel injector rail that does not have a pressure regulator or a return circuit to the fuel tank. Fuel pressure for this engine is regulated by the engine's ECM. The ECM receive fuel pressure and temperature feedback from the gasoline fuel sensor manifold and uses this information to control the ground side of the fuel pump. Fuel pressure is regulated by the ECM pulse width modulating (PWM) the fuel pump. The fuel pressure and temperature sensor manifold has a return or "bleed" circuit that connects back to the fuel tank. This circuit is used to bleed off any vapor that develops in the line and return a small amount of fuel to the tank. The fuel comes from the fuel tank and passes through the fuel pump. Fuel exits the fuel pump, passes through the filter and then enters the fuel pressure and temperature manifold assembly. Fuel flows through the feed circuit and is delivered to the fuel injector rail. Fuel that enters the bleed circuits through they bypass valve in the manifold is returned to the fuel tank.

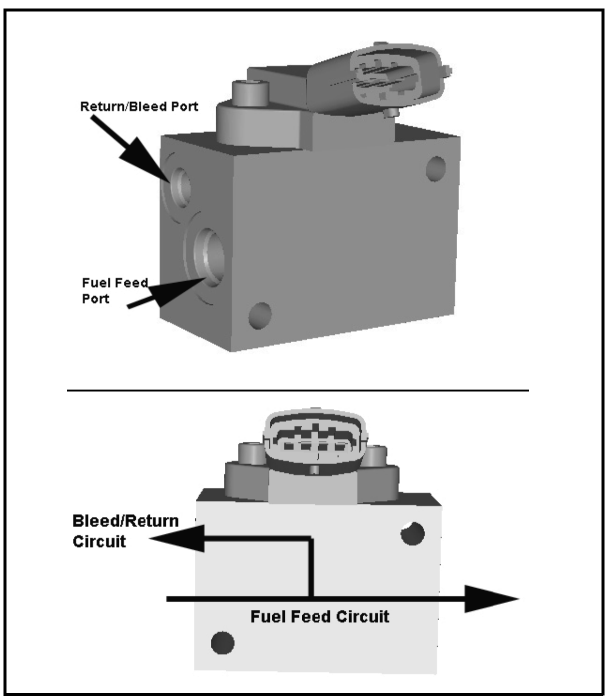


Figure 3-81. Gasoline Fuel Pressure and Temperature Manifold Assembly

Fuel Filter

After the fuel is drawn into the fuel pump, the fuel flows through the gasoline fuel filter. The fuel filter will trap small particles as the fuel passes through the filter to remove debris and prevents the fuel pressure and temperature manifold and fuel injectors from becoming damaged. Maintenance of the fuel filter is required as indicated in Section 1.

Fuel Injector Rail

Fuel flows from the fuel pressure and temperature manifold assembly to the fuel rails where the fuel is delivered to the fuel injectors. The fuel rail also contains a Schrader valve which is utilized to test the regulated pressure of the fuel system.

Fuel Injector

The fuel supply is maintained on the top of the injector from the injector rail. The injector is fed a "pulse" signal through the wire harness which causes the injector to open. During regular operating conditions the ECM controls the opening and duration of opening of the injector. During lower RPM operation the injector signals or "pulses" are less frequent then when the engine is operating at higher RPMs. The engine has been calibrated to deliver the precise amount of fuel for optimum performance and emission control.

3.31 GM ENGINE FUEL SYSTEM REPAIR

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.

NOTICE

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

Propane Fuel System Leak Test

CAUTION

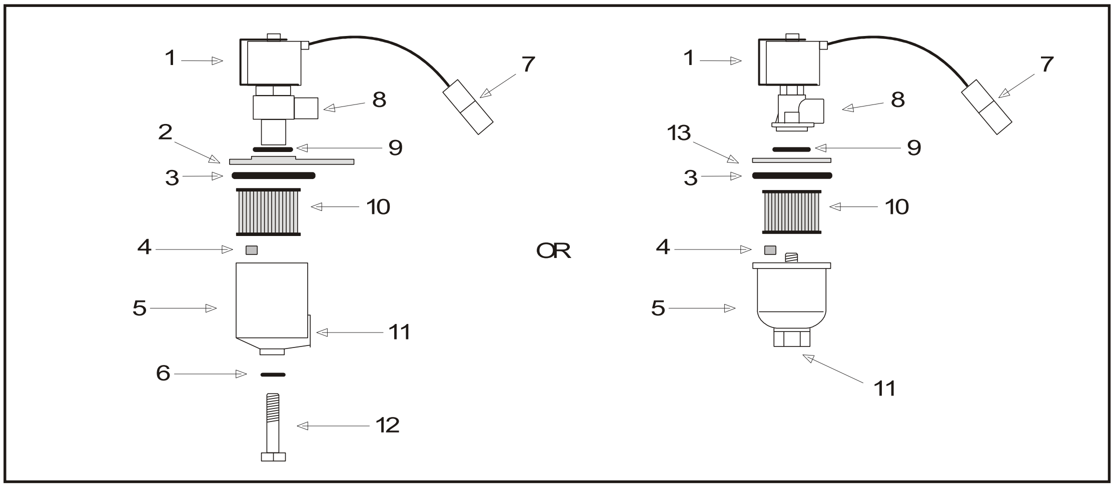
NEVER USE AN OPEN FLAME OF ANY TYPE TO CHECK FOR PROPANE FUEL SYSTEM LEAKS.

Always inspect the propane fuel system for leaks after performing service. Check for leaks at the fittings of the serviced or replaced component. Use a commercially available liquid leak detector or an electronic leak detector. When using both methods, use the electronic leak detector first to avoid contamination by the liquid leak detector.

Draining Oil Build Up From The Propane Regulator

Refer to Section 1.

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 3-82. 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 and remove it.
4. Pull the filter housing from the Electric lock off assembly.
5. Remove the filter from the housing.
6. Locate Filter magnet and remove it.
7. Remove and discard the housing seal.
8. If equipped, remove and discard the retaining bolt seal.
9. Remove and discard mounting plate to lock off O-ring seal.

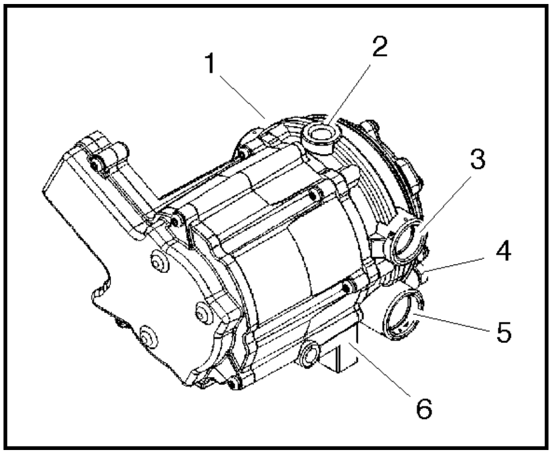
INSTALLATION

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. If equipped, 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. If equipped, 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 bowl retainer 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.

Electronic Pressure Regulator (EPR) Assembly Replacement



1. Pressure Regulator Section
2. Fuel Inlet
3. Coolant Passage
4. Primary Test Port
5. Secondary Test Port
6. Voice Coil Section

Figure 3-83. EPR Assembly

The EPR assembly is a made up of two separate components. The Voice Coil Section is not serviceable and can only be replaced as an assembly. The pressure regulator section is serviceable and will be detailed in this section.

REMOVAL

1. Relieve the propane fuel system pressure. Refer to Propane Fuel System Pressure Relief.
2. Disconnect the negative battery cable.
3. Slowly remove the fuel inlet fitting at the Electric Lock Off.

NOTE: *Residual vapor pressure will be present in the fuel system.*

4. Disconnect the electrical connector to the Electric Lock off.
5. Remove the Electric Lock Off from the regulator.
6. Remove the lock pin from the vapor fitting on the regulator housing and remove the fitting and hose and retain the pin.
7. Remove the lock pin from the pressure sensor on the regulator housing and remove the Sensor and retain the pin.
8. Using a clamp pliers pinch off the hoses on the coolant lines to the regulator.
9. Remove the lock pin from both the water fittings on the regulator housing and remove the fittings and hoses and retain the pin.
10. Disconnect the EPR electrical connector.
11. Remove the (3) three nuts from the EPR isolators and the EPR mounting bracket.
12. Remove the EPR from the bracket.
13. Remove the (3) three mounting isolators.

INSTALLATION

NOTICE

DO NOT USE TEFLON TAPE ON ANY FUEL FITTING. USE A LIQUID PIPE THREAD SEALANT WHEN INSTALLING FITTINGS.

CHECK ALL THE O-RINGS ON THE VAPOR AND WATER FITTINGS FOR ANY DAMAGE REPLACE IF NECESSARY.

LUBE ALL THE O-RINGS WITH AN O-RING LUBE BEFORE INSTALLING.

1. Install the three (3) rubber isolators to the bottom of the EPR
2. Install the EPR assembly to the bracket and tighten the retaining nuts.

NOTE: *Do not over tighten the isolators and cause a separation of the isolators.*

3. Install the fuel temperature sensor into the regulator opening and lock in place with the locking pin, connect the electrical connector.
4. Insert the fuel vapor line and fitting into the regulator port and lock in place with the locking pin.
5. Install both the water hoses and fittings into the regulator and lock in place with the locking pin remove the clamp pliers from the hoses.
6. Install the electric lock off into the regulator inlet and tighten into proper location, connect the electrical connector.
7. Connect the fuel supply line and tighten until fully seated.
8. Connect the EPR electrical connector.
9. Open the manual valve.

10. Start the vehicle and leak check the propane fuel system at each serviced fitting Refer to Propane Fuel System Leak Test.

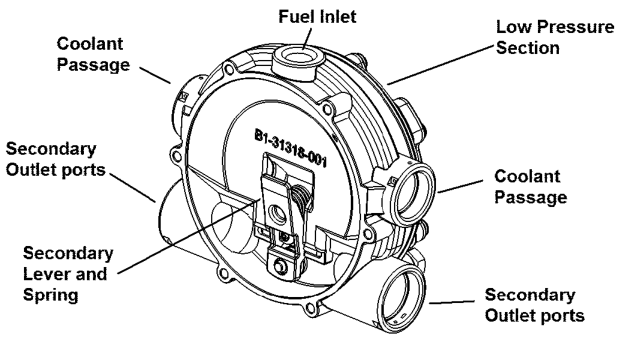


Figure 3-84. Pressure Regulator Section

PRESSURE REGULATOR SECTION REMOVAL

1. Remove the EPR refer to EPR Removal Procedure.
2. Remove the six (6) regulator to voice coil screws using the special tool and separate the regulator from the actuator.

NOTICE

DO NOT REMOVE THE SECONDARY DIAPHRAGM RETAINING PLATE AND DIAPHRAGM THIS WILL VOID THE WARRANTY OF THE ACTUATOR SECTION.

PRESSURE REGULATOR SECTION INSTALLATION

1. Install the regulator to the actuator section using the six (6) retaining screws and tighten 70 in lbs (8 Nm).
2. Install the EPR refer to EPR Installation.

Temperature Manifold Absolute Pressure (TMAP) Sensor

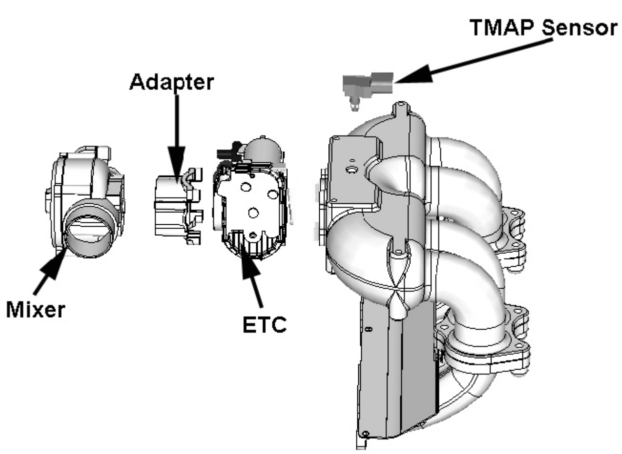


Figure 3-85. (TMAP) Sensor & Electronic Throttle Control (ETC)

REMOVAL

1. Disconnect the TMAP electrical connector.
2. Remove the two retaining bolts.
3. Remove the TMAP.

INSTALLATION

NOTE: *Apply a small amount of O-ring lubricant before installation.*

1. Install in the TMAP.
2. Tighten retaining bolts to 62 lb-in (7 Nm).

Start the vehicle and check for proper operation.

Electronic Throttle Control Replacement

See Figure 3-85.

REMOVAL

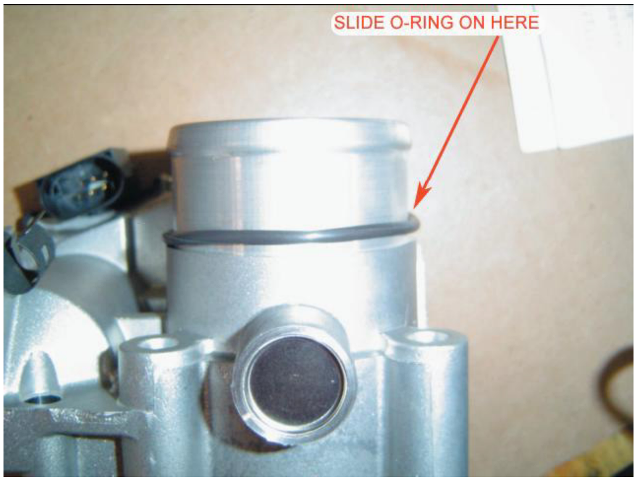
1. Disconnect the negative battery cable.
2. Remove the air intake duct.
3. Release the hose clamp on the vapor fuel line and remove the vapor hose.
4. Disconnect the TMAP electrical connector.
5. Disconnect the electronic throttle control connector.
6. Remove the manifold to throttle body adapter bolts and remove the throttle body mixer assembly.
7. Pull the throttle body assembly from the adapter.
8. Remove electronic throttle control device.
9. Remove the O-rings gasket and discard.

INSTALLATION

NOTICE

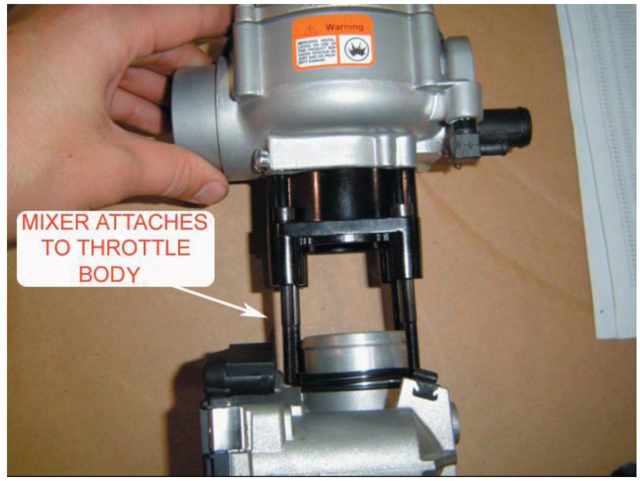
LIGHTLY LUBRICATE BOTH THROTTLE CONTROL DEVICE TO ADAPTER O-RINGS.

1. Install the O-ring on throttle body. Press it down to the bottom of the surface.



2. Install the two quad seals. Install one seal at a time to insure the seal does not roll. The seal must sit flat on the throttle body.

3. Attach mixer and throttle body together. The two parts do not bolt together; they will be secured when you mount it on the intake. Notice the orientation of the air inlet and throttle body cover.



4. Place gasket on intake manifold and attach mixer/throttle assembly to manifold.

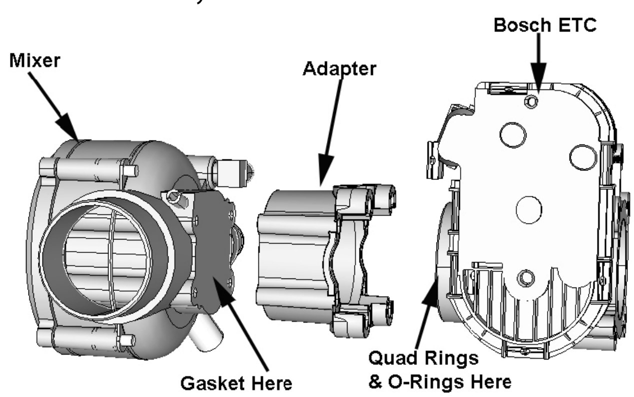


Figure 3-86. Mixer Assembly

Mixer Replacement

See Figure 3-86.

REMOVAL

1. Remove the Throttle control device Refer to Electronic Throttle Body Replacement.
2. Remove the four (4) bolts to the throttle control device to mixer adapter bolts.
3. Remove and discard the mixer to adapter gasket.

INSTALLATION

NOTICE

COVER THROTTLE BODY ADAPTER OPENING TO PREVENT DEBRIS FROM ENTERING ENGINE UNTIL REASSEMBLY.

1. Install Mixer to adapter gasket onto the mixer.
2. Install the mixer to the throttle control device to mixer adapter and secure with the 4 retaining screws. Tighten 80 lb-in (9 Nm).
3. Install Throttle body. Refer to Electronic Throttle Control Device Replacement.
4. Start the engine and leak check all fittings and connections.

Coolant Hose Replacement

REMOVAL

1. Drain the coolant.
2. Using hose clamp pliers, disconnect both hose clamps on each hose.
3. Remove the hose from each of the fittings.

INSTALLATION

NOTE: *Use hose material and lengths specified by JLG.*

1. Install the hose clamps to each hose and set the clamp back on each hose to make installation easier.
2. Fit the hose to the fittings.
3. Secure by positioning each of the clamps.

Vapor Hose Replacement

REMOVAL

1. Using hose clamp pliers disconnect both hose clamps.
2. Remove the vapor hose from each fitting.

INSTALLATION

NOTICE

THE VAPOR SUPPLY HOSE IS SPECIFICALLY DESIGNED, DO NOT USE HOSE MATERIAL OR LENGTH OTHER THAN JLG SPECIFIED PARTS.

1. Install hose clamps and set back on each hose.
2. Reinstall the vapor hose to each fitting.
3. Reset clamps.
4. Start engine and check for leaks.

Engine Control Module Replacement

REMOVAL

1. Disconnect Negative battery cable.
2. Remove controller from mounting bracket.
3. Push connector lock back to unlock connector.
4. Unplug controller and remove.

INSTALLATION

NOTICE

THE CONTROLLER IS CALIBRATED FOR EACH ENGINE VERIFY YOU HAVE THE CORRECT CONTROLLER

1. Plug connector into controller.
2. Push lock into place.
3. Mount controller into mounting bracket.
4. Reconnect the battery cable.
5. Start engine.
6. Check for any DTC codes and clear.
7. Verify engine is in closed loop and no warning lights are illuminated.

Heated Exhaust Gas Oxygen Sensor Replacement

REMOVAL

1. Disconnect Negative battery cable.
2. Disconnect the O2 sensor electrical connector.
3. Using an O2 Sensor socket, remove the O2 Sensor and discard.

INSTALLATION

NOTICE

BEFORE INSTALL THE O2 SENSOR LUBRICATE THREADS WITH ANTI-SEIZE COMPOUND GM P/N 5613695 OR EQUIVALENT. AVOID GETTING COMPOUND ON THE SENSOR TIP.

1. Install O2 sensor. Tighten to 30 ft.lb. (41 Nm).
2. Start engine.
3. Check for any DTC codes and clear.
4. Verify engine is in closed loop and no warning lights are illuminated.

3.32 GM ENGINE LPG FUEL SYSTEM DIAGNOSIS

Fuel System Description

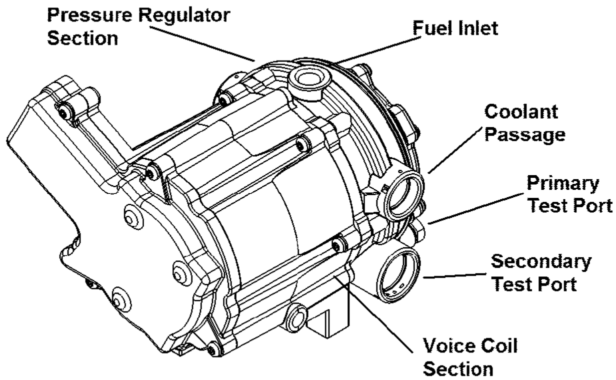


Figure 3-87. EPR Assembly

To maintain fuel and emission control on the LPG fuel system the Engine Control Units (ECM) relies on numerous engine sensor and output data from the Electronic Pressure Regulator (EPR). The ECM will then determine the target fuel calibration and command the EPR to reposition the voice coil to the proper position which, subsequently reposition the secondary lever in the pressure regulator to maintain proper control. The EPR and ECM will continue to communicate back and forth during normal operation.

In the event that the EPR fails to communicate or the Communications Area Network (CAN) cable fails to transmit data the regulator will operate in an open loop configuration. As the air valve vacuum in the mixer venturi is communicated to the secondary chamber of the regulator the secondary diaphragm will be drawn in a downwards motion. This downward motion will cause the secondary lever to open thus allowing more fuel to enter the mixer.

In the (LPR) the fuel is vaporized and the pressure reduced in two stages. The first stage reduces the pressure to approximately 1.0 to 3.0 psi (6.8 to 20.6 kPa). The second stage reduces the pressure to approximately negative 1.5" of water column.

The fuel is then drawn from the secondary chamber of the LPR by the vacuum generated by air flowing through the mixer. This vacuum signal is also used to generate lift for the mixer air valve. This vacuum signal is most commonly referred to as air valve vacuum. In the mixer, the fuel mixes with the air entering the engine. This air/ fuel mixture is then drawn into the engine for combustion.

Diagnostic Aids

This procedure is intended to diagnose a vehicle operating on LPG. If the vehicle will not continue to run on LPG, refer to Hard Start for preliminary checks. Before proceeding with this procedure, verify that the vehicle has a sufficient quantity of fuel and that liquid fuel is being delivered to the LPR. Also, ensure that the manual shut off valve on the LPG tank is fully opened and that the excess flow valve has not been activated.

Tools Required:

- 7/16 Open end wrench (for test port plugs)
- DVOM (GM J 39200, Fluke 88 or equivalent).
- 12 volt test light

Diagnostic Scan Tool

- Diagnostic Display tool.

Pressure Gauges

- IMPCO ITK-2 Test kit
- Water Column Gauge / Manometer (GM 7333-6 or equivalent).
- 0-10 PSI Gauge

Test Description

The numbers below refer to step numbers on the diagnostic table.

5. This step determines if the LPR requires replacement

6. This step determines if the problems are in the mechanical side of the Pressure Regulator or the Electronic Voice Coil

10. This step determines if the Mixer requires replacement

14. This step determines if the Lock Off requires replacement

17. This step determines if the Fuel Filter requires replacement.

Table 3-14. LPF Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
1	Were you referred to this procedure by a DTC diagnostic chart?	--	Go to Step 3	Go to Step 2
2	Perform the On Board Diagnostic (OBD) System Check. Are any DTCs present in the ECM?	--	Go to the applicable DTC Table	Go to Step 3
3	Verify that the LPG fuel tank has a minimum of 1/4 tank of fuel, that the manual valve is open and the tank quick connect is fully engaged Does the vehicle have fuel?	--	Go to Step 4	--
4	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Start the engine and allow it to reach operating temperature. Does the engine start and run?	--	Go to Step 5	Go to Step 8
5	With the engine idling, observe the pressure reading for the LPR secondary pressure. Does the fuel pressure fluctuate rhythmically OUTSIDE the specified range?	-1.0" to -2.0" w.c	Go to Step 25	Go to Step 6
6	1. Disconnect the EPR electrical connectors. NOTE: This action will cause a DTC to be set by the ECM 2. With the engine idling observe the pressure reading on the secondary test port. Is the fuel pressure WITHIN the specified range?	-1.0" to -2.0" w.c	Go to Fuel Control System Diagnosis	Go to Step 7
7	1. Inspect the air intake stream between the mixer assembly and the throttle body for leaks. 2. Inspect the fuel hose connection between the LPR and mixer assembly for damage or leakage. 3. Inspect any vacuum hoses for leaks Was a problem found and corrected?	--	Go to Step 26	Go to Step 22
8	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR secondary pressure. Does the fuel pressure indicate a vacuum is present?	--	Go to Step 12	Go to Step 9
9	1. Remove Air induction hose to the mixer 2. Observe the air valve for movement while the engine is cranking. Note: Movement of the air valve will be minimal at cranking speeds. Does the air valve move when the engine is cranked?	--	Go to Step 11	Go to Step 10
10	1. Inspect the air intake stream to the mixer assembly and the throttle body for vacuum leaks. 2. Inspect the vacuum hoses from the mixer for proper connection and condition. Was a problem found and repaired?	--	Go to Step 26	Go to Step 24
11	Inspect the fuel hose connection between the LPR and the mixer assembly for damage or leakage. Was a problem found and repaired?	--	Go to Step 26	Go to Step 12
12	1. Connect a 0-10 psi gauge to the primary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR primary pressure. Is the fuel pressure ABOVE the specified value?	1-3 PSI	Go to Step 22	Go to Step 13
13	1. Turn OFF the ignition. 2. Disconnect the LPL connector. 3. Install a test light between the pins of the LPL connector. 4. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 14	Go to Step 16
14	Using a DVOM, check the resistance of the low pressure lock-off (LPL). Is the resistance within the specified range?	12W - 16W	Go to Step 15	Go to Step 23

Table 3-14. LPF Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
15	1. Turn the ignition OFF. 2. Close the manual shut-off valve on the LPG tank. CAUTION: When disconnecting LPG fuel lines, liquid LPG may be present. Perform this step in a well ventilated area. 3. Loosen the fuel inlet hose fitting at the inlet of the LPL. Was fuel present when the fitting was loosened?	--	Go to Step 23	Go to Step 17
16	1. Turn OFF the ignition. 2. Connect the test light to chassis ground and probe pin A of the LPL connector. 3. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 20	Go to Step 21
17	1. Remove the LPG fuel filter / LPL. 2. Remove the filter from the LPL. 3. Empty the contents of the inlet side of the LPG fuel filter onto a clean surface. 4. Inspect the contents of the LPG fuel filter for an excessive amount of foreign material or water. If necessary, locate and repair the source of contamination. 5. Verify the LPG fuel filter is not restricted or plugged. Was a problem found?	--	Go to Step 19	Go to Step 18
18	The fuel supply system or hoses are plugged or restricted, locate and repair the problem. Is the action complete?	--	Go to Step 26	--
19	Replace the fuel filter. Refer to Fuel Filter Replacement. Is the action complete?	--	Go to Step 26	--
20	Repair the open in the lock-off ground circuit. Is the action complete?	--	Go to Step 26	--
21	Repair the open in the lock-off power circuit. Is the action complete?	--	Go to Step 26	--
22	Replace the low pressure regulator (LPR). Refer to Low Pressure Regulator Replacement. Is the action complete?	--	Go to Step 26	--
23	Replace the lock-off. Refer to Lock-off Replacement. Is the action complete?	--	Go to Step 26	--
24	Replace the mixer assembly. Refer to Fuel Mixer Replacement. Is the action complete?	--	Go to Step 26	--
25	The fuel supply system is operating normally, if a failure of the control solenoids is suspected. Refer to Fuel Control System Diagnosis. 1. Install the test plug in the LPR secondary chamber. 2. If you were sent to this routine by another diagnostic chart, return to the previous diagnostic procedure. Is the action complete?	--	System OK	--
26	1. Disconnect all test equipment 2. Install the primary and secondary test port plugs. 3. Start the engine. 4. Using SNOOP or equivalent, leak check the test port plugs. Is the action complete?	--	System OK	--

Table 3-15. Symptom Diagnosis

Checks	Action
Important Preliminary Checks	
Before Using This Section	Before using this section, you should have performed On Board Diagnostic Check and determined that: 1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.
LPG Fuel System Check	1. Verify the customer complaint. 2. Locate the correct symptom table. 3. Check the items indicated under that symptom. 4. Operate the vehicle under the conditions the symptom occurs. Verify HEGO switching between lean and rich. **IMPORTANT! Normal HEGO switching indicates the LPG fuel system is in closed loop and operating correctly at that time.**
Visual and Physical Checks	[2] Check all ECM system fuses and circuit breakers. [2] Check the ECM ground for being clean, tight and in its proper location. [2] Check the vacuum hoses for splits, kinks and proper connections. [2] Check thoroughly for any type of leak or restriction. [2] Check for air leaks at all the mounting areas of the intake manifold sealing surfaces. [2] Check for proper installation of the mixer module assembly. [2] Check for air leaks at the mixer assembly. [2] Check the ignition wires for the following conditions: - Cracking - Hardness - Proper routing - Carbon tracking [2] Check the wiring for the following items: - Proper connections, pinches or cuts. [2] The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first.
Intermittent	
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	[2] Faulty electrical connections or wiring can cause most intermittent problems. [2] Check the suspected circuit for the following conditions: - Faulty fuse or circuit breaker - Connectors poorly mated - Terminals not fully seated in the connector (backed out) - Terminals not properly formed or damaged - Terminal to wires poorly connected - Terminal tension insufficient. [2] Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension. If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension. [2] Checking for poor terminal to wire connections requires removing the terminal from the connector body.
Operational Test	If a visual and physical check does not locate the cause of the problem, drive the vehicle with a scan tool. When the problem occurs, an abnormal voltage or scan reading indicates the problem may be in that circuit.

Table 3-15. Symptom Diagnosis

Checks	Action
Intermittent Malfunction Indicator Lamp (MIL)	The following components can cause intermittent MIL and no DTC(s): [2] A defective relay, Control Module driven solenoid, or a switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating. [2] The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc. [2] The ignition secondary voltage shorted to a ground. [2] The Malfunction Indicator Lamp (MIL) circuit or the Diagnostic Test Terminal intermittently shorted to ground. [2] The Control Module grounds.
Loss of DTC Memory	To check for the loss of the DTC Memory: 1. Disconnect the TMAP sensor. 2. Idle the engine until the Malfunction Indicator Lamp illuminates. The ECM should store a TMAP DTC. The TMAP DTC should remain in the memory when the ignition is turned OFF. If the TMAP DTC does not store and remain, the ECM is faulty
Additional Checks	
No Start	
DEFINITION: The engine cranks OK, but does not start.	
Preliminary Checks	Refer to Important Preliminary Checks.
Control Module Checks	If a scan tool is available: [2] Check for proper communication with both the ECM [2] Check the fuse in the ECM battery power circuit. Refer to Engine Controls Schematics. [2] Check battery power, ignition power and ground circuits to the ECM. Refer to Engine Control Schematics. Verify voltage and/or continuity for each circuit.
Sensor Checks	[2] Check the TMAP sensor. [2] Check the Magnetic pickup sensor (RPM).
Fuel System Checks	**Important:** A closed LPG manual fuel shut off valve will create a no start condition. [2] Check for air intake system leakage between the mixer and the throttle body. [2] Verify proper operation of the low pressure lock-off solenoids. [2] Check the fuel system pressures. Refer to the LPG Fuel System Diagnosis. [2] Check for proper mixer air valve operation.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check for bare or shorted ignition wires. [2] Check for loose ignition coil connections at the coil.
Engine Mechanical Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2] Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes.

Table 3-15. Symptom Diagnosis

Checks	Action
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. [2] Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis
Hard Start	
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	[2]Check the Engine Coolant Temperature sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. IF the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to DTC 111 [2] Check the Crankshaft Position (CKP) sensor. [2]Check the Throttle position (TPS) sensor.
Fuel System Checks	Important: A closed LPG manual fuel shut off valve will create an extended crank OR no start condition. [2] Verify the excess flow valve in the LPG manual shut-off valve is not tripped. [2] Check mixer module assembly for proper installation and leakage. [2] Verify proper operation of the low pressure lock-off solenoids. [2] Verify proper operation of the EPR [2] Check for air intake system leakage between the mixer and the throttle body. [2] Check the fuel system pressures. Refer to the Fuel System Diagnosis.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check for bare or shorted ignition wires. [2] Check for moisture in the distributor cap if applicable. [2] Check for loose ignition coil connections. **Important:** 1. If the engine starts but then immediately stalls, Check the Crankshaft Position (CKP). 2. Check for improper gap, debris or faulty connections.
Engine Mechanical Checks	Important: The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2] Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes. [2] Check the intake and exhaust manifolds for casting flash.
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. [2] Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis or Exhaust System in the GM Base Engine Service Manual

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Checks	[2]
Cuts Out, Misses	
DEFINITION: A surging or jerking that follows engine speed, usually more pronounced as the engine load increases which is not normally felt above 1500 RPM. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Checks	[2] Refer to Important Preliminary Checks.
Ignition System Checks	[2] Start the engine. [2] Wet down the secondary ignition system with water from a spray bottle, and look/listen for arcing or misfiring as you apply water. [2] Check for proper ignition output voltage with spark tester J 26792. [2] Check for a cylinder misfire. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Remove the spark plugs in these cylinders and check for the following conditions: [2] Insulation cracks [2] Wear [2] Improper gap [2] Burned electrodes [2] Heavy deposits [2] Visually/Physically inspect the secondary ignition for the following: [2] Ignition wires for arcing, cross-firing and proper routing [2] Ignition coils for cracks or carbon tracking
Engine Mechanical Checks	[2] Perform a cylinder compression check. [2] Check the engine for the following: - Improper valve timing - Bent pushrods - Worn rocker arms - Worn camshaft lobes. - Broken or weak valve springs. [2] Check the intake and exhaust manifold passages for casting flash.
Fuel System Checks	[2] Check the fuel system - plugged fuel filter, low fuel pressure, etc. Refer to LPG Fuel System Diagnosis. [2] Check the condition of the wiring to the low pressure lock-off solenoid.
Additional Check	Check for Electromagnetic Interference (EMI). [2] EMI on the reference circuit can cause a missing condition. [2] Monitoring the engine RPM with a scan tool can detect an EMI. [2] A sudden increase in the RPM with little change in the actual engine RPM, indicates EMI is present. [2] If the problem exists, check the routing of the secondary wires and the ground circuit.
Hesitation, Sag, Stumble	
DEFINITION: The vehicle has a momentary lack of response when depressing the accelerator. The condition can occur at any vehicle speed. The condition may cause the engine to stall if it's severe enough.	
Preliminary Checks	Refer to Important Preliminary Checks.
Fuel System Checks	[2] Check the fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system. [2] Check the Manifold Absolute Pressure (MAP) sensor response and accuracy. [2] Check LPL electrical connection [2] Check the mixer air valve for sticking or binding. [2] Check the mixer module assembly for proper installation and leakage. [2] Check the EPR electrical connections.

Table 3-15. Symptom Diagnosis

Checks	Action
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly. [2] Check for the proper ignition voltage output with J 26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check for faulty spark plug wires [2] Check for fouled spark plugs.
Additional Check	[2] Check for manifold vacuum or air induction system leaks [2] Check the generator output voltage.
Backfire	
DEFINITION: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary Check	[2] Refer to Important Preliminary Checks.
Ignition System Checks	**Important! LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.** [2] Check for the proper ignition coil output voltage using the spark tester J26792 or the equivalent. [2] Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires. [2] Check the connection at each ignition coil. [2] Check for deteriorated spark plug wire insulation. [2] Check the spark plugs. The correct spark plugs for LPG are (R42LTS) [2] Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits
Engine Mechanical Check	Important! The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than a gasoline fuel supply system. [2] Check the engine for the following: - Improper valve timing - Engine compression - Manifold vacuum leaks - Intake manifold gaskets - Sticking or leaking valves - Exhaust system leakage [2] Check the intake and exhaust system for casting flash or other restrictions.
Fuel System Checks	[2] Perform a fuel system diagnosis. Refer to LPG Fuel System Diagnosis.
Lack of Power, Sluggishness, or Sponginess	
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Refer to the LPG Fuel system OBD System Check [2] Compare the customer's vehicle with a similar unit. Make sure the customer has an actual problem. Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics [2] Remove the air filter and check for dirt or restriction. [2] Check the vehicle transmission Refer to the OEM transmission diagnostics.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	[2] Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check for the proper ignition output voltage with the spark tester J 26792 or the equivalent. [2] Check for proper installation of the mixer module assembly. [2] Check all air inlet ducts for condition and proper installation. [2] Check for fuel leaks between the LPR and the mixer. [2] Verify that the LPG tank manual shut-off valve is fully open. [2] Verify that liquid fuel (not vapor) is being delivered to the LPR.
Sensor Checks	[2] Check the Heated Exhaust Gas Oxygen Sensor (HEGO) for contamination and performance. Check for proper operation of the MAP sensor. [2] Check for proper operation of the TPS sensor.
Exhaust System Checks	[2] Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. - Check for possible plugged catalytic converter.
Engine Mechanical Check	Check the engine for the following: [2] Engine compression [2] Valve timing [2] Improper or worn camshaft. Refer to Engine Mechanical in the Service Manual.
Additional Check	[2] Check the ECM grounds for being clean, tight, and in their proper locations. [2] Check the generator output voltage. [2] If all procedures have been completed and no malfunction has been found, review and inspect the following items: [2] Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. [2] Check the scan tool data.
Poor Fuel Economy	
DEFINITION: Fuel economy, as measured by refueling records, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an by refueling records.	
Preliminary Checks	[2] Refer to Important Preliminary Checks. [2] Check the air cleaner element (filter) for dirt or being plugged. [2] Visually (Physically) check the vacuum hoses for splits, kinks, and proper connections. [2] Check the operators driving habits for the following items: - Is there excessive idling or stop and go driving? - Are the tires at the correct air pressure? - Are excessively heavy loads being carried? - Is their often rapid acceleration? [2] Suggest to the owner to fill the fuel tank and to recheck the fuel economy. [2] Suggest that a different operator use the equipment and record the results.
Fuel System Checks	[2] Check the LPR fuel pressure. Refer to LPG Fuel System Diagnosis. [2] Check the fuel system for leakage.
Sensor Checks	[2] Check the Temperature Manifold Absolute Pressure (TMAP) sensor.
Ignition System Checks	[2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits [2] Check the ignition wires for the following items: - Cracking - Hardness - Proper connections
Cooling System Checks	[2] Check the engine thermostat for always being open or for the wrong heat range

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Check	[2] Check the transmission shift pattern. Refer to the OEM Transmission Controls section the Service Manual. [2] Check for dragging brakes.
Rough, Unstable, or Incorrect Idle, Stalling	
DEFINITION: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Check	Refer to Important Preliminary Checks.
Sensor Checks	[2]Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe drive-ability problem. [2]Check the Heated Exhaust Gas Oxygen Sensor (HEGO) performance: [2]Check the Temperature Manifold Absolute Pressure (TMAP) sensor response and accuracy.
Fuel System Checks	[2]Check for rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. [2]Check for a sticking mixer air valve. [2]Verify proper operation of the EPR. [2]Perform a cylinder compression test. Refer to Engine Mechanical in the Service Manual. [2]Check the LPR fuel pressure. Refer to the LPG Fuel System Diagnosis. [2]Check mixer module assembly for proper installation and connection.
Ignition System Checks	[2]Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2]Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Blistered insulators - Heavy deposits [2]Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.
Additional Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. [2]Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command. [2]Check the ECM grounds for being clean, tight, and in their proper locations. [2]Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality.
Engine Mechanical Check	[2] Check the engine for the following: - Broken motor mounts - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes
Surges/Chuggles	
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	Refer to Important Preliminary Checks.
Sensor Checks	[2] Check Heated Exhaust Gas Oxygen Sensor (HEGO) performance.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	[2] Check for Rich or Lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. [2] Check the fuel pressure while the condition exists. Refer to LPG Fuel System Diagnosis. [2] Verify proper fuel control solenoid operation. [2] Verify that the LPG manual shut-off valve is fully open. [2] Check the in-line fuel filter for restrictions.
Ignition System Checks	[2] Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. [2] Verify that the spark plugs are correct for use with LPG (R42LTS) [2] Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits - Check the Crankshaft Position (CKP) sensor.
Additional Check	[2] Check the ECM grounds for being clean, tight, and in their proper locations. [2] Check the generator output voltage. [2] Check the vacuum hoses for kinks or leaks. [2] Check Transmission

Table 3-16. DTC to SPN/FMI Cross Reference Chart

DTC	Description	SPN Code	FMI Code
16	Crank Never Synced at Start	636	8
91	Fuel Pump Low Voltage	5294	4
92	Fuel Pump High Voltage	94	3
107	MAP Low Voltage	106	4
108	MAP High Pressure	106	16
111	IAT Higher Than Expected 1	105	15
112	IAT Low Voltage	105	4
113	IAT High Voltage	105	3
116	ECT Higher Than Expected 1	110	15
117	ECT Low Voltage	110	4
118	ECT High Voltage	110	3
121	TPS 1 Lower Than TPS 2	51	1
122	TPS 1 Signal Voltage Low	51	4
123	TPS 1 Signal Voltage High	51	3
127	IAT Higher Than Expected 2	105	0
129	BP Low Pressure	108	1
134	EGO 1 Open/Inactive	724	10
154	EGO 2 Open/Inactive	520208	10
171	Adaptive Learn High Gasoline	520200	0
172	Adaptive Learn Low Gasoline	520200	1
182	Fuel Temp Gasoline Low Voltage	174	4
183	Fuel Temp Gasoline High Voltage	174	3
187	Fuel Temp LPG Low Voltage	520240	4
188	Fuel Temp LPG High Voltage	520240	3
217	ECT Higher Than Expected 2	110	0
219	Max Govern Speed Override	515	15
221	TPS 2 Signal Voltage Low	51	0
222	TPS 2 Signal Low Voltage	520251	4
223	TPS 2 Signal High Voltage	520251	3
261	Injector Driver 1 Open	651	5
262	Injector Driver 1 Shorted	651	6
264	Injector Driver 2 Open	652	5
265	Injector Driver 2 Shorted	652	6
267	Injector Driver 3 Open	653	5
268	Injector Driver 3 Shorted	653	6
270	Injector Driver 4 Open	654	5
271	Injector Driver 4 Shorted	654	6
336	Crank Sync Noise	636	2
337	Crank Loss	636	4
341	Cam Sync Noise	723	2
342	Cam Sensor Loss	723	4
420	Gasoline Cat Monitor	520211	10

Table 3-16. DTC to SPN/FMI Cross Reference Chart

DTC	Description	SPN Code	FMI Code
524	Oil Pressure Low	100	1
562	System Voltage Low	168	17
563	System Voltage High	168	15
601	Flash Checksum Invalid	628	13
604	RAM Failure	630	12
606	COP Failure	629	31
642	External 5V Reference Low	1079	4
643	External 5V Reference High	1079	3
685	Power Relay Open	1485	5
686	Power Relay Shorted	1485	4
687	Power Relay Short to Power	1485	3
1111	Fuel Rev Limit	515	16
1112	Spark Rev Limit	515	0
1151	Closed Loop Multiplier High LPG	520206	0
1152	Closed Loop Multiplier Low LPG	520206	1
1155	Closed Loop Multiplier High Gasoline	520204	0
1156	Closed Loop Multiplier Low Gasoline	520204	1
1161	Adaptive Learn High LPG	520202	0
1162	Adaptive Learn Low LPG	520202	1
1165	LPG Cat Monitor	520213	10
1171	LPG Pressure Higher Than Expected	520260	0
1172	LPG Pressure Lower Than Expected	520260	1
1173	EPR Comm Lost	520260	31
1174	EPR Voltage Supply High	520260	3
1175	EPR Voltage Supply Low	520260	4
1176	EPR Internal Actuator Fault	520260	12
1177	EPR Internal Circuitry Fault	520260	12
1178	EPR Internal Comm Fault	520260	12
1612	RTI 1 loss	629	31
1613	RTI 2 Loss	629	31
1614	RTI 3 Loss	629	31
1615	A/D Loss	629	31
1616	Invalid Interrupt	629	31
1625	Shutdown Request	1384	31
1626	CAN Tx Failure	639	12
1627	CAN Rx Failure	639	12
1628	CAN Address Conflict Failure	639	13
1629	Loss of TSC 1	639	31
2111	Unable to Reach Lower TPS	51	7
2112	Unable to Reach Higher TPS	51	
2135	TPS 1/2 Simultaneous Voltages	51	31
2229	BP Pressure High	108	0

SECTION 4. BOOM & PLATFORM

4.1 PLATFORM

Support Removal

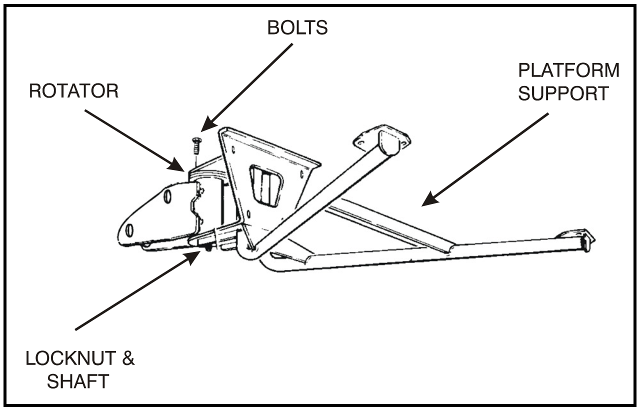
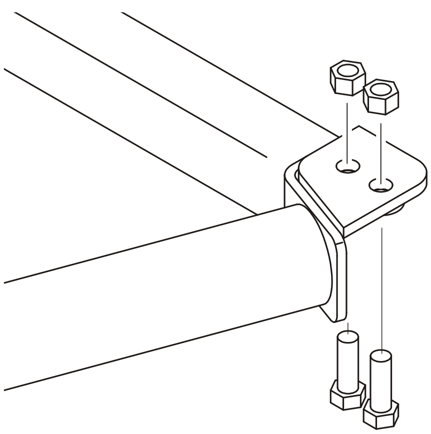


Figure 4-1. Location of Components Platform Support

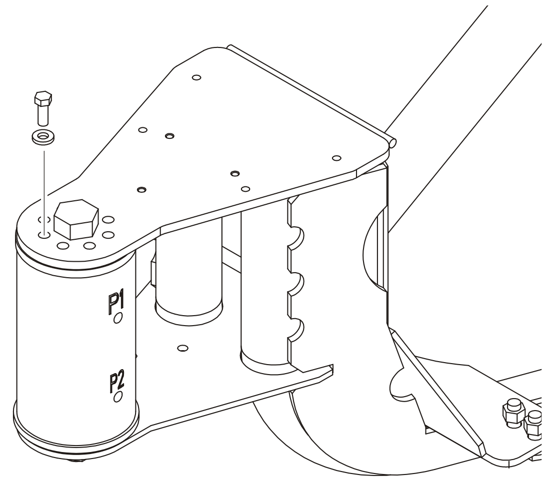
1. Disconnect electrical cables from control console.
2. Remove the bolts securing the platform to the platform support, then remove the platform.



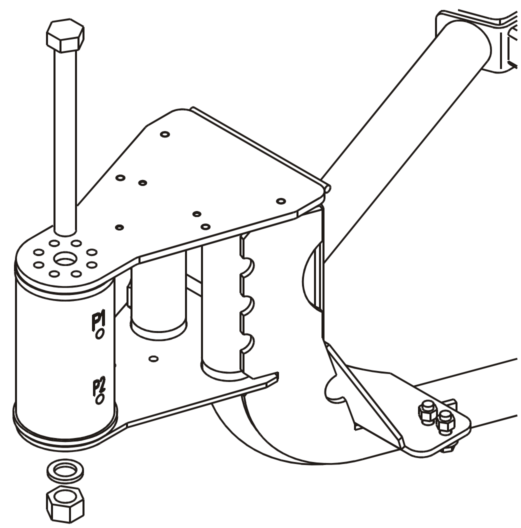
3. Using a suitable device, support the platform support.

NOTE: *The platform support weighs approximately 77 lbs. (35 kg).*

4. Remove the bolts and locknuts securing the support to the rotator.



5. Using a suitable brass drift and hammer, remove the rotator shaft, then remove the support from the rotator.

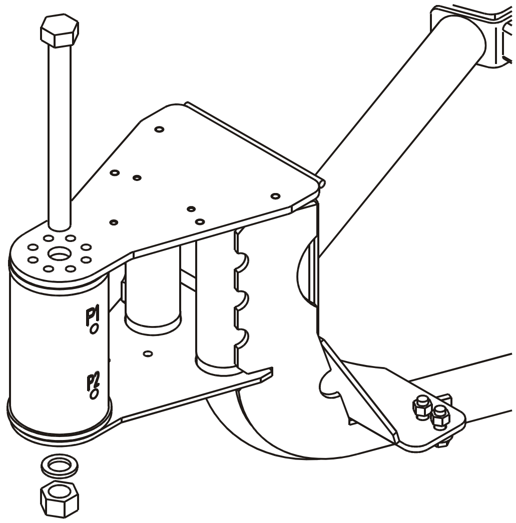


Support Installation

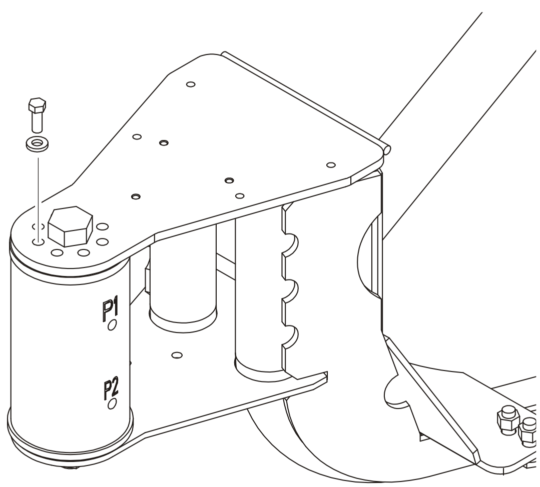
1. Using a suitable device, support the platform support and position it on the rotator.

NOTE: *The platform support weighs approximately 77 lbs. (35 kg).*

2. Install the rotator center bolt.

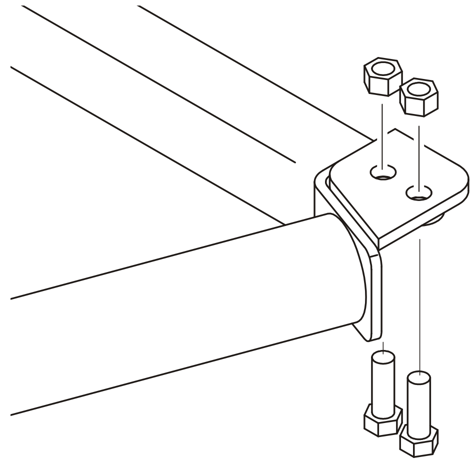


3. Apply JLG Threadlocker P/N 0100011 to the eight bolts and locknuts securing the support to the rotator and install the bolts and locknuts.



4. Torque the nut on the rotator center bolt to 480 ft. lbs. (651 Nm). Torque the retaining bolts to 50 ft. lbs. (68 Nm).

5. Position the platform on the platform support and install the bolts securing the platform to the platform support. Torque the bolts to 75 ft. lbs. (102 Nm).



6. Connect the electrical cables to the platform control console.

Platform Sections Replacement

The platform is made up of five sections: floor, right side, left side, back (console box mounting.) and gate. The sections are secured with huck magna grip fastener and collars. Replace damaged platform sections as follows:

1. Support the huck collar with a sledge hammer or other suitable support.

2. Using a hammer and chisel, remove the collar from the fastener as shown in the diagram below.

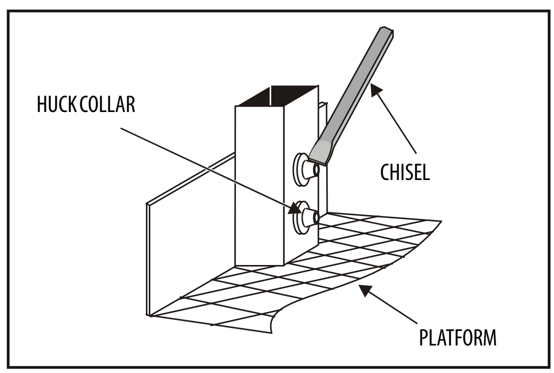
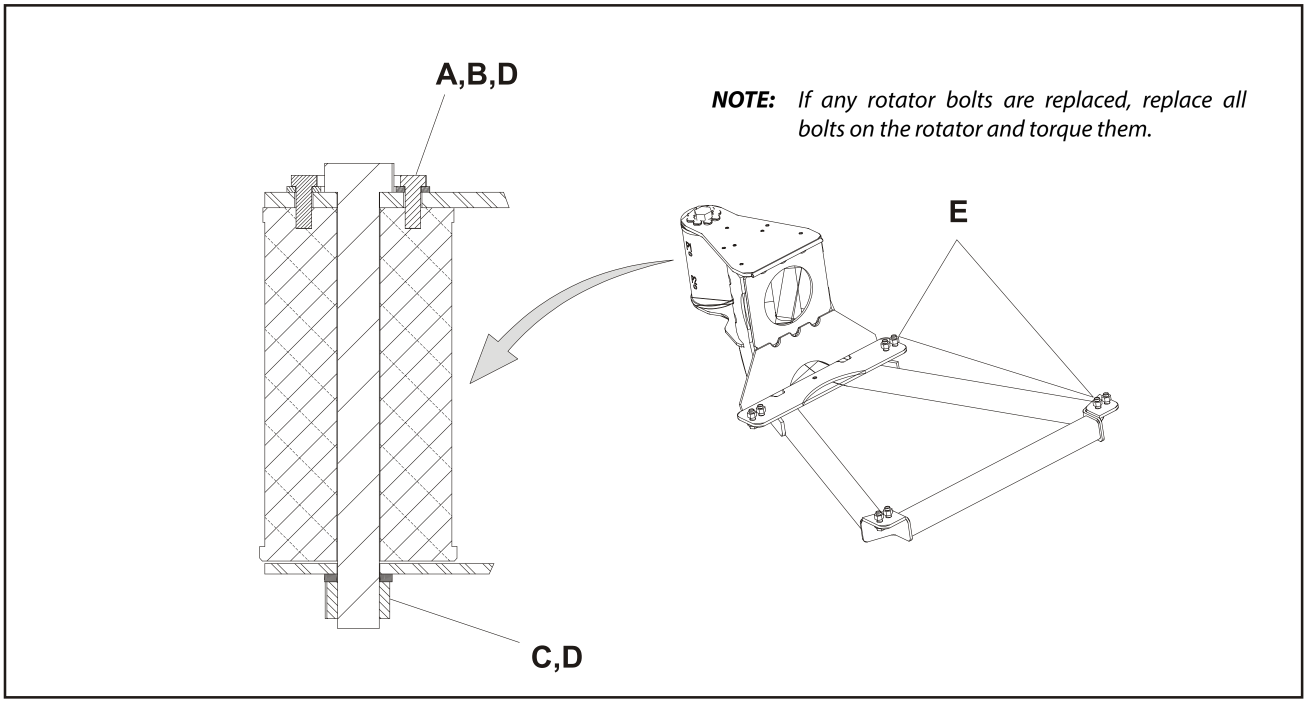


Figure 4-2. Platform Section Replacement

3. When installing new section of platform replace fasteners with 1/4 x 20 NC x 2 1/4" grade 5 bolts, flatwashers and locknuts.

4. When installing a new gate to platform, replace rivets with 1/4 x 20 NC x 2 “grade 5 bolts, flatwashers and locknuts.



A	Torque to 50 ft.lbs. (68 Nm)
B	JLG Thread locker (#0100011)
C	Torque to 480 ft. lbs. (650 Nm)
D	Check torque every 150 hours of operation
E	Torque to 85 ft. lbs. (115 Nm)

Figure 4-3. Platform Support Torque Values

4.2 ROTATOR AND SLAVE CYLINDER

Removal

1. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

2. Remove hardware from pin #1. Using a suitable brass drift and hammer remove pin #1 from the fly boom.

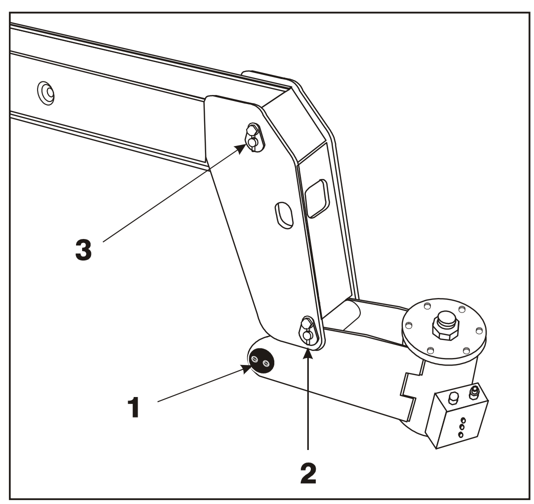


Figure 4-4. Reassembly of Components-Rotator and Leveling Cylinder

3. Supporting the rotator, remove the hardware from pin #2. Using a suitable brass drift and hammer, remove pin #2 from the fly boom and remove the rotator.

4. Telescope the fly section out approximately 20 inches (50.8 cm) to gain access to the slave leveling cylinder. (800 AJ only)

5. Supporting the slave, cylinder remove the hardware from pin #3. Using a suitable brass drift and hammer remove pin #3 from the fly boom.

6. Tag and disconnect hydraulic lines to the slave leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the slave cylinder.

4.3 UPPER BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in tower upright.

NOTICE

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

2. Tag and disconnect hydraulic lines from connectors at boom assembly. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

3. Disconnect dual capacity indicator limit switch from side of boom section. (800A only)

4. Remove hydraulic lines and electrical cables from Powertrack.

5. Using suitable lifting equipment, adequately support Powertrack weight along entire length.

6. Remove bolt #1 securing the push tube on the fly boom section.

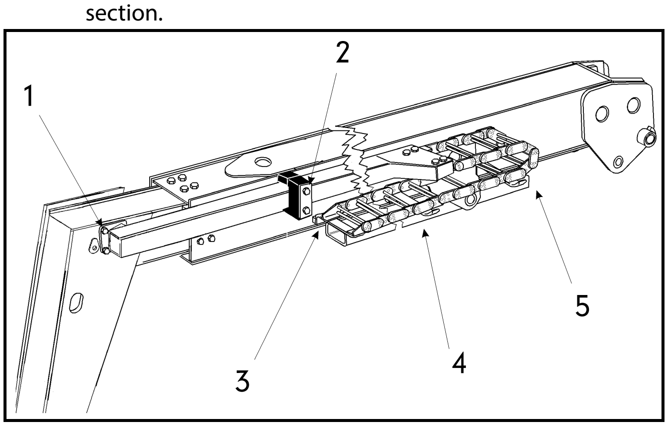


Figure 4-5. Boom Powertrack Components

7. Remove bolt #2 securing the push tube on the mid boom section.

8. With Powertrack supported and using all applicable safety precautions, remove bolts #3, #4 and #5 securing rail to the base boom section. Remove Powertrack from boom section.

4.4 BOOM CLEANLINESS GUIDELINES

The following are guidelines for internal boom cleanliness for machines that are used in excessively dirty environments.

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.

2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.

4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.

5. If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no "puddling" of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.

6. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

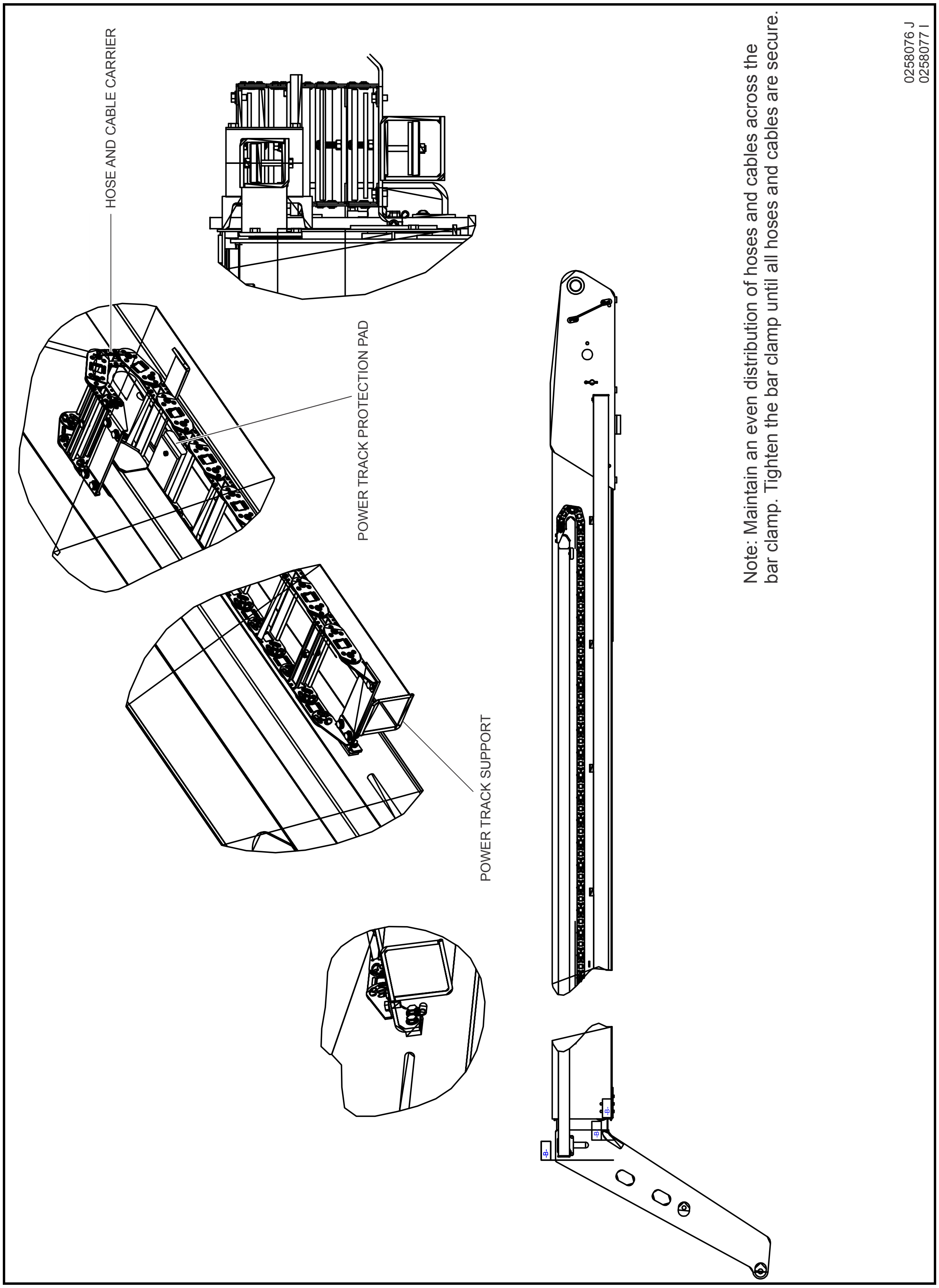


Figure 4-6. Powertrack Installation Upper Boom (Sheet 1 of 2)

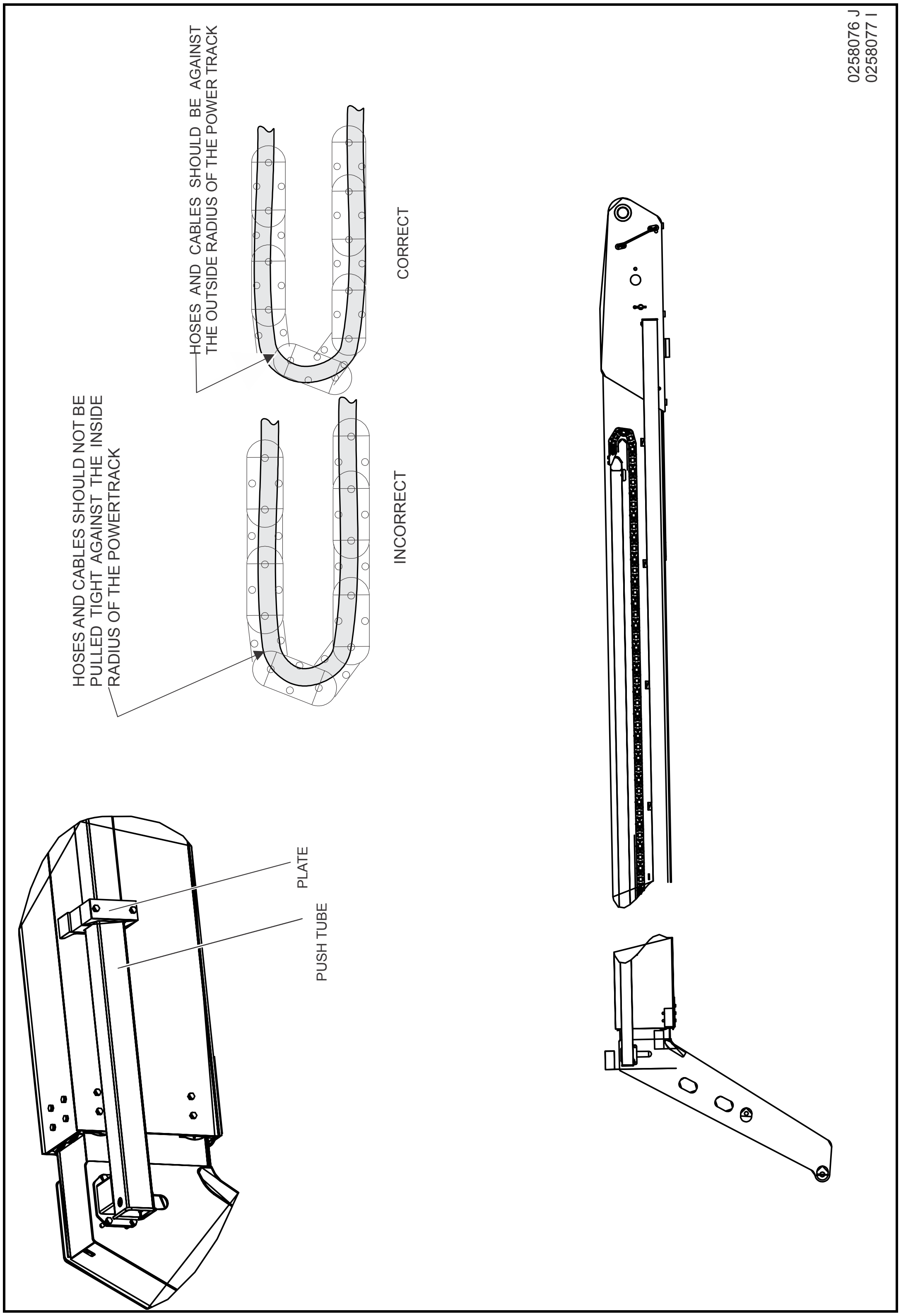


Figure 4-7. Powertrack Installation Upper Boom (Sheet 2 of 2)

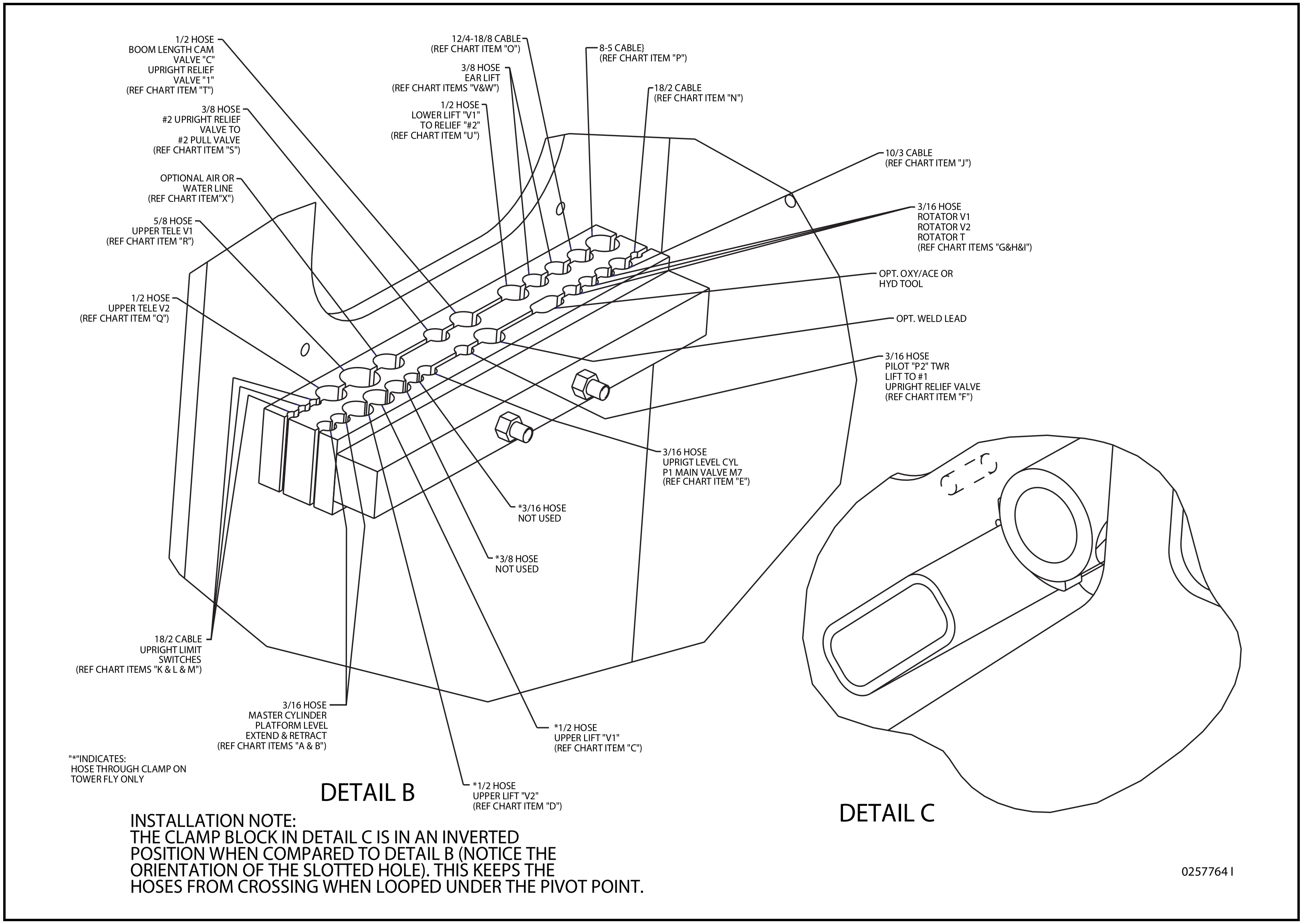
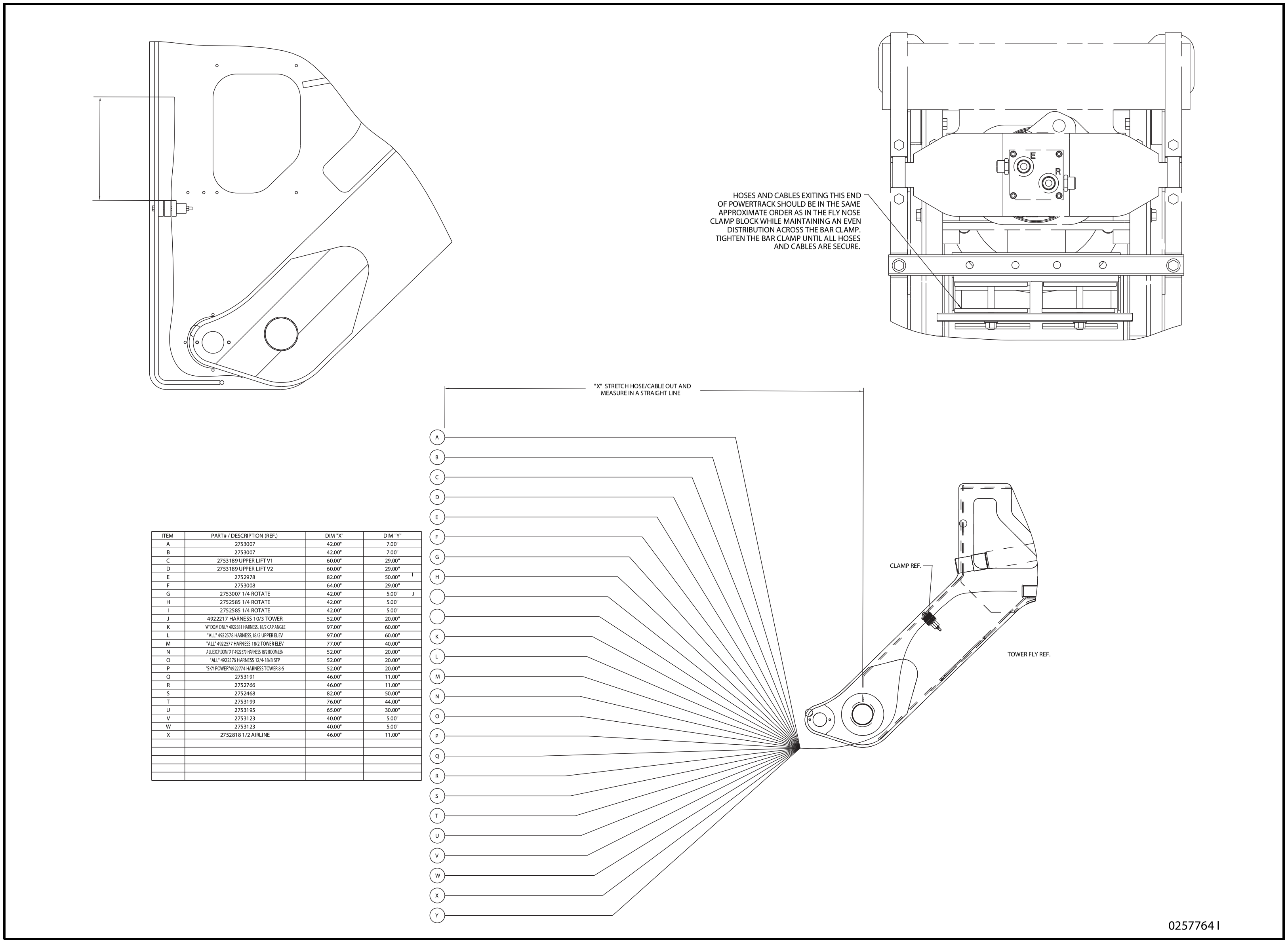


Figure 4-8. Tower Powertrack Installation Upper Boom (Sheet 1 of 2)



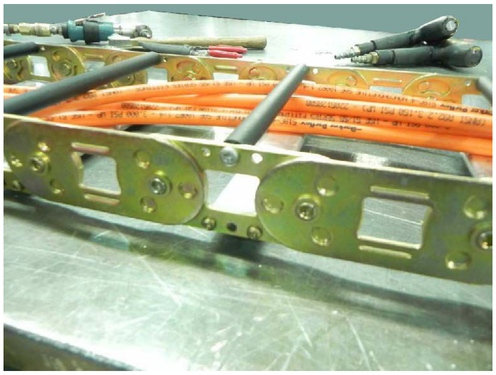
ITEM	PART# / DESCRIPTION (REF.)	DIM "X"	DIM "Y"
A	2753007	42.00"	7.00"
B	2753007	42.00"	7.00"
C	2753189 UPPER LIFT V1	60.00"	29.00"
D	2753189 UPPER LIFT V2	60.00"	29.00"
E	2752978	82.00"	50.00"
F	2753008	64.00"	29.00"
G	2753007 1/4 ROTATE	42.00"	5.00"
H	2752585 1/4 ROTATE	42.00"	5.00"
I	2752585 1/4 ROTATE	42.00"	5.00"
J	4922217 HARNESS 10/3 TOWER	52.00"	20.00"
K	"A" DOM ONLY 4922581 HARNESS, 18/2 CAP ANGLE	97.00"	60.00"
L	"ALL" 4922578 HARNESS,18/2 UPPER ELEV	97.00"	60.00"
M	"ALL" 4922577 HARNESS 18/2 TOWER ELEV	77.00"	40.00"
N	ALL EXCP.DOM "AJ" 4922579 HARNESS 18/2 BOOM LEN	52.00"	20.00"
O	"ALL" 4922576 HARNESS 12/4-18/8 STP	52.00"	20.00"
P	"SKY POWER"4922774 HARNESS TOWER 8-5	52.00"	20.00"
Q	2753191	46.00"	11.00"
R	2752766	46.00"	11.00"
S	2752468	82.00"	50.00"
T	2753199	76.00"	44.00"
U	2753195	65.00"	30.00"
V	2753123	40.00"	5.00"
W	2753123	40.00"	5.00"
X	2752818 1/2 AIRLINE	46.00"	11.00"

Figure 4-9. Tower Powertrack Installation Upper Boom (Sheet 2 of 2)

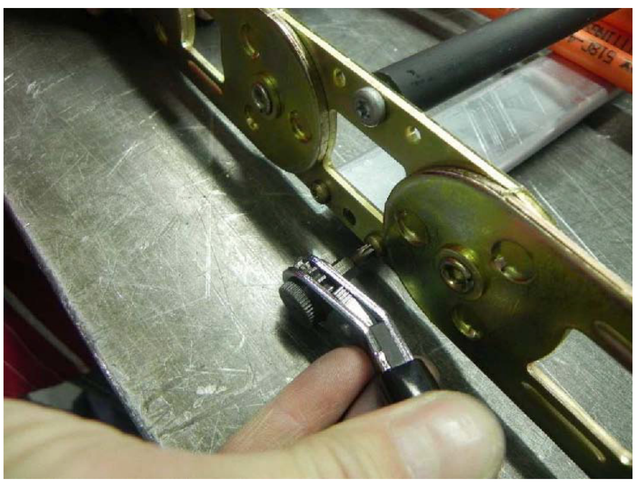
4.5 POWERTRACK MAINTENANCE

Flat Bar Removal

NOTE: *Hoses shown in the Powertrack are for example only. Actual hose and cable arrangements will be different.*



1. Use a small ¼" ratchet and a T-20 Torx bit. Remove the 8-32 x 0.500 screws from both sides. (If the track also has a flat bar on the inside of the track instead of round bar/poly, perform the same step to remove it.)

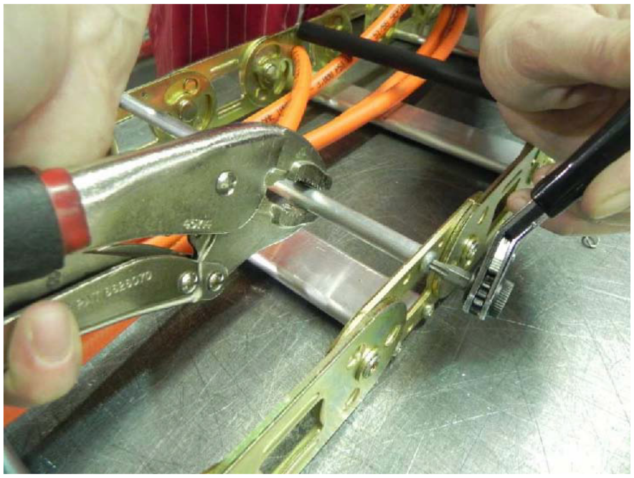


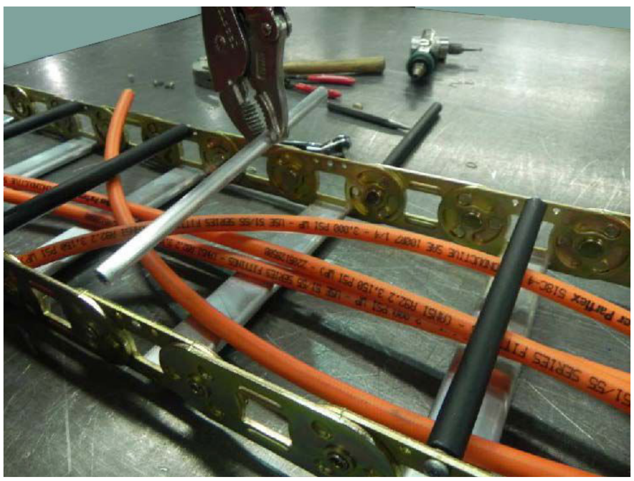
Round Bar/Poly Bar Removal

1. Use a small ¼" ratchet with a T-25 Torx bit. Remove the 10-24 x 0.812 screw. (If the bar spins then grip the bar and poly tightly with a vise-grip).

2. Lift up one end of the bar and slide the poly roller off.

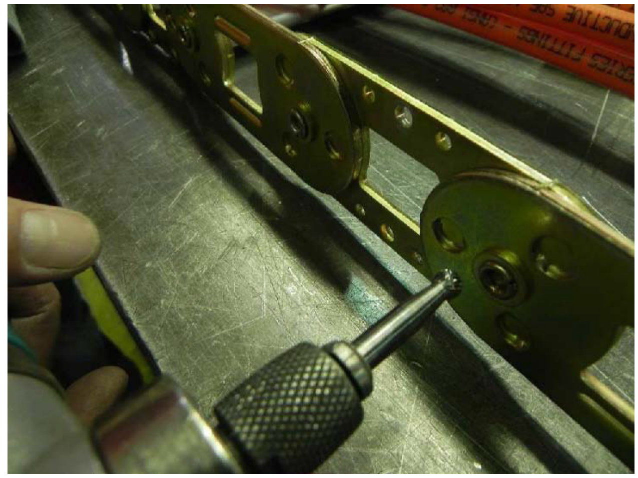
3. While gripping the bar tightly, remove the other 10-24 x 0.812 screw.



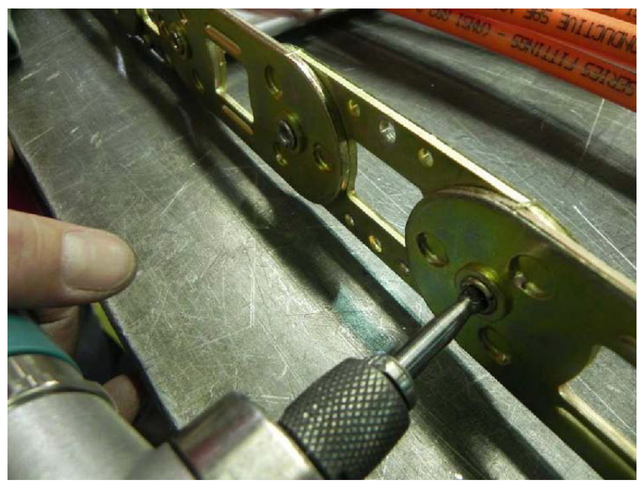


Removing and Installing Links

1. To remove the links, the rivets holding the links together must be removed. The following will show one way this can be done. Use a right angle die grinder with a ¼" ball double cut bur.

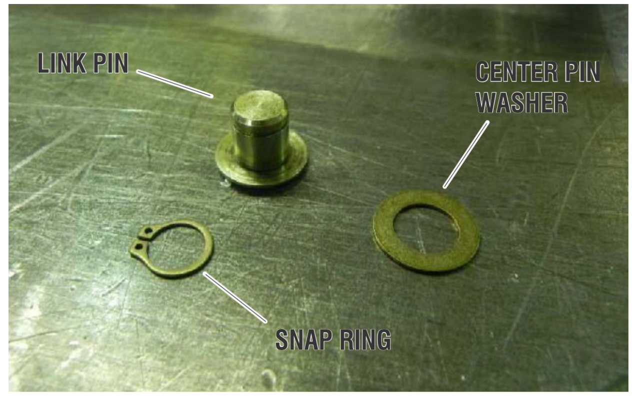


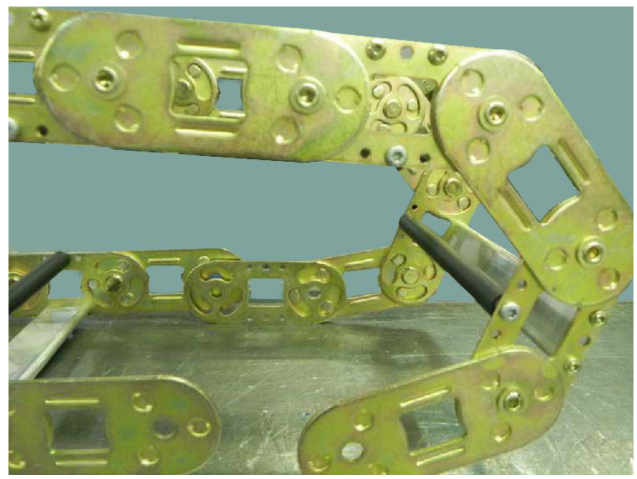
2. Insert the tool into the rolled over end of the rivet as shown. Grind out the middle of the rivet until the rolled over part of the rivet falls off. Repeat this step for all rivets that must be removed.



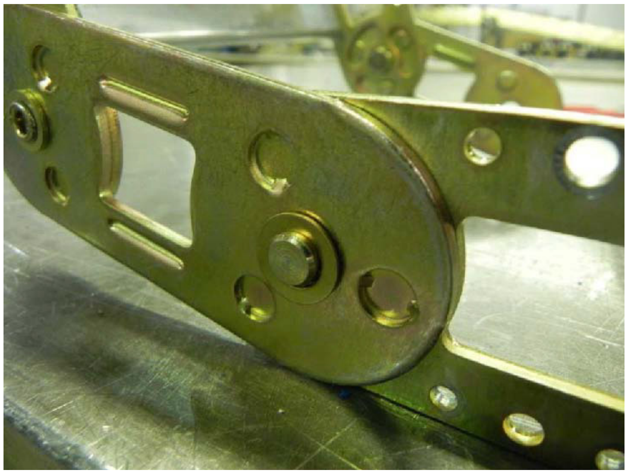
3. After grinding, it is sometimes necessary to use a center punch to punch out the rivet from the link.

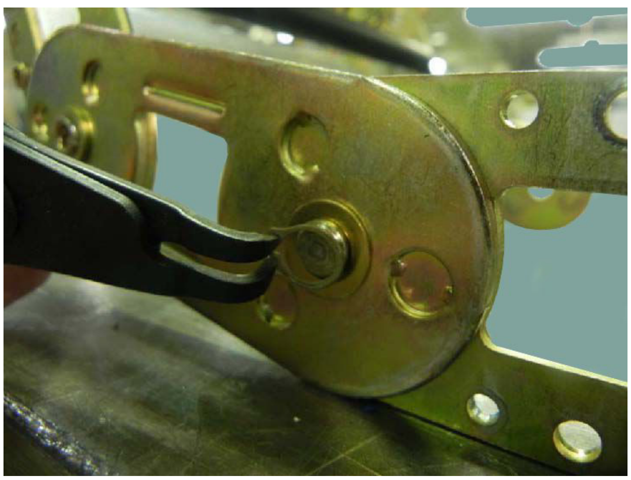
4. To install new links, extend the upper moving end over the lower part of the track so the new connection point is in the curved part of the track. This will allow the round half-shears to be rotated in a way they will fit into the peanut-shaped cut-outs.



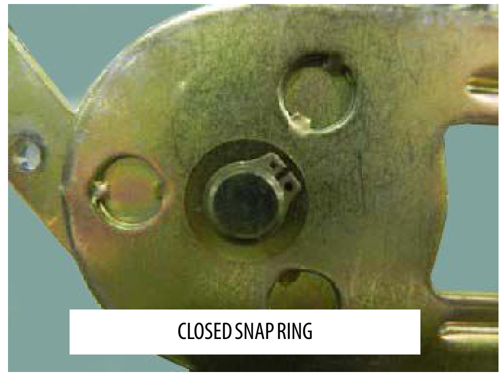


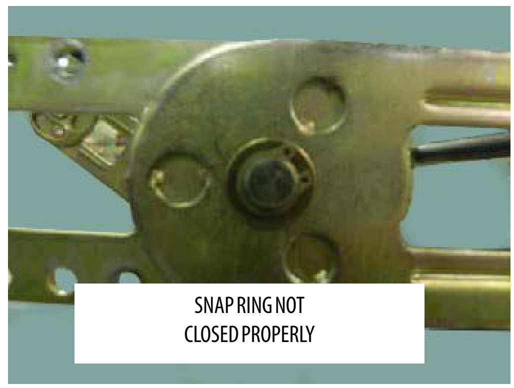
5. Install the pin into the center hole, then slide the washer over the pin. Install the snap ring into the groove in the pin.



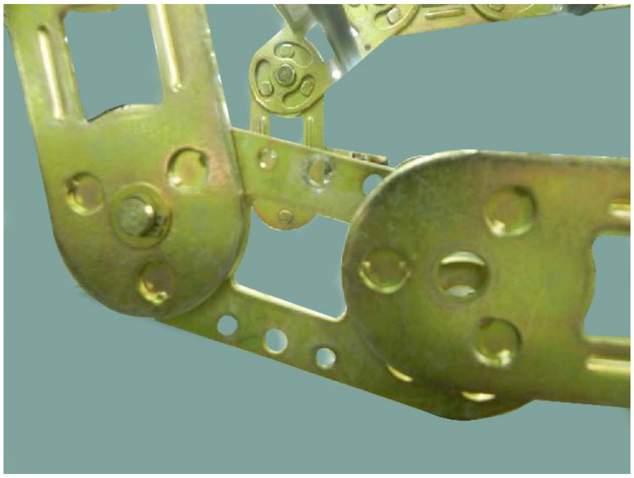


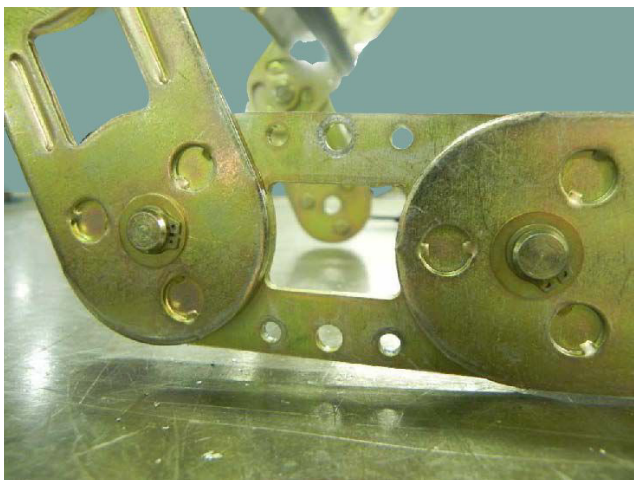
NOTE: *When installing snap rings make sure they are seated in the pin groove and closed properly.*





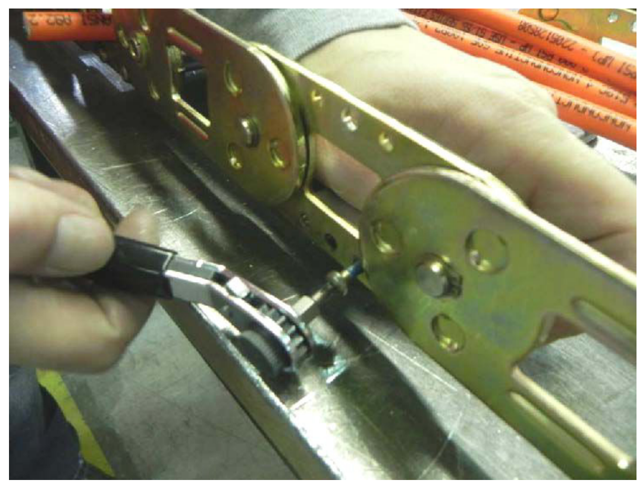
6. Install more pins, washers, and snap rings into all the links where a rivet was removed.





Installing a New Flat Bar

1. While holding the flat bar, install new 8-32 x 0.500 self threading torx screws into both holes on each side of track.



NOTE: *Maximum tightening torque for the 8-32 screw is 18-20 in-lbs (2-2.2 Nm).*

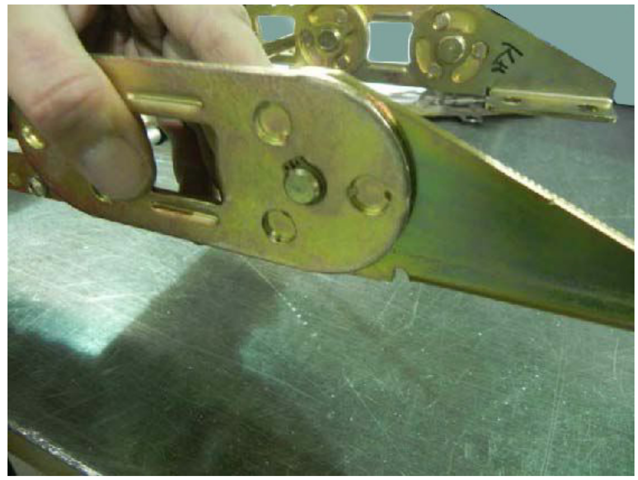
Installing a New Round Bar/Poly Roller

1. While tightly holding the round bar, install the new 10-24 x 0.812 self threading torx screw. Next lift up the other end and slide a new poly roller on. Install another 10-24 x 0.812 screw on the other side.

NOTE: *Maximum tightening torque for the 10-24 screw is 45-50 in-lbs (5-5.6 Nm).*

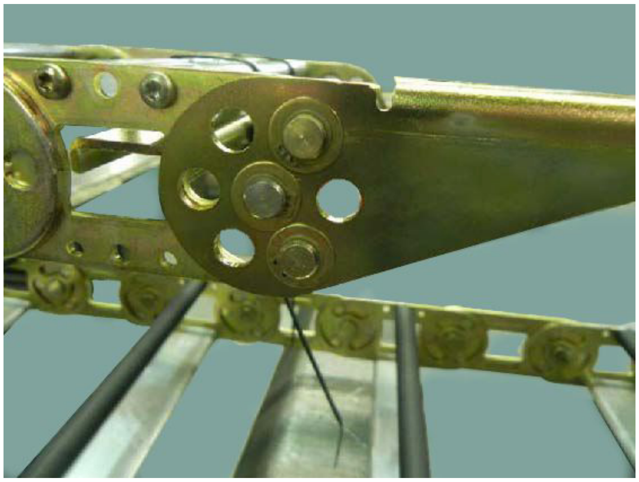
Replacing a Fixed End Bracket

1. Remove the bracket by removing the center pin, washer, and snap ring. Install a new bracket then reinstall the pin, washer, and new snap ring. After installing the new bracket make sure that it rotates correctly.



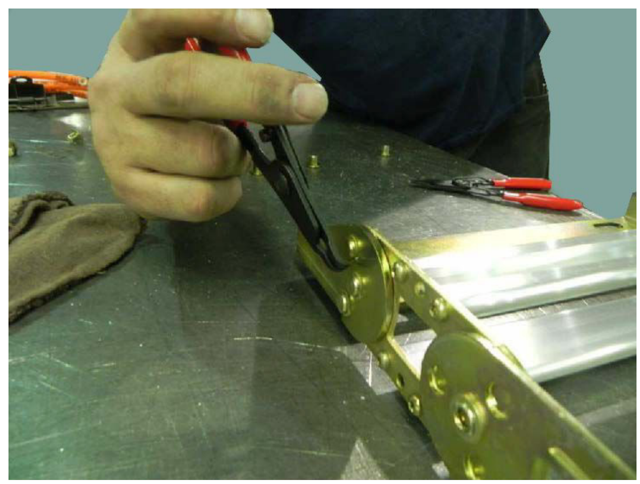
Replacing a Moving End Bracket

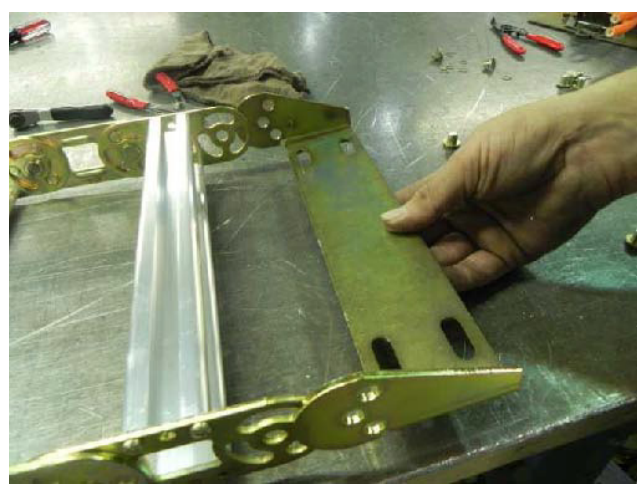
1. Remove bracket by removing all pins, washers, and snap rings. Replace with a new bracket and reinstall the pins, washers, and new snap rings. After installing a new bracket make sure that it rotates correctly.



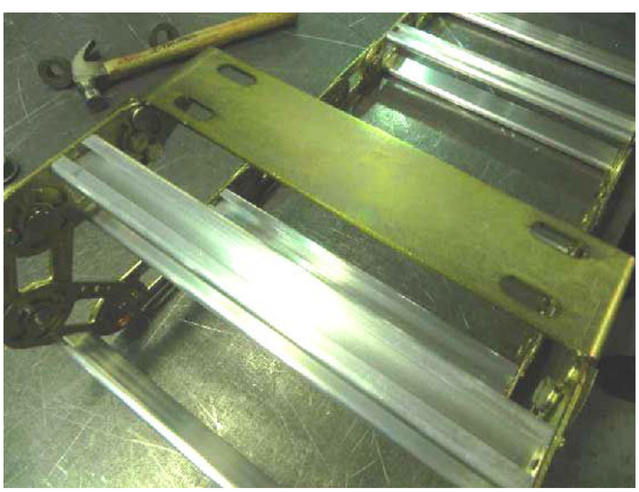
Replacing a One Piece Bracket

1. Remove all pins, washers, and snap rings and slide the bracket off of the links.





2. To install a new bracket, slide the bracket over the links and reinstall the pins, washers, and new snap rings. After installing the new bracket make sure that it rotates correctly.



4.6 UPPER BOOM

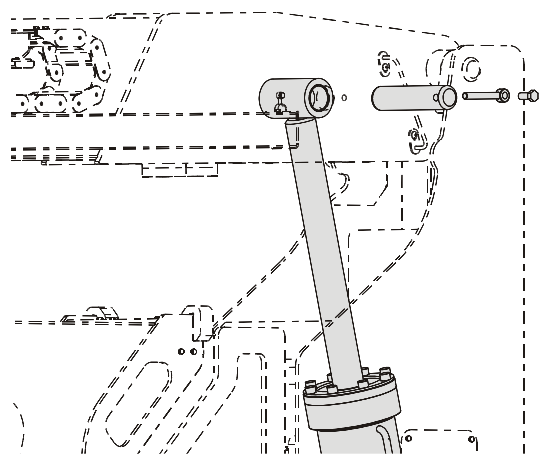
Removal

1. Using a suitable lifting equipment, adequately support boom assembly weight along entire length.

NOTICE

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

2. Tag and disconnect hydraulic lines from telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Using a suitable brass drift and hammer, remove hardware securing the upper lift cylinder rod end pin to the base boom section. Remove the upper lift cylinder pin from base boom. Retract the upper lift cylinder by using the auxiliary power switch.

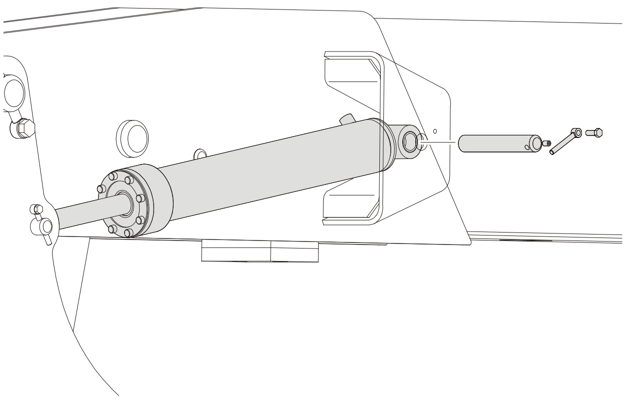


4. Remove the Master Cylinder as follows:
   a. Using an adequate supporting device, support the master cylinder so it doesn't fall when the retaining pins are removed.

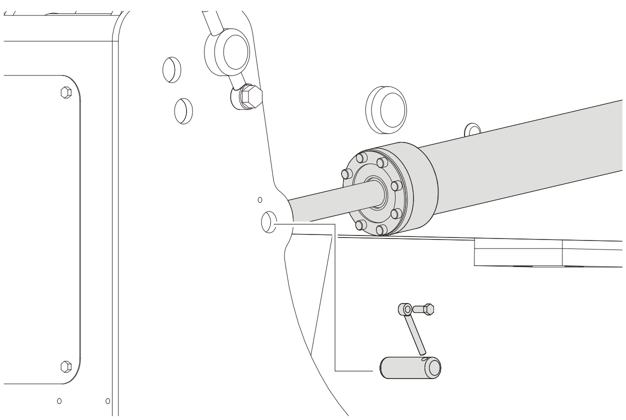
NOTE: *The master cylinder weighs approximately 58.5 lbs. (26.5 kg).*

   b. Tag and disconnect hydraulic lines from Master Cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

c. Remove the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section. Next, install a 3/8-16 UNC threaded lifting eye into the threaded hole of the pin and pull pin out.

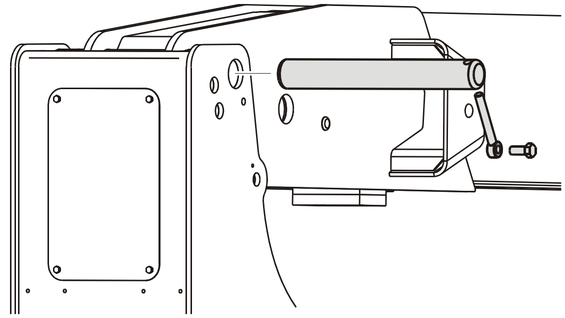


d. Remove the bolt and keeper pin securing the master cylinder rod end pin to the upright. Remove the pin.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

5. Remove the bolt and keeper pin securing the boom pivot pin to the upright. Using a suitable brass drift and hammer, remove the pivot pin from upright.



6. Using all applicable safety precautions, carefully lift boom assembly clear of upright and lower to ground or suitably supported work surface.

NOTE: *The upper boom alone weighs approximately 2226 lbs. (1010 kg). Including the slave cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

Disassembly

1. Remove hardware securing telescope cylinder to back end of the base boom section.
2. Remove hardware which secures the wear pads to the base boom section; remove the wear pads from the top, sides and bottom of the base boom section.
3. Using overhead crane or suitable lifting device, remove fly boom assembly from base section.
4. Remove hardware from the telescope cylinder pin. Using a suitable brass drift and hammer remove the cylinder pin from fly boom section.
5. Pull the telescope cylinder partially from aft end of the fly boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
6. Carefully remove the telescope cylinder and place telescope cylinder on a suitable trestle.

NOTE: *The Upper Boom Telescope Cylinder can be removed without disassembling the upper boom by disconnecting hydraulic lines, top attaching pin of upper lift cylinder and telescope cylinders as directed above, and pulling out the telescope cylinder from the rear, thru the access plate opening of the upright.*

7. Remove hardware which secures the wear pads to the aft end of fly boom section; remove the wear pads from the top, sides and bottom of the fly boom section.

Inspection

NOTE: *When inspecting pins and bearings, refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

1. Inspect upper boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.
3. Inspect upper lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
4. Inspect inner diameter of boom pivot bearing for scoring, distortion, wear, or other damage. Replace bearing as necessary.
5. Inspect all wear pads for excessive wear, or other damage. Replace pads when worn as specified in Figure 4-22., Location And Thickness Of Wear Pads.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Measure inside dimensions of the base section to determine the number of shims required for proper fit.
2. Install side, top and bottom wear pads to the aft end of fly section; shim evenly to the measurements of the inside of base boom section.

NOTICE

WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

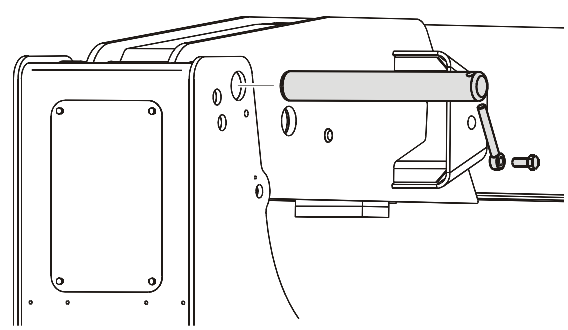
3. Secure the sling and lifting device at the telescope cylinder's approximate center of gravity, and lift the cylinder to the aft end of the fly boom section.
4. Slide telescope cylinder into the aft end of fly boom section. Align attachment holes in fly boom section with hole in rod end of telescope cylinder.
5. Install telescope cylinder pin and secure with mounting hardware.
6. Secure the sling and lifting device at the fly boom assembly approximate center of gravity.
7. Slide fly boom assembly into the base boom section. Shim boom, if necessary, for a total of 1/32 inch clearance.
8. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 1/32 inch clearance.
9. Align the cylinder with the slots at aft end of base boom section, then secure cylinder with mounting hardware.

Installation

1. Using all applicable safety precautions, carefully lift boom assembly to align the pivot holes in the boom with those of the upright.

NOTE: *The upper boom alone weighs approximately 2226 lbs. (1010 kg). Including the slave cylinder, rotator, and platform support the assembly weighs approximately 3185 lbs. (1445 kg).*

2. Using a suitable brass drift and hammer, install the pivot pin into the upright. Install the bolt and keeper pin securing the boom pivot pin to the upright.

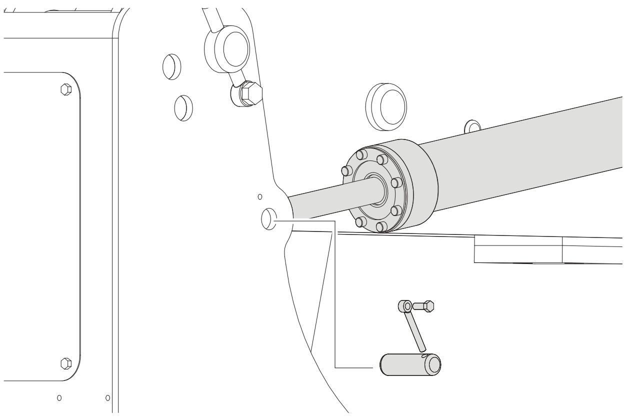


3. Install the Master Cylinder as follows:

   a. Using an adequate supporting device, align the master cylinder with the mounting holes on the boom and upright.

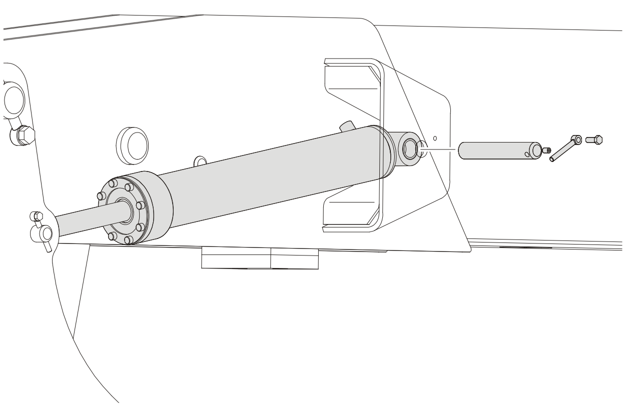
NOTE: *The master cylinder weighs approximately 58.5 lbs. (26.5 kg).*

   b. Install the master cylinder rod end pin. Install the bolt and keeper pin securing the master cylinder rod end pin to the upright.



NOTE: *When installing the master cylinder rod end pin, insert the keeper hardware pin to prevent the pin from inserting too far.*

   c. Install the barrel end retaining pin. Install the bolt and keeper pin securing the master cylinder barrel end pin to the base boom section.



   d. Connect hydraulic lines to the master cylinder as tagged during removal.

4.7 UPRIGHT

Removal

NOTICE

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

1. Remove the upper boom. Refer to Section 4.6, Upper Boom.

2. Tag and disconnect hydraulic lines to the upper lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

3. Remove mounting hardware from Upper lift Cylinder barrel end. Using a suitable brass drift and hammer, remove pin #1 from Upright and remove Upper Lift Cylinder.

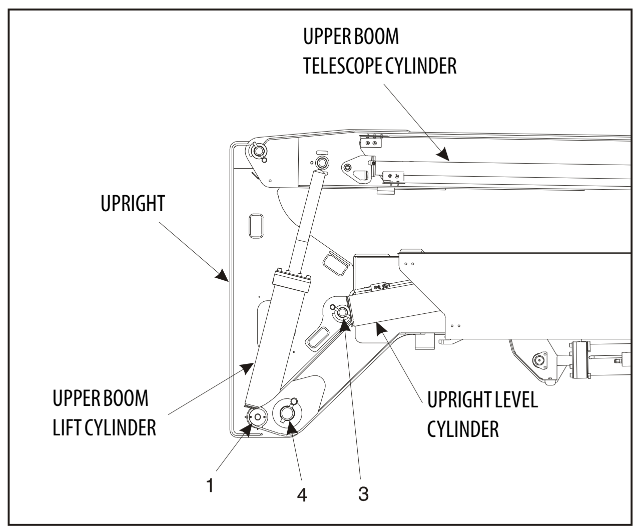


Figure 4-10. Location of Components - Upright

4. Disconnect wiring harness to horizontal limit switch.

5. Disconnect the Upright Level Cylinder as follows:

   a. Using a suitable lifting device, support the Upright.

   b. Remove mounting hardware securing hose bracket in upright, and remove the hose bracket.

   c. Remove mounting hardware securing the upright level cylinder to the upright. Using a suitable brass drift and hammer, remove pin #3 from upright and disconnect the upright level cylinder from the upright.

6. Remove mounting hardware from the Upright Pivot Pin using a suitable brass drift and hammer. Remove pin # 4 from tower boom assembly and remove the upright from the machine.

NOTE: *Steps 7 thru 10 are only necessary if the upright level cylinder is to be removed.*

7. With upright removed, override tower telescope limit switch and extend the tower boom to gain access to the upright level cylinder rod end attach pin.

8. Tag and disconnect hydraulic lines to the upright lift cylinder. Use a suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

9. Using an overhead crane or suitable lifting device, support the upright lift cylinder, remove mounting hardware from the barrel end of the upright lift cylinder and remove the pin.

10. Carefully remove the upright lift cylinder and place on a suitable work surface.

Installation

NOTE: *Steps 1 thru 4 are only necessary if the upright level cylinder is to be removed.*

1. Using a suitable lifting device, carefully install the upright lift cylinder into place in the tower boom.

2. Install the pin and mounting hardware at the barrel end of the upright lift cylinder.

3. Connect the hydraulic lines to the upright lift cylinder as tagged during removal.

4. Override the tower telescope limit switch and retract the tower boom.

5. Using an adequate lifting device, install the upright into position. Install pin # 4 into the tower boom assembly and secure it in place with the mounting hardware.

6. Connect the Upright Level Cylinder as follows:

   a. Align the holes in the cylinder and upright for pin #3, and install the pin into the upright and connect the upright level cylinder to the upright. Install the mounting hardware securing the pin.

   b. Install the hose bracket and secure in place with the mounting hardware.

7. Connect the wiring harness to horizontal limit switch.

8. Align the holes in the upper lift cylinder and upright for pin #1 and install the pin. Secure the pin in place with the mounting hardware.

9. Connect the hydraulic lines to the upper lift cylinder as tagged during removal.

10. Install the upper boom. Refer to Section 4.6, Upper Boom.

4.8 TOWER BOOM ASSEMBLY

Removal

NOTICE

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

1. Using an overhead crane or suitable lifting device, support the entire Tower Boom Assembly and separately support the tower lift cylinder.

2. Remove mounting hardware from tower lift cylinder rod end. with a brass drift and hammer, remove the tower Lift cylinder Pin disconnecting the tower lift cylinder.

3. Remove mounting hardware from the upright leveling cylinder rod end. with a brass drift and hammer, remove the pin, disconnecting the upright cylinder. Remove with suitable lifting device.

4. Remove mounting hardware from the tower boom pivot pin. Using a suitable brass drift and hammer, remove pin #2 from turntable assembly.

5. Using all applicable safety precautions, carefully lift the Tower Boom Assembly clear of turntable and lower to ground or a suitable supported work surface.

6. Remove the Tower Fly as follows:

   a. Mark all hoses and wiring harnesses at bracket on rear end of tower base boom for future assembly. Remove hoses and wiring from tower boom Powertrack.

b. Remove mounting hardware that secures the Powertrack to tower base boom and remove the Powertrack.

c. Remove mounting hardware from tower boom telescope cylinder barrel and rod end.

d. Slide the telescope cylinder out of the base boom, support with an overhead crane or suitable lifting device.

e. Remove mounting hardware that secures the wear pads to the front of tower base boom section; Remove the wear pads from the top sides and bottom of the tower base boom.

f. Using an overhead crane or suitable lifting device, remove the fly section

Inspection

NOTE: *Refer to Section 2, Pins and Composite Bearing Repair Guidelines.*

1. Inspect tower boom pivot pin for wear scoring, tapering, and ovality, or other damage. Replace pins as necessary.
2. Inspect tower boom pivot attach points for scoring, tapering, and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of tower boom pivot bearings for scoring, distortion, wear, or other damage.
4. Inspect lift cylinder attach pin for wear, scoring, tapering, and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of upright attach point bearings for scoring, distortion, wear, or other damage. Replace bearing as necessary.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of tower boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.
8. Inspect Powertrack for damage such as cracking, wear, or other damage. Replace links or assembly, as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during dissembly.*

1. Measure inside dimensions of the tower base section to determine the number of shims required for proper fit.
2. Install side, top, bottom wear pads to the aft end of tower fly section; shim evenly to the measurements of the inside of the base boom section.

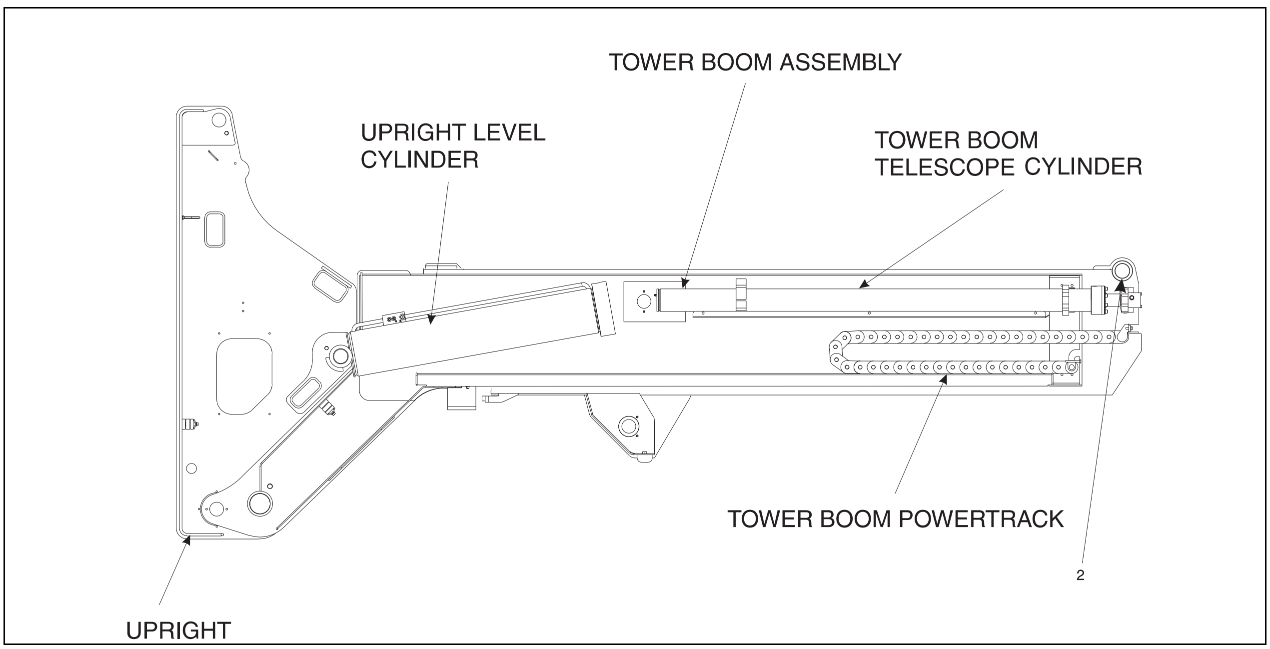


Figure 4-11. Location of Components - Tower Boom Powertrack

NOTICE

WHEN ASSEMBLING TOWER BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

3. Align upright leveling cylinder with attach holes in tower fly boom. Using a soft head mallet, install the cylinder pin into tower fly boom and secure with mounting hardware.
4. Secure the sling and lifting device at the tower fly boom assembly's approximate center of gravity.
5. Slide tower fly boom assembly into the tower base boom section, for a total of 1/32 inch clearance.
6. Install wear pads into the forward position of the tower base boom section. Shim boom, if necessary, for a total of 1/32 inch clearance.
7. Align the telescope cylinder with the slots at the aft end of tower base boom section, then secure cylinder with mounting hardware.
8. Attach internal Powertrack to tower base boom at bottom only and extended out of boom that the Powertrack links are opened at top.
9. Attach hoses and wiring harnesses at front end of base boom and route thru the Powertrack. Secure hoses and wiring harnesses with hose brackets.
10. Roll the Powertrack back into the base boom section and attach loose end of the Powertrack to the inside top of the fly boom section.

Installation

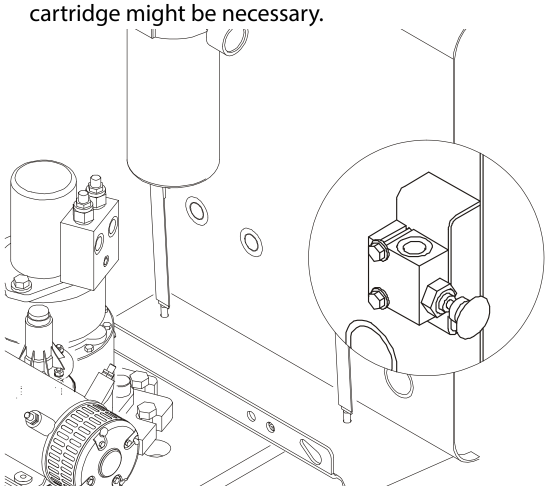
1. Using a suitable lifting device, position boom assembly on turntable so that the pivot holes in both boom and turntable are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Connect all wiring connectors to the correct connectors.
5. Connect all hydraulic lines of boom assembly.
6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
7. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
8. Retract and lower boom, noting the performance of the retraction cycle.

Tower Out of Sync

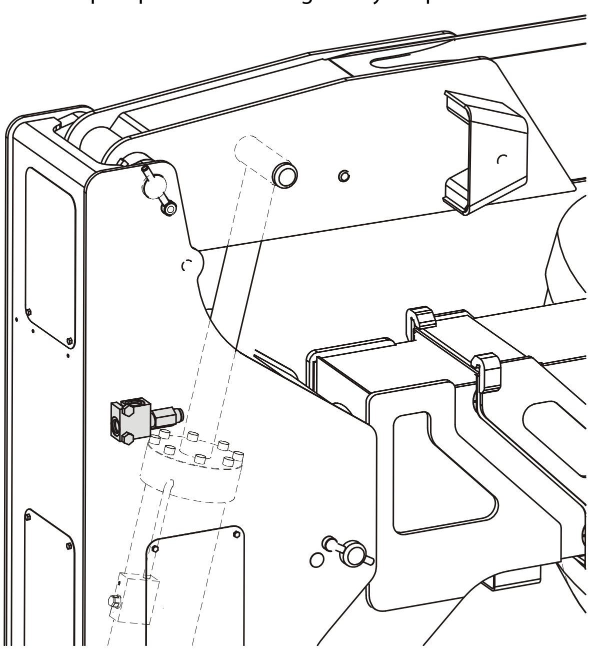
Tower is out of sync backwards, upright leaning toward the platform.

When towering down the upright cylinder bottoms out before the lower lift. Problems that could cause this are:

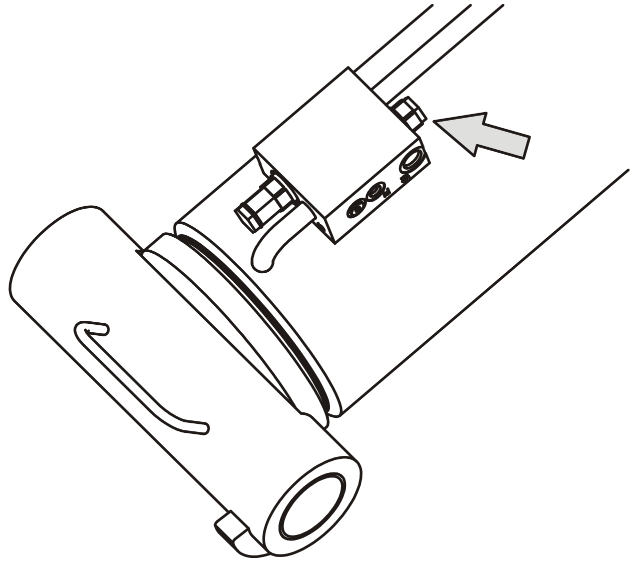
1. The releveling valve (red knob on the oil tank P/N: 4640866), this is a poppet valve that could be leaking fluid out of the closed loop. Manually opening the valve and flushing it can eliminate any contaminate on the seat. The seat could also be damaged, so replacing the cartridge might be necessary.



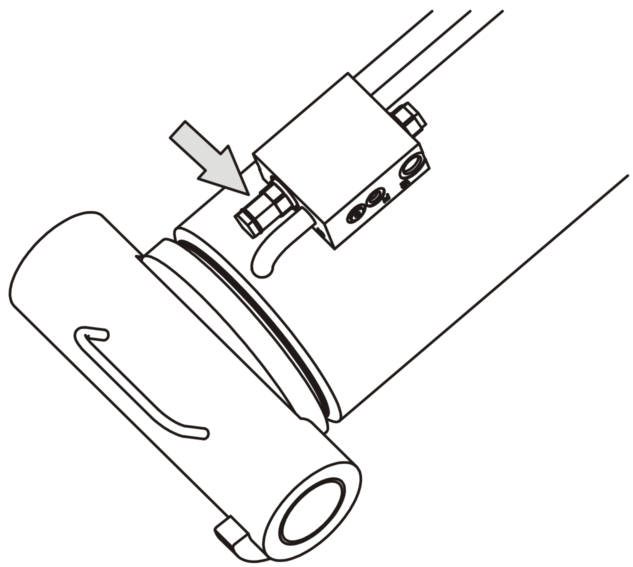
2. A relief valve is located in the upright (P/N: 4640929). This relief valve could be leaking backwards out of the loop. Replace the cartridge. They are pre-set.



3. The counter/balance valve in the piston end of the upright level cylinder. There could be a leak path from the valve port to the pilot port.
Replace the counter/balance valve.



4. The counter/balance valve in the rod end of the lower lift cylinder. There could be a leak path from the valve port to the pilot port. Replace the counter/balance valve.

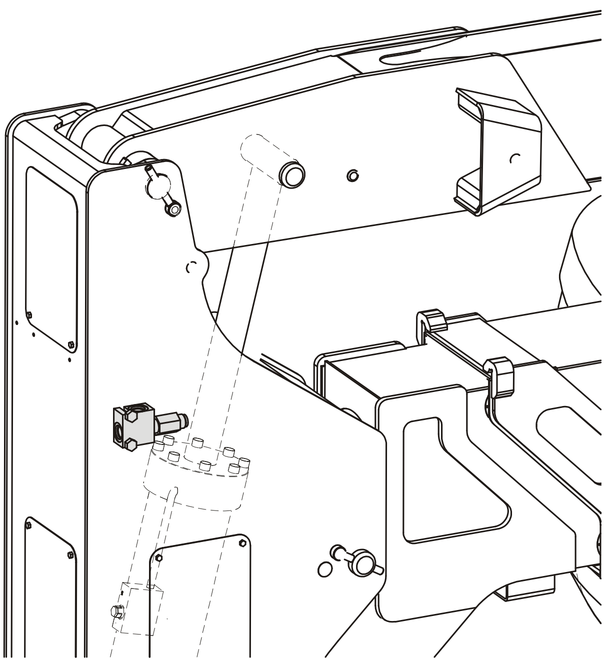


5. The packing on either the upright or lower cylinder can cause this. Do cylinder tests to determine if either cylinder needs new packing.

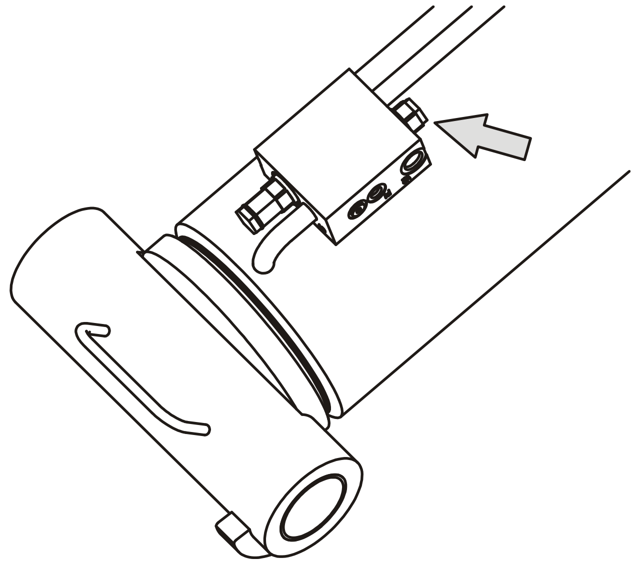
Tower is out of sync forwards, upright leaning toward the steer axle.

When towering down, the lower lift cylinder bottoms out before the upright level cylinder. This is caused by too much oil between the two cylinders. Problems that could cause this are:

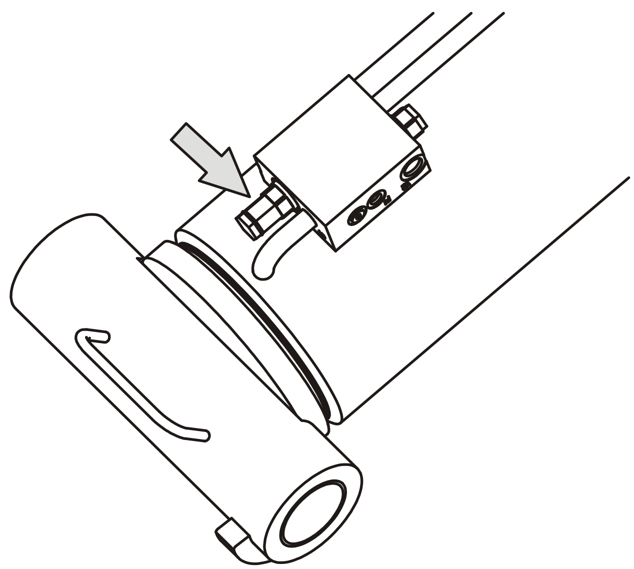
1. The relief valve located in the upright (P/N: 4640929). If this valve is set too low or has contaminate in it causing it to leak prematurely, when lifting down oil can pass through it causing the volume to grow between the cylinders. Flush the valve out and reinstall it, or replace the cartridge. The cartridge pressure is pre-set so no adjustment can be made.



2. The counterbalance valve in the piston end of the upright level cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



3. The counterbalance valve in the rod end of the lower lift cylinder. There could be a leak path from the pilot port to the valve port. Replace the counterbalance valve.



4. The packing on the lower lift cylinder can cause this. Do a cylinder test to check this out. Refer to Section 2.4, Cylinder Drift Test.

4.9 UPRIGHT MONITORING SYSTEM

The UMS provides a visual and audible warning to the operator when the limits of the upright assembly alignment have been reached. In addition, the UMS will not allow the tower boom to be lowered when the upright assembly is misaligned in a direction oriented away from the work platform.

Re-Synchronizing Upright

A pull type control valve allows the operator to adjust the upright level cylinder if the upright is not 90° (vertical) relative to the chassis (Refer to Figure 4-12.). This valve is located in the tank compartment area.

Perform the following steps with the aid of an assistant:

1. Turn the key switch to the ground control position.
2. Start the engine.
3. Pull and hold the red re level knob located next to the main control valve. Refer to Figure 4-12.
4. Raise the tower boom 6 feet (1.8 m).
5. Release the red relevel knob.
6. Lower the tower boom fully and continue to hold down the switch to Tower Down for an additional 20 seconds.
7. Repeat steps 3 thru 6 as necessary until the upright is 90° (vertical) relative to the chassis.

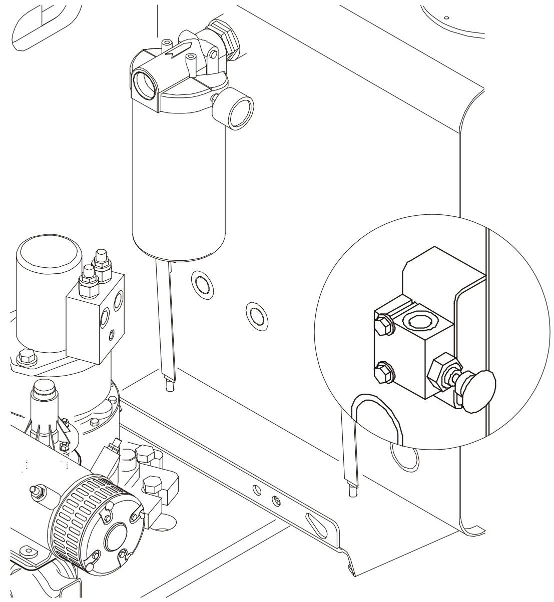


Figure 4-12. Releveling Valve

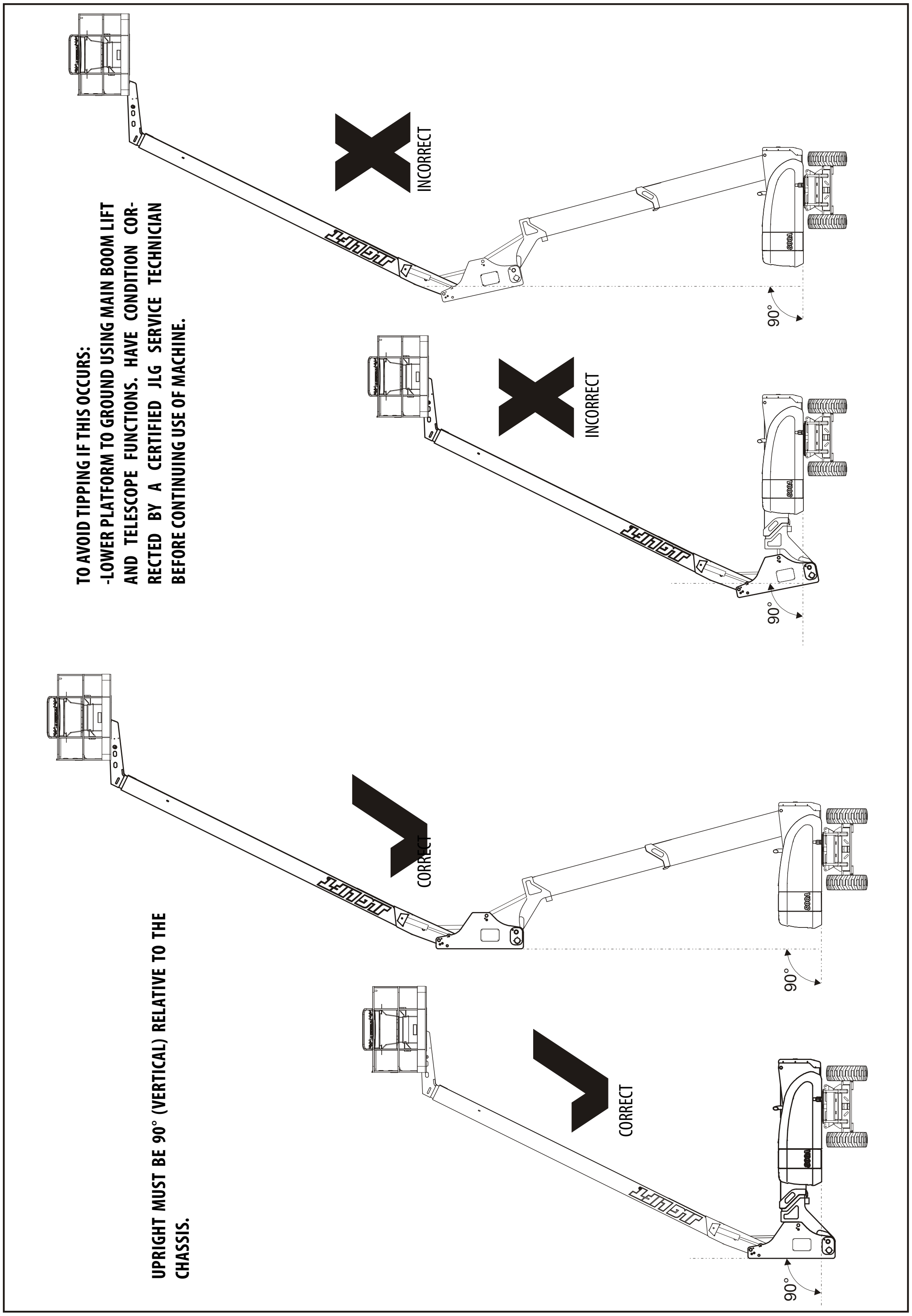


Figure 4-13. Boom Upright Positioning

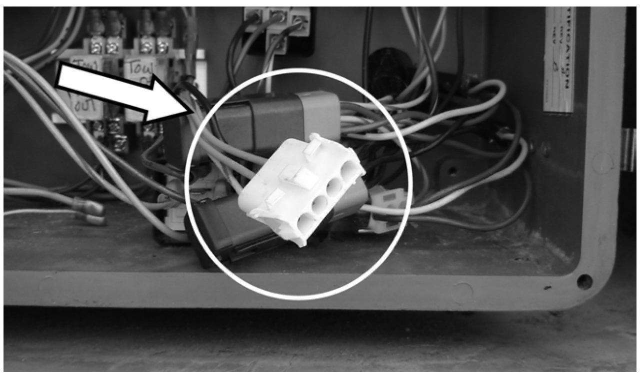
Calibration - Pre ADE Machines

NOTICE

CALIBRATION OF THE UPRIGHT MONITORING SYSTEM REQUIRES THE MACHINE TO BE ON A FIRM AND LEVEL SURFACE WITH SUFFICIENT OVERHEAD CLEARANCE TO FULLY ELEVATE THE TOWER BOOM.

1. Refer to Section 6 for operating instructions and menu structures for the hand-held analyzer.

2. Connect the hand-held analyzer at the ground control station using the four-pin analyzer connector shown below.



3. Pull out the emergency stop button at the ground control station and start the engine from the ground controls.

NOTE: *The boom malfunction indicator light at the ground controls will flash until the initial calibration is performed.*

4. To calibrate the Upright Monitoring System through the hand-held analyzer, you must be in access level 1. To advance to access level 1, scroll to the ACCESS LEVEL menu and press "ENTER" ENTER. Using the arrows on the keypad, enter the password "33271" and press "ENTER" ENTER.

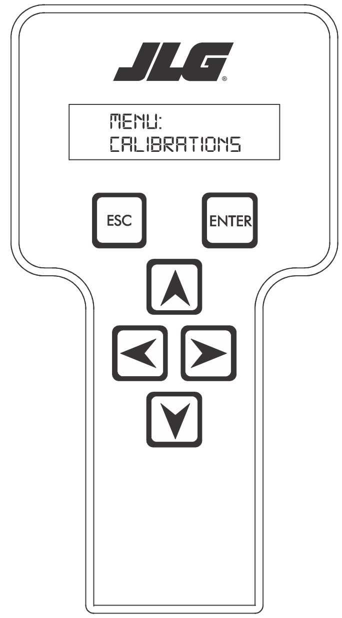
NOTE: *Repeat step #4 if the correct access level is not displayed.*

5. Calibrate the Upright Monitoring System (UMS) sensors by the following procedure:

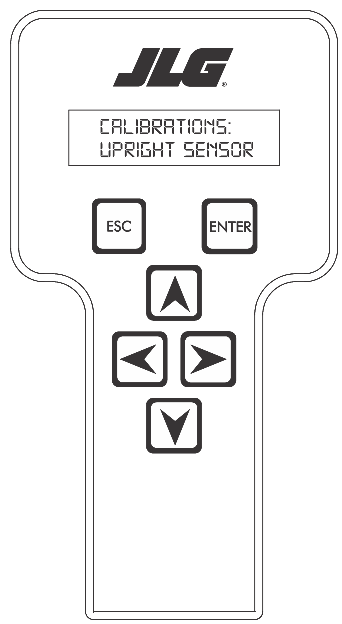
NOTICE

THE UPRIGHT SENSOR AND TURNTABLE SENSOR WILL BE CALIBRATED SIMULTANEOUSLY THROUGH THIS STEP.

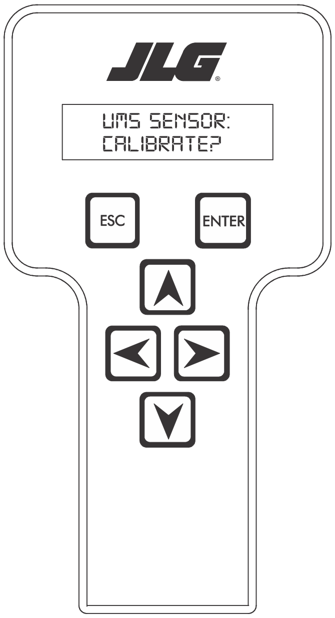
a. In access level 1, scroll through the menu items until "CALIBRATIONS" is displayed on the second line of the analyzer screen as shown below.



b. When "CALIBRATIONS" is displayed, press "ENTER" ENTER to advance to the next screen. The screen will display the following:

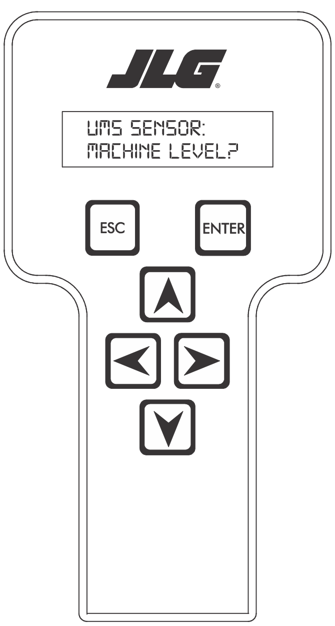


c. Press "ENTER", and the following screen will be displayed asking if you wish to calibrate the upright monitoring system.



NOTE: *By pressing the left or right arrow keys in this screen, you may view the output of the sensor.*

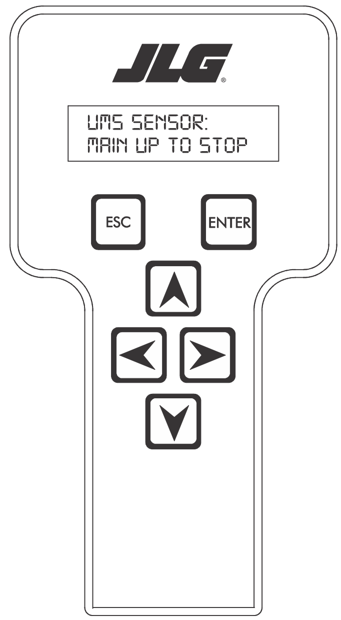
d. Press "ENTER" and the screen will display the following:



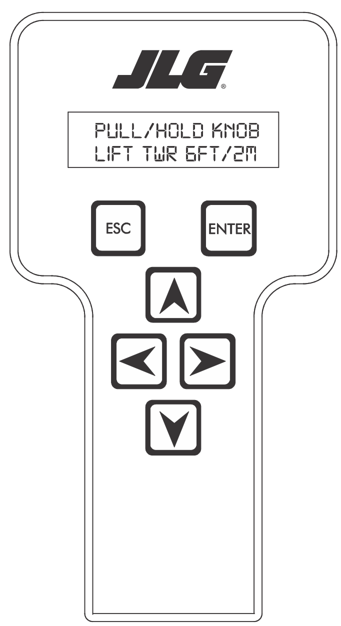
NOTICE

THE MACHINE MUST BE LEVEL FOR PROPER CALIBRATION.

e. Verify the machine is level and press "ENTER". The screen will display the following, asking you to fully elevate the main boom.



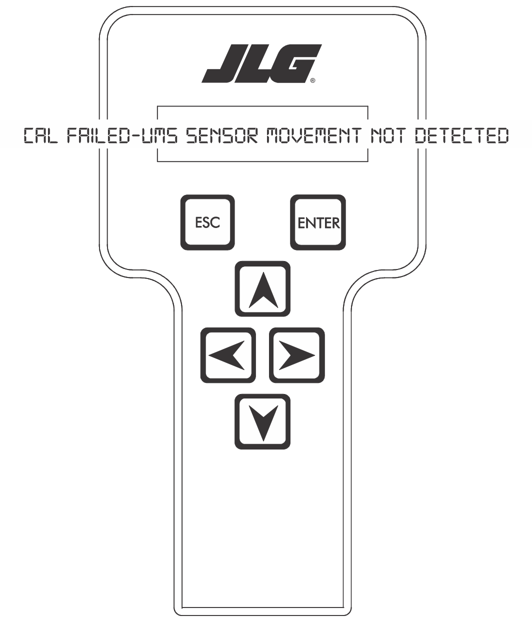
f. Start the machine and fully elevate the main boom. After the main boom has been fully elevated, press "ENTER". The analyzer will display the following:



NOTE: *By pressing the left or right arrows in this screen, you may view the output of each sensor.*

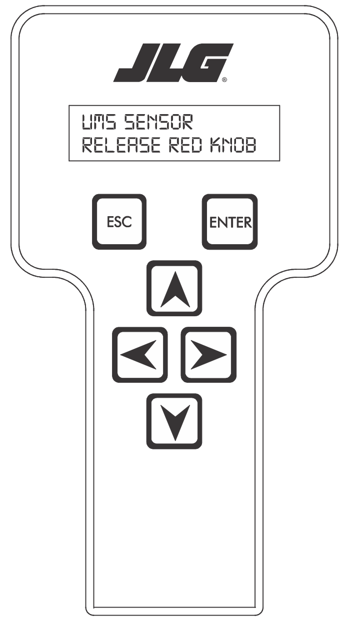
g. Pull and hold the red re-leveling knob on the hydraulic tank while lifting the tower boom. Raise the tower boom six (6) feet or two (2) meters. After elevating the tower the required distance, press "ENTER" .

If the UMS did not detect adequate sensor activity, the screen will display:

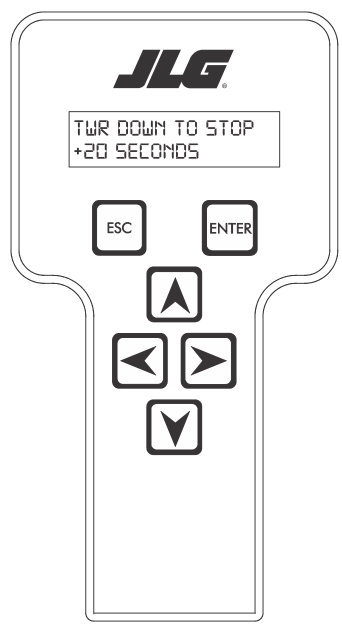


Should you get the above message, verify that the sensor is installed correctly and verify the sensor connection to the sensor harness is secure. Also, ensure the red knob is held fully open for the required time.

If the calibration is executing properly, you shall see the following display:



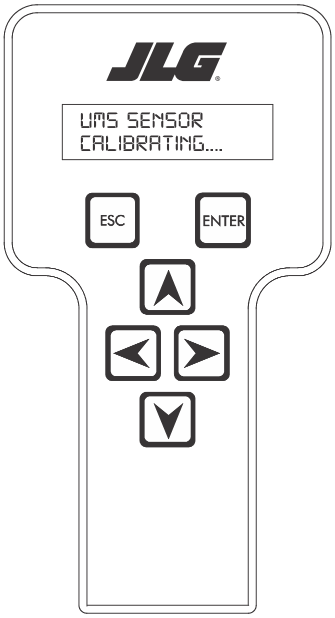
h. When viewing the above display, press "ENTER" . The screen will display the following:



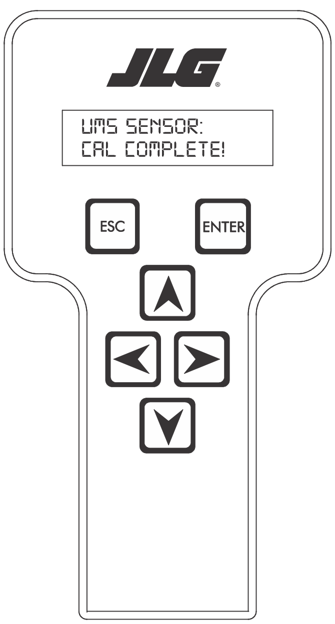
i. Lower the tower boom onto the boom stop. Continue to hold the tower boom down function for an additional twenty (20) seconds **WITHOUT RELEASING THE FUNCTION SWITCH**. The calibration must recognize continuous activation of the tower down function switch for the required time.
After the required activation time has passed,

release the function switch and press “ENTER” 

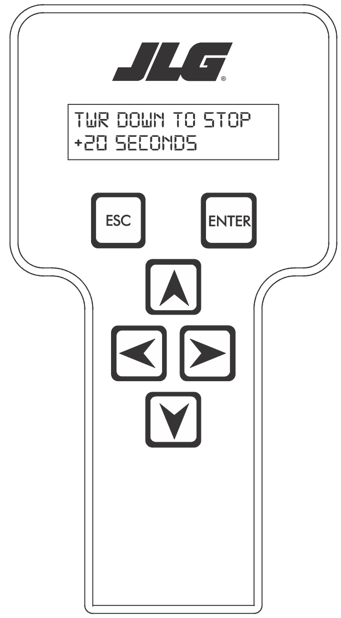
. The analyzer will display the following message:



If the calibration has been completed successfully, the screen will automatically change to:



If the calibration has *not* been completed successfully, the display will automatically change to:



Repeat step i until the calibration time requirement has been satisfied.

⚠ WARNING

DO NOT RAISE THE TOWER BOOM AGAIN DURING CALIBRATION.

j. To correctly complete the calibration process, fully retract and fully lower the boom. Once the machine is in the stowed position, turn off the machine and disconnect the analyzer.

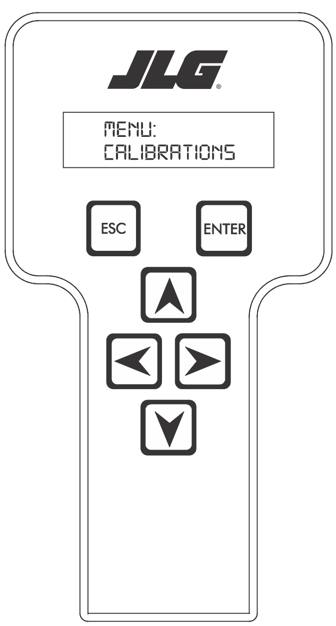
Calibration - ADE Equipped Machines

1. Connect the JLG Hand-held analyzer to the original analyzer connection in the ground box.

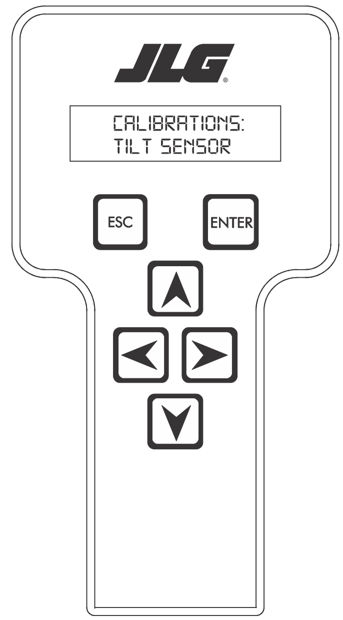
NOTICE

DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

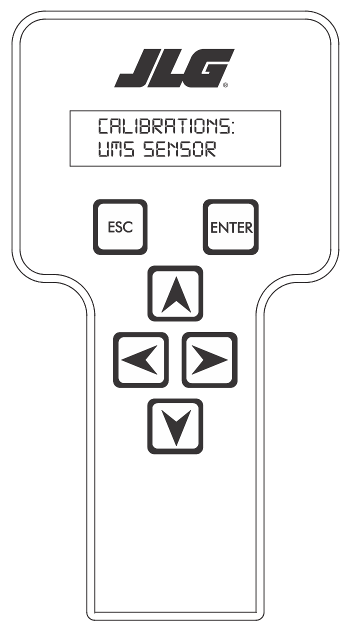
2. Pull out the emergency stop button at the ground control station and start the engine from the ground controls.
3. To calibrate the Upright Monitoring System through the hand-held analyzer, you must be in access level 1. To advance to access level 1, scroll to the ACCESS LEVEL menu and press "ENTER". Using the arrows on the keypad, enter the password "33271" and press "ENTER".
4. Calibrate the upright monitoring system sensor by the following procedure:
   a. In access level 1, scroll through the menu items until "CALIBRATIONS" is displayed on the second line of the analyzer screen. The screen will display the following:



   b. After pressing 'ENTER" one of the following screens will be displayed:



Or

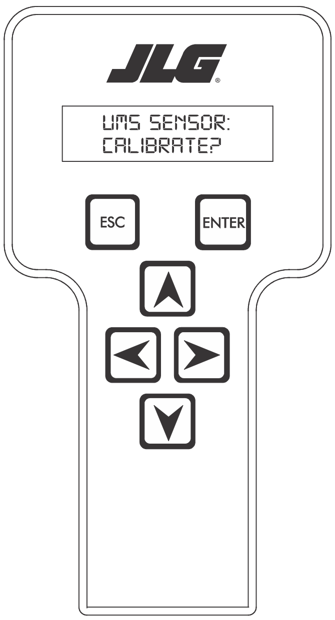


   c. Scroll left to right through the above menu items until "UMS SENSOR" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" key.

NOTICE

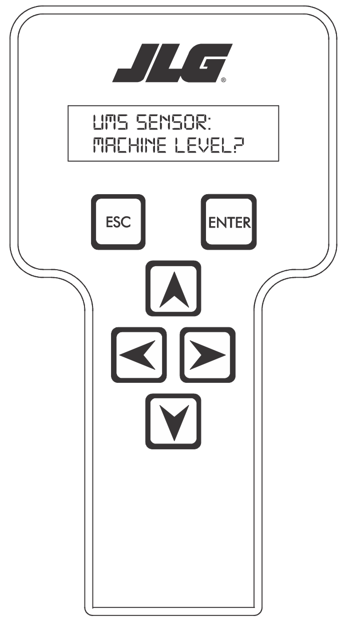
IT IS NOT NECESSARY TO CALIBRATE THE TILT SENSOR IN THE GROUND CONTROL MODULE AT THIS TIME. HOWEVER, WHEN THE TILT SENSOR IN THE GROUND CONTROL MODULE IS RECALIBRATED, THE UPRIGHT MONITORING SYSTEM TILT SENSOR MUST BE RECALIBRATED AS WELL.

d. After selecting "UMS SENSOR", the following screen will appear:



NOTE: *By pressing the left or right arrow keys in this screen, you may view the output of the sensor.*

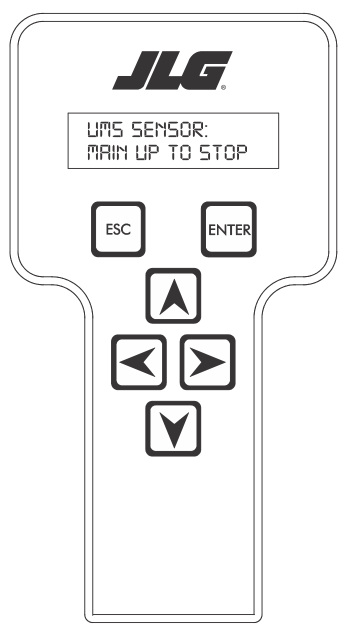
e. Press "ENTER" and the next screen will display the following, asking if the machine is on a level surface:



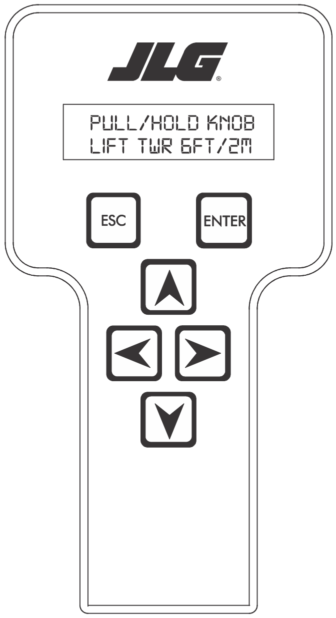
NOTICE

THE MACHINE MUST BE LEVEL FOR PROPER CALIBRATION.

f. Verify the machine is level and press "ENTER". The screen will display the following, asking you to fully elevate the main boom:



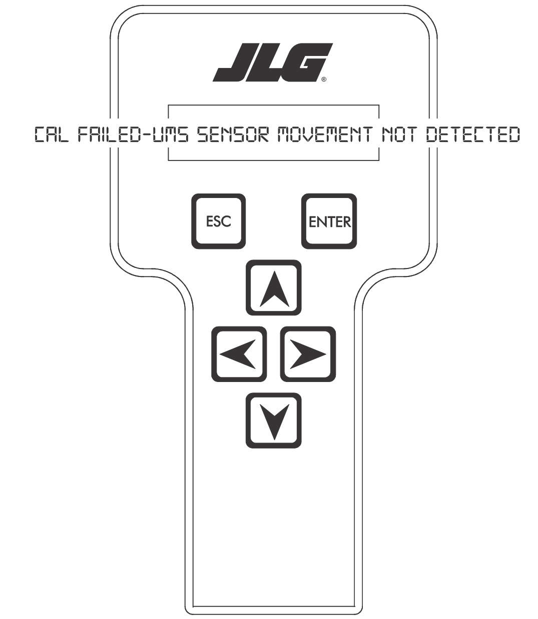
g. After the main boom has been fully elevated, press "ENTER" ENTER. The analyzer will display the following:



NOTE: *By pressing the left or right arrows in this screen, you may view the output of each sensor.*

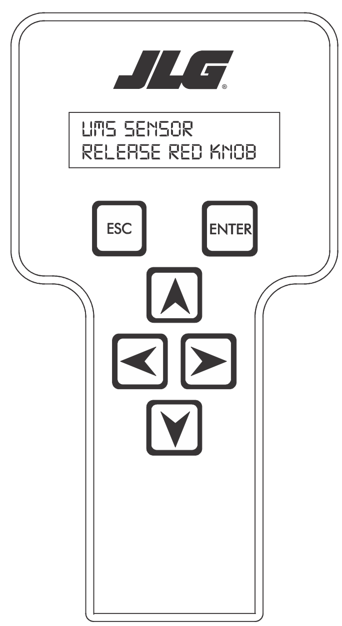
h. With the aid of an assistant, pull and hold the red re-leveling knob on the hydraulic tank while lifting the tower boom. Raise the tower boom six (6) feet or two (2) meters. After elevating the tower the required distance, press “ENTER” ENTER.

If the upright monitoring system did not detect adequate sensor activity, the screen will display:

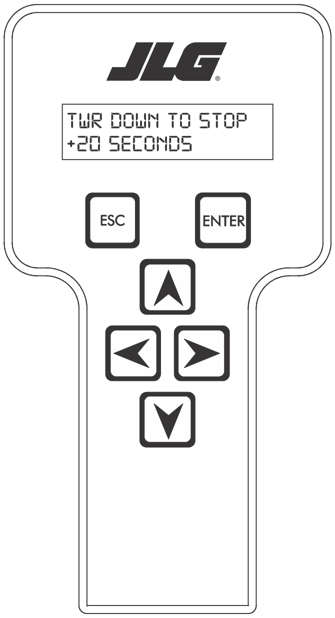


Should you get the above message, verify that the sensor is installed correctly and verify the sensor connection to the sensor harness is secure. Also, ensure the red knob is held fully open for the required time.

If the calibration is executing properly, you shall see the following display:

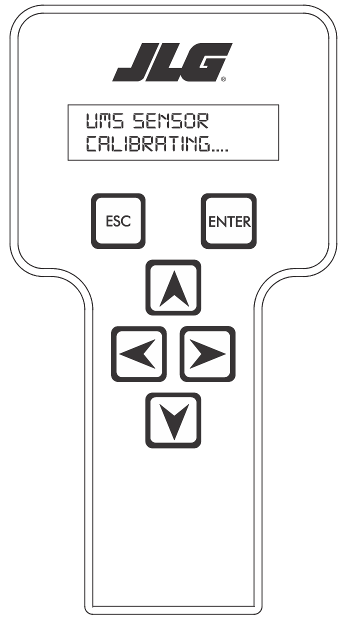


i. When viewing the above display, press "ENTER". The screen will display the following:

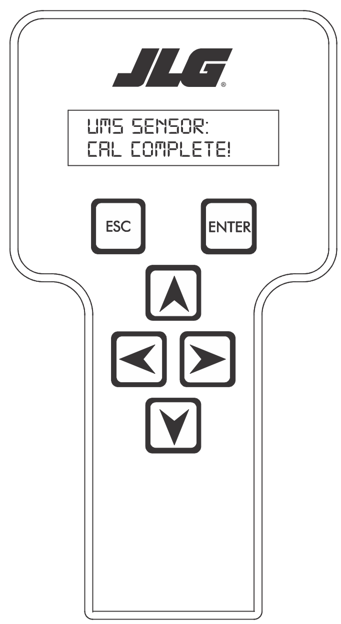


j. Lower the tower boom onto the boom stop. Continue to hold the tower boom down function for at least twenty (20) seconds **WITHOUT RELEASING THE FUNCTION SWITCH**. The calibration must recognize continuous activation of the tower down function switch for the required time.

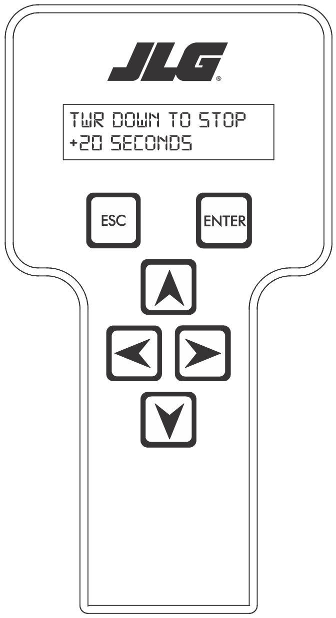
After the required activation time has passed, release the function switch and press "ENTER". The analyzer will display the following message:



If the calibration has been completed successfully, the screen will automatically change to:



If the calibration has not been completed successfully, the display will automatically change to:



Repeat step j until the calibration time requirement has been satisfied.

⚠ WARNING

DO NOT RAISE THE TOWER BOOM AGAIN DURING CALIBRATION.

k. To correctly complete the calibration process, fully retract and fully lower the main boom. Once the machine is in the stowed position, turn off the machine and disconnect the analyzer.

Calibration Faults

CAL Failed-Chassis Not Level

In the event the turntable tilt switch input is logic low indicating that the machine is not level the UMS calibration screens shall display this fault.

CAL Failed-UMS Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL Failed-Turntable Sensor Raw Output Out Of Range

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the turntable sensor.

CAL Failed-Calibration Disrupted

If calibration is disrupted, the control system shall display this fault.

CAL Failed- UMS Sensor Movement Not Detected

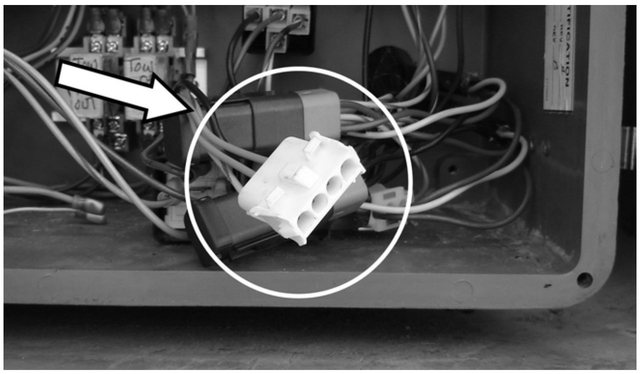
The UMS angle has not detected the required amount of movement during calibration.

Function Check

NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

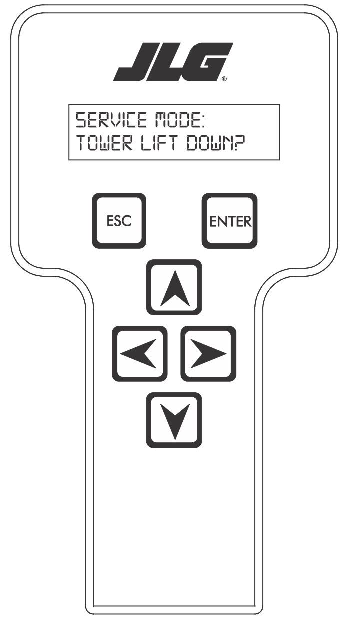
1. Connect the hand-held analyzer at the ground control station using the four-pin connector.



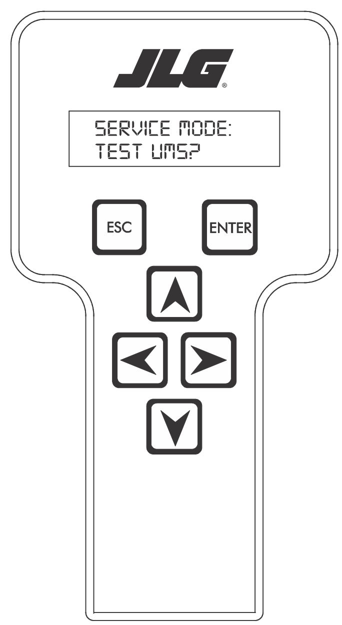
2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.

3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER" . Using the arrows on the keypad, enter the password "33271" and press "ENTER" .

4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" to select this menu item. After pressing "ENTER" one of the following screens will be displayed:

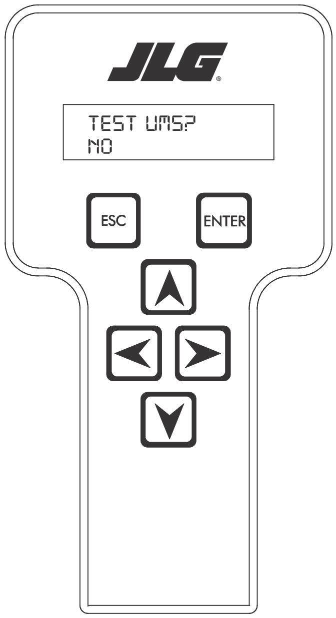


or

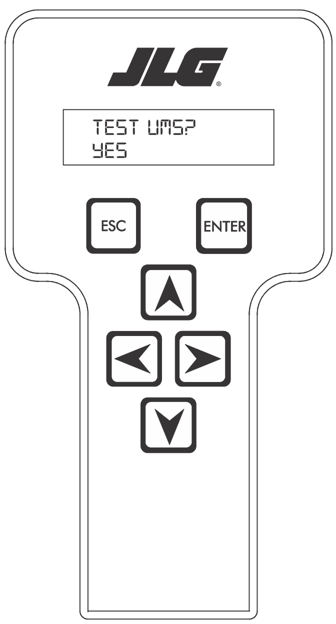


5. Scroll left to right through the above menu items until "TEST UMS?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" key.

6. The controller will now display the following:



or, by pressing the up and down arrow keys:



7. When the "YES" message is displayed, press the "ENTER" key to automatically perform a function test. Upon the function test, the system will activate the Upright Monitoring System, warning lights, and alarm. Verify that the alarm sounds, the boom malfunction indicator lights (platform and ground) are illuminated.

8. From the ground controls, raise the tower boom several feet. Verify that the tower boom will not lower.

9. To end the system test, press the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.

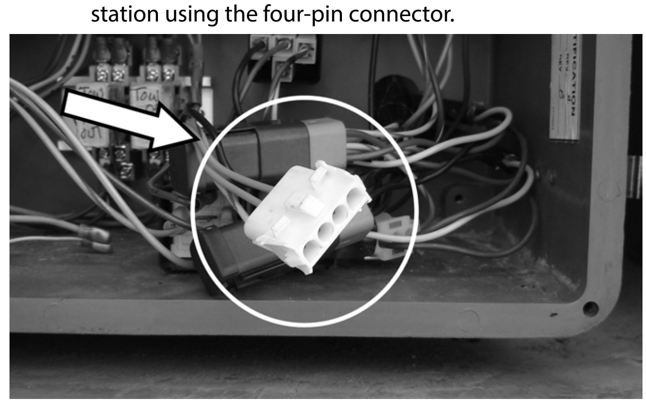
Service Mode/Tower Boom Retrieval

The UMS software incorporates a service mode to temporarily disengage the UMS and allow a tower lift down operation when the UMS has detected a backward stability concern.

NOTICE

ON ADE EQUIPPED MACHINES, DO NOT CONNECT TO THE ANALYZER CONNECTION PORT INSTALLED WITH THE UPRIGHT MONITORING SYSTEM MODULE.

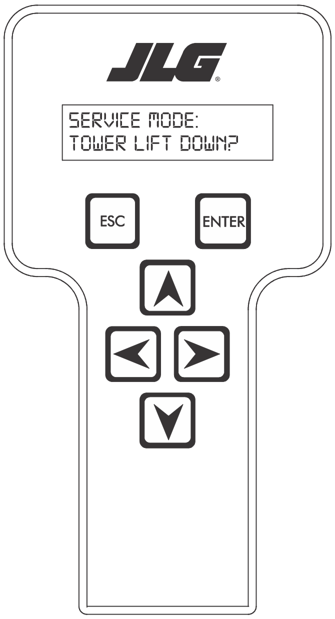
1. Connect the hand-held analyzer at the ground control station using the four-pin connector.



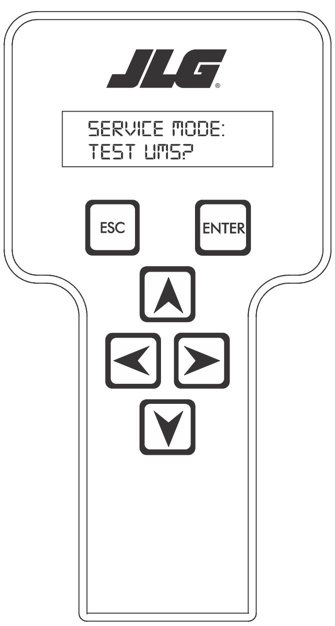
2. Pull out the emergency stop button at the ground control station and turn the key switch to ground controls. Start the engine.

3. Advance to access level 1 by scrolling to the ACCESS LEVEL menu and press "ENTER". Using the arrows on the keypad, enter the password "33271" and press "ENTER".

4. Scroll through the top level menu until SERVICE MODE appears. Press "ENTER" to select this menu item. After pressing "ENTER" one of the following screens will be displayed:

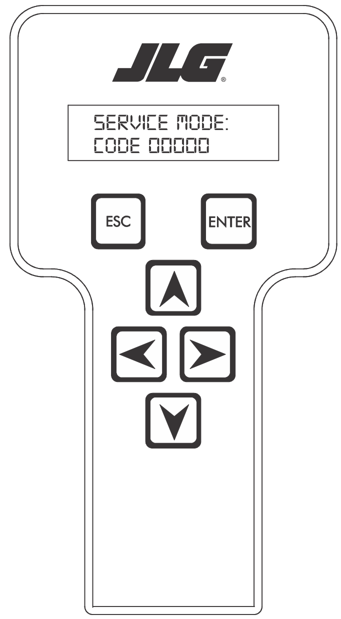


or

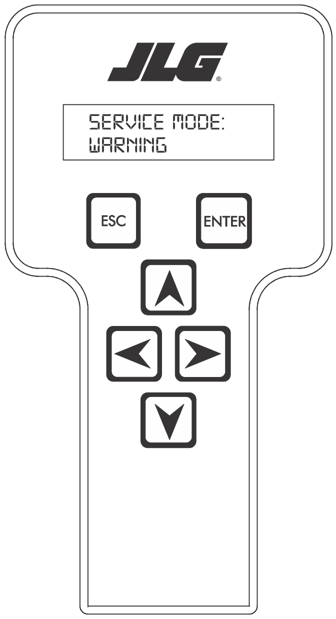


5. Scroll left to right through the above menu items until "TOWER LIFT DOWN?" sub menu appears on the bottom line of the analyzer display. Press the "ENTER" key.

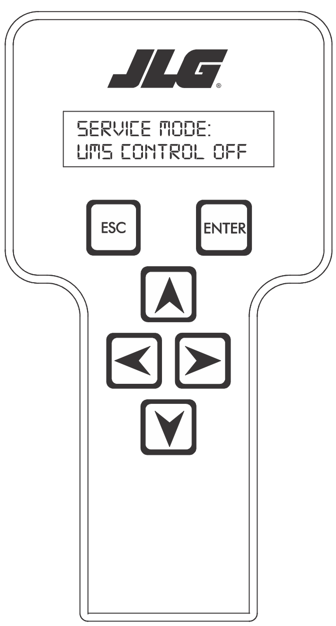
6. The controller will now display the following:



7. Enter the service code "**81075**" and press the "ENTER" key. The controller display will now display the following,

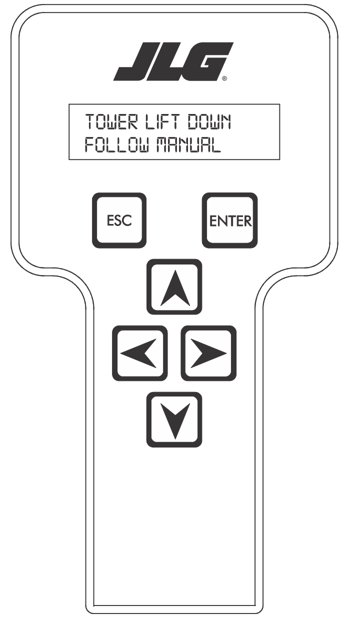


followed by:



The flashing and scrolling messages will repeat until the "ENTER" key is pressed.

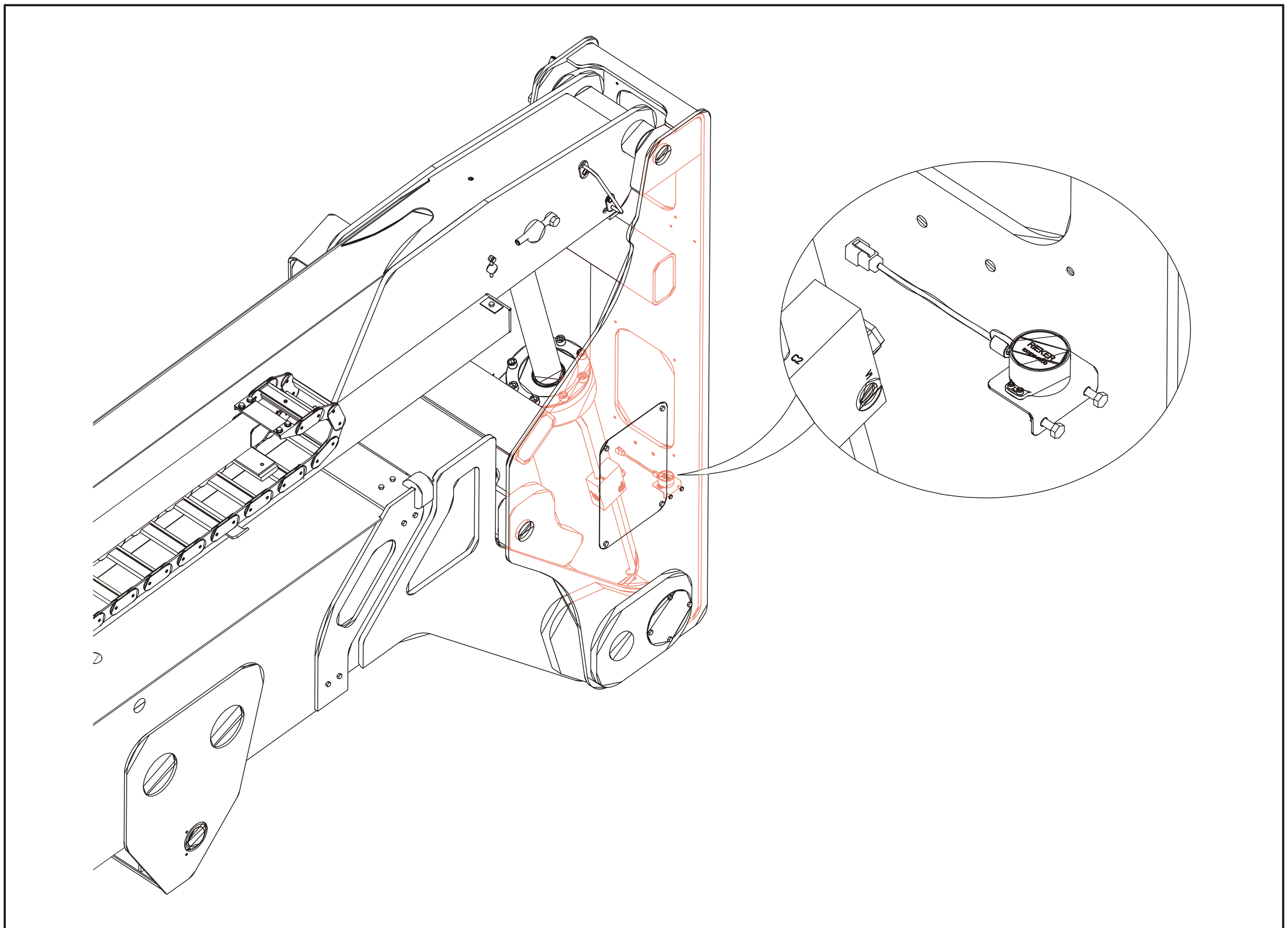
8. When the "ENTER" key is pressed, the UMS will be disabled and the display will read:



9. Before using tower lift down adhere to the following:

- Make sure the main boom is fully retracted.
- Make sure the tower boom is fully retracted.
- Slowly lower the tower boom.

10. When the platform has been safely lowered to the ground, exit the service mode by pressing the Emergency Stop Switch (EMS) at the ground controls. Upon loss of power (pressing the EMS) to the system, the upright monitoring system will reset and all functionality will be restored to the machine.



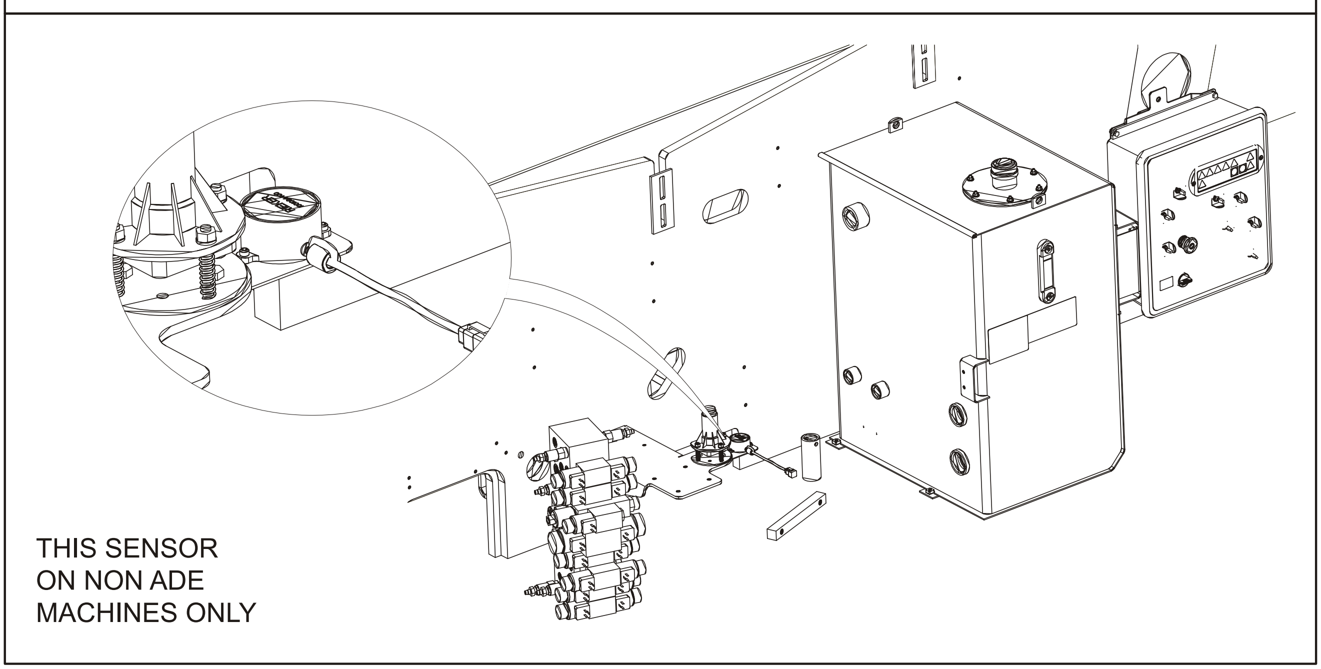


Figure 4-14. UMS Sensor Location

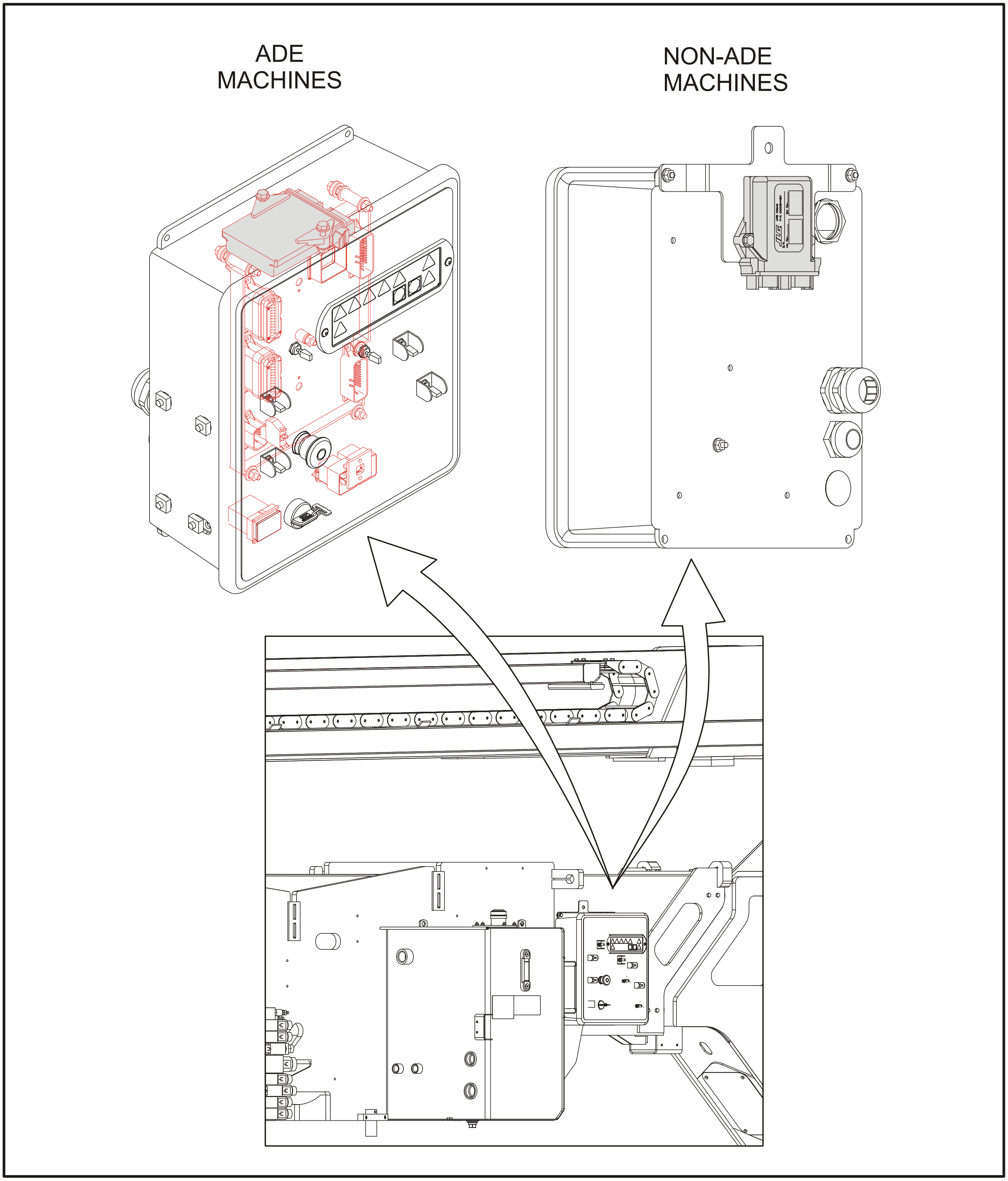


Figure 4-15. UMS Module Location

J1		J2	
1	IGN POWER (7-33V)	1	+5V ANALOG EXCITATION
2	GROUND	2	ANALOG INPUT 0
3	DIGITAL INPUT 0	3	ANALOG GROUND
4	DIGITAL INPUT 1	4	+5V ANALOG EXCITATION
5	DIGITAL INPUT 2	5	ANALOG INPUT 1
6	DIGITAL INPUT 3	6	ANALOG GROUND
7	DIGITAL OUTPUT 0 (PWM, IF)	7	ANALOG INPUT 2
8	DIGITAL OUTPUT 1 (PWM, IF)	8	ANALOG INPUT 3 (NOT POPULATED)
9	DIGITAL OUTPUT 2 (PWM, IF)	9	CANBUS HIGH
10	DIGITAL OUTPUT 3 (PWM, IF)	10	CANBUS LOW
11	DIGITAL OUTPUT 4 (PWM)	11	ANALYZER TRANSMIT
12	DIGITAL OUTPUT 5 (PWM)	12	ANALYZER RECEIVE

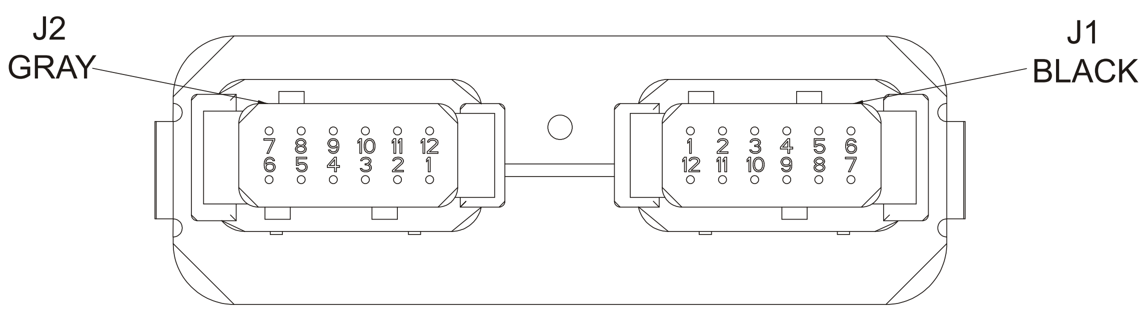


Figure 4-16. UMS Module Pin Identification

4.10 UMS TROUBLESHOOTING AND FAULT MESSAGES - NON-ADE MACHINES

Tower Lift Down Permanently Closed

2/2 FUNCTION LOCKED OUT - TOWER LIFT DOWN PERMANENTLY CLOSED

The control system shall illuminate lamps and sound the alarm at startup for one second on and one second off. If the control system detects the TOWER LIFT DOWN, it shall report a fault. The TOWER LIFT DOWN function shall be locked out and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually until the condition is cleared.

Solution:

- Inspect switch and harness. Voltage (»12V) should only be present on J1-3 of the UMS module when Tower Down switch is closed.

Backward Stability Concern Message

2/5 UMS SENSOR BACKWARD LIMIT REACHED

When the upright angle relative to the turntable is higher than +2.5° (away from the work platform), tower lift down shall be disallowed immediately. Tower Lift Down shall be re-allowed when the upright angle relative to the turntable is less than 2.0°. If Tower Lift Down is disabled for more than 1.5 seconds, the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm shall light/sound continually and a fault shall be raised. These conditions shall be latched along with Tower Lift Down until the upright angle is less than 2.0° for 2 seconds and the Tower Lift Down command is returned to neutral.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Follow the corrective action listed on decal 1702265 located near the red knob of the machine.
- Inspect machine hydraulics.

Forward Stability Concern Message

2/5 UMS SENSOR FORWARD LIMIT REACHED

When the upright angle relative to the turntable is less than –4.0° for longer than 1.5 seconds, the ground boom malfunction indicator lamp, the platform distress lamp, and platform alarm shall light/sound continually and a fault shall be raised. The light/alarm signal shall be removed only when the upright angle reaches values greater than –3.0° for 2 seconds.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Tower lift down.
- Inspect machine hydraulics.

UMS Out of Usable Range Message

2/5 UMS SENSOR OUT OF USABLE RANGE

When both the Turntable tilt sensor and the UMS sensor read greater then ±10° in the same direction the UMS shall be disengaged until the condition no longer exists and a fault shall be raised.

Solution:

- Verify the message clears when operating the machine on grade less than 10°.
- Inspect sensor mounting.
- Verify sensor calibration on level pad.

Battery Voltage < 9.0 Volts

4/4 SYSTEM VOLTS LOW

Battery voltage is below 9V.

Solution:

- Inspect battery and alternator output.
- Inspect harness, looking closely for possible short circuits.

Battery Voltage > 16.0 Volts

4/4 SYSTEM VOLTS HIGH

Battery voltage is above 16V.

Solution:

- Inspect battery and alternator output.

UMS Sensor Not Calibrated Message

8/1 UMS SENSOR NOT CALIBRATED

If the control system detects a sensor out of range condition or a not calibrated fault with the UMS angle sensor, the control system shall report a fault and disable Tower Lift Down and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually.

If the control system detects that either angle sensor has not been calibrated, the ground boom malfunction lamp will flash at a 3 Hz rate until the system is calibrated or disabled.

Solution:

- Calibrate sensor.

UMS Sensor Faulted

8/1 UMS SENSOR FAULTED

If the system detects that the UMS sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control system shall report a fault.

Solution:

- Inspect wire harness going to the sensor and UMS module.
- Inspect sensor mounting.
- Replace sensor.

Tower Lift Down Output Short to Ground or Open Circuit

8/1 TOWER LIFT DOWN OUTPUT SHORT TO GROUND OR OPEN CIRCUIT

Short to Ground or open circuit has been detected on the Tower Lift Down output.

Solution:

- Inspect harness and valve.

Tower Lift Down Output Short to Battery

8/1 TOWER LIFT DOWN OUTPUT SHORT TO BATTERY

Short to battery has been detected on the Tower Lift Down output.

Solution:

- Inspect harness and valve.

Platform Indicator Output Short to Ground or Open Circuit

8/1 PLATFORM INDICATOR OUTPUT SHORT TO GROUND OR OPEN CIRCUIT

Short to Ground or open circuit has been detected on the Platform Indicator output.

Solution:

- Inspect harness.

Platform Indicator Output Short to Battery

8/1 PLATFORM INDICATOR OUTPUT SHORT TO BATTERY

Short to battery has been detected on the Platform Indicator output.

Solution:

- Inspect harness.

Ground Indicator Output Short to Ground

8/1 GROUND INDICATOR OUTPUT SHORT TO GROUND OR OPEN CIRCUIT

Short to Ground or open circuit has been detected on the Ground Indicator output.

Solution:

- Inspect harness.

Ground Indicator Output Short to Battery

8/1 GROUND INDICATOR OUTPUT SHORT TO BATTERY

Short to battery has been detected on the Ground Indicator Output.

Solution:

- Inspect harness.

Turntable Sensor Not Calibrated Message

8/1 TURNTABLE SENSOR NOT CALIBRATED

If the control system detects that the Chassis Tilt sensor is not calibrated or there is an internal fault with the sensor, the control system shall disable Tower Lift Down and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually.

If the control system detects that either angle sensor has not been calibrated, the ground boom malfunction lamp will flash at a 3 Hz rate until the system is calibrated or disabled.

Solution:

- Calibrate sensor.

Turntable Sensor Faulted

8/1 TURNTABLE FAULTED

If the system detects that the Chassis tilt sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control system shall report a fault

Solution:

- Inspect wire harness going to the sensor and UMS module.
- Inspect sensor mounting.
- Replace sensor.

EEPROM checksums failure

9/9 EEPROM FAILURE – CHECK ALL SETTINGS

A critical failure occurred with the EEPROM. Personalities, machine configuration digits, etc. may be reset to default values and should be checked.

Solution:

- Contact JLG if message is reoccurring.

4.11 UMS TROUBLESHOOTING AND FAULT MESSAGES - ADE MACHINES

Backward Stability Concern Message

2/5 UMS SENSOR BACKWARD LIMIT REACHED

When the upright angle relative to the turntable is higher than +2.5° (away from the work platform), tower lift down will be disallowed immediately. Tower Lift Down will be re-allowed when the upright angle relative to the turntable is less than 2.0°. If Tower Lift Down is disabled for more than 1.5 seconds, the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm will light/sound continually and a fault shall be raised. These conditions will be latched along with Tower Lift Down until the upright angle is less than 2.0° for 2 seconds and the Tower Lift Down command is returned to neutral.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Follow the corrective action listed on decal 1702265 located near the red knob of the machine.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Forward Stability Concern Message

2/5 UMS SENSOR FORWARD LIMIT REACHED

When the upright angle relative to the turntable is less than –4.0° for longer than 1.5 seconds, the ground control boom malfunction indicator lamp, the platform malfunction indicator lamp, and platform alarm will light/sound continually and a fault will be raised. The light/alarm signal will stop only when the upright angle reaches values greater than –3.0° for 2 seconds.

Solution:

- Inspect sensor mounting.
- Verify sensor calibration on level pad.
- Tower lift down.
- Inspect machine hydraulics. Refer to Holding Valve Checks in Section 5 - Hydraulics.

Auto Detection Input Low Message

2/5 AUTO DETECTION INPUT LOW

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness, there should be 12 volts going into pin J1-5 (black connector) of UMS module.

UMS Sensor Communications lost

6/6 UMS SENSOR COMMUNICATIONS LOST

If the UMS detects a valid ground module software version but digital input 2 is not tied high the UMS module shall report a fault.

Solution:

- Inspect wire harness; CANbus communications are on pins J2-9 & J2-10 (gray connector) of the UMS module.
- Using access level 1 of the UMS module, under “DIAGNOSTICS” CAN, EX/SEC and TX/SEC should be values greater than 0. Also “BUS OFF:” and “BUS ERR:” should be 0 and “PASSIVE:” should be a low value.

Out of Usable Range Message

8/1 UMS SENSOR OUT OF USABLE RANGE

When both the Chassis tilt sensor and the UMS sensor read greater than 10° in the same direction the UMS will be disengaged until the condition no longer exists and a fault shall be raised.

Solution:

- Verify the message clears when operating the machine on grade less than 10°.
- Inspect sensor mounting.
- Verify sensor calibration on level pad.

UMS Sensor Not Calibrated Message

8/1 UMS SENSOR NOT CALIBRATED

If the control system detects a sensor out of range condition or a not calibrated fault with the UMS angle sensor, the control system shall report a fault and disable Tower Lift Down and activate the ground boom malfunction indicator lamp, upright tilted lamp and platform alarm continually

If the control system detects that the UMS angle sensor has not been calibrated, the ground boom malfunction lamp will flash at a 3 Hz rate until the system is calibrated or disabled.

Solution:

- Calibrate sensor.

UMS Sensor Faulted Message

8/1 UMS SENSOR FAULTED

If the system detects that the UMS sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control system shall report a fault.

Solution:

- Inspect wire harness going to the sensor and UMS module.
- Inspect sensor mounting.
- Replace sensor.

Incompatible Software Detected Message

9/9 INCOMPATIBLE SOFTWARE DETECTED

If the control system detects that the ground module software is incompatible with the UMS module, the UMS module shall report a fault and disable the footswitch signal to the ground module.

Solution:

- Update ground module software.

Calibration Faults

CAL FAILED-CHASSIS NOT LEVEL

The control system shall display a fault in the event the raw sensor output is greater than ±5° for the chassis sensor.

CAL FAILED-UMS SENSOR RAW OUTPUT OUT OF RANGE

The control system shall display a fault in the event the raw sensor output is greater then ±5° for the UMS sensor.

CAL FAILED-CALIBRATION DISRUPTED

If calibration is disrupted, the control system shall display this fault.

CAL FAILED- UMS SENSOR MOVEMENT NOT DETECTED

The UMS angle has not detected the required amount of movement during calibration.

4.12 ARTICULATING JIB

NOTE: *Pin numbers listed in the following procedures are referenced in Figure 4-17., Location of Components-Articulating Jib*

Removal

1. For platform/support removal see platform/support removal diagram. (See Section 4.1, Platform).
2. Position the articulating jib boom level with the ground.
3. Remove mounting hardware from slave cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.
4. Remove mounting hardware from articulating jib boom pivot pin #2. Using a suitable brass drift and hammer, remove the pivot pin from boom assembly.

Disassembly

1. Remove mounting hardware from articulating jib boom pivot pins #3 and #4. Using a suitable brass drift and hammer, remove the pins from articulating jib boom pivot weldment.
2. Remove mounting hardware from rotator support pins #5 and #6. Using a suitable brass drift and hammer, remove the pins from rotator support.
3. Remove mounting hardware from lift cylinder pin #7. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.

Inspection

NOTE: *When inspecting pins and bearings Refer to Section 2.5, Pins and Composite Bearing Repair Guidelines.*

1. Inspect articulating fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect articulating fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of articulating fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary.
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.

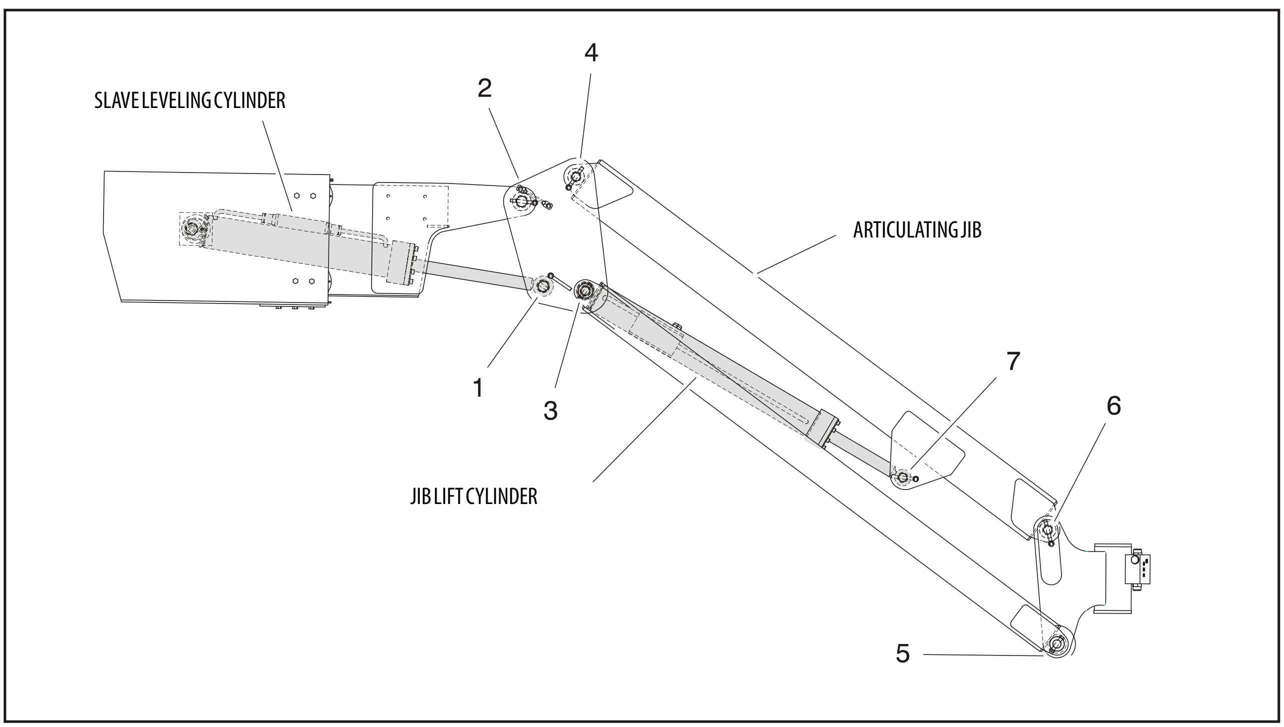


Figure 4-17. Location of Components-Articulating Jib

7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

1. Align lift cylinder with attach holes in articulating jib boom. Using a soft head mallet, install cylinder pin #7 into articulating jib boom and secure with mounting hardware.
2. Align rotator support with attach hole in articulating jib boom. Using a soft head mallet, install rotator support pin #6 into articulating jib boom and secure with mounting hardware.
3. Align bottom tubes with attach holes in rotator support. Using a soft head mallet, install rotator support pin #5 into articulating jib boom and secure with mounting hardware.
4. Align articulating jib boom with attach hole in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #4 into articulating jib boom and secure with mounting hardware.
5. Align bottom tubes with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install rotator support pin #3 into articulating jib boom pivot weldment and secure with mounting hardware.
6. Align articulating jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin #2 into fly boom assembly and secure with mounting hardware.
7. Align the slave leveling cylinder with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin #1 into articulating jib boom pivot weldment and secure with mounting hardware.

4.13 SEQUENCE FOR HOSE REPLACEMENT IN THE TOWER BOOM

1. Remove the tower boom front cover bolts, exposing the Powertrack.
2. Remove bolts to disconnect the top bar of the Powertrack
3. Pull the Powertrack out of base boom. (as far as hoses will allow)
4. At left side rear of upright, remove access cover plate (4) bolts. (others if necessary)
5. Remove access cover plate, (4) bolts, from bottom front of fly boom.
6. Cut cable ties that attach hose to be replaced.
7. Disconnect hose that is to be replaced, and cap the male fitting.
8. Attach the new hose to the end of the hose to be replaced.
9. Pull these lines thru the upright and out the bottom, then feed back into the fly boom.
10. At the Powertrack, in front of the tower boom, open the Powertrack links to expose the hose to be replaced.
11. Pull hose to be replaced, attached to the new hose, thru the fly boom and thru the Powertrack links.
12. Disconnect new hose from the replaced hose and connect to fitting where the damaged hose was connected.
13. Roll Powertrack back into base, and attach the top bar of the Powertrack (2) bolts to the inside top of the fly boom section.
14. Check for leaks and hardware tightened securely.
15. Replace access cover plates and front cover.

4.14 LIMIT SWITCHES ADJUSTMENT

Upper Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise upper boom to 10 degrees above horizontal. limit switch should activate before this point.
3. Lower upper boom until limit switch resets. This should be 1 degree above to 4 degrees below horizontal. (See Figure 4-21. for adjustments)

NOTE: *Angle indicator should be placed approx. 2 ft. from the upper boom pivot pin and the attach point on the upper boom. Tower angle switch must be reset before upper boom angle switch can be activated.*

Tower Boom Horizontal Limit Switch

1. Place machine on level surface.
2. Raise Tower Boom to 13 degrees above horizontal. The tower angle limit switch should activate at this point.
3. Lower the tower boom until the limit switch resets. This should be 2 to 7 degrees below where the switch was activated. (See Figure 4-18. and Figure 4-19. for adjustments).

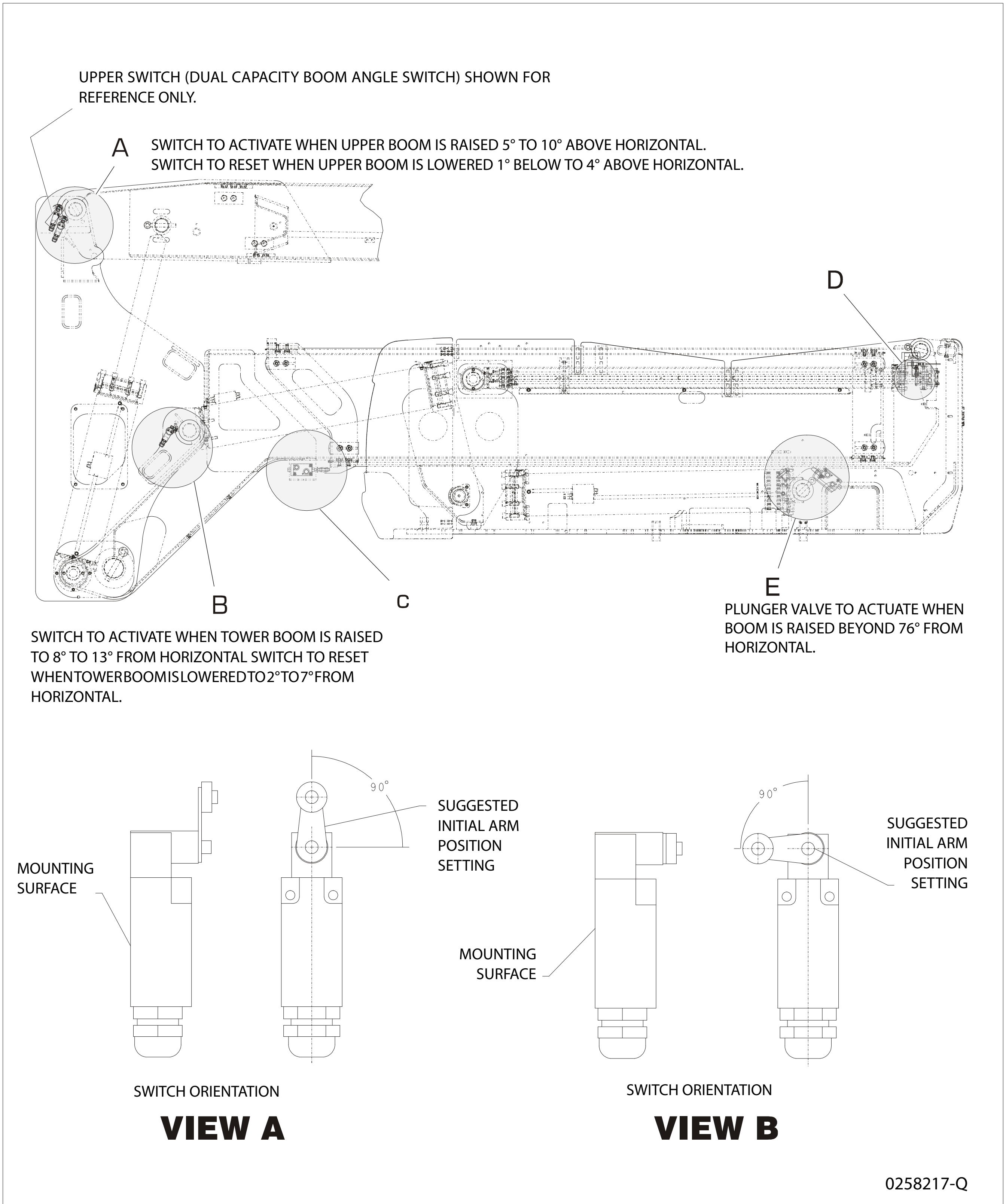
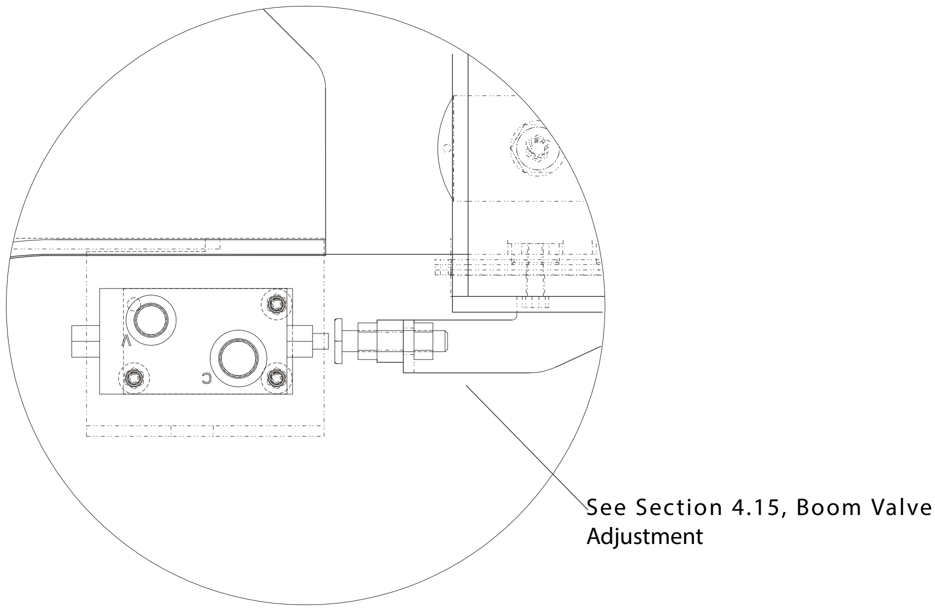


Figure 4-18. Boom Valve and Limit Switches Location. (Sheet 1 of 3)



VIEW C

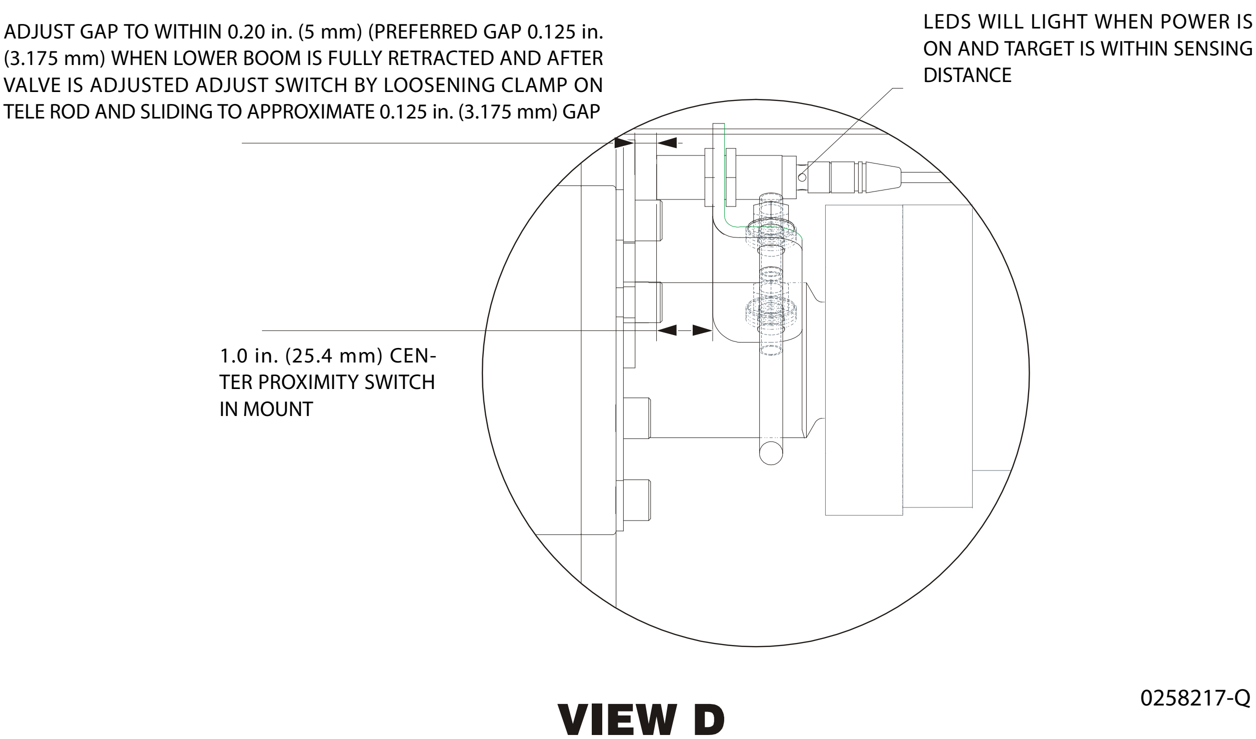


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Figure 4-19. Boom Valve and Limit Switches Location. (Sheet 2 of 3)

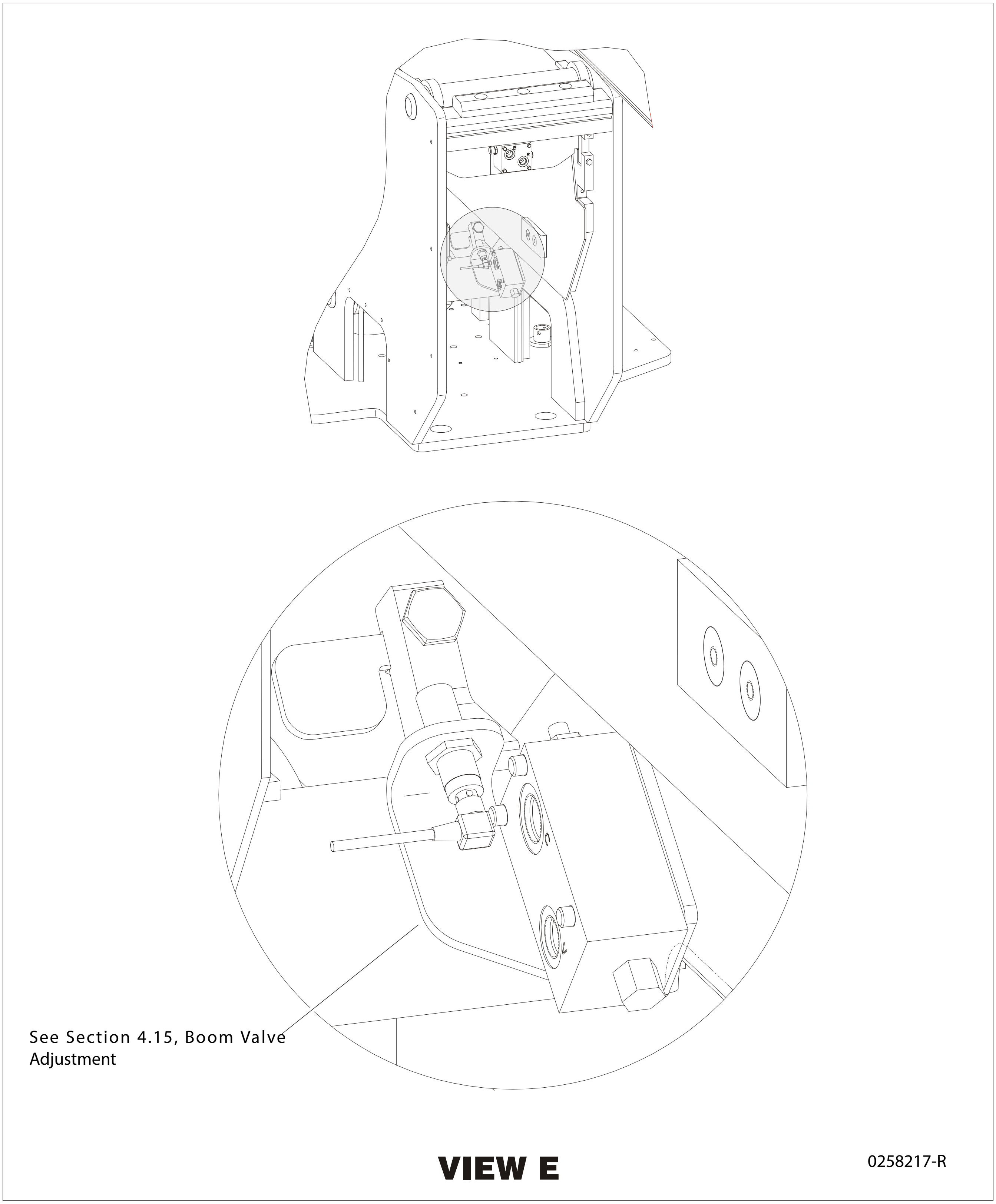


Figure 4-20. Boom Valve and Limit Switches Location. (Sheet 3 of 3)

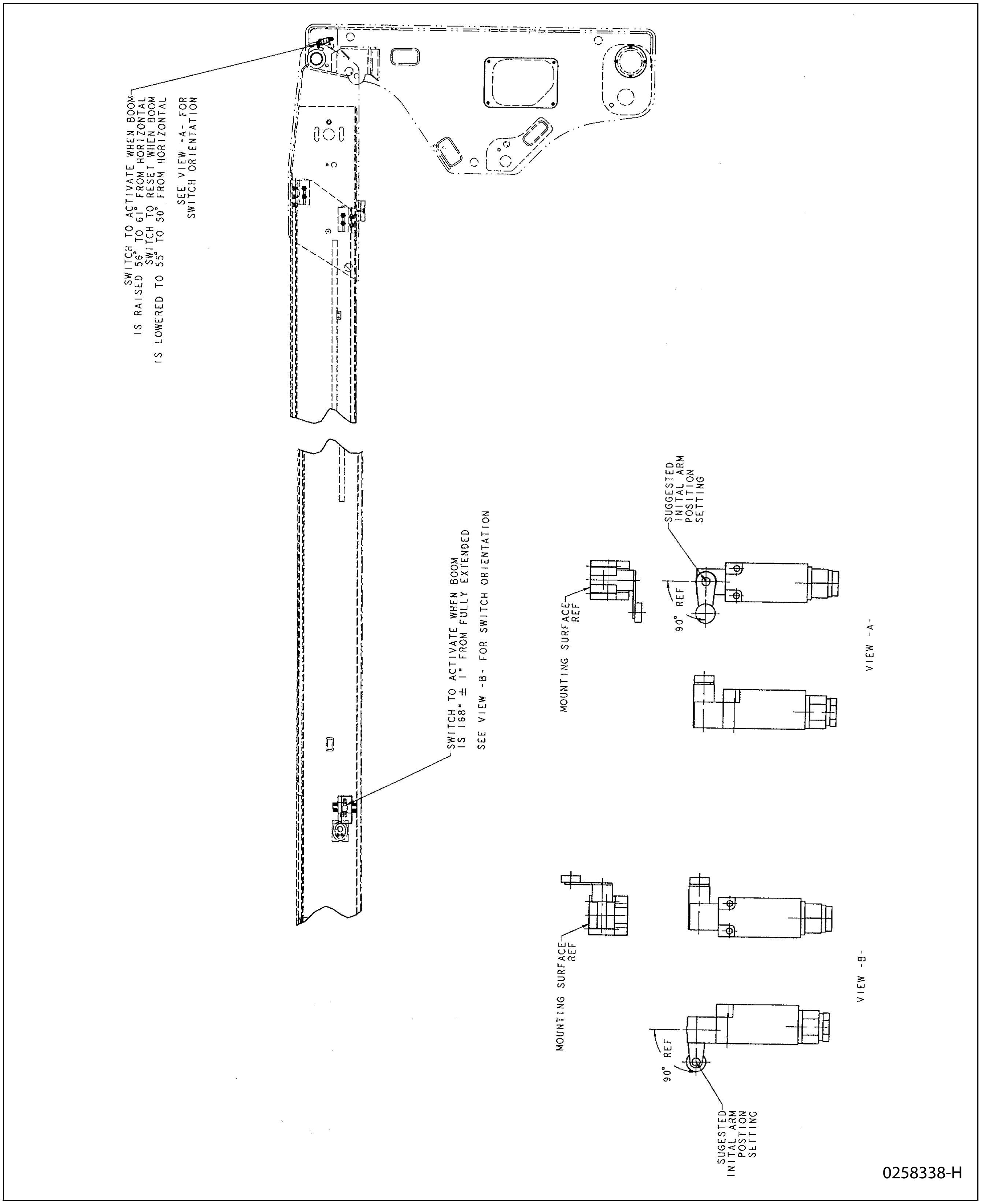


Figure 4-21. Dual Capacity Switches Installation (800 Only if equipped)

Dual Capacity Angle Limit Switch (800A only)

NOTE: *The boom position and location of the Upper Boom Dual Capacity Switch requires a working surface 20 ft. high to safely check and adjust the switch.*

1. Place machine on level surface.
2. From platform control, with less than 500 lbs. (227 kg) in platform, raise tower boom to maximum angle. Extend upper boom until the capacity indicator lights change from 1000 lbs. (454 kg) to 500 lbs. (227 kg).
3. With upper boom length in this position, raise the upper boom until the indicator lights change back to the 1000 lbs. (454 kg) indicator.
4. The Dual Capacity Limit Switch, located at the telescope cylinder of the Upper Boom, Figure 4-21., will activate the 1000 lb. light when the upper boom is at 56 to 61 degrees.

NOTE: *Place angle indicator on main base boom at least 2 ft. from pivot pin.*

5. Lower upper boom until 500 lb. light comes on. The boom angle at this point should be 50 to 55 degrees.

NOTE: *If limit switch settings need to be changed, you will need to recheck that the 500 lb. light comes on at 50 degrees to 55 degrees when lifting down.*

6. Raise, extend, retract, and lower upper boom. Check for smooth operation.

Upper Boom Length Switch (800 A only)

1. Lift upper boom to approximately horizontal.
2. Telescope boom out until 500 lb. light comes on (may need to use auxiliary power to position boom correctly).
3. Mark the wear pad location on the main fly boom.
4. Telescope the upper boom to full extension.
5. Measure from the mark on the fly boom to the wear pad. The dimension should be 167" to 169".
6. Lower the tower boom until limit switch resets. This should be 2 to 7 degrees below where the switch

4.15 BOOM VALVE ADJUSTMENT

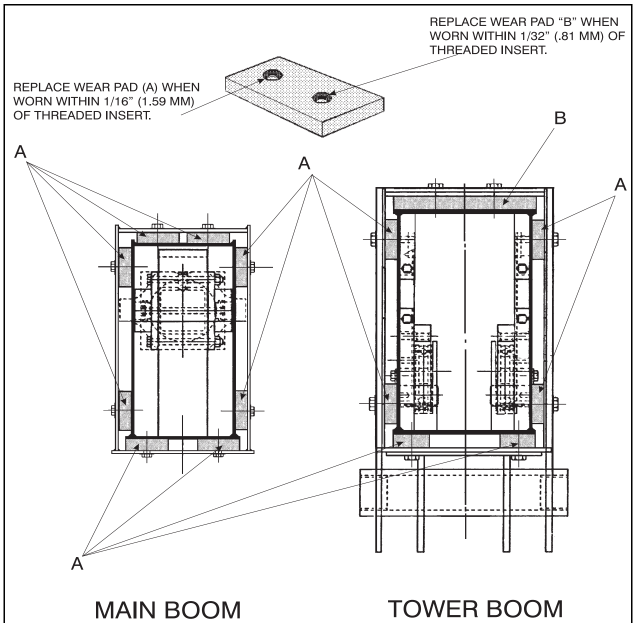
1. Adjust the screws so the plunger on the valves has 0.250 in. (6.35 mm) travel remaining when the lower boom is fully raised and retracted.
2. After the valves are adjusted, adjust the proximity switches to within 0.20 in. (5 mm) of their target. The LED’s on the proximity switches will light when the power is on and the switch is within 0.20 in. (5 mm) of the target. There is a proximity switch to back up both valves.

NOTE: *The cam valve under the boom requires the tower boom to be completely lowered and the cam valve mounted on T/T requires the tower boom to be fully elevated prior to adjustment.*

Tower Boom

1. Shim up wear pads until 1/32 inch (0.8 mm) clearance to adjacent surface.

2. Replace wear pads when worn to within 1/16 inch (1.59 mm) of threaded insert.



WEAR PADS		
PAD NUMBER	THICKNESS OF NEW PAD	REPLACE WHEN WORN TO
A	5/8" (15.8 mm)	9/16" (14.3 mm)
B	3/4" (19.0 mm)	5/8" (15.8 mm)

Figure 4-22. Location And Thickness Of Wear Pads

NOTE: *Wear pads are made of polyethylene; these pads are intended to slide on polyurethane painted surfaces.*

3. When adjusting wear pads, removing or adding shims, bolt length must also be changed.

   a. When adding shims, longer bolts must be used to ensure proper thread engagement in insert.

   b. When shims are removed, shorter bolts must be used so bolt does not protrude from insert and come into contact with boom surface.

Upper Boom

1. Shim up wear pads to within 1/32 inch (.79 mm) clearance between wear pad and adjacent surface.

2. Replace wear pads when worn within 1/16 inch (1.59 mm) and 1/8 inch (3.18 mm) - B, C, D of threaded insert. See Figure 4-22., Location And Thickness Of Wear Pads

3. Adjusting wear pads, removing or adding shims, bolt length must also be changed.

   a. When adding shims, longer bolts must be used to ensure proper thread engagement in insert.

   b. When shims are removed, shorter bolts must be used so bolt does not protrude from insert and Sheaves and wire rope must be replaced as sets.

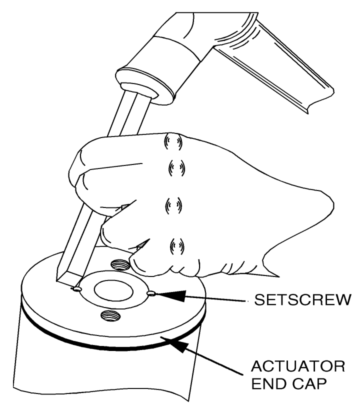
4.16 ROTATOR (PRIOR TO S/N 0300067538)

Disassembly

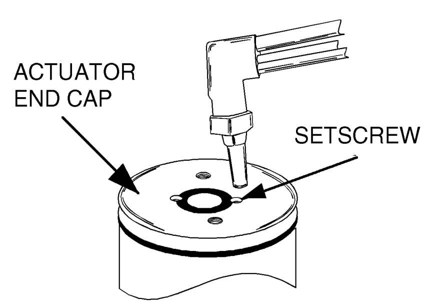
1. Place actuator on a clean workbench.

2. Remove all hydraulic fittings.

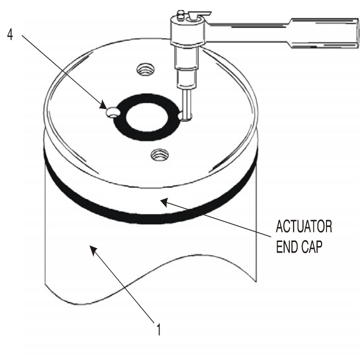
3. Using a suitable hammer and chisel remove the portion of end cap securing setscrew.



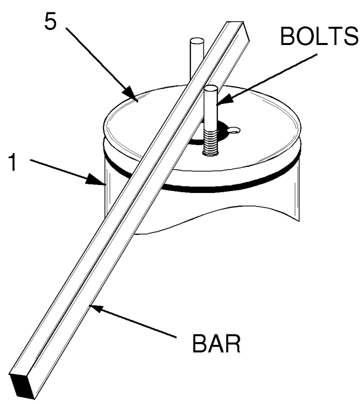
4. Using a torch, apply heat to the setscrews on the bottom of actuator.



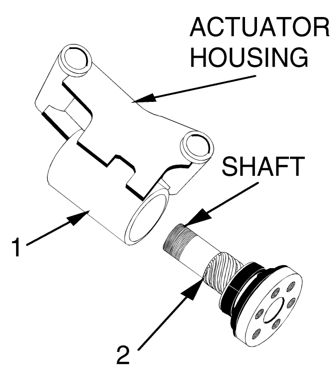
5. Remove the two (2) setscrews (4) from bottom of the actuator (1). Discard setscrew.



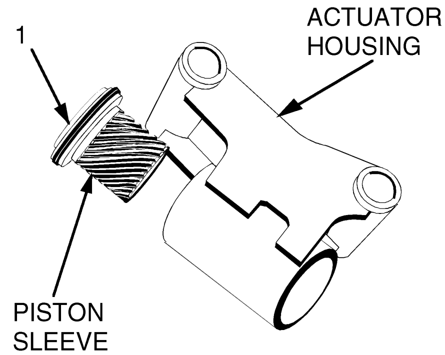
6. Place two (2) 3/8"x16 NC bolts in threaded holes in bottom of the actuator. Using a suitable bar, unscrew the end cap (5). Remove the end cap from actuator (1).



7. Remove the shaft (2) from piston sleeve (3) and the actuator housing (1).



8. Remove piston sleeve (3) from housing (1).



9. Remove all seals and bearings from grooves. Discard seals.

Inspection

1. Clean all parts thoroughly.

2. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.

NOTE: *A small amount of wear in the spline teeth will have little effect on the actuator strength. New spline sets are manufactured with a backlash of about 0.005 in. per mating set. After long service, a backlash of about 0.015 per set may still be acceptable in most cases, depending on the required accuracy of the application.*

3. Check the ring gear for wear and weld damage to the pins.

4. Inspect the cylinder bore for wear and scratches.

Assembly

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

1. Install piston seal (7) and rod seal (6) on the piston sleeve (3).

NOTE: *Apply a coat of grease to the thrust ring before sliding onto the shaft.*

2. Install new seal (8), thrust ring (10) and bearing (9) on shaft (2).

NOTE: *Apply a coat of grease to the thrust ring before sliding onto the end cap.*

3. Install new seals (11), back-up ring (12), cap bearing (13), bearing packing (14) and thrust ring (10) on end cap (5).
4. Place the actuator in the vertical position, install the piston sleeve (3) in timed relation to the housing (1).

NOTICE

DO NOT MISALIGN THE SLEEVE TOO MUCH ANY ONE WAY, AS IT WILL MARK THE CYLINDER BORE.

NOTE: *The timing marks (the small punch marks on the face of each gear), must be aligned for proper shaft orientation. (See Actuator Timing.)*

5. Install the shaft (2) into housing (1) by aligning the proper punched timing marks. (See Actuator Timing Figure 2-35.)
6. Temporarily tape the threaded portion of the shaft will help installation past the shaft seals (masking tape).
7. The end cap (5) is torqued to 40 - 50 ft. lbs. (54 - 68 Nm), such that the actuator begins rotation at approximately 100 psi (6.895 Bar) pressure.
8. The end cap must be secured against the shaft by installing axial set screws (4).

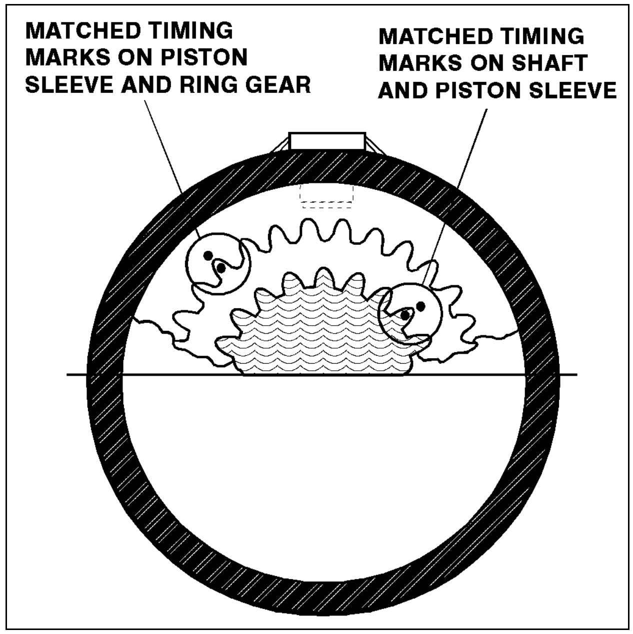
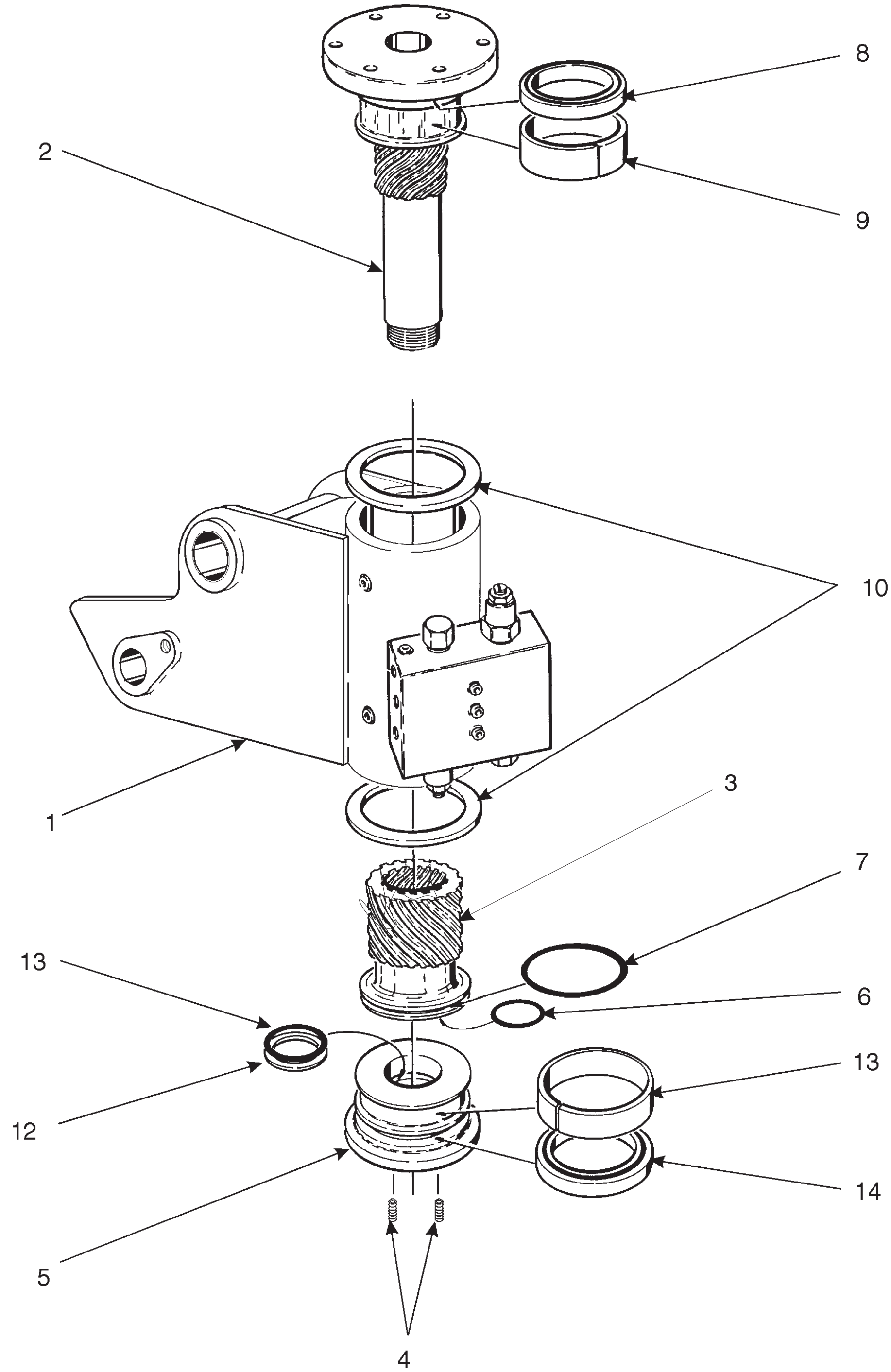


Figure 4-23. Actuator Timing



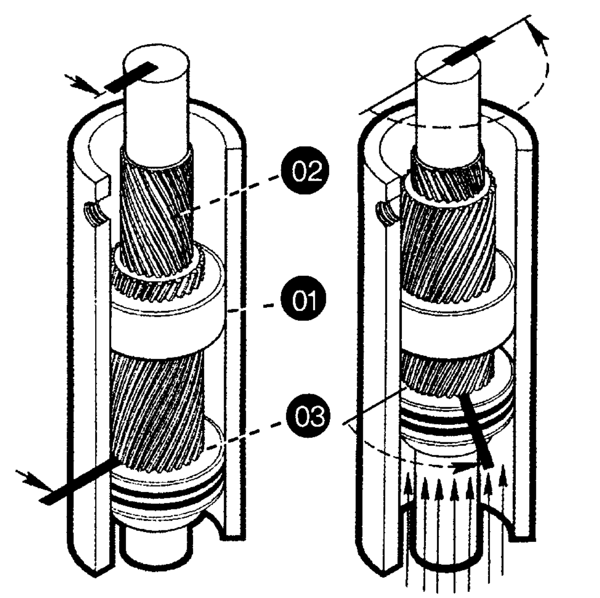
1. Housing/Ring Gear Assembly
2. Shaft
3. Piston/Sleeve Assembly
4. Set Screws
5. Cap, End
6. Seal, Rod
7. Seal, Piston
8. Packing, Bearing
9. Bearing, Shaft
10. Thrust Ring
11. Seal, Cap
12. Ring, Back-up
13. Bearing, Cap
14. packing

Figure 4-24. Rotator Assembly (Prior to S/N 0300067538)

4.17 ROTATOR ASSEMBLY (S/N 0300067538 TO S/N 0300183033)

Theory of Operation

The L20 Series rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear teeth (01) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (02), and the annular piston sleeve (03). Helical spline teeth machined on the shaft engage matching splines on the in- side diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing - similar to the operation of a hydraulic cylinder - while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.



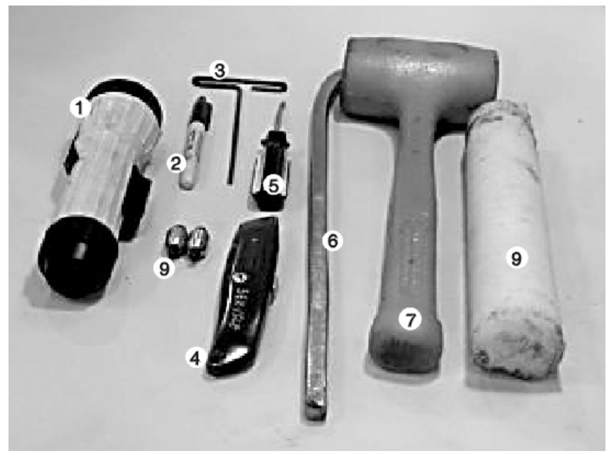
Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.

As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

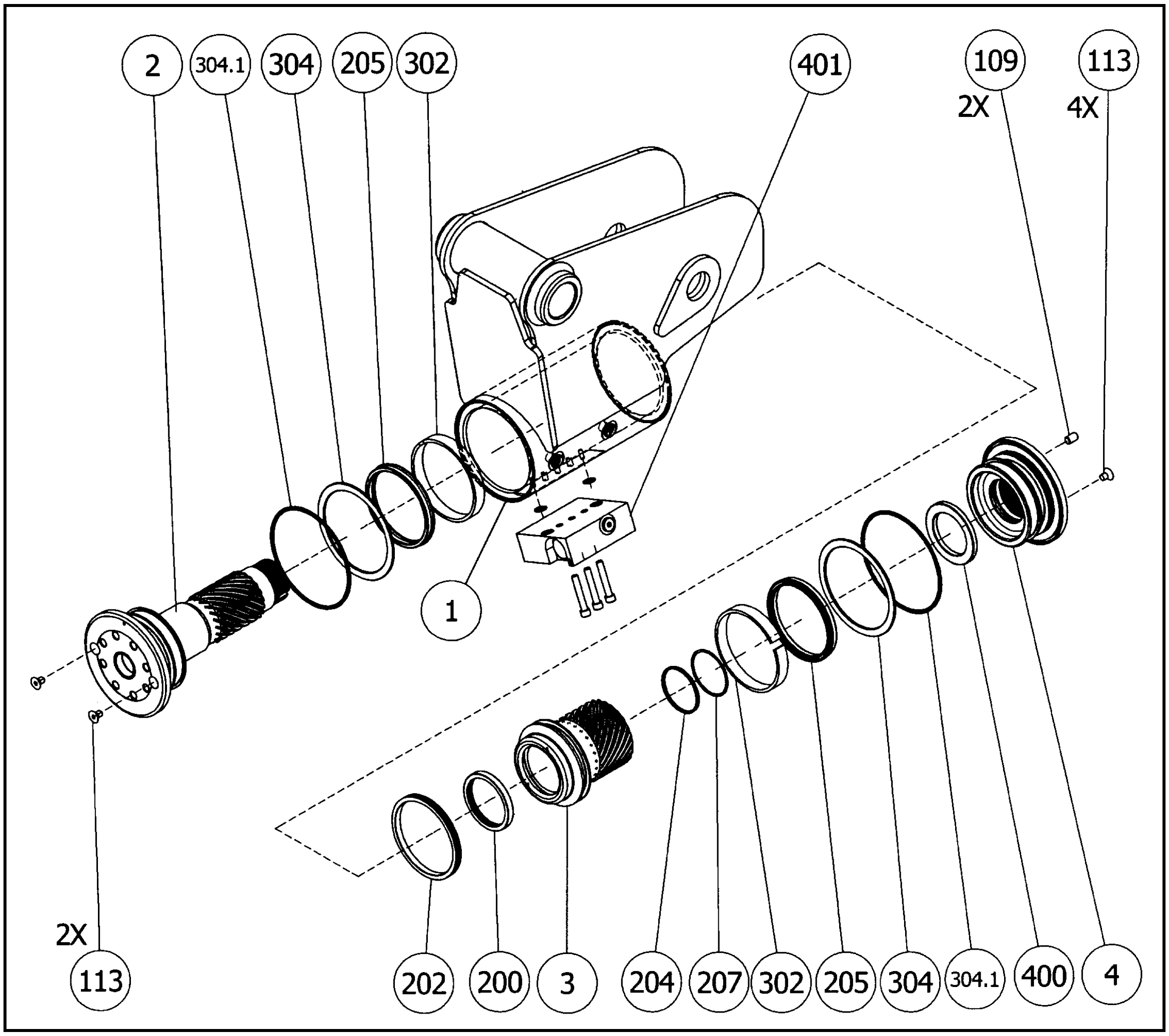
Required Tools

Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:



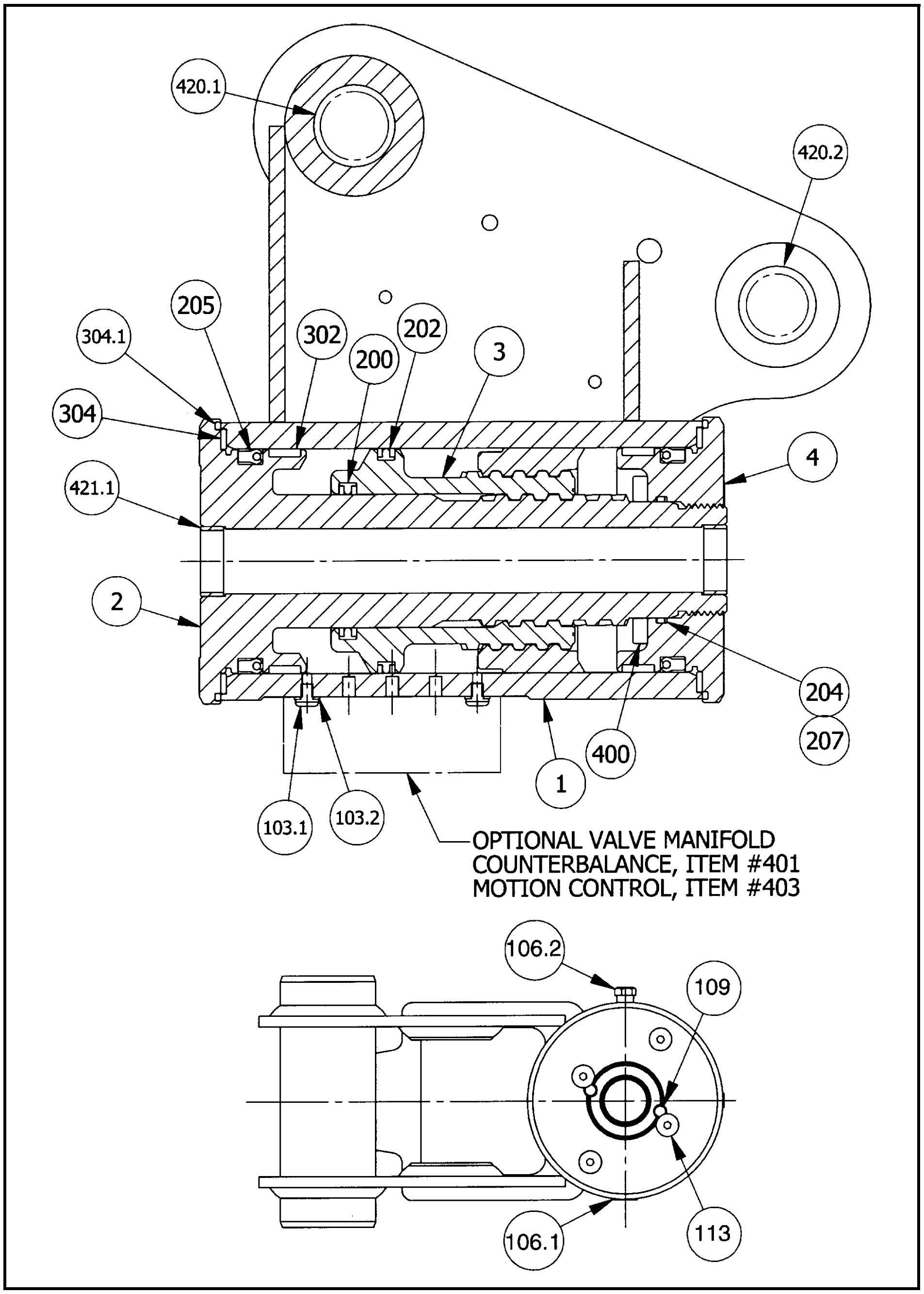
1. **Flashlight** - helps examine timing marks, component failure and overall condition.
2. **Felt Marker** - match mark the timing marks and outline troubled areas.
3. **Allen wrench** - removal of port plugs and set screws.
4. **Box knife** - removal of seals.
5. **Seal tool** - assembly and disassembly of seals and wear guides.
6. **Pry bar** - removal of end cap and manual rotation of shaft.
7. **Rubber mallet**- removal and installation of shaft and piston sleeve assembly.
8. **Nylon drift** - installation of piston sleeve
9. **End cap dowel pins** - removal and installation of end cap (sold with Helac seal kit).

The seal tool is merely a customized standard flat head screwdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vice and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.



PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	420.1 Bushing
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-25. Rotator - Exploded View (S/N 0300067538 to S/N 0300183033)



PARTS	HARDWARE	SEALS	BEARINGS	ACCESSORIES
1. Housing	103.1. Screw	200. T-Seal	302. Wear Guide	400. Stop Tube
2. Shaft	103.2. Washer	202. T-Seal	304. Thrust Washer	420.1 Bushing
3. Piston Sleeve	106.1. Port Plug	204. O-ring		420.2 Bushing
4. End Cap	106.2. Port Plug	205. Cup Seal		421.1 Bushing
	109. Lock Pin	207. Backup Ring		
	113. Capscrew	304.1. Wiper Seal		

Figure 4-26. Rotator- Assembly Drawing (S/N 0300067538 to S/N 0300183033)

Disassembly

CAUTION

SECURE PRODUCT TO SLOTTED TABLE OR VISE.

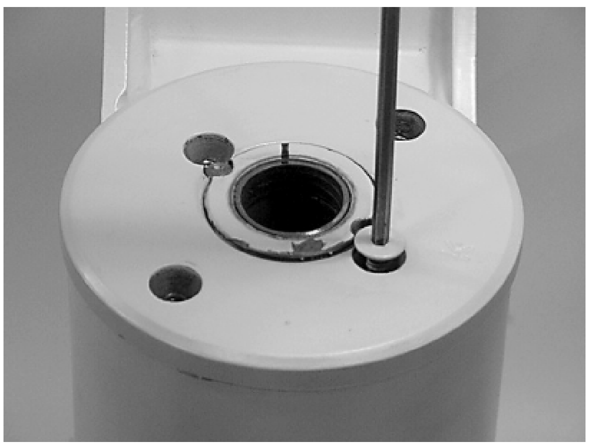
CAUTION

CONTENTS UNDER PRESSURE. WEAR APPROVED EYE PROTECTION. USE CAUTION WHEN REMOVING PORT PLUGS AND FITTINGS.

NOTICE

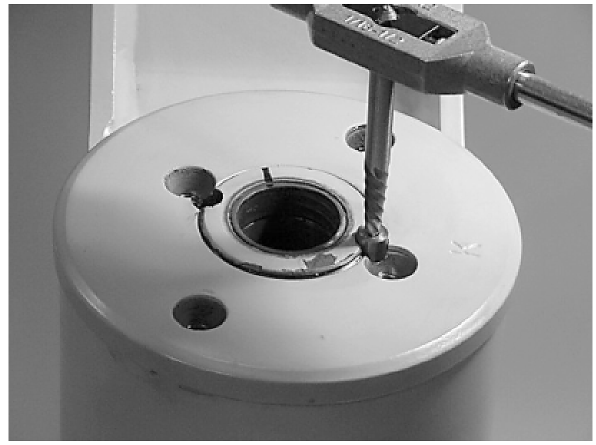
MAKE SURE WORK AREA IS CLEAN.

1. Remove the cap screws (113) over end cap lock pins (109).



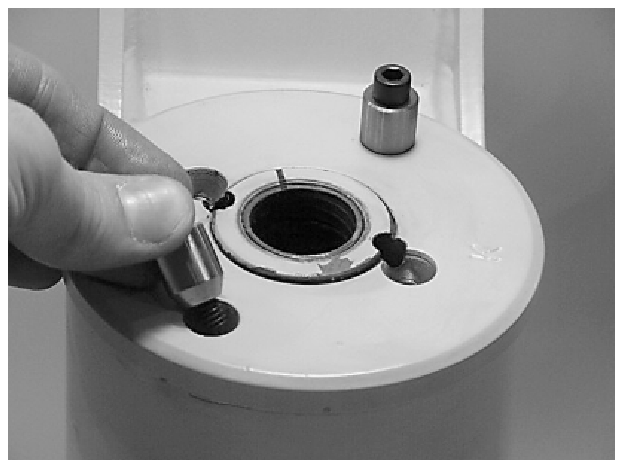
2. Using a 1/8" (3.18mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/16" (4.76mm).

3. Remove the lock pins using an "Easy Out" (a size #2 is shown).



If the pin will not come out with the "Easy Out", use 5/1 6" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

4. Install the end cap (4) removal tools provided with the Helac seal kit.

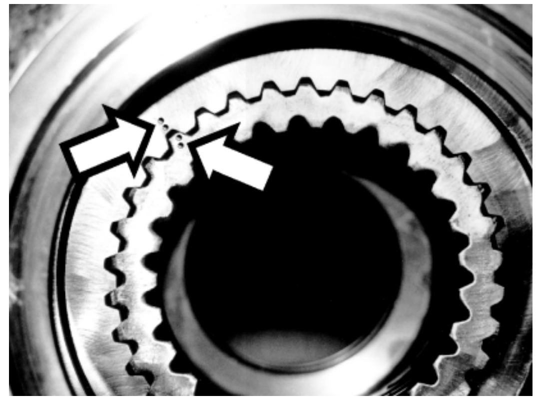


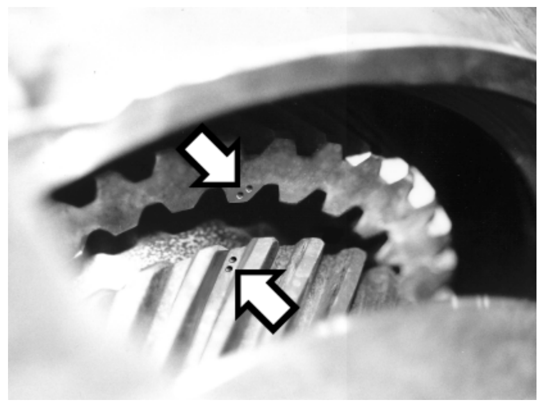
5. Using a metal bar, or similar tool, unscrew the end cap (4) by turning it counter clockwise.

6. Remove the end cap (4) and set aside for later inspection.

7. Remove the stop tube if equipped. The stop tube is an available option to limit the rotation of the actuator.

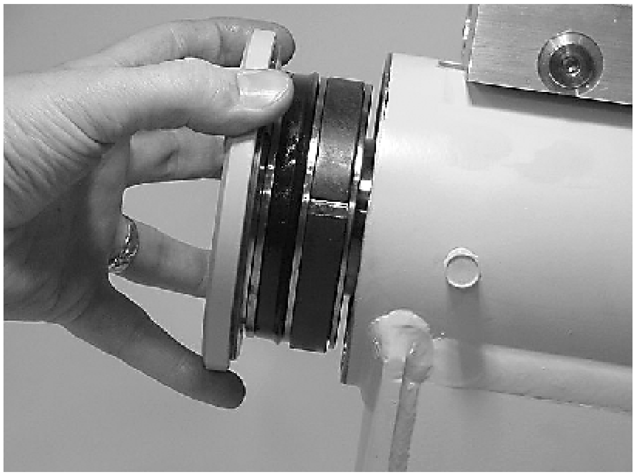
8. Every actuator has timing marks for proper engagement.





9. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.

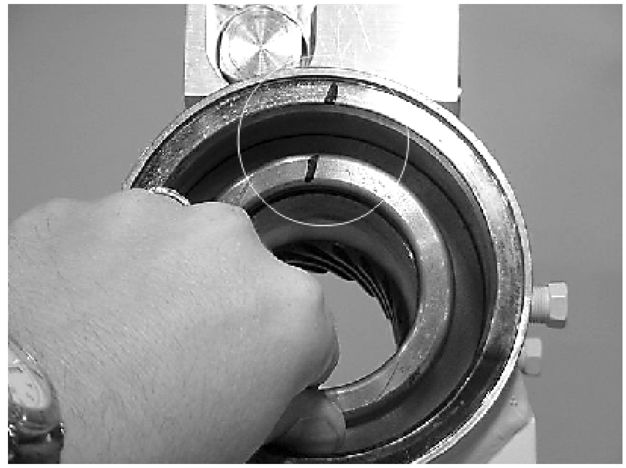
10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.



11. Before removing the piston (3), mark the housing (1) ring gear in relation to the piston O.D. gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

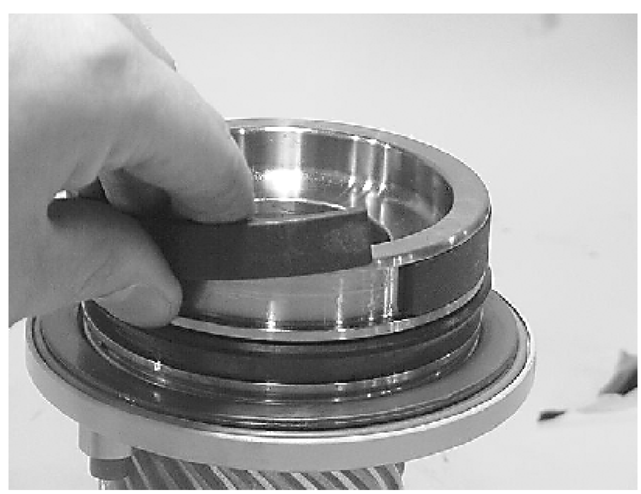
12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is not damaged.

13. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

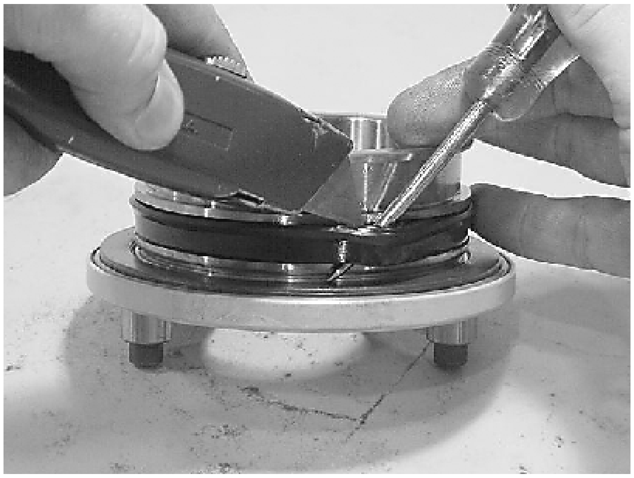


14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

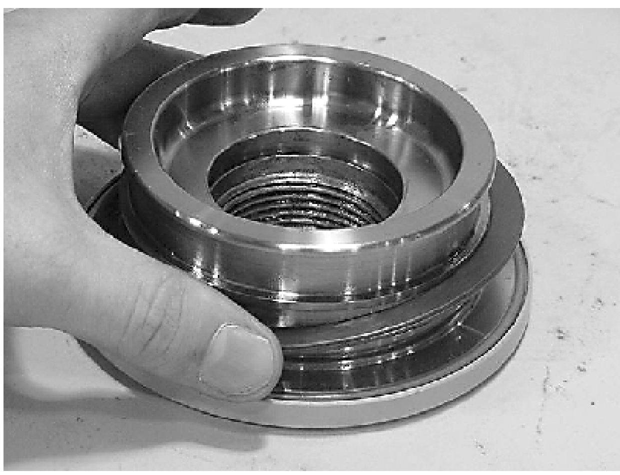
15. Remove the wear guides (302) from the end cap (4) and shaft (2).



16. To remove the main pressure seals (205), it is easiest to cut them using a sharp razor blade being careful not to damage the seal groove.



17. Remove the thrust washers (304), from the end cap (4) and shaft (2).



18. Remove the wiper seal (304.1) from its groove in the end cap (4) and shaft (2).

19. Remove the piston O.D. seal (202) from the piston.

20. Remove the piston I.D. seal (200). You may now proceed to the inspection process.

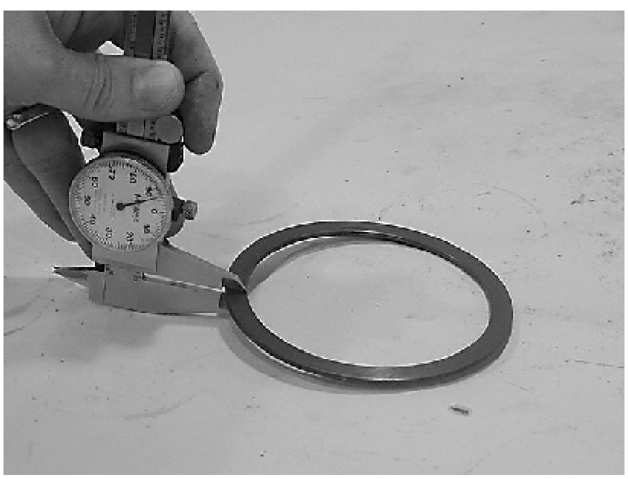
Inspection

NOTICE

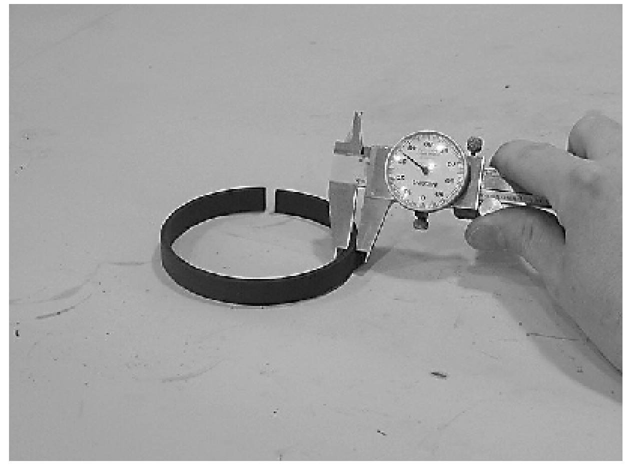
SMALL OR MINOR SURFACE SCRATCHES CAN BE CAREFULLY POLISHED.

1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, rod surface, housing bore and gear teeth.

2. Inspect the thrust washers (304) for rough or worn edges and surfaces. Measure it's thickness to make sure it is within specifications (Not less than 0.092" or 2.34 mm).

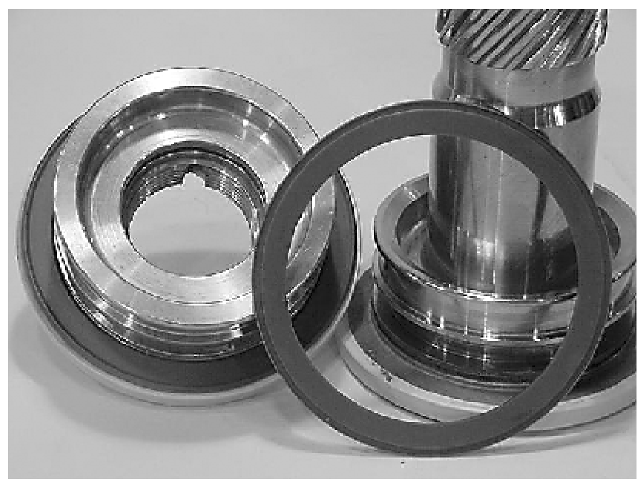


3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

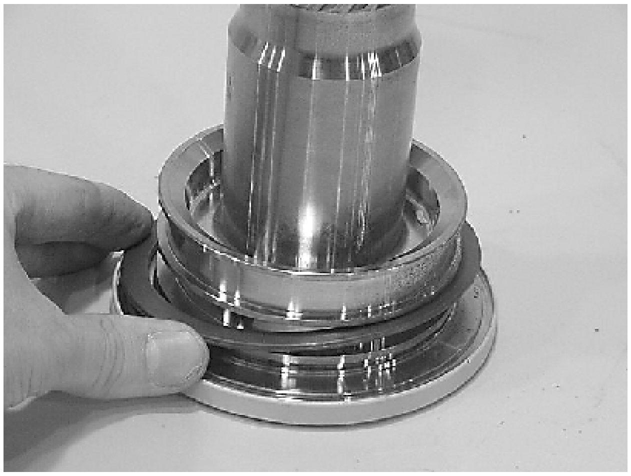


Assembly

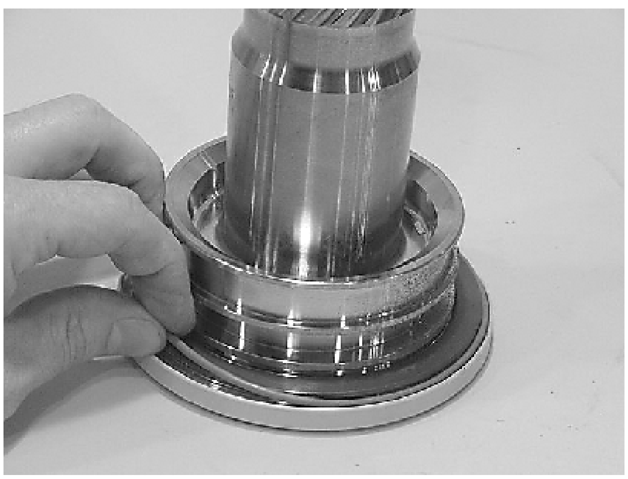
1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.



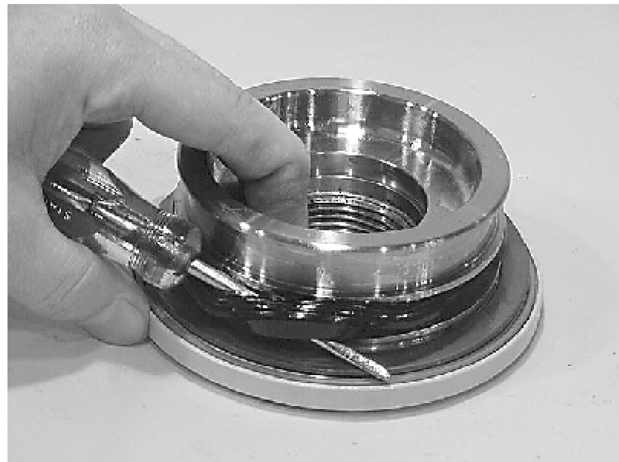
2. Install the thrust washer (304) onto shaft (2) and end cap (4).



3. Install the wiper seal (304.1/green 0-ring) into the groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).



4. Using a seal tool install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.



5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the O-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

7. Install the inner T-seal (200) into the piston (3) using a circular motion.

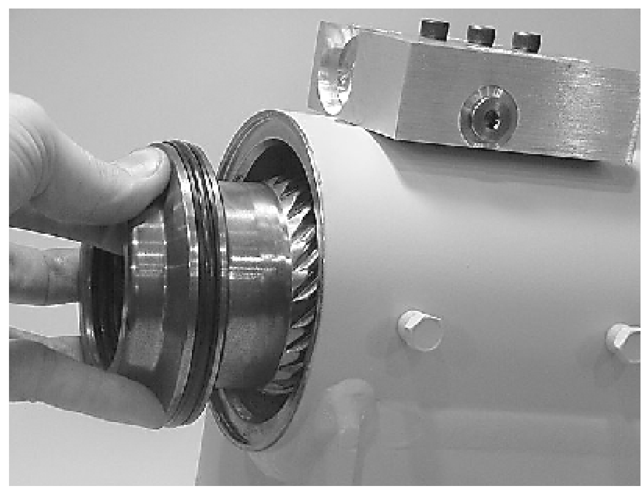
   Install the outer T-seal (202) by stretching it around the groove in a circular motion.

   Each T-seal has 2 back-up rings (see drawing for orientation).

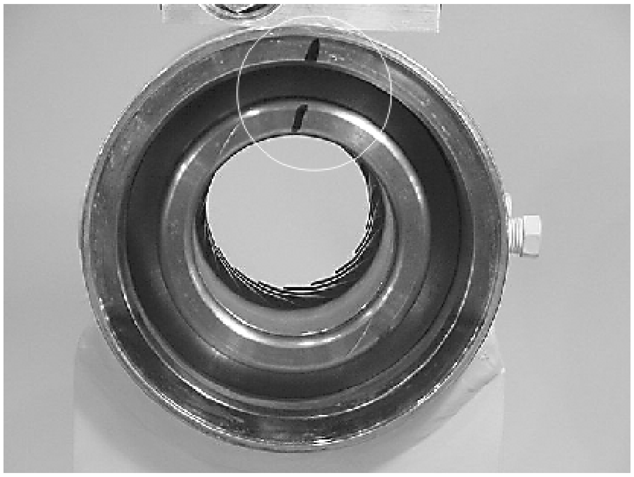
Beginning with the inner seal (200) insert one end of b/u ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly.

Repeat this step for the outer seal (202).

8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

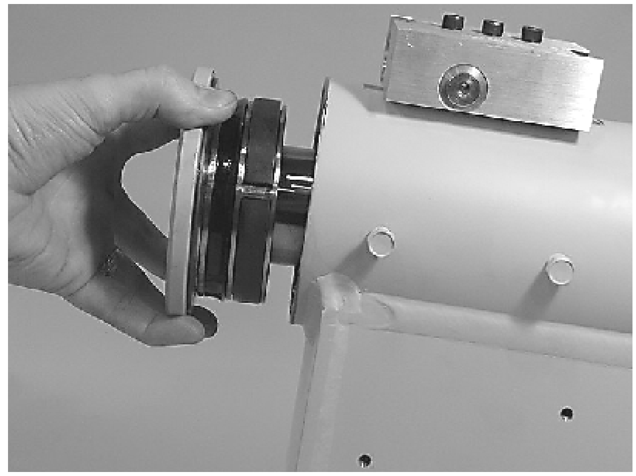


9. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.

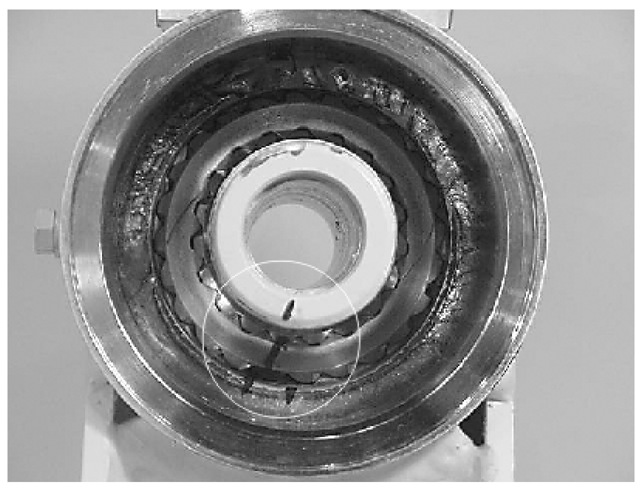


10. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.

11. Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.



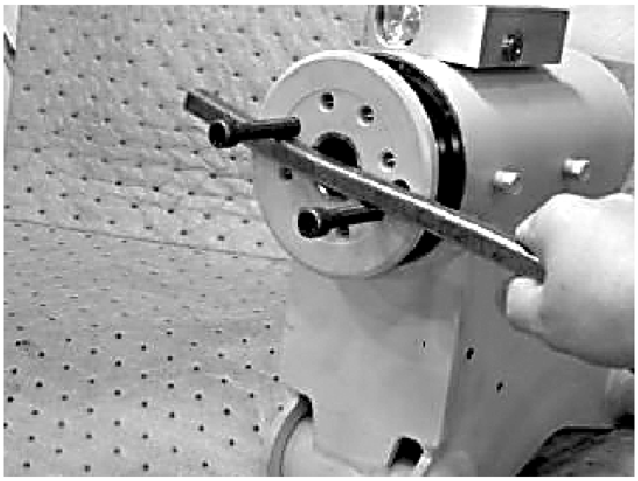
12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



13. Install 2 bolts in the threaded holes in the flange. Using a bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

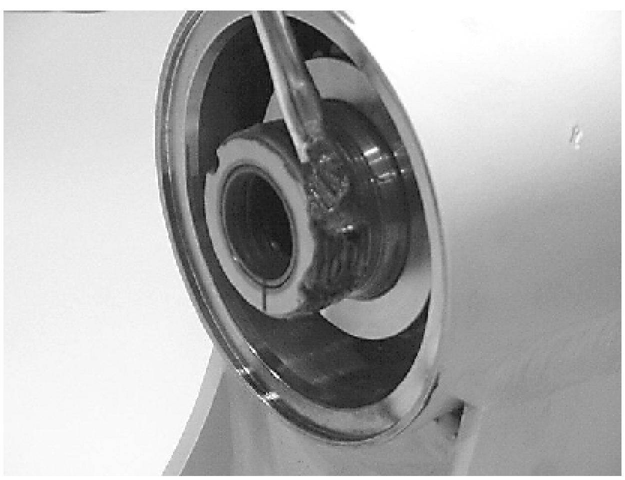
NOTICE

AS THE SHAFT IS ROTATED, BE CAREFUL NOT TO DISENGAGE THE PISTON AND HOUSE GEARING.



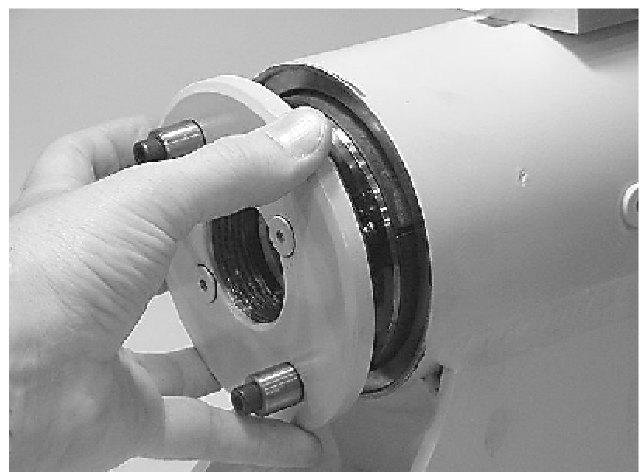
14. Install the stop tube onto the shaft end, if equipped. Stop tube is an available option to limit the rotation of an actuator.

15. Coat the threads on the end of the shaft with anti-seize grease to prevent galling.

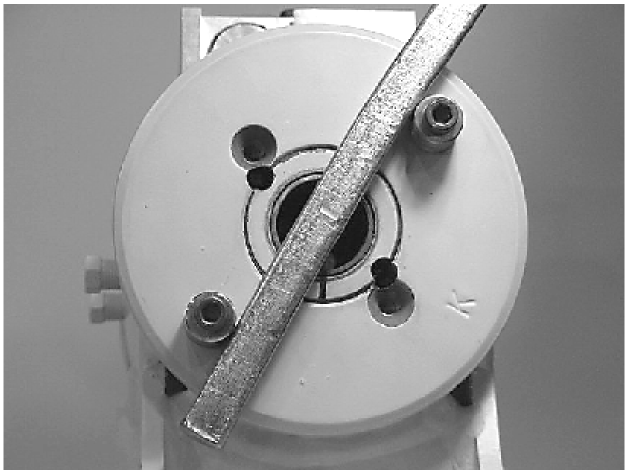


16. Install the 0-ring (204) and back-up ring (207) into the inner seal groove on the end cap (4).

17. Thread the end cap (4) onto the shaft (2) end. Make sure the wear guide remains in place on the end cap as it is threaded into the housing (1).

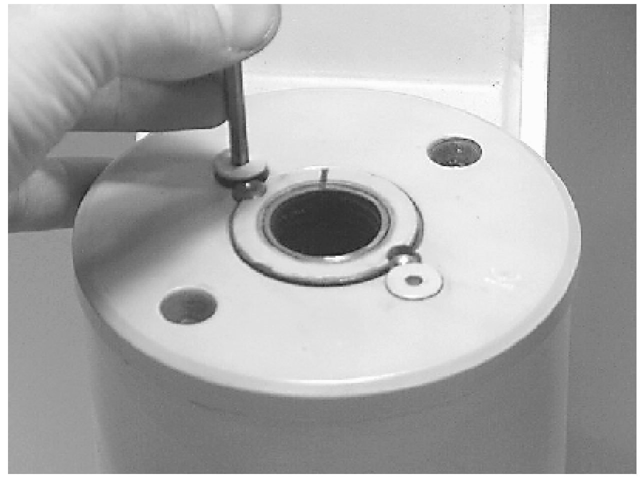


18. Tighten the end cap (4). In most cases the original holes for the lock pins will line up.



19. Place the lock pins (109) provided in the Helac seal kit in the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.

20. Insert the set screws (113) over the lock pins. Tighten them to 25 in. lbs. (2.825 Nm).



Installing Counterbalance Valve

Refer to Figure 4-27., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old JLG Threadlocker P/N 0100011.

2. Make sure the new valve has the O-rings in the counterbores of the valve to seal it to the actuator housing.

3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. JLG Threadlocker P/N 0100011 should be applied to the shank of the three bolts at the time of installation.

4. Torque the 1/4-inch bolts 110 to 120 in.lbs. (12.4 to 13.5 Nm). Do not torque over 125 in.lbs. (14.1 Nm). Torque the 5/16-inch bolts 140 in.lbs. (15.8 Nm). Do not torque over 145 in.lbs. (16.3 Nm).

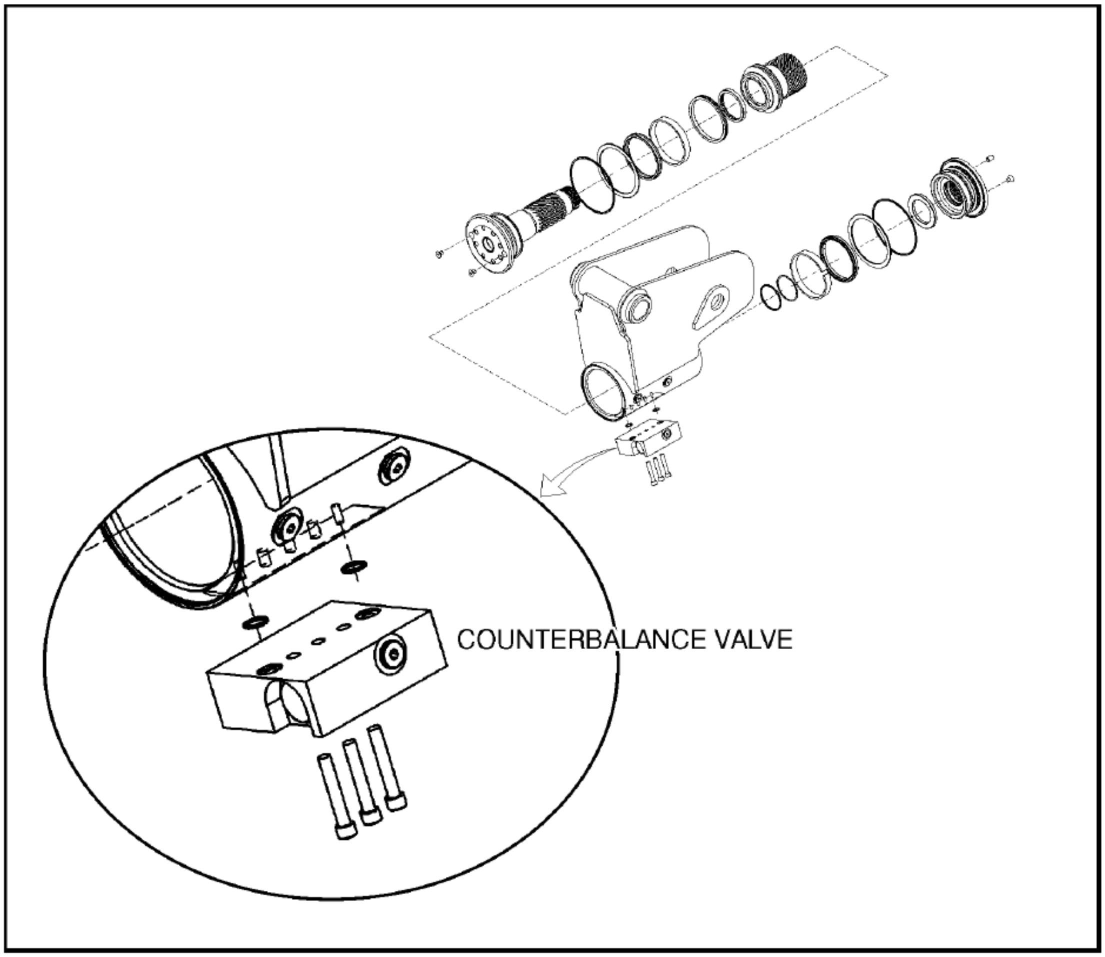


Figure 4-27. Rotator Counterbalance Valve

Testing the Actuator

If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see Installation and Bleeding) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.

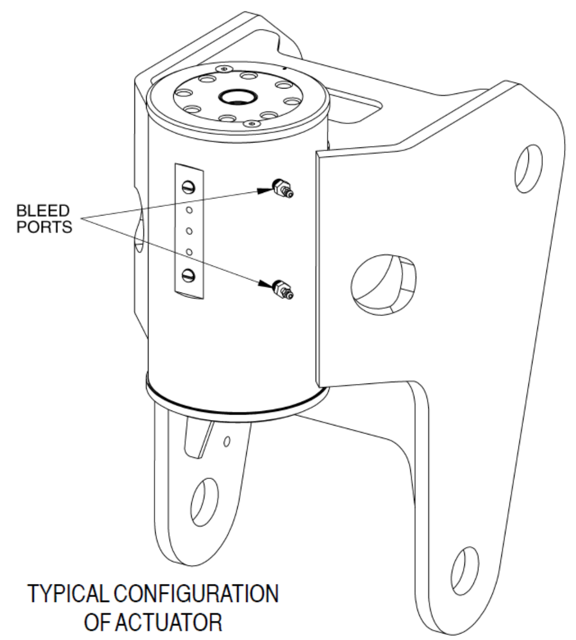
Installation and Bleeding

After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16" inside diameter x 5/16" outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.



TYPICAL CONFIGURATION OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.

3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.

4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

Troubleshooting

Table 4-1. Troubleshooting

Problem	Cause	Solution
1. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks.
	c. Control or counterbalance valve has internal leak	c. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	d. Piston and/or shaft seal leak	d. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	e. Corrosion build-up on the thrust surfaces	e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed.
	f. Swollen seals and composite bearings caused by incompatible hydraulic fluid	f. Re-build the actuator. Use fluid that is compatible with seals and bearings.
2. Operation is erratic or not responsive	a. Air in actuator	a. Purge air from actuator. See bleeding procedures.
3. Shaft will not fully rotate	a. Twisted or chipped gear teeth	a. Check for gear binding. Actuator may not be able to be re-built and may need to be replaced. Damage could be a result of overload or shock.
	b. Port fittings are obstructing the piston	b. Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.
4. Selected position cannot be maintained	a. Control or counterbalance valve has internal leak	a. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	b. Piston and/or shaft seal leak	b. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	c. Air in actuator	c. Purge air from actuator. See bleeding procedures

4.18 DRIVE CARD SETUP PROCEDURES

Lift, Swing, and Drive Cards

1. Center the input potentiometers. Power up the card, but do not start the engine. Place the common lead of a voltmeter on pin #6 and place the other lead on pin #8. Rotate the potentiometer, leaving the joystick in the center position, until the voltmeter reads 2.5 volts. Secure the set screw on the potentiometer. When the potentiometer is centered and the joystick is in the center position, LED #3 should not be illuminated.

2. Install test harness JLG P/N 4922012.

3. Set the minimum and maximum currents. The input potentiometer must be centered before continuing with this procedure. Power up the card, but do not start the engine. Place the current meter in series with the “A” output. Turn P3 counter clockwise until the adjustment potentiometer starts to click. This will set to maximum current to its lowest value. Move the joystick until LED #3 illuminates and hold the stick in this position. Adjust P4 until the meter equals the current setting range given in Table 4-2. Rotating the adjustment potentiometer clockwise will increase the current. This will set the minimum current setting for the “A” output. To set the maximum current for the “A” output, hold the joystick in its maximum position. Turn P3 clockwise until the meter reading equals the setting in Table 4-2. Follow the same procedure for the “B” output. Use P8 for the minimum current adjustment and P7 for the maximum current adjustment.

4. Set the ramp up and the ramp down times. Step 2 must be performed before continuing with procedure. Power up the card, but do not start the engine. Place the current meter in series with the “A” output. Move the joystick from the center position to the extreme position. Watch the meter for the time it takes the output to go to from 0 current to maximum current. This is the ramp up time. Adjust P1 until this time matches the time given in Table 4-3. Rotating the adjustment potentiometer clockwise will increase the ramp time. To set the ramp down time, hold the joystick in the extreme position. Release the joystick and watch the meter for the time it takes the output to go from the maximum current setting to 0 current. Adjust P2 until this time matches the time in Table 4-3. Rotating the adjustment potentiometer clockwise will increase the ramp time. Follow the same procedure for the “B” output. Use P5 for the ramp up adjustment and P6 for the ramp down adjustment.

Flow Control Card

1. Set the input potentiometer. Power up the card, but do not start the engine. Place the common lead of a voltmeter on pin #15 and place the other lead on pin #8. Rotate the potentiometer and verify the input to the card is 3.8 volts when the input potentiometer is in its minimum position. Rotate the input potentiometer to its maximum position and verify the input to the card is 0 volts.

2. Set the minimum and maximum current settings. The input potentiometer must function properly before continuing with this procedure. Turn P3 counter clockwise until the adjustment pot starts clicking. Place a current meter in series with the “A” output. Rotate the input potentiometer to its minimum setting and operate the telescope function. Adjust P4 until the meter reading matches the setting in Table 4-2. This sets the minimum current setting for the card. Rotate the input potentiometer to its extreme position and operate the telescope function. Turn P3 clockwise until the meter reading matches the setting in Table 4-2. This sets the maximum current for the card.

3. Set the ramp up and the down times. Step 2 must be completed before continuing with this procedure. Power up the card, but do not start the engine. Place the current meter in series with the “A” output. Turn the input potentiometer to its extreme position and operate the telescope function. watch the meter for the time it takes the output to go from 0 current to maximum current. This is ramp up time. Adjust P1 until this time matches the time in Table 4-3. Rotating the adjustment potentiometer clockwise will increase ramp time. To set the ramp down time, hold the telescope function switch and watch the time it takes the output to go from the maximum current down to 0 current. This is the ramp down time. Adjust P2 until this time matches the setting time in Table 4-3. Rotating the adjustment potentiometer clockwise will increase the ramp time.

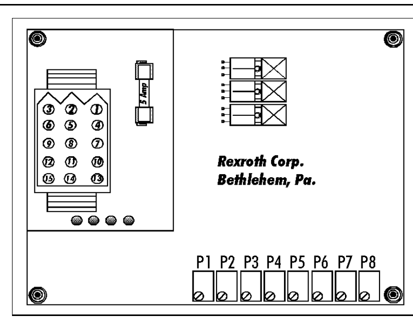


Figure 4-28. Control Card

Table 4-2. Ramp Current Setting Range

FUNCTION	MINIMUM CURRENT	MAXIMUM CURRENT
UPPER LIFT UP	450 to 550 mA	1300 to 1500 mA
UPPER LIFT DOWN	450 to 550 mA	1700 to 2000 mA (Set 450 mA higher than Upper lift)
SWING RIGHT	450 to 550 mA	1000 to 1300 mA
SWING LEFT	450 to 550 mA	1100 to 1300 mA (Set 100 mA higher than swing right)
FLOW CONTROL	750 to 850 mA	1100 to 1300MA (Set using Main Tele)
DRIVE FORWARD	20 to 60 mA	130 to 160 mA
DRIVE REVERSE	20 to 60 mA	130 to 160 mA

Table 4-3. Ramp time Setting

FUNCTION	RAMP TIME
Lift Up	Ramp UpTime = 5:00 sec. Ramp Down Time = 3:00 sec.
Lift Down	Ramp Up Time =5:00 sec. Ramp Down Time =3:00 sec.
Swing Right	Ramp Up Time =7:00 sec. Ramp Down Time =3:00 sec.
Swing Left	Ramp Up Time =7:00 sec. Ramp Down Time =3:00 sec.
Drive Forward	Ramp Up Time =4:30 sec. Ramp Down Time = 2:30 sec.
Drive Reverse	Ramp Up Time = 4:30 sec. Ramp Down Time = 2:00 sec.
Flow Control	Ramp Up Time =3:00 sec. Ramp Down Time =0.00 sec.

4.19 FOOT SWITCH ADJUSTMENT

Adjust so that functions will operate when pedal is at center of travel. If switch operates within last 1/4 in. (6.35 mm) of travel, top or bottom, it should be adjusted.

NOTES:

SECTION 5. BASIC HYDRAULIC INFORMATION AND SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

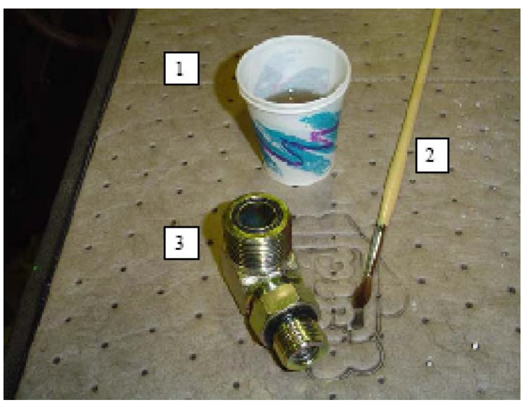
When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

NOTE: *All o-ring fittings must be pre-lubricated with hydraulic oil prior to assembly.*

Cup and Brush

The following is needed to correctly oil the o-ring in this manner:

- A small container for hydraulic oil.
- Small paint brush.



1. Hold the fitting in one hand while using the brush with the other hand to dip into the container. Remove excess hydraulic oil from the brush so an even film of oil is applied on the o-ring.

2. Holding the fitting over the hydraulic oil container, brush an even film of oil around the entire o-ring in the fitting, making sure the entire o-ring is completely saturated.

3. Turn the o-ring on the other side of the fitting and repeat the previous step, ensuring the entire o-ring is coated with hydraulic oil.

Dip Method

NOTE: *This method works best with Face Seal o-rings, but will work for all o-ring fitting types.*

The following is needed to correctly oil the o-ring in this manner:

- A small leak proof container.
- Sponge cut to fit inside the container.
- A small amount of hydraulic oil to saturate the sponge.

1. Place the sponge inside the container and add hydraulic oil to the sponge until it is fully saturated.
2. Dip the fitting into the sponge using firm pressure. Upon lifting the fitting, a small droplet will form and drip from the bottom of the fitting. This should signify an even coating of oil on the fitting.

3. O-ring Boss type fittings will require more pressure in able to immerse more of the fitting into the saturated sponge. This will also cause more oil to be dispersed from the sponge.

Spray Method

This method requires a pump or trigger spray bottle.

1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

1. Fill the bottle with hydraulic oil.
2. Using slight pressure to the body of the spray bottle, invert the bottle so the brush end is in the downward position.
3. Brush hydraulic oil on the entire o-ring, applying an even coat of oil.

5.2 VALVES - THEORY OF OPERATION

Solenoid Control Valve - Rexroth

Control valves used are four-way three-position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral) the valve spool returns to neutral (center) and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consist of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

Relief Valves

Relief valves are installed at various points within the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

5.3 HOLDING VALVE CHECKS

1. Start the machine and warm the hydraulic system to operating temperature.

NOTICE

PERFORM ALL HOLDING VALVE CHECKS FROM THE GROUND CONTROL STATION WITH AN EMPTY PLATFORM.

2. Check the Upright level cylinder rod side holding valve as follows:
   a. Fully retract and fully lower the main boom and tower boom assemblies.
   b. Power the main boom lift down function into the turntable boom rest by holding the function switch down between 10 and 20 seconds.
   c. Verify the upright remains perpendicular to the turntable and that the Upright Monitoring System alarms have not been activated.
3. Check the Upright level cylinder barrel side holding valve function as follows:
   a. Fully retract and fully lower the main boom and tower boom assemblies. Raise the tower boom between 2 ft. and 5 ft. (0.6 m and 1.5 m).
   b. Pull and hold the re-leveling knob between 20 and 30 seconds.
   c. Verify the upright remains perpendicular to the turntable and that the Upright Monitoring System alarms have not been activated.
4. Check the Tower lift cylinder barrel side holding valve function as follows:
   a. Fully raise and fully retract the tower boom. Fully raise and fully extend the main boom.
   b. Using auxiliary power, fully lower the tower boom.
   c. Verify the upright remains perpendicular to the turntable and that the Upright Monitoring System alarms have not been activated.

5. Check the Tower lift up holding valve function as follows:
   a. Fully retract and fully lower the main boom and tower boom assemblies.
   b. Install a 5000 psi (345 bar) pressure gauge to the pressure tap connection installed on port #7 or port MX7 of the main control valve block. This pressure test connection was installed in earlier steps.
   c. Hold the tower boom lift up function between 2 and 5 seconds, and then release the function.
   d. Verify that the gauge reads, and maintains, pressure above 1000 psi (68.95 bar) for one minute.

NOTE: *If pressure does not remain above the stated pressure for one minute, replace the tower lift check valve (#7017474).*

   e. Activate tower lift down to release any trapped pressure and remove pressure gauge from the test port.
6. Load the platform with the rated capacity and cycle all functions a minimum of five (5) times to confirm safe and proper operational characteristics.
7. The machine may be returned to service once proper operation is confirmed.

5.4 CYLINDERS - THEORY OF OPERATION

Systems Incorporating Double Acting Cylinders

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: - Lower Lift, Tower Telescope, Slave Level/Main Level, Upper Lift, Upper Telescope, Master Level/Upright Level, Articulating Jib Boom Lift, Steer and Axle lockout. A double acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.

Systems Incorporating Holding Valves

Holding valves are used in the - Lower Lift, Tower Telescope, Upright Level, Lockout, Articulating Jib Boom Lift, Upper Lift/ Slave Level and Upper Telescope circuits to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

5.5 CYLINDER CHECKING PROCEDURE

NOTE: *Cylinder check must be performed anytime a system component is replaced or when improper system operation is suspected.*

Cylinders Without Counterbalance Valves - Master Cylinder and Steer Cylinders

1. Using all applicable safety precautions, activate engine and fully extend cylinder to be checked. Shut down engine.
2. Carefully disconnect hydraulic hoses from retract port of cylinder. There will be some initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should be no further drainage from the retract port.
3. Activate engine and extend cylinder.
4. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to port and retract cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repair must be made.
5. With cylinder fully retracted, shut down engine and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate engine and retract cylinder. Check extend port for leakage.
7. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, than activate cylinder through one complete cycle and check for leaks. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repairs must be made.

Cylinders With Single Counterbalance Valve

(Main Lift Cylinder)

NOTICE

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.

⚠ WARNING

WHEN WORKING ON THE MAIN LIFT CYLINDER, RAISE THE BOOM TO HORIZONTAL AND SUPPORT THE UPPER BOOM, UPRIGHT, AND TOWER BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE SUPPORT IN PLACE.

2. Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn IGNITION SWITCH to ON, move control switch or lever for applicable cylinder in each direction, then turn IGNITION SWITCH to OFF. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate cylinder port block.
3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
4. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should be no further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.
6. If used, remove lifting device from upright or remove prop from below upper boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

Cylinders With Dual Counterbalance Valves

(Articulating Jib Boom Lift, and Slave, Slave Level, Tower Lift, Upright level, Main Telescope and Tower Telescope)

NOTICE

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.

⚠ WARNING

IF WORKING ON THE TOWER BOOM LIFT CYLINDER, RAISE TOWER BOOM HALFWAY, FULLY ELEVATE UPPER BOOM WITH TELESCOPE CYLINDER FULLY RETRACTED AND ATTACH AN OVERHEAD CRANE TO THE UPRIGHT FOR SUPPORT, LEAVING APPROXIMATELY 1 INCH (2.54 CM) OF SLACK IN CHAIN OR SLING FOR TEST PURPOSES. IF WORKING ON THE UPRIGHT LEVEL, RAISE THE TOWER BOOM HALFWAY, THEN RAISE UPPER BOOM TO HORIZONTAL, AND SUPPORT WITH A CRANE OR SUITABLE LIFTING DEVICE, APPROXIMATELY 1 INCH (2.54 CM) BELOW UPPER BOOM. IF WORKING ON THE PLATFORM LEVEL CYLINDER, STROKE PLATFORM LEVEL CYLINDER FORWARD UNTIL PLATFORM SITS AT A 45 DEGREES ANGLE.

2. Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn IGNITION SWITCH to ON, move control switch or lever for applicable cylinder in each direction, then turn IGNITION SWITCH to OFF. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate cylinder port block.

3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.

4. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should be no further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.

5. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.

6. If used, remove lifting device from upright or remove prop from below upper boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

5.6 CYLINDER REPAIR

Axle Lockout Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the counterbalance valves from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

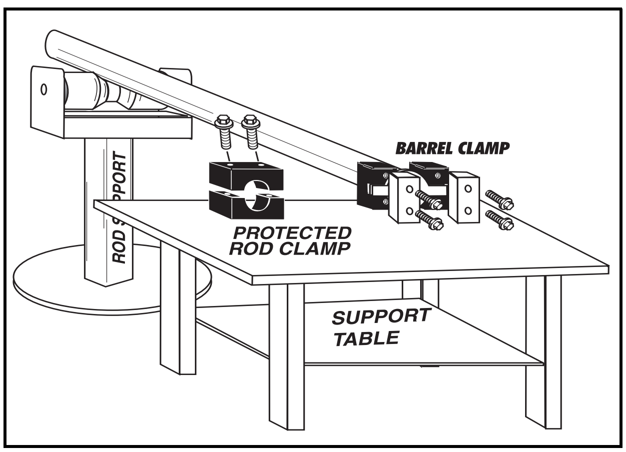


Figure 5-1. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

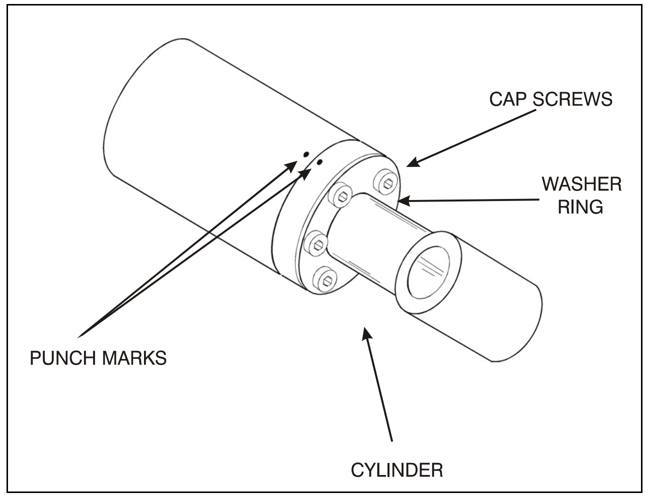
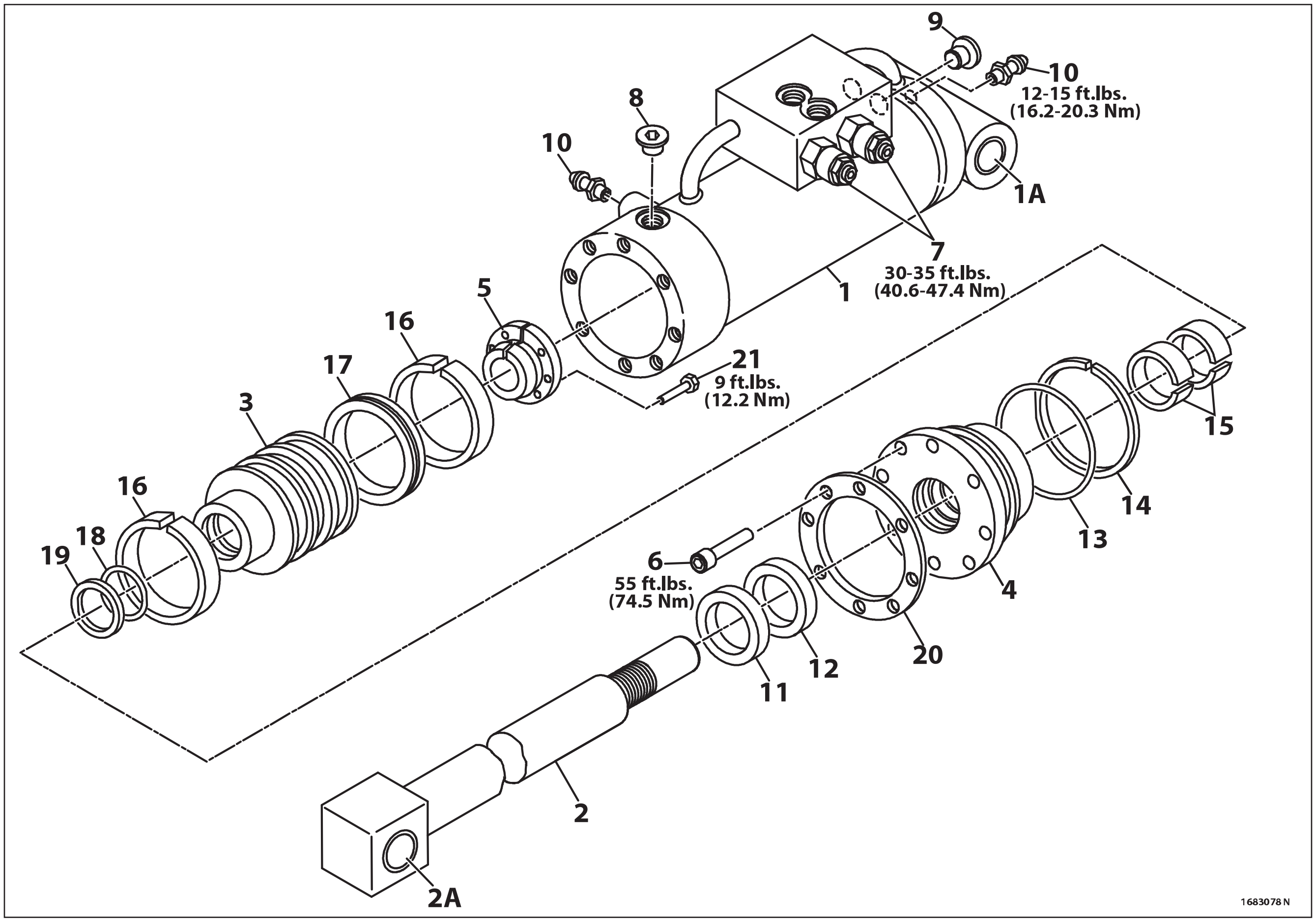


Figure 5-2. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Barrel
2. Rod
3. Piston
4. Head
5. Tapered Bushing
6. Bolt
7. Counterbalance Valve
8. O-ring Plug
9. O-ring Plug
10. Bleeder Valve
11. Wiper
12. Rod Seal
13. O-ring
14. Backup Ring
15. Wear Ring
16. Wear Ring
17. T-Seal
18. O-ring
19. Backup Ring
20. Washer Ring
21. Bolt

Figure 5-3. Axle Lockout Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

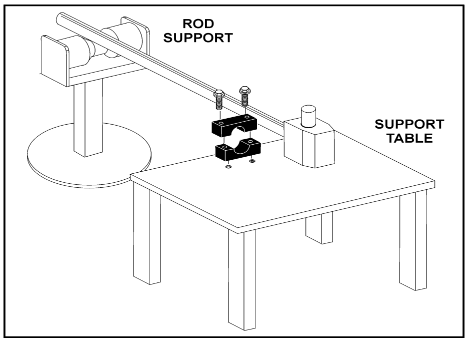


Figure 5-4. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

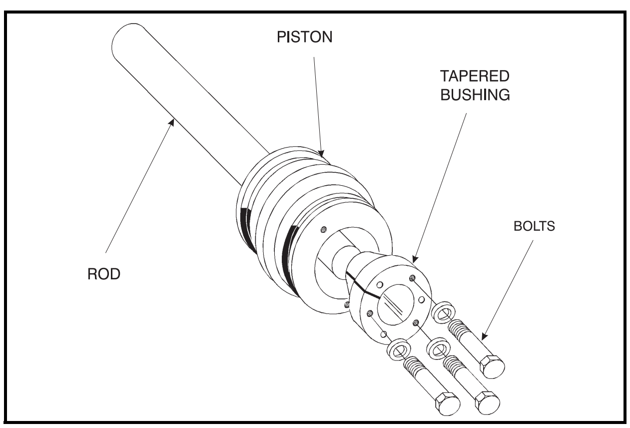


Figure 5-5. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

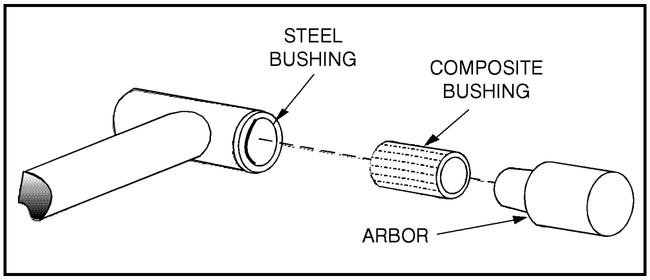


Figure 5-6. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

15. If applicable, inspect port block fittings and holding valve. Replace as necessary.

16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

17. If applicable, inspect piston rings for cracks or other valve damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

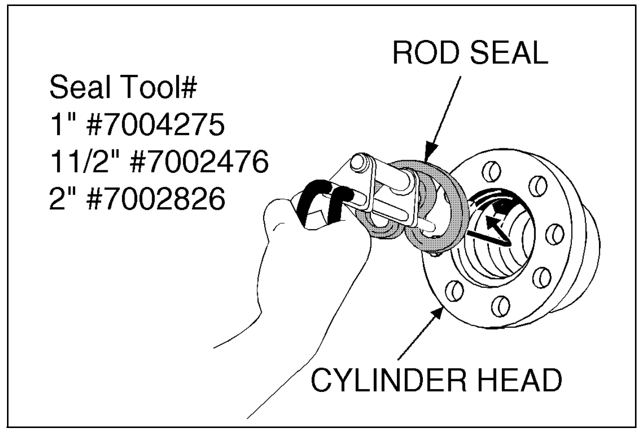


Figure 5-7. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

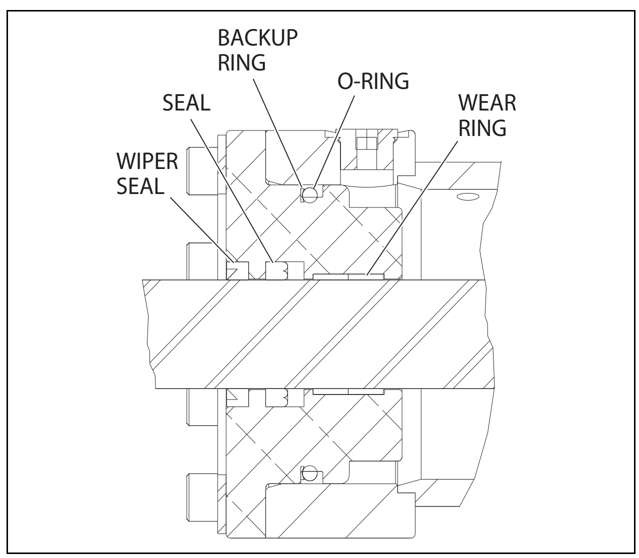
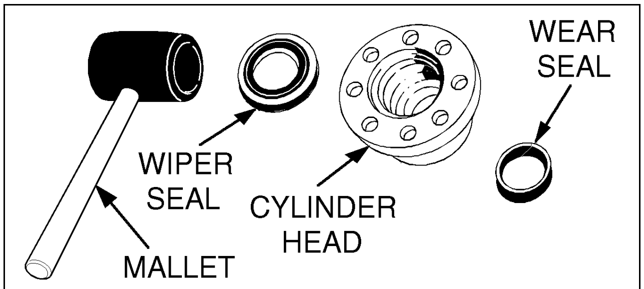


Figure 5-8. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-9. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

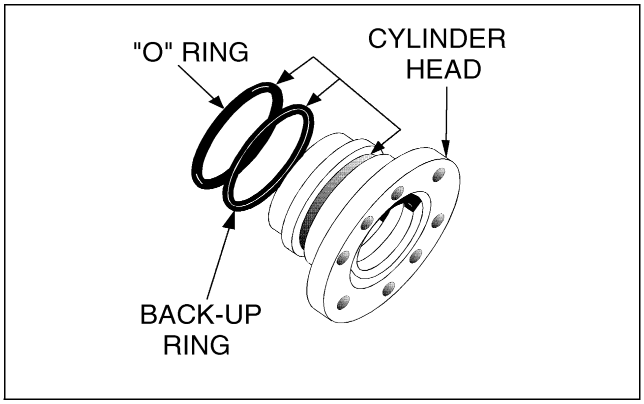


Figure 5-10. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

7. Install the bolts in tapered bushing.

8. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

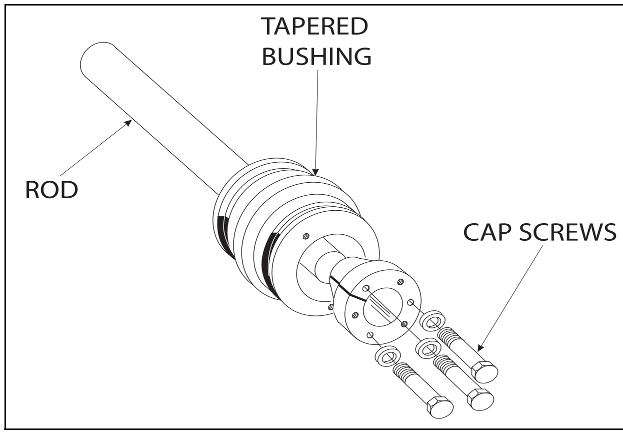


Figure 5-11. Tapered Bushing Installation

9. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

10. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

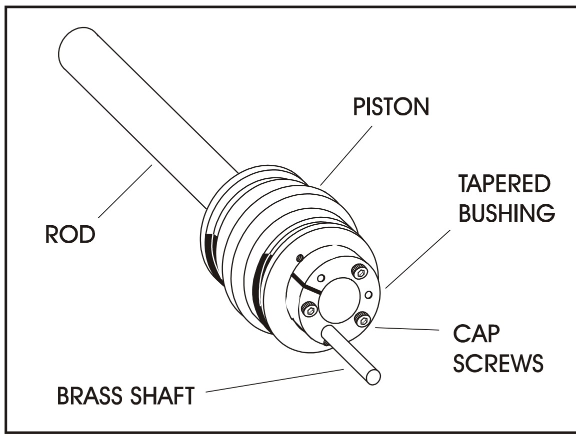


Figure 5-12. Seating the Tapered Bearing

11. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. Remove the cylinder rod from the holding fixture.

13. Place seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 5-13., Piston Seal Kit Installation).

14. Place a new o-ring and back-up rings in the inner piston diameter groove.

15. Place new seals in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

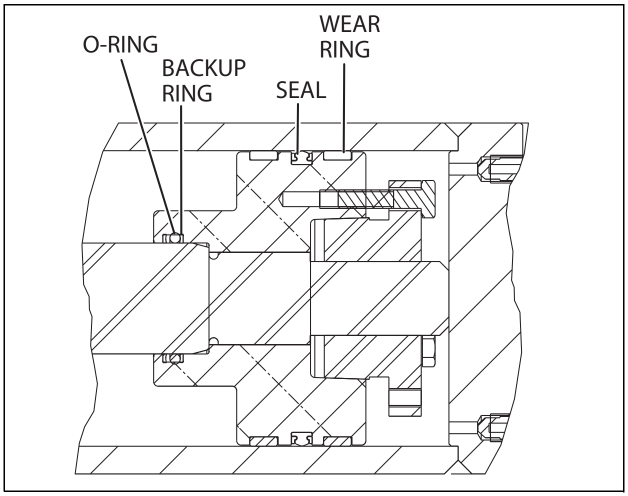


Figure 5-13. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

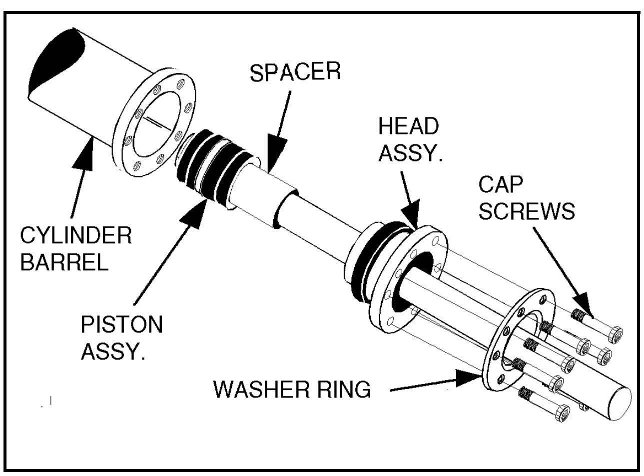


Figure 5-14. Rod Assembly Installation

19. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 55 ft.lbs. (75 Nm).

20. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Upright Level Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If necessary, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

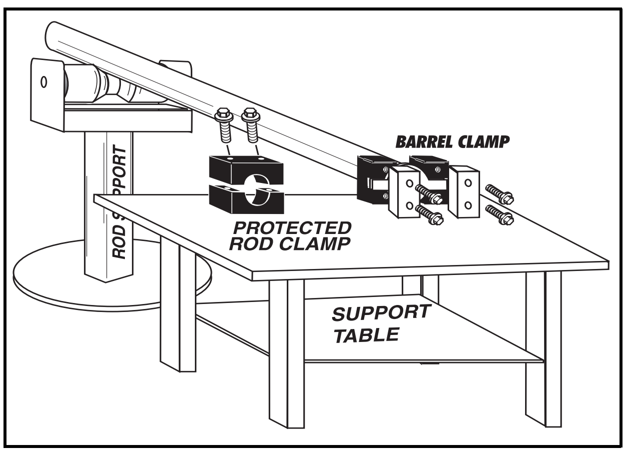


Figure 5-15. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

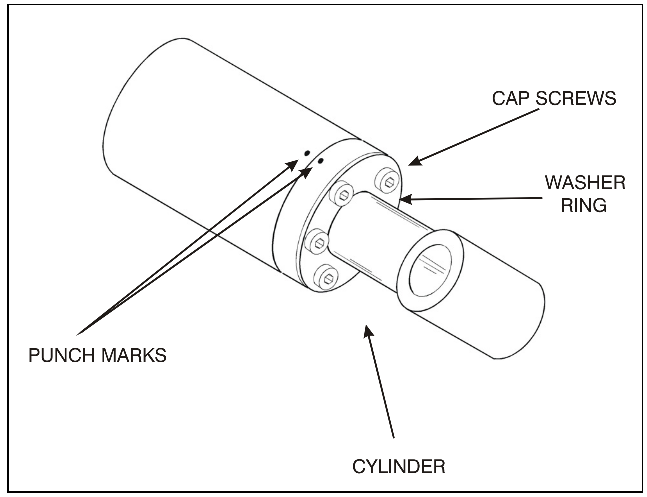
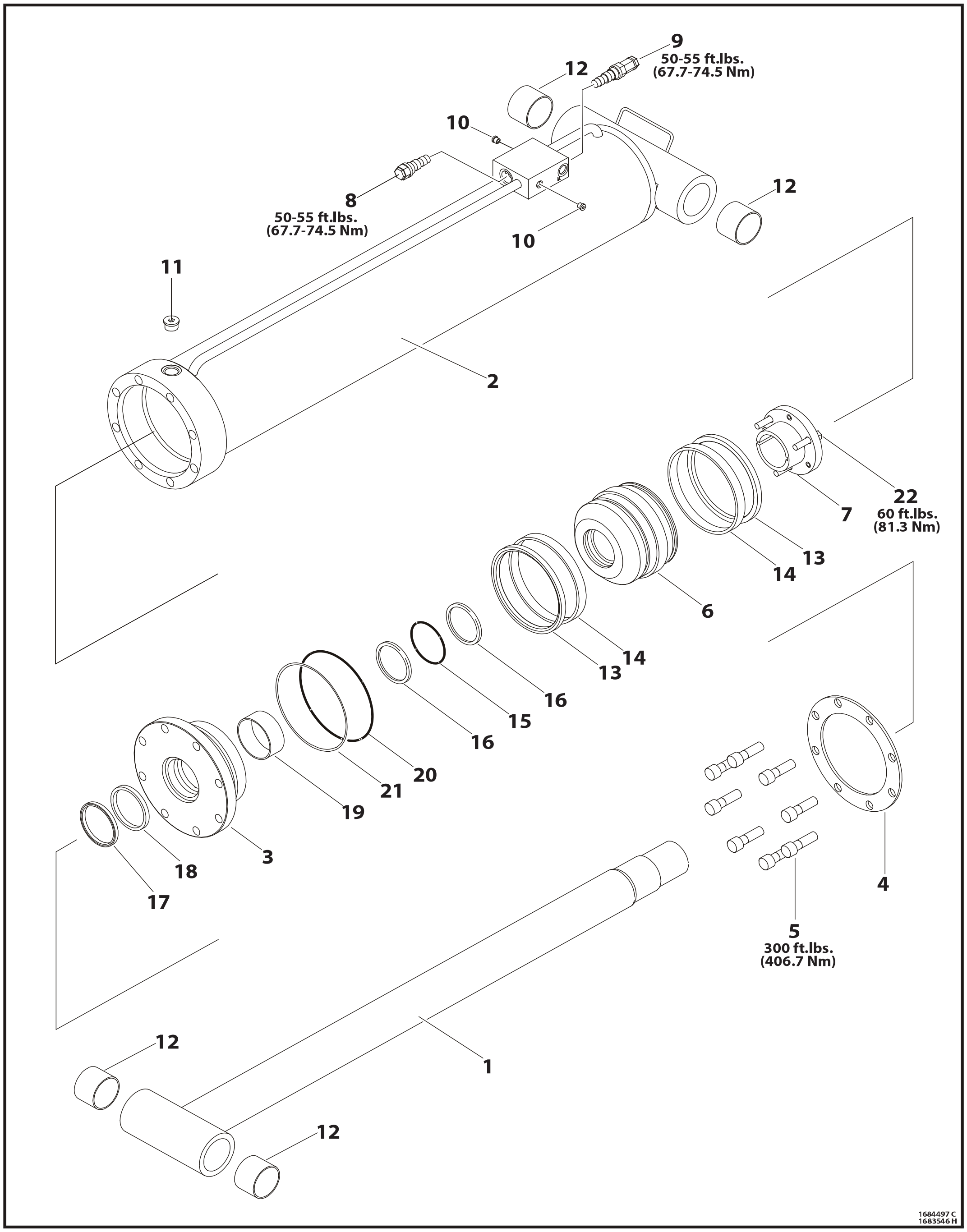


Figure 5-16. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Rod	6. Piston	11. O-ring Plug	15. Washer Ring	19. Wear Ring
2. Barrel	7. Tapered Bushing	12. Bushing	16. Backup Ring	20. O-ring
3. Head	8. Valve Cartridge	13. Lock Ring	17. Wiper	21. Backup Ring
4. Washer Ring	9. Valve Cartridge	14. Seal	18. Rod Seal	22. Bolt
5. Bolt	10. O-ring Plug			

Figure 5-17. Upright Level Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

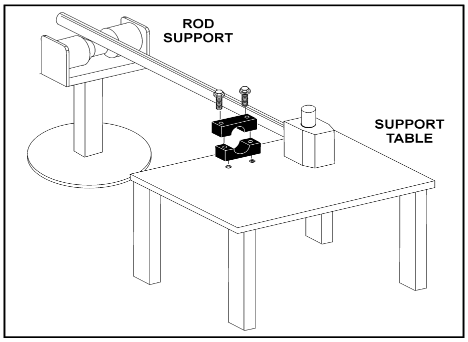


Figure 5-18. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

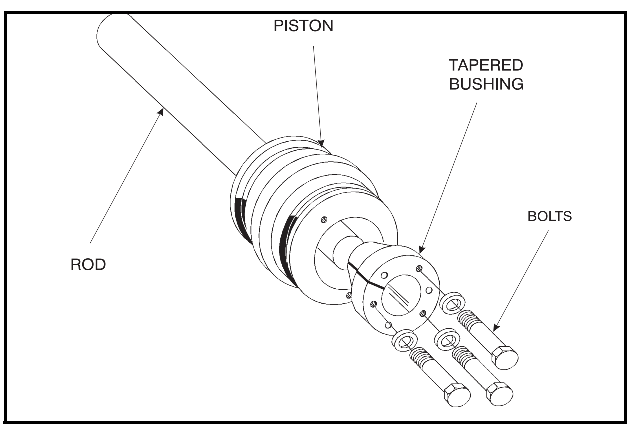


Figure 5-19. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove the rod from the holding fixture. Remove the cylinder head gland, if applicable. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

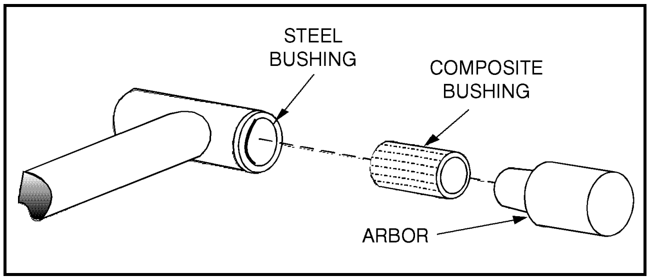


Figure 5-20. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

15. If applicable, inspect port block fittings and holding valve. Replace as necessary.

16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

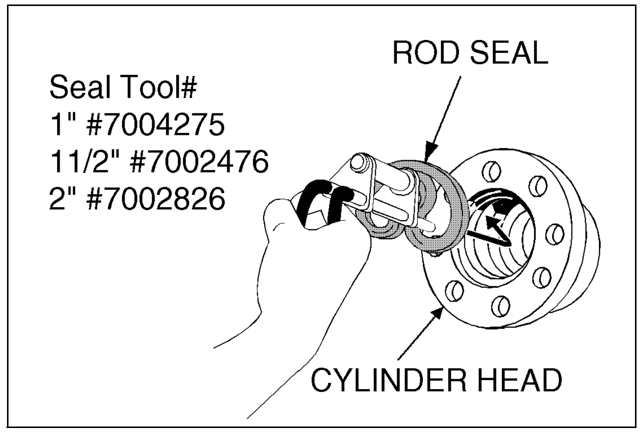


Figure 5-21. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

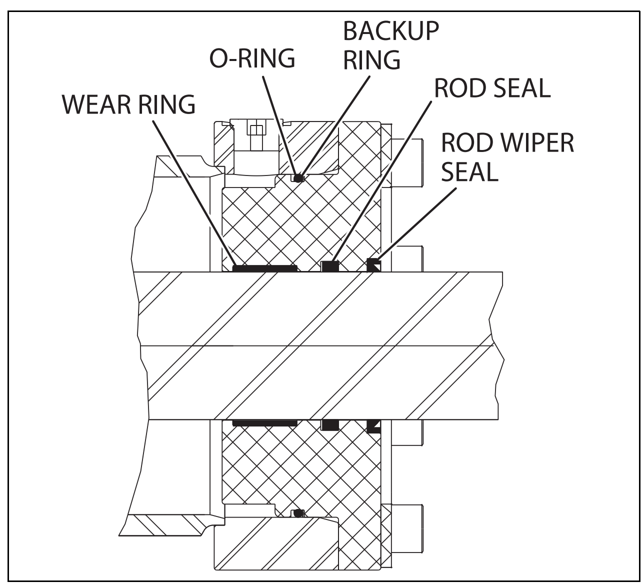
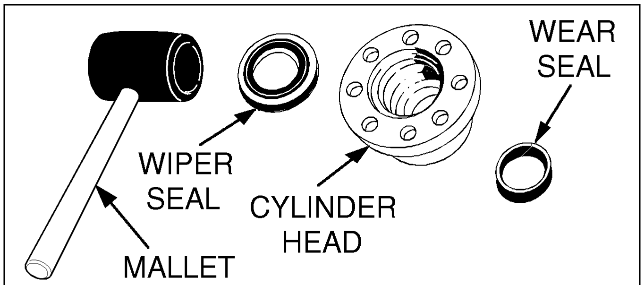


Figure 5-22. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-23. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

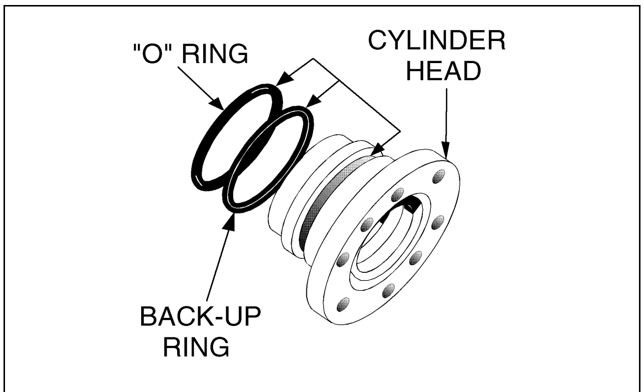


Figure 5-24. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
7. Thread piston onto rod and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

8. Install the bolts in tapered bushing.
9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

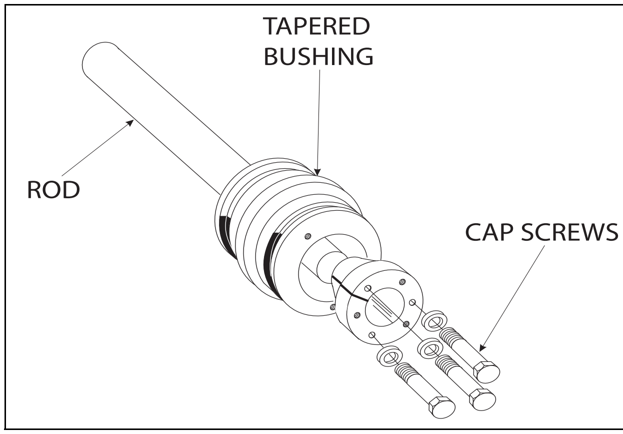


Figure 5-25. Tapered Bushing Installation

10. Tighten the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).
11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

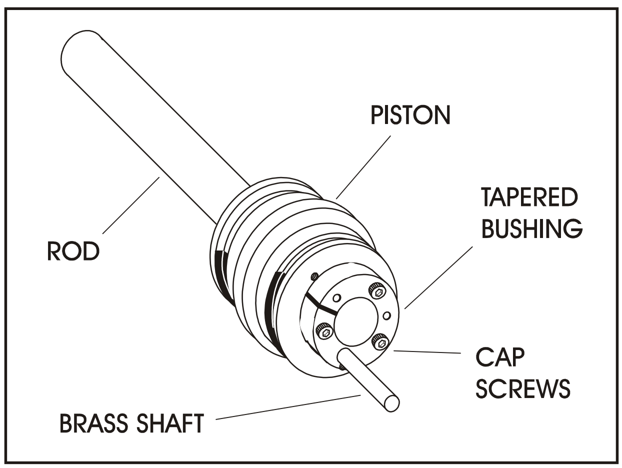


Figure 5-26. Seating the Tapered Bearing

12. Rotate the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).
13. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

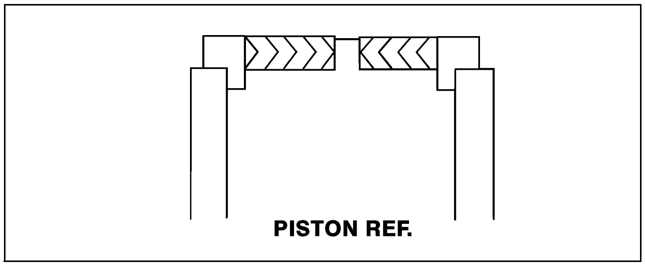


Figure 5-27. Hydrolock Piston Seal Installation

14. Place a new ring washer and back-up rings in the inner piston diameter groove.

15. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

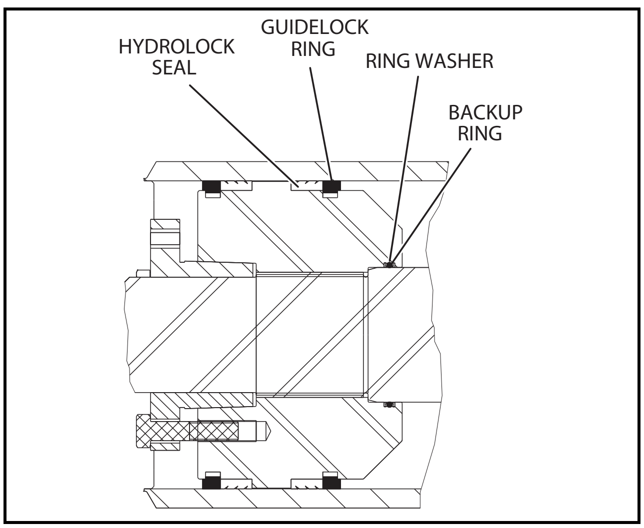


Figure 5-28. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

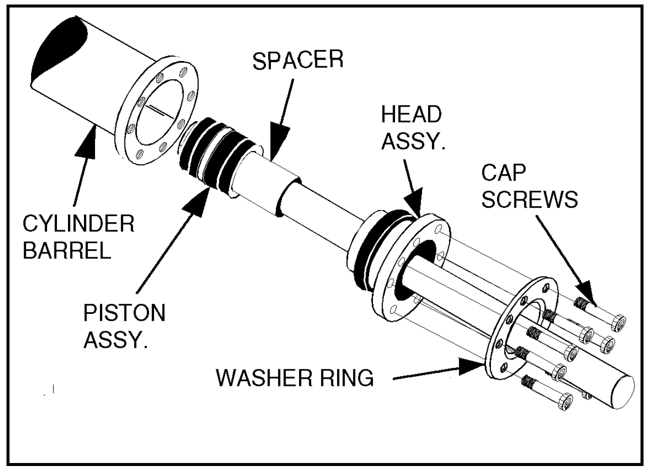


Figure 5-29. Rod Assembly Installation

19. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 300 ft.lbs. (406 Nm).

20. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

21. If removed, install the cartridge-type counterbalance valve and fittings in the rod port block, using new o-rings as applicable.

Jib Lift Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the counterbalance valves from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

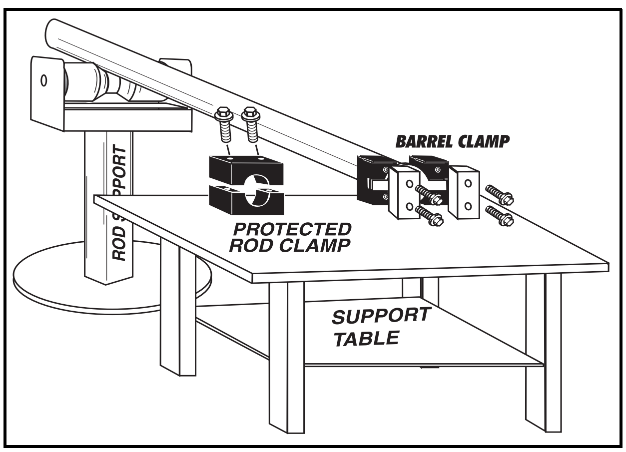


Figure 5-30. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

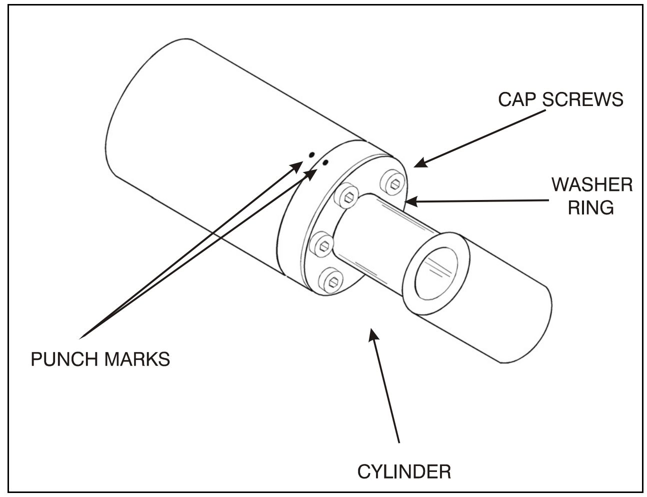
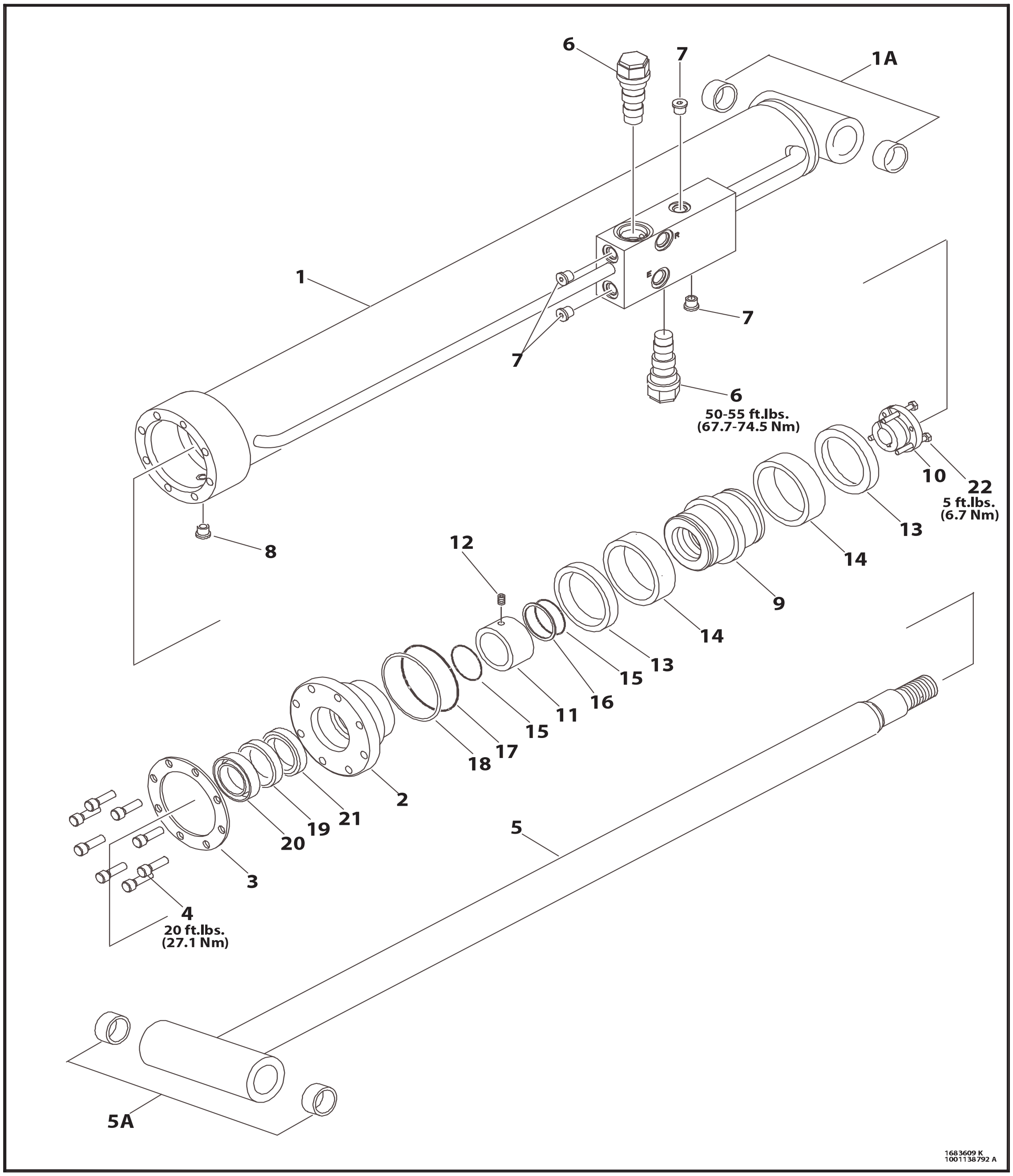


Figure 5-31. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Barrel	5. Rod	9. Piston	14. Piston Seal	19. Seal
1A. Bushing	5A. Bushing	10. Tapered Bushing	15. O-ring	20. Wiper
2. Head	6. Counterbalance Valve	11. Tube Spacer	16. Backup Ring	21. Wear Ring
3. Ring Washer	7. O-ring Plug	12. Setscrew	17. O-ring	22. Capscrew
4. Bolt	8. O-ring Plug	13. Lock Ring	18. Backup Ring	

Figure 5-32. Jib Lift Cylinder (800AJ Only)

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

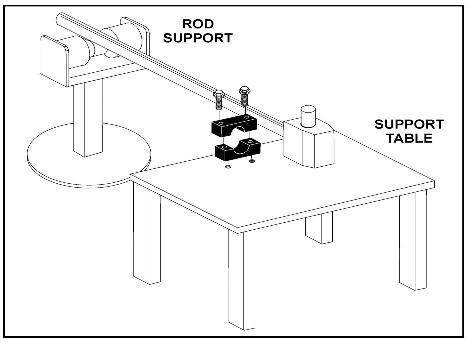


Figure 5-33. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

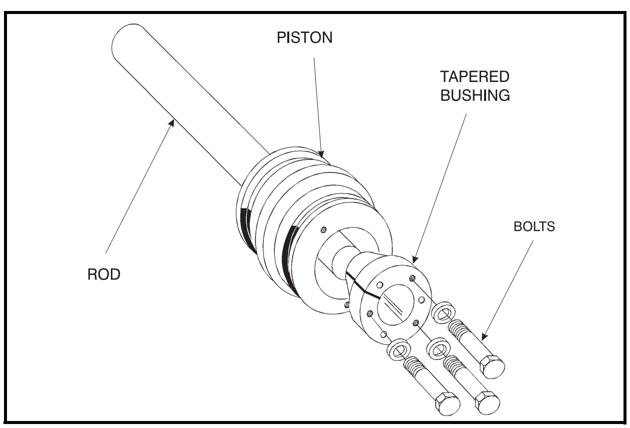


Figure 5-34. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

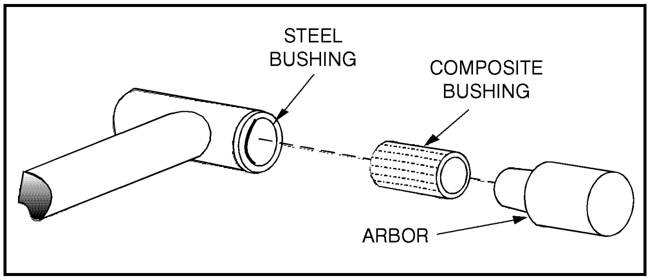


Figure 5-35. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

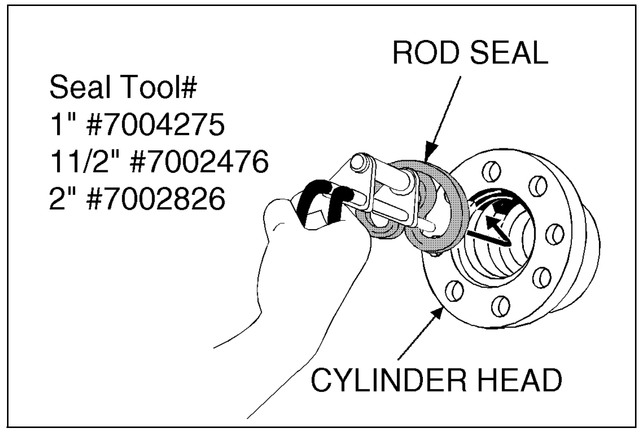


Figure 5-36. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

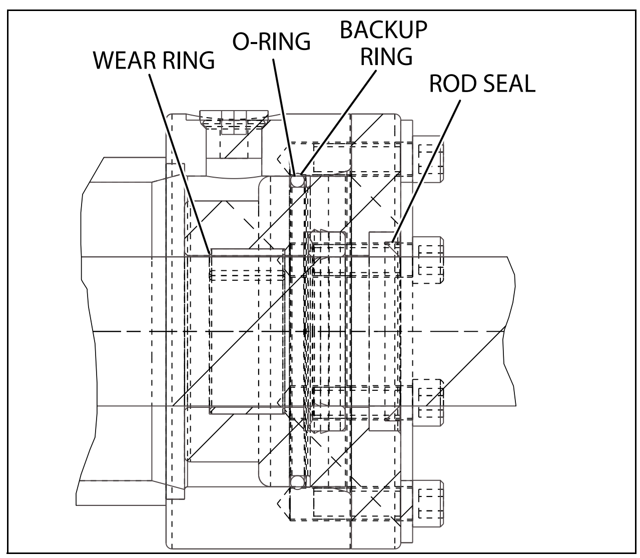
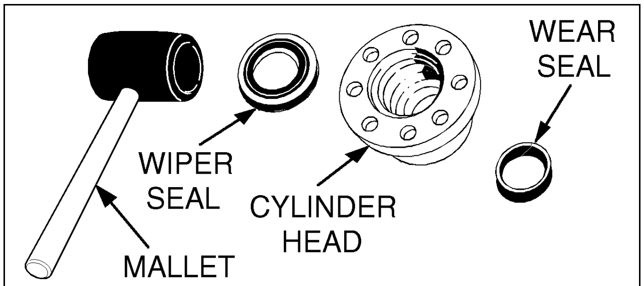


Figure 5-37. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-38. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

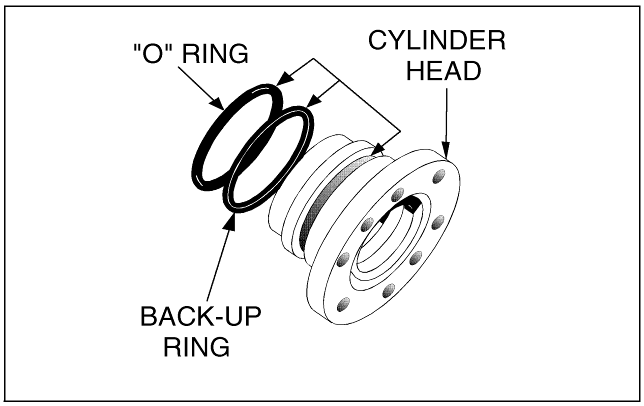


Figure 5-39. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. Place a new o-ring and back-up rings in the inner piston diameter groove.
7. Place new seals and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).
8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
9. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
10. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

11. Install the bolts in tapered bushing.
12. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

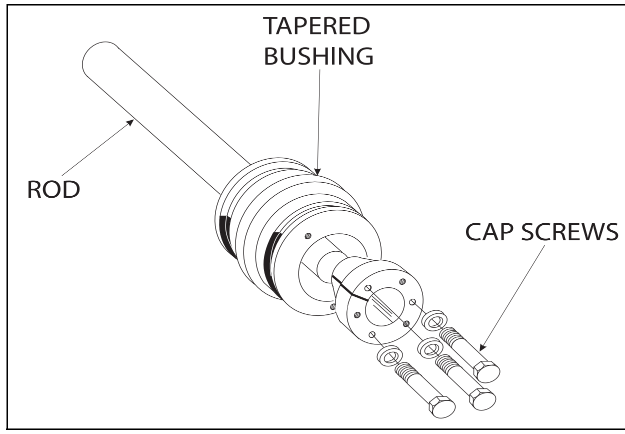


Figure 5-40. Tapered Bushing Installation

13. Tighten the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).
14. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews

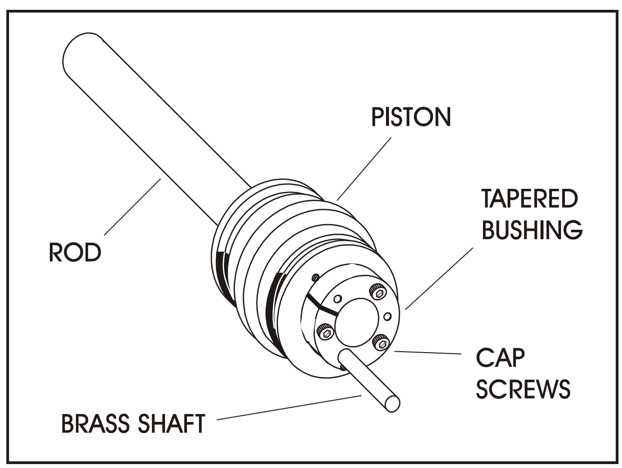


Figure 5-41. Seating the Tapered Bearing

15. Rotate the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

16. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

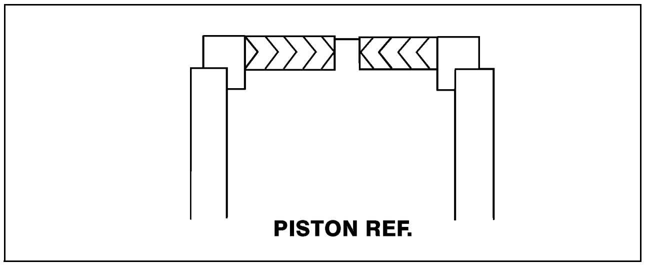


Figure 5-42. Hydrolock Piston Seal Installation

17. Place a new o-ring and back-up rings in the inner piston diameter groove.

18. Place new hydrolock seal and guidelock rings in the applicable outside diameter grooves of the cylinder piston. (See Figure 5-43., Piston Seal Kit Installation).

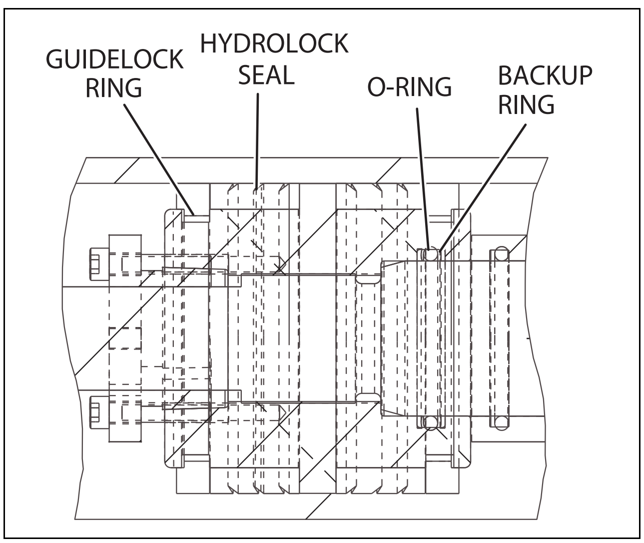


Figure 5-43. Piston Seal Kit Installation

19. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

20. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

21. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

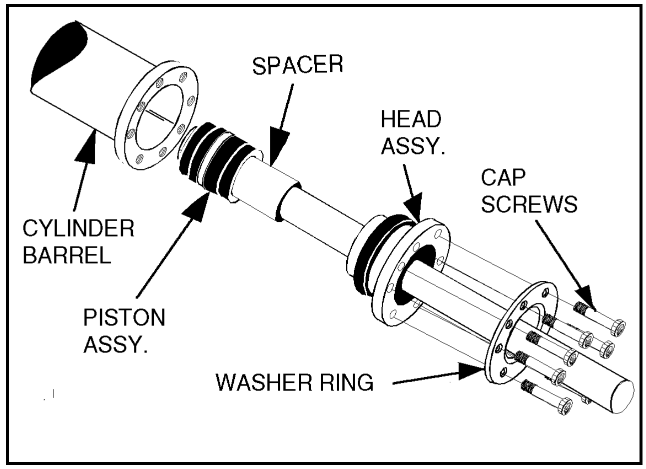


Figure 5-44. Rod Assembly Installation

22. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 20 ft.lbs. (27 Nm).

23. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

24. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Main Boom Lift Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

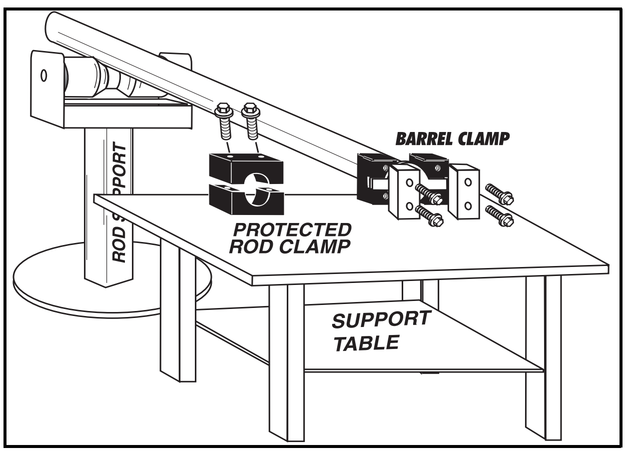


Figure 5-45. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

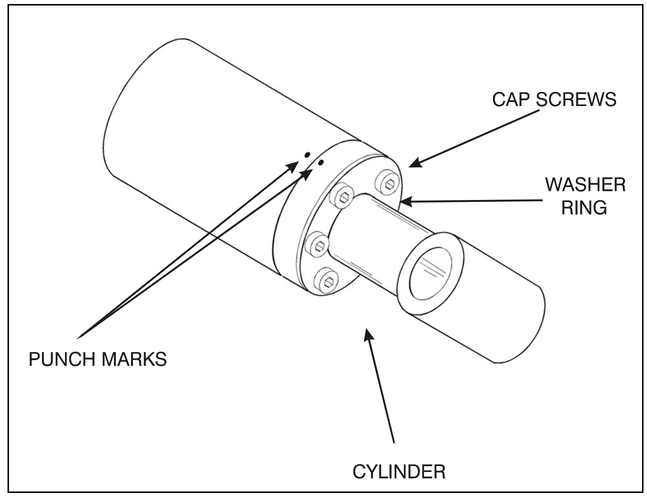
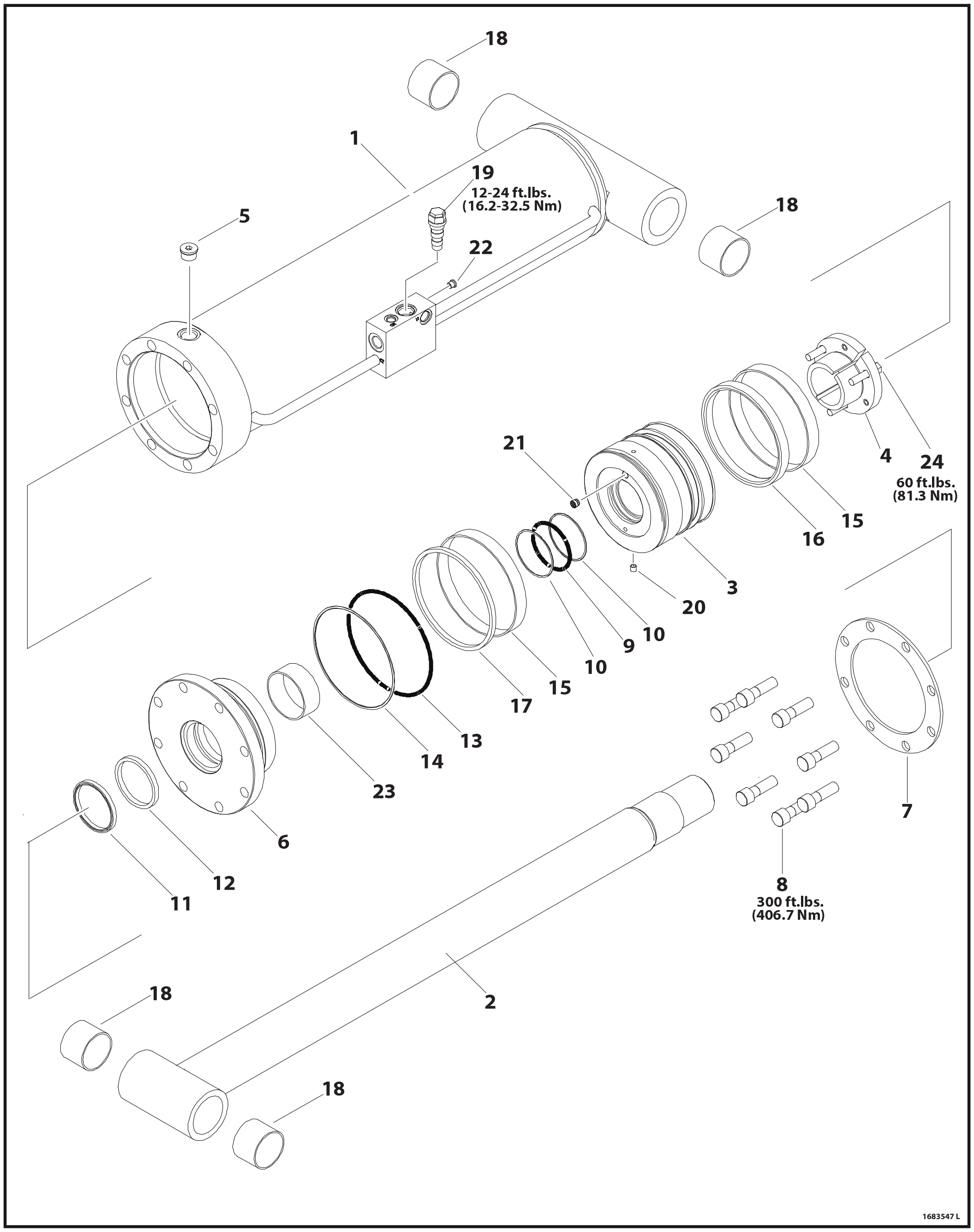


Figure 5-46. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Barrel	6. Head	11. Wiper	16. T-Seal	21. Check Valve
2. Rod	7. Ring Washer	12. Rod Seal	17. Seal	22. Plug
3. Piston	8. Bolt	13. O-ring	18. Bushing	23. Wear Ring
4. Tapered Bushing	9. O-ring	14. Backup Ring	19. Valve Cartridge	24. Bolt
5. O-ring Plug	10. Backup Ring	15. Wear Ring	20. Orifice	

Figure 5-47. Main Boom Lift Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

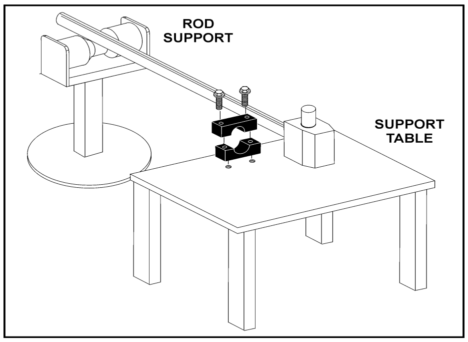


Figure 5-48. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

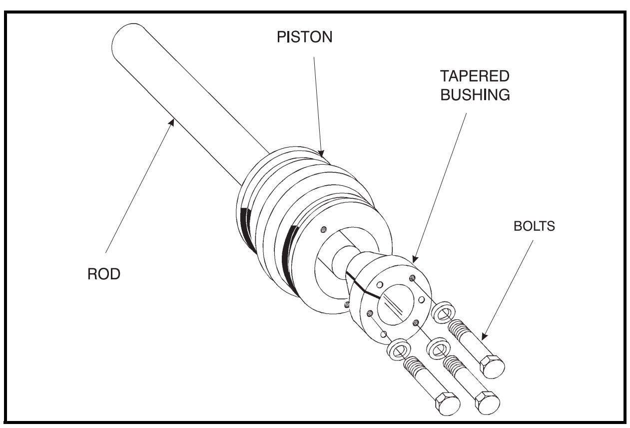


Figure 5-49. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

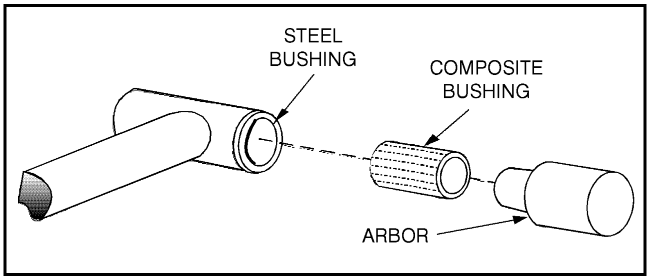


Figure 5-50. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

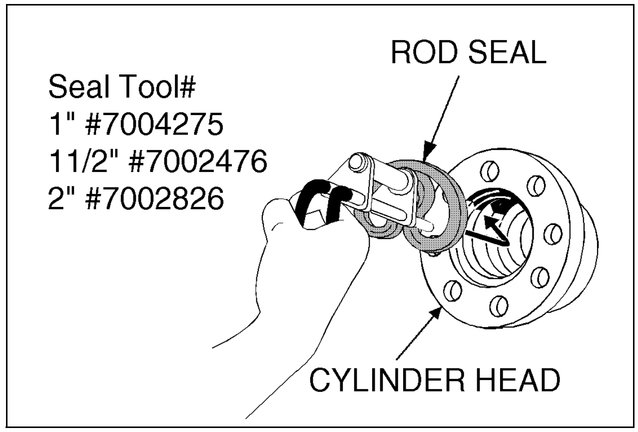


Figure 5-51. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

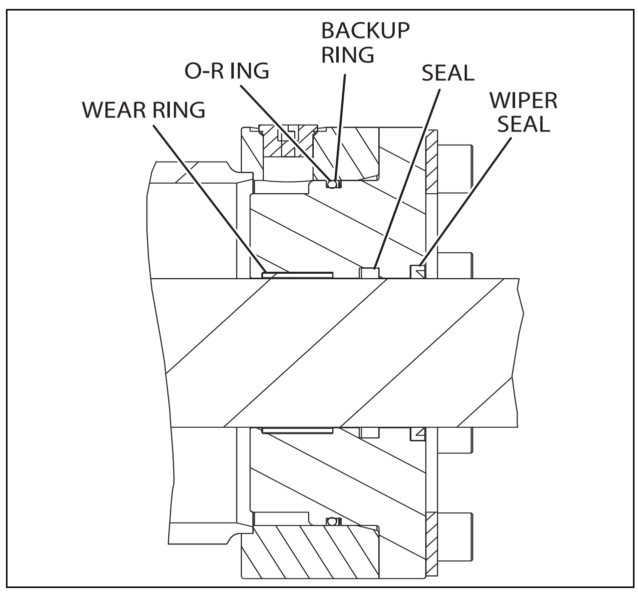
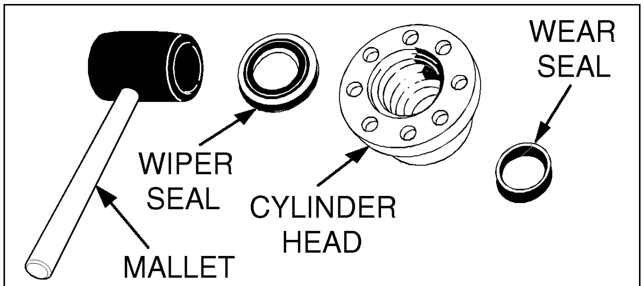


Figure 5-52. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-53. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

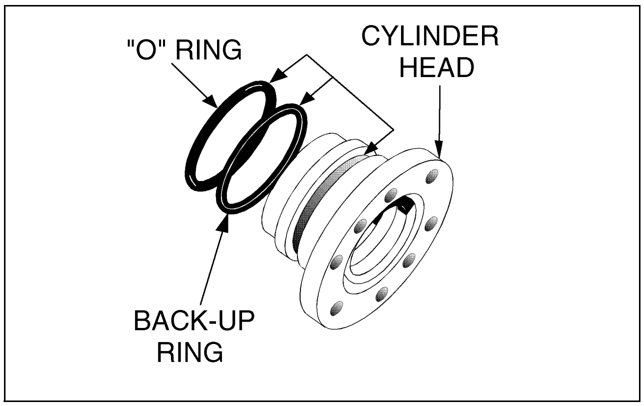


Figure 5-54. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Carefully thread the piston on the cylinder rod hand-tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

7. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

⚠ WARNING

WHEN REBUILDING THE MASTER, SLAVE, LOWER LIFT, UPPER LIFT, ARTICULATING FLY BOOM LIFT, UPRIGHT LEVEL, TOWER TELESCOPE, OR UPPER TELESCOPE CYLINDERS, APPLY JLG THREADLOCKER P/N 0100011 TO TAPERED BUSHING BOLTS, THEN TIGHTEN SECURELY. INSTALL THE BOLTS IN TAPERED BUSHING.

8. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

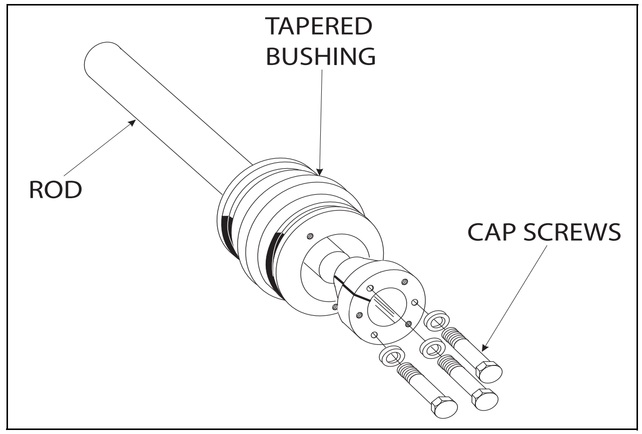


Figure 5-55. Tapered Bushing Installation

9. Tighten the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).

10. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

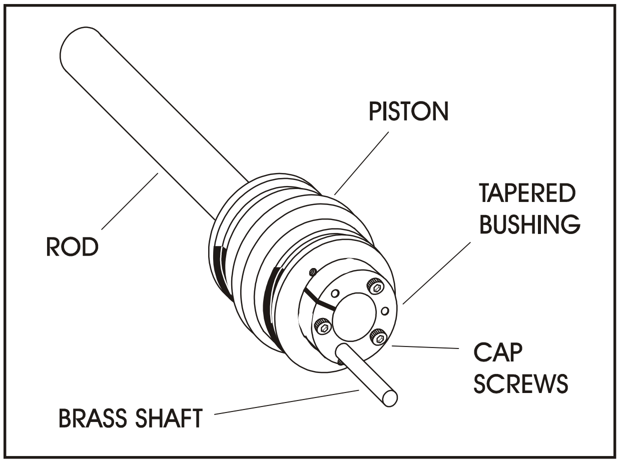


Figure 5-56. Seating the Tapered Bearing

11. Rotate the capscrews evenly and progressively in rotation to 60 ft.lbs. (81 Nm).
12. Remove the cylinder rod from the holding fixture.
13. Place a new ring washer and back-up rings in the inner piston diameter groove.
14. Place T-seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

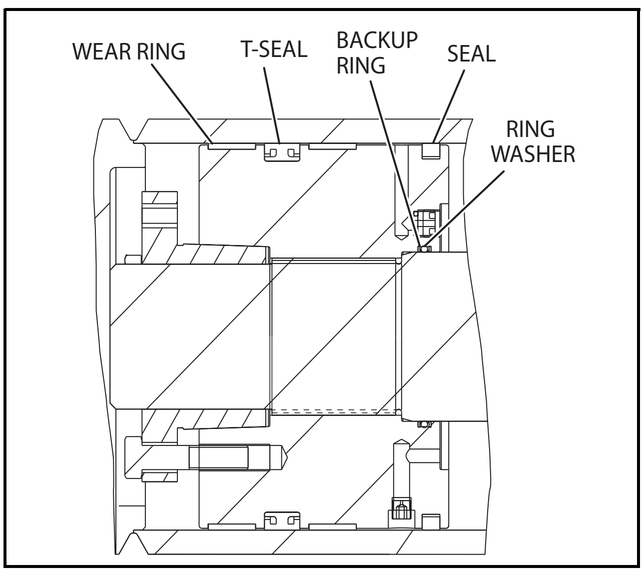


Figure 5-57. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

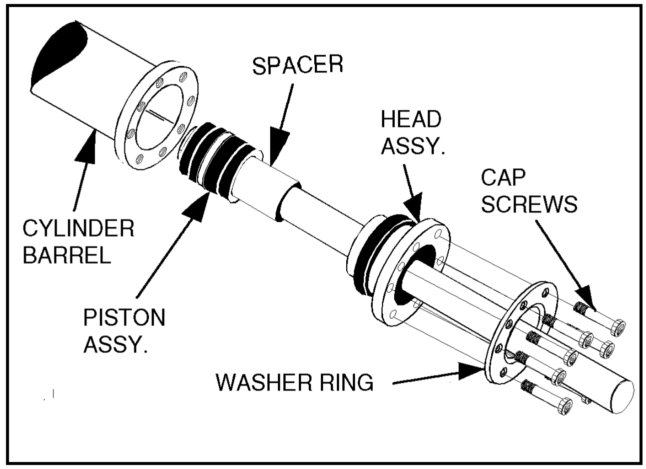


Figure 5-58. Rod Assembly Installation

18. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 300 ft.lbs. (406 Nm).
19. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Tower Lift Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

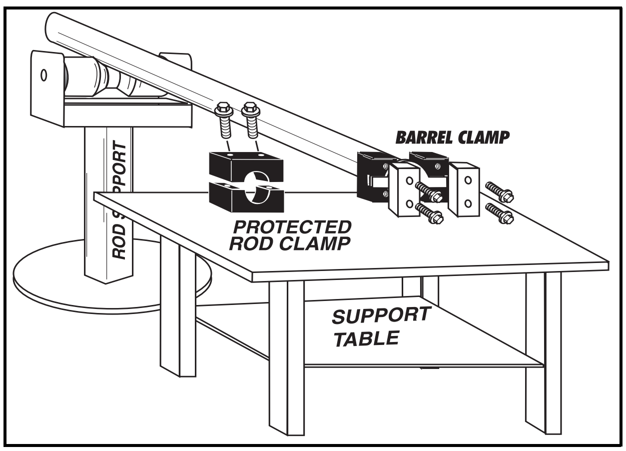


Figure 5-59. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

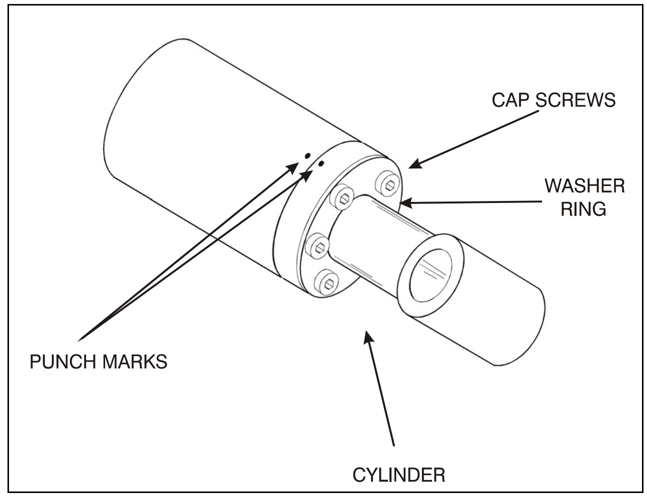
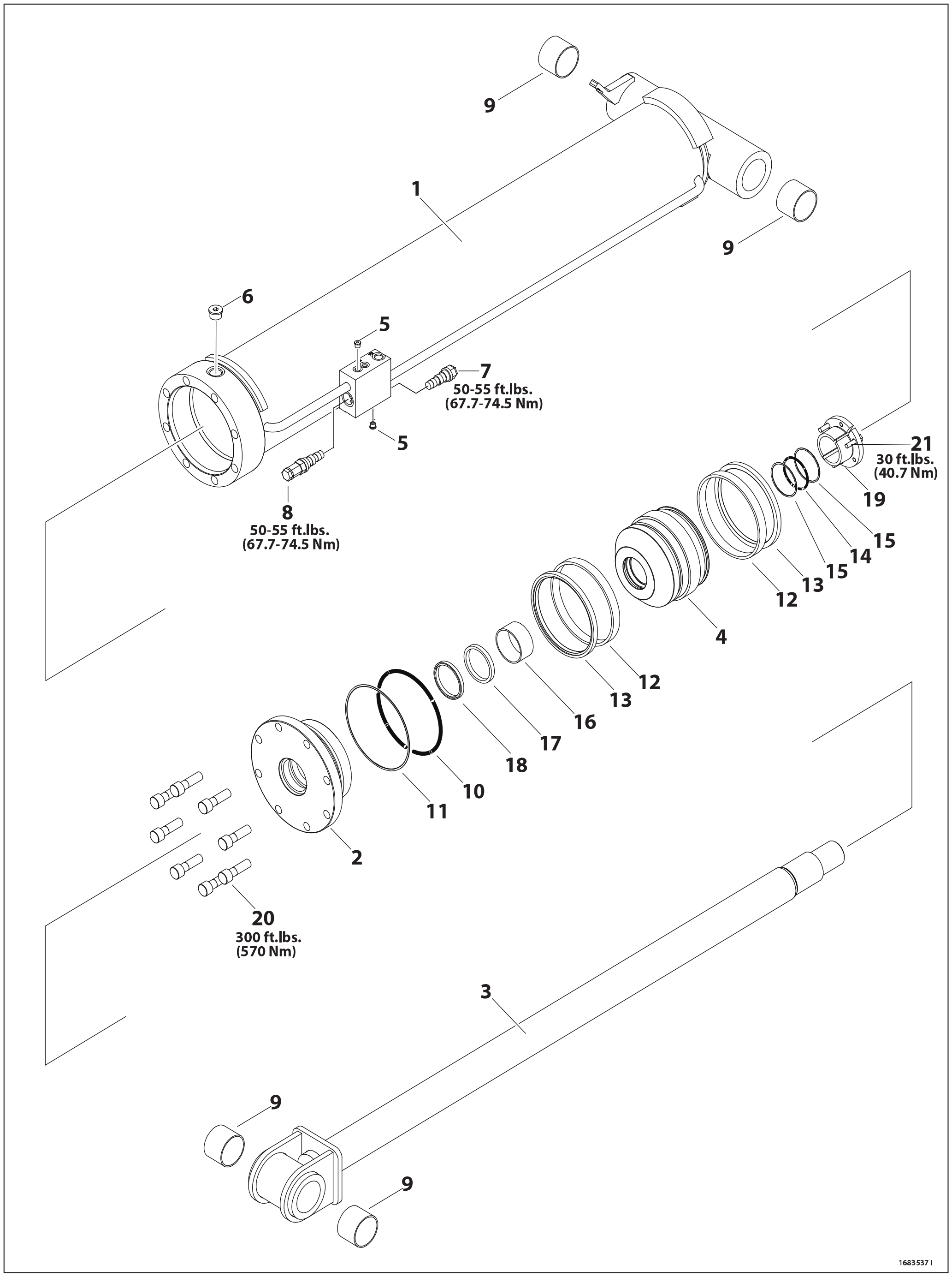


Figure 5-60. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Barrel
2. Head
3. Rod
4. Piston
5. O-ring Plug
6. O-ring Plug
7. Valve Cartridge
8. Valve Cartridge
9. Bushing
10. O-ring
11. Lock Ring
12. Seal
13. Lock Ring
14. O-ring
15. Backup Ring
16. Wear Ring
17. Seal
18. Wiper
19. Tapered Bushing
20. Capscrew
21. Bolt

Figure 5-61. Tower Lift Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

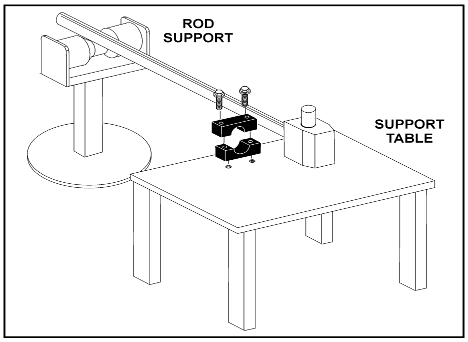


Figure 5-62. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

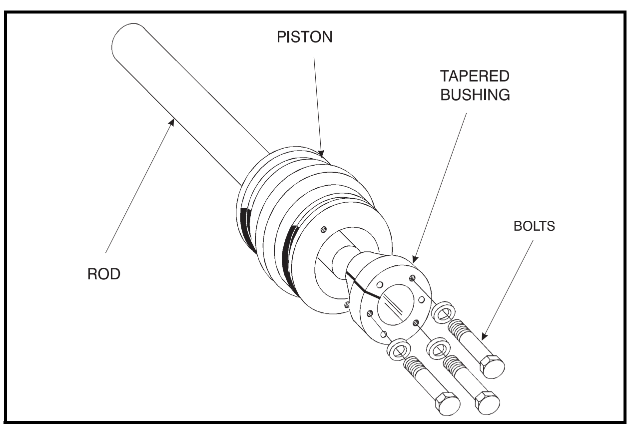


Figure 5-63. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

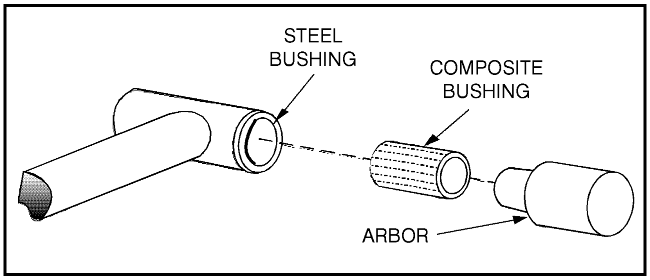


Figure 5-64. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

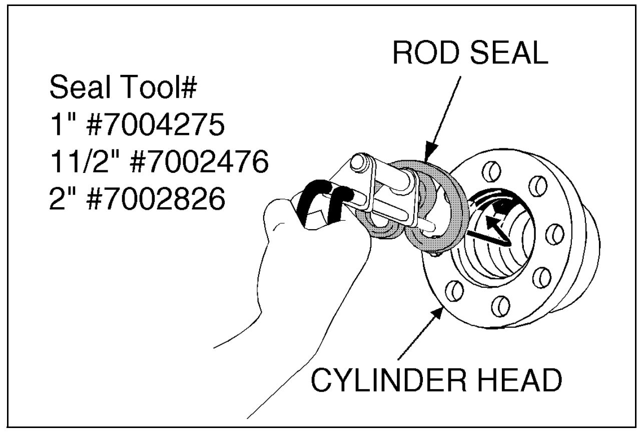


Figure 5-65. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

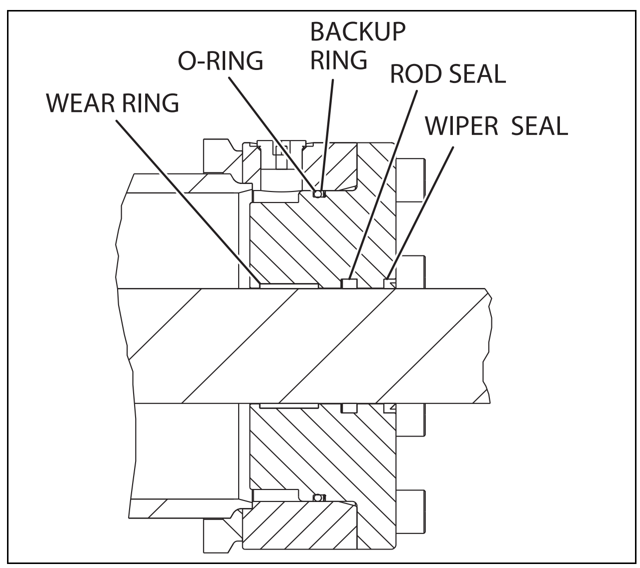
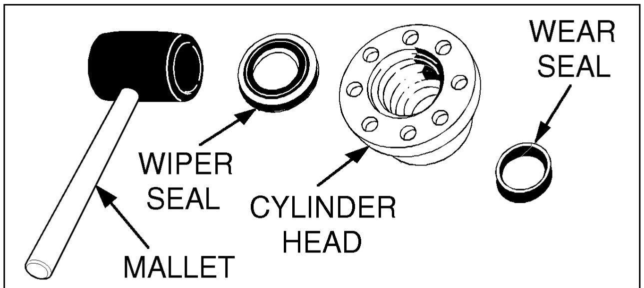


Figure 5-66. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-67. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

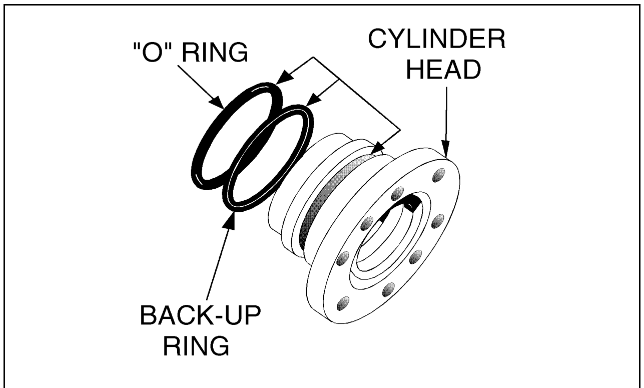


Figure 5-68. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

5. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

6. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

7. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

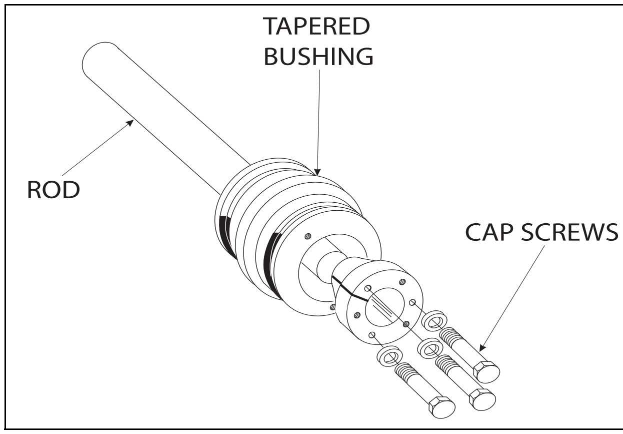


Figure 5-69. Tapered Bushing Installation

8. Tighten the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

9. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

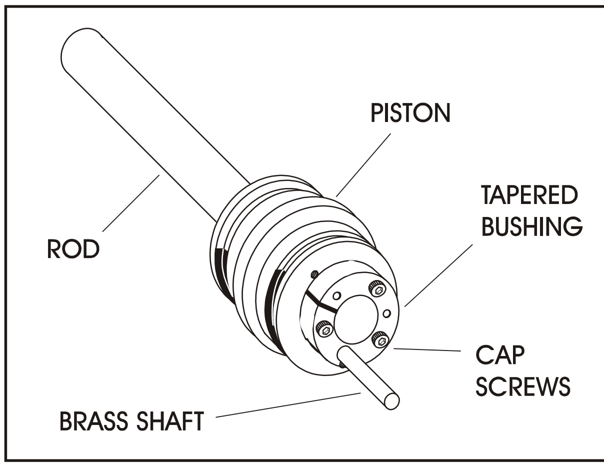


Figure 5-70. Seating the Tapered Bearing

10. Rotate the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

11. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

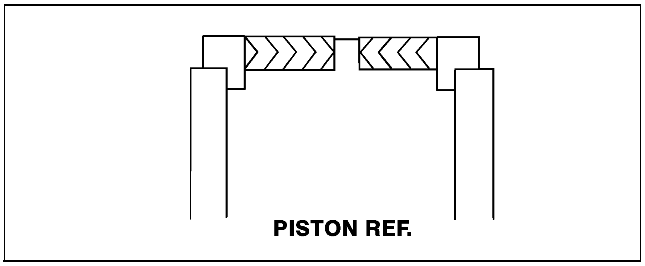


Figure 5-71. Hydrolock Piston Seal Installation

12. Place a new o-ring and back-up rings in the inner piston diameter groove.

13. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

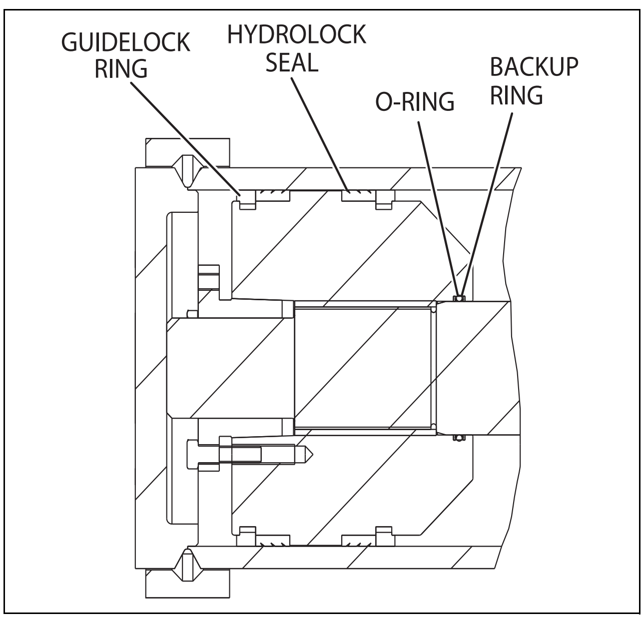


Figure 5-72. Piston Seal Kit Installation

14. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

15. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

16. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

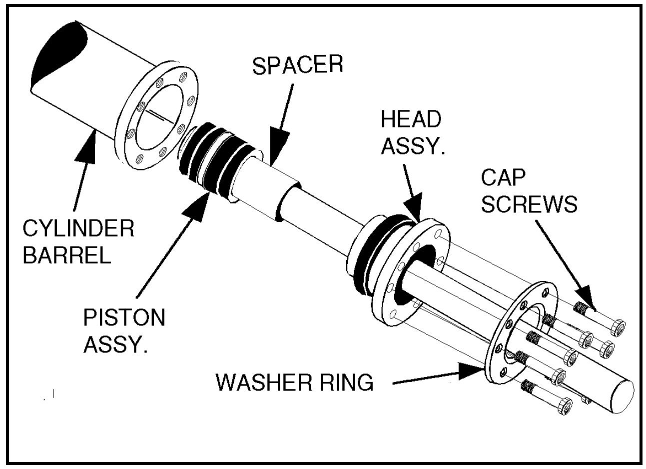


Figure 5-73. Rod Assembly Installation

17. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 300 ft.lbs. (406 Nm).

18. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

19. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Master Cylinder - 800A

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

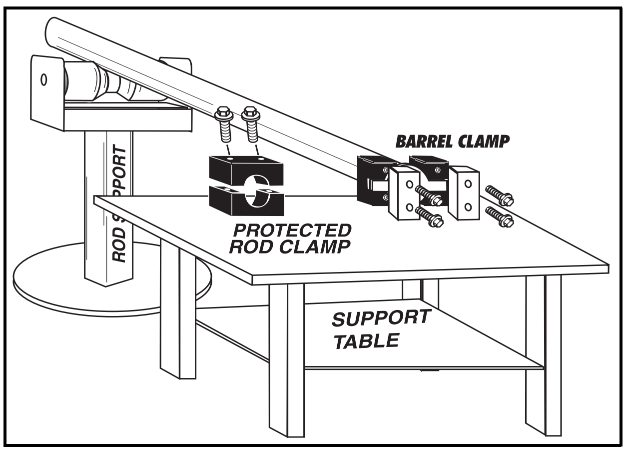


Figure 5-74. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

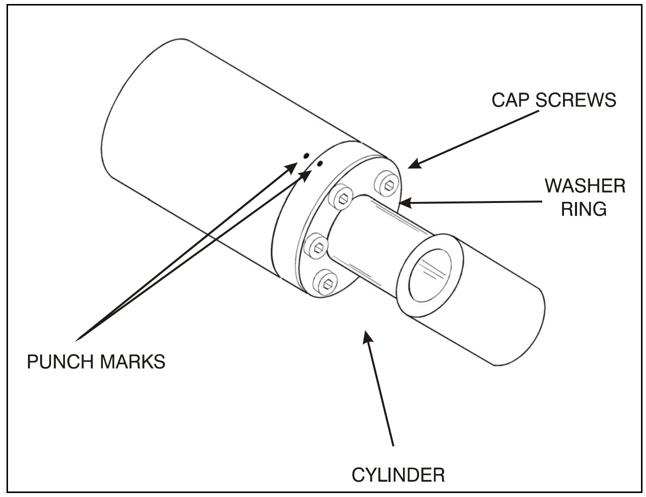
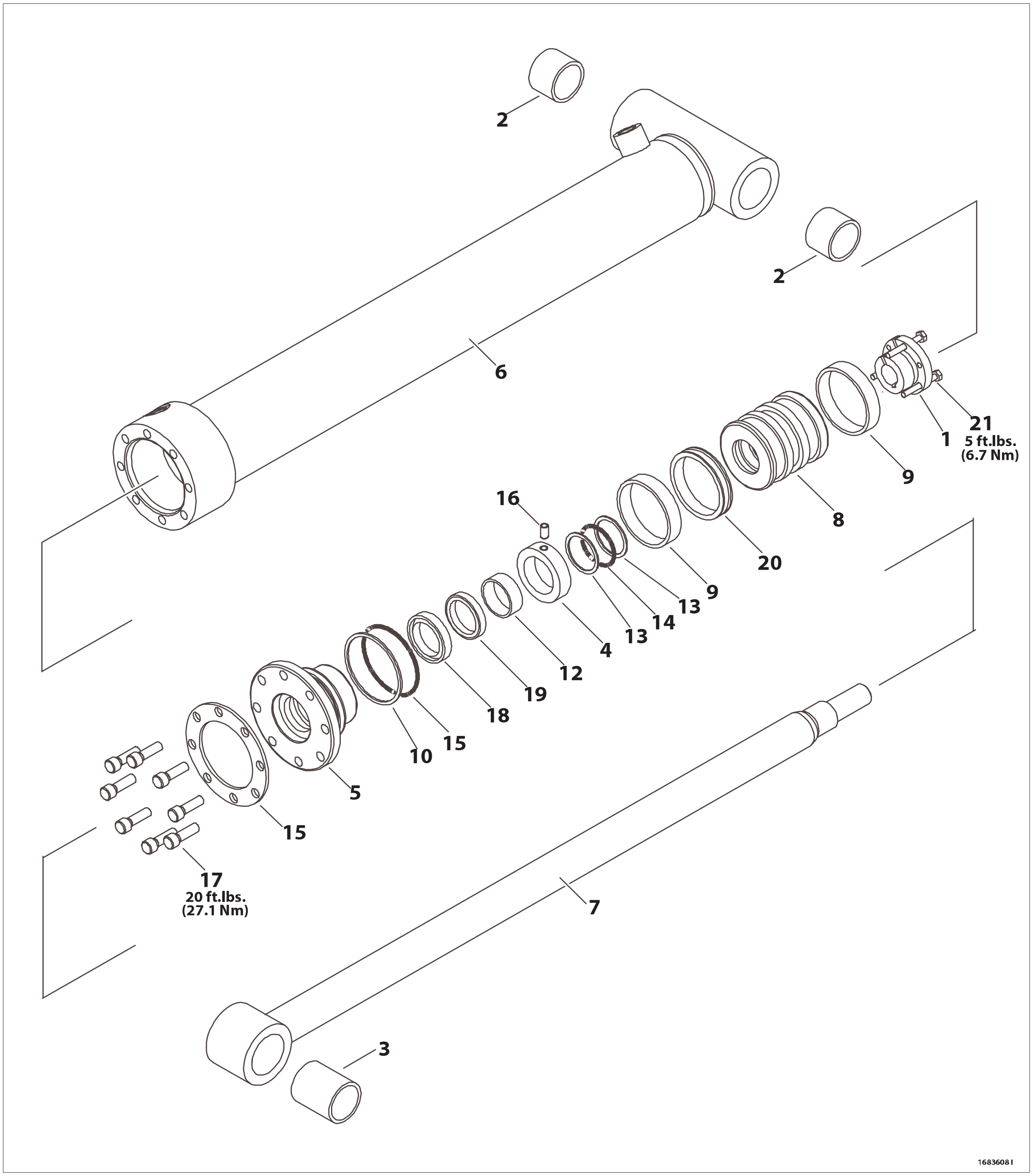


Figure 5-75. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Tapered Bushing	6. Barrel	10. Backup Ring	14. O-ring	18. Wiper
2. Bushing	7. Rod	11. Washer Ring	15. O-ring	19. Seal
3. Bushing	8. Piston	12. Wear Ring	16. Setscrew	20. T-Seal
4. Tube Spacer	9. Wear Ring	13. Backup Ring	17. Capscrew	21. Capscrew
5. Head				

Figure 5-76. Master Cylinder - 800A

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

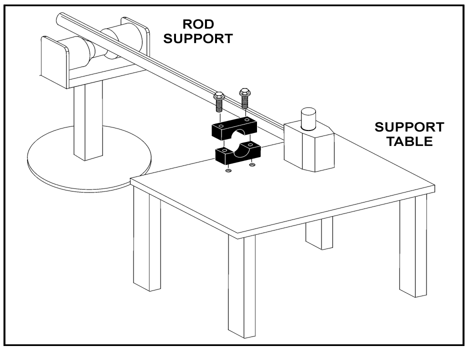


Figure 5-77. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

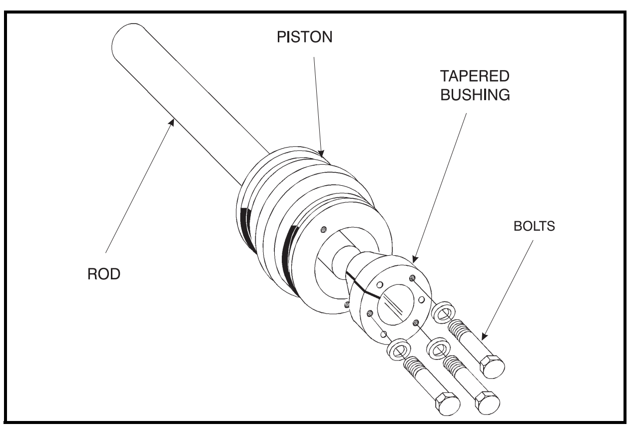


Figure 5-78. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

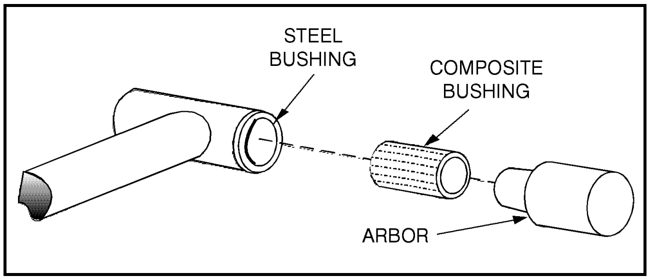


Figure 5-79. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

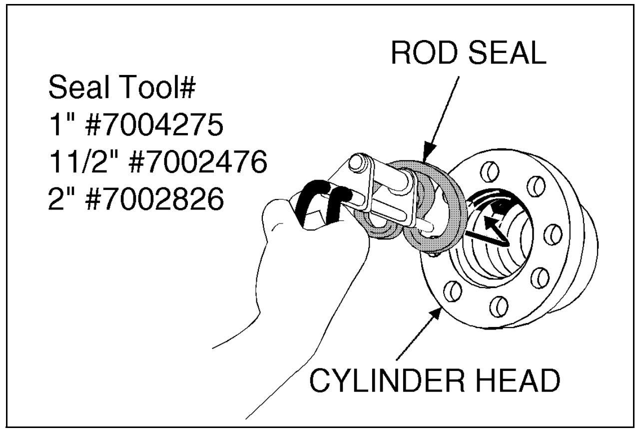


Figure 5-80. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

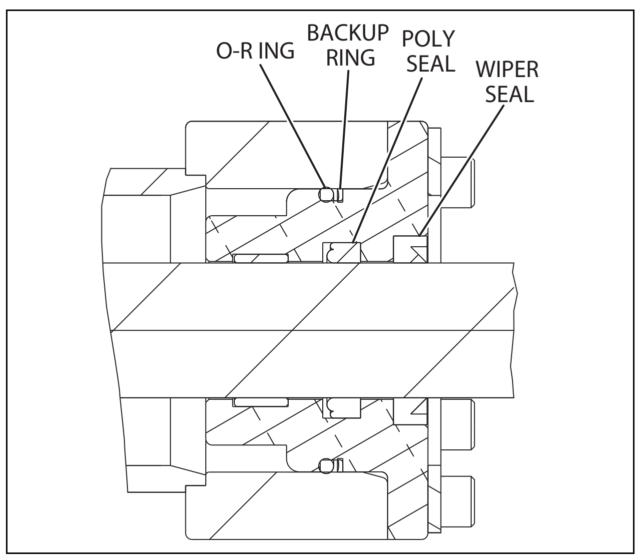
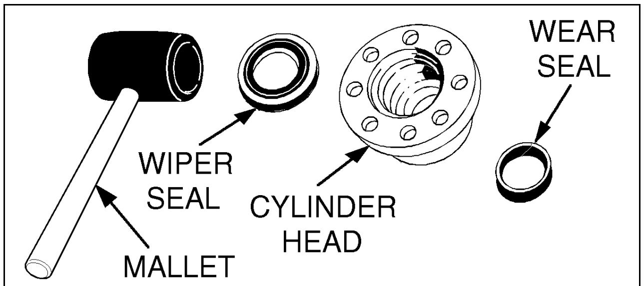


Figure 5-81. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-82. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

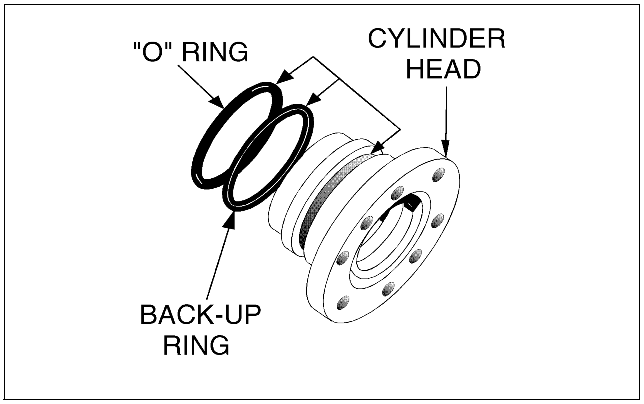


Figure 5-83. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

5. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

6. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

7. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

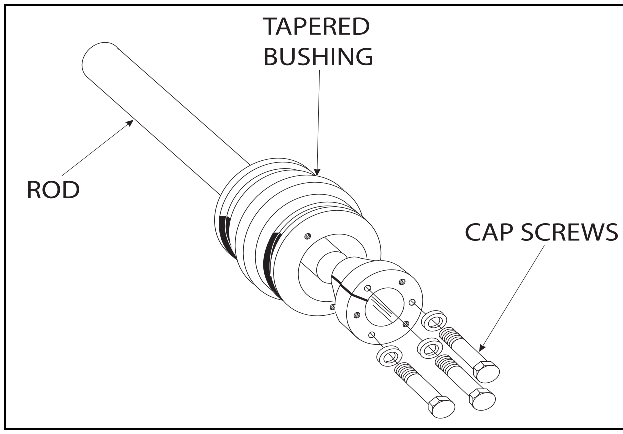


Figure 5-84. Tapered Bushing Installation

8. Tighten the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

9. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

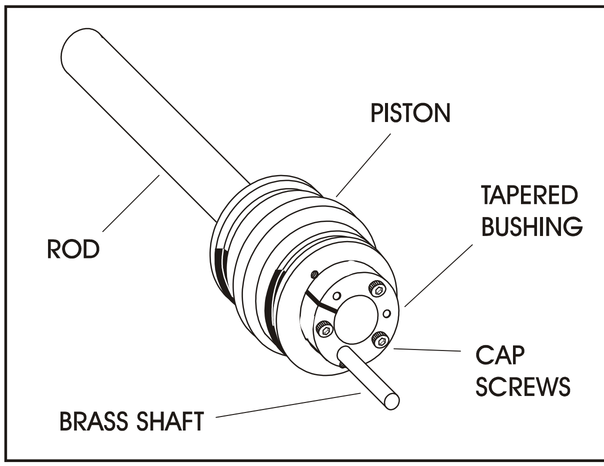


Figure 5-85. Seating the Tapered Bearing

10. Rotate the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

11. Remove the cylinder rod from the holding fixture.

12. Place a new o-ring and back-up rings in the inner piston diameter groove.

13. Place T-seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

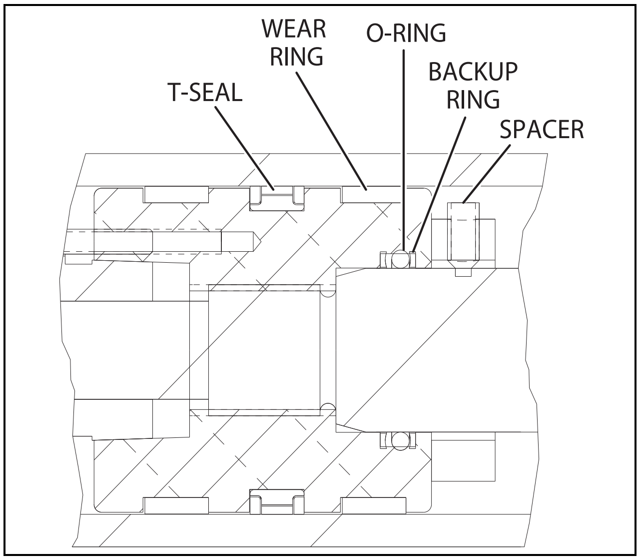


Figure 5-86. Piston Seal Kit Installation

14. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

15. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

16. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

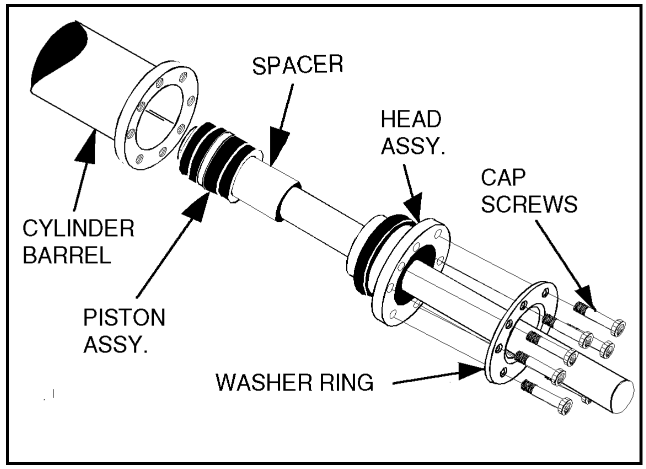


Figure 5-87. Rod Assembly Installation

17. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 20 ft.lbs. (27 Nm).

18. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

19. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Master Cylinder - 800 AJ

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

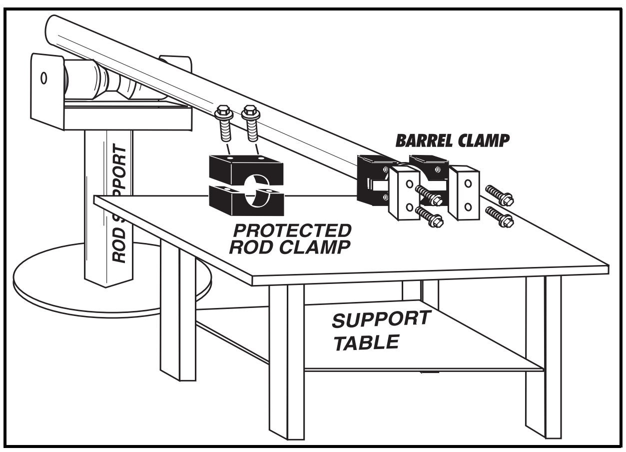


Figure 5-88. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

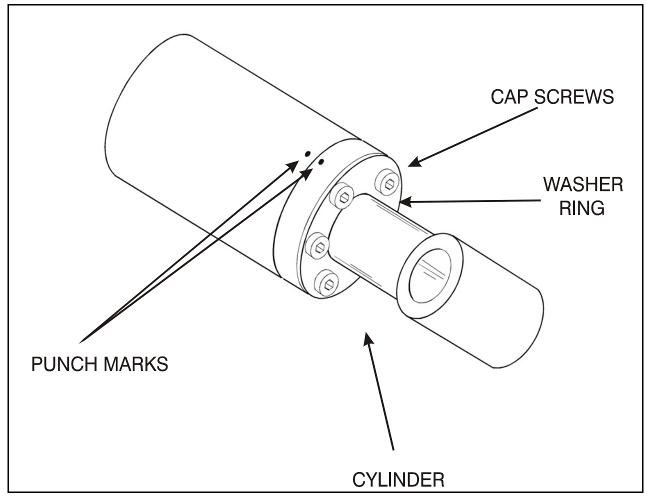
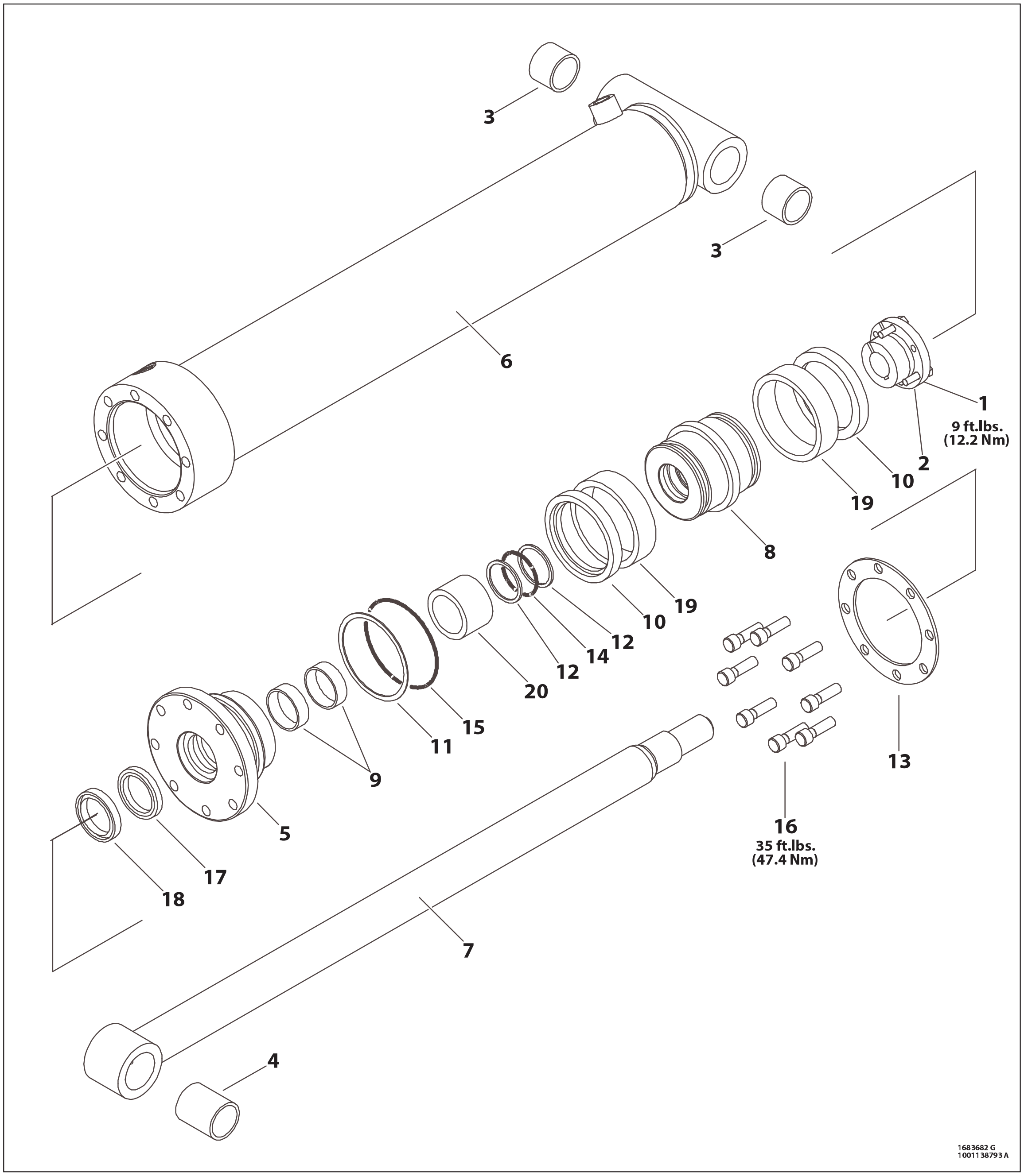


Figure 5-89. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Capscrew	6. Barrel	11. Backup Ring	16. Capscrew
2. Tapered Bushing	7. Rod	12. Backup Ring	17. Rod Seal
3. Bushing	8. Piston	13. Washer Ring	18. Wiper
4. Bushing	9. Wear Ring	14. O-ring	19. Seal
5. Head	10. Lock Ring	15. O-ring	20. Tube Spacer

Figure 5-90. Master Cylinder - 800AJ

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

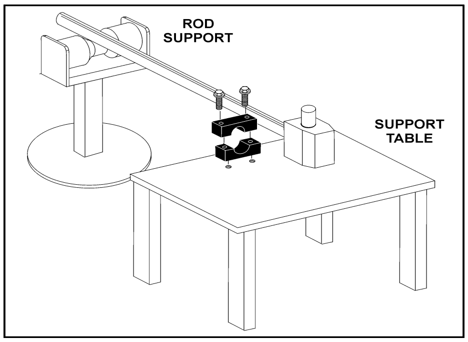


Figure 5-91. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

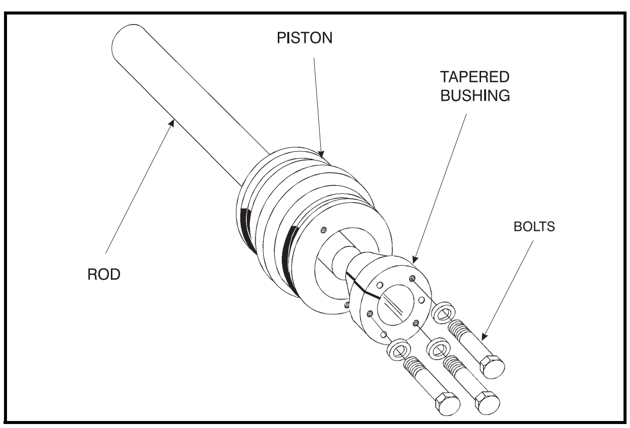


Figure 5-92. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

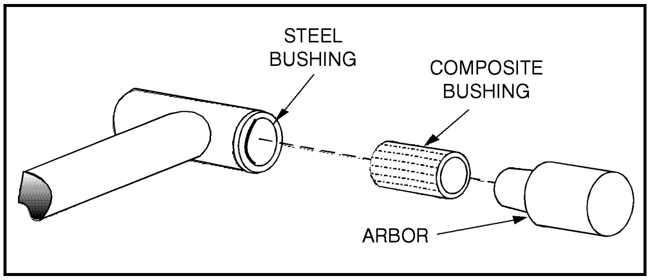


Figure 5-93. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

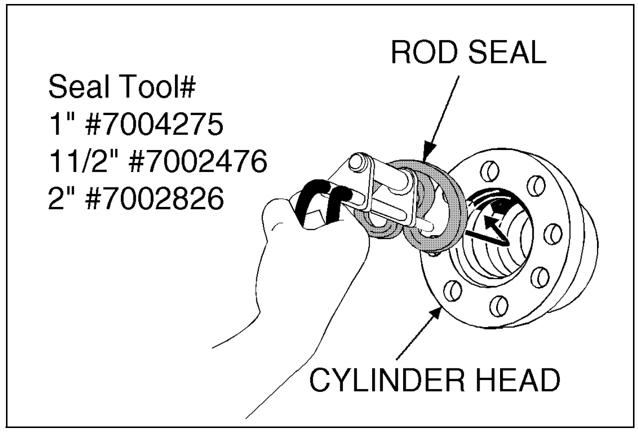


Figure 5-94. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

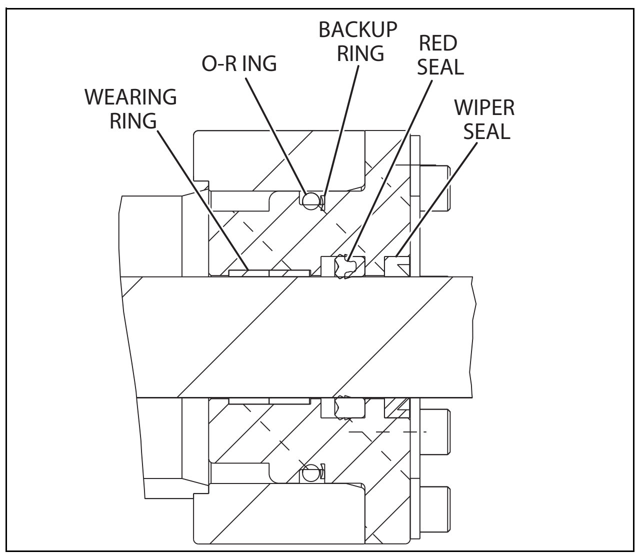
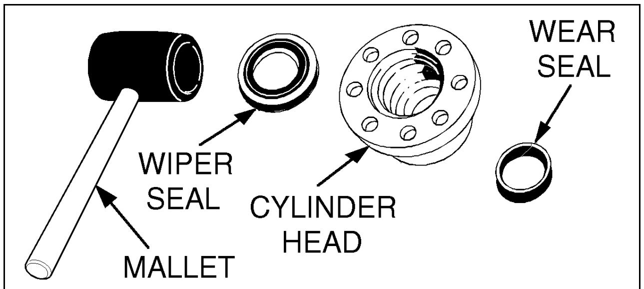


Figure 5-95. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-96. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

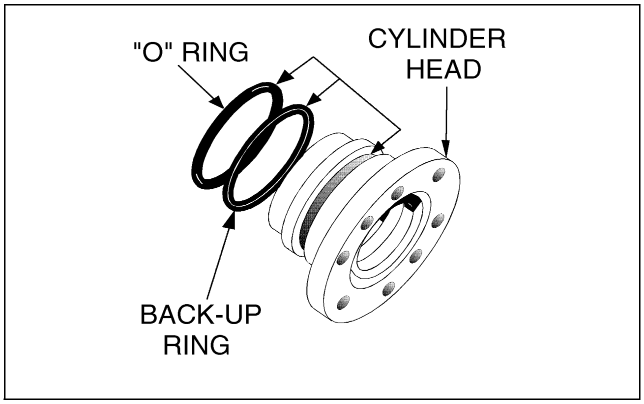


Figure 5-97. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

7. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

8. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

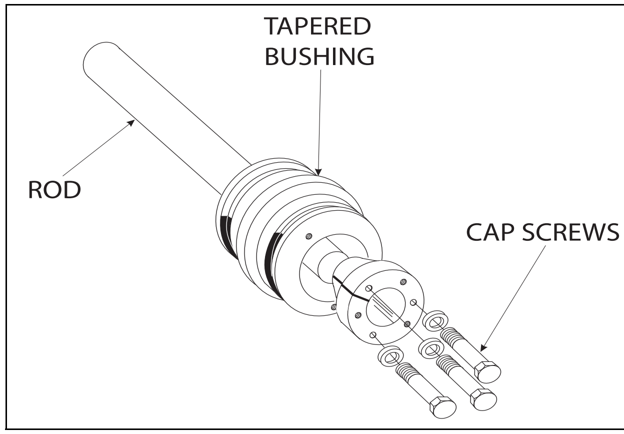


Figure 5-98. Tapered Bushing Installation

9. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

10. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

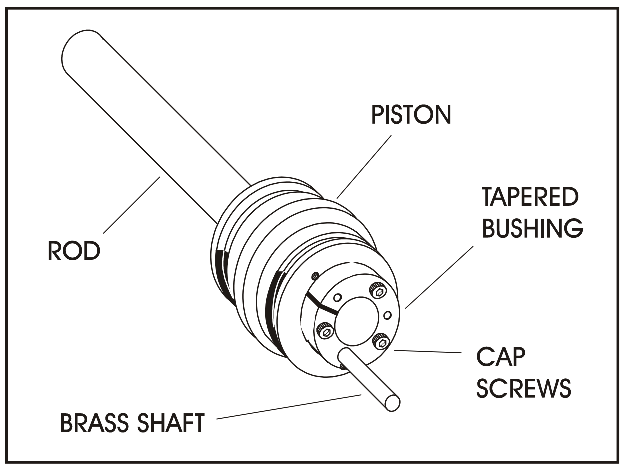


Figure 5-99. Seating the Tapered Bearing

11. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

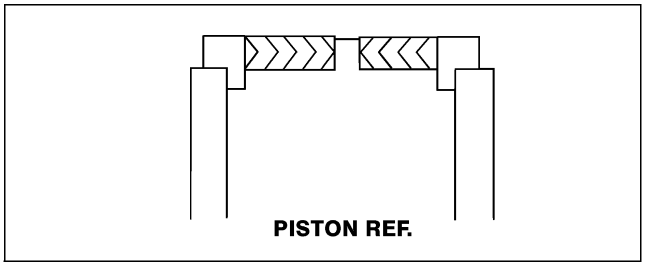


Figure 5-100. Hydrolock Piston Seal Installation

13. Place a new o-ring and back-up rings in the inner piston diameter groove.

14. Place new hydrolock seals and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

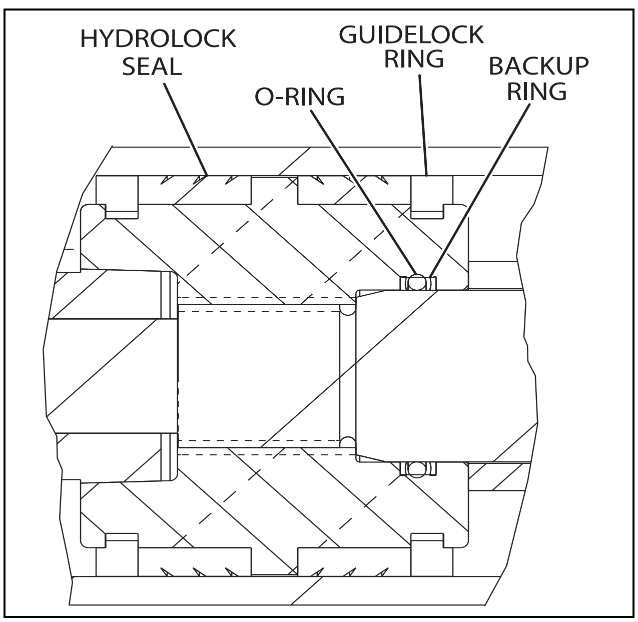


Figure 5-101. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

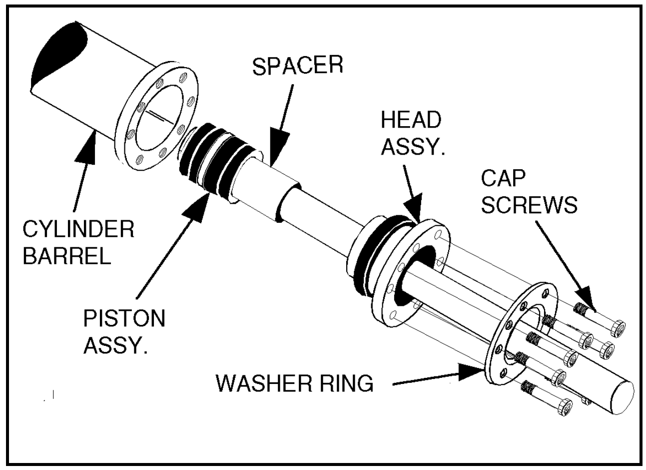


Figure 5-102. Rod Assembly Installation

18. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (47 Nm).

19. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Slave Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

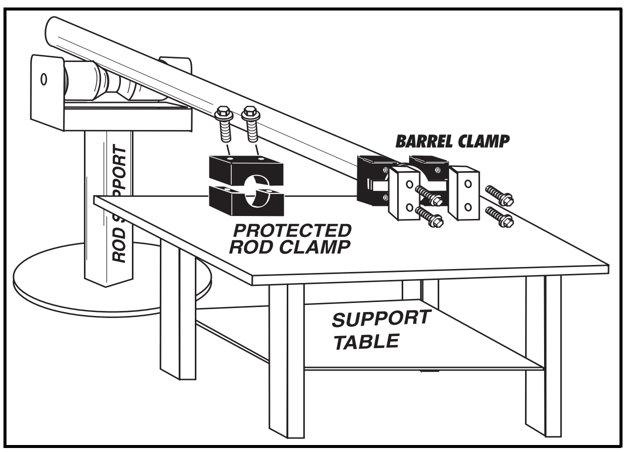


Figure 5-103. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

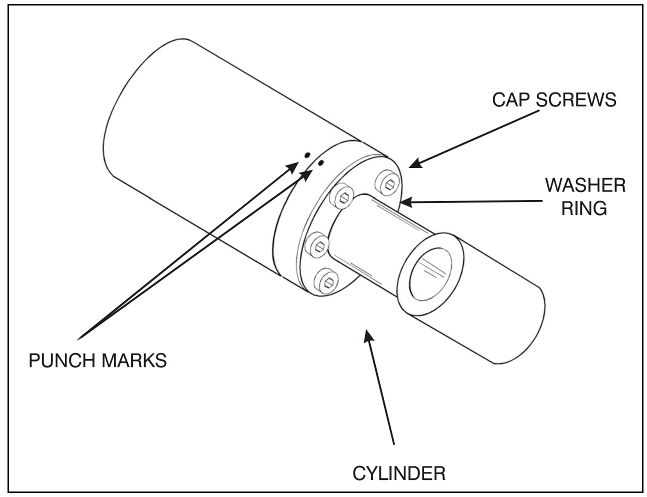
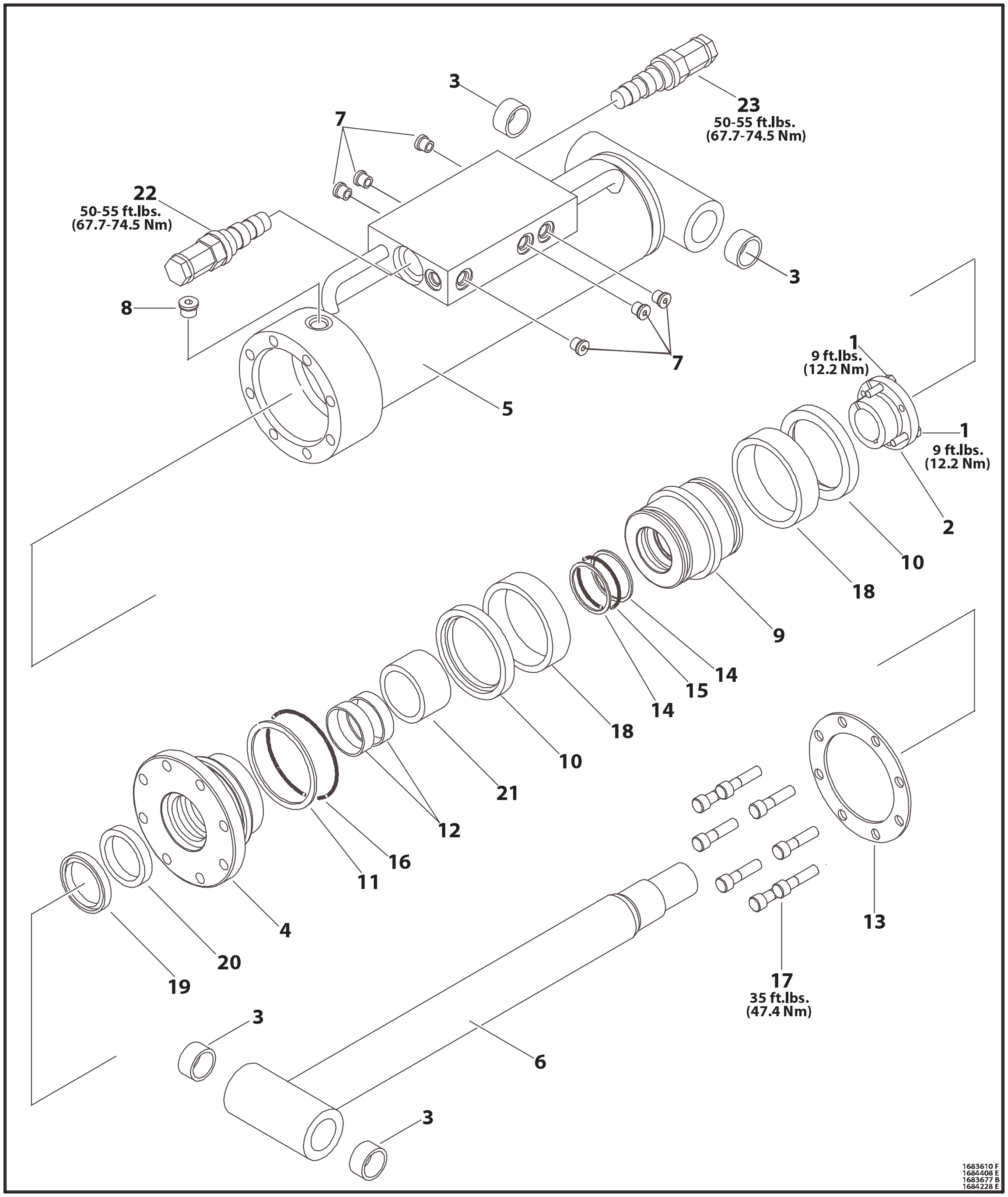


Figure 5-104. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Capscrew	6. Rod	11. Backup Ring	16. O-ring	21. Tube Spacer
2. Tapered Bushing	7. Plug	12. Wear Ring	17. Capscrew	22. Cartridge Valve
3. Bushing	8. Plug	13. Washer Ring	18. Seal	23. Cartridge Valve
4. Head	9. Piston	14. Backup Ring	19. Wiper	
5. Barrel	10. Lock Ring	15. O-ring	20. Seal	

Figure 5-105. Slave Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

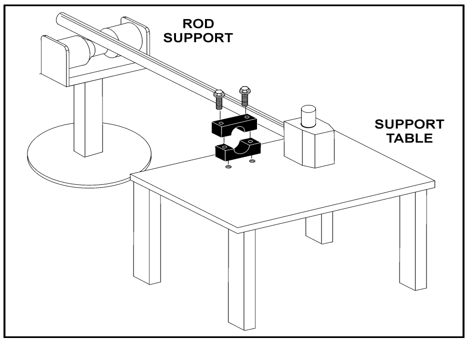


Figure 5-106. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

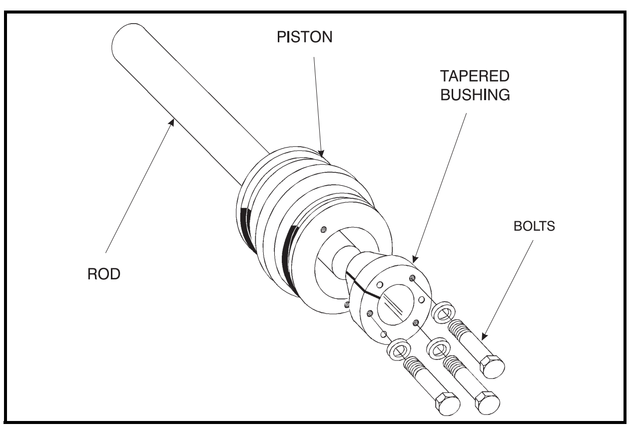


Figure 5-107. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

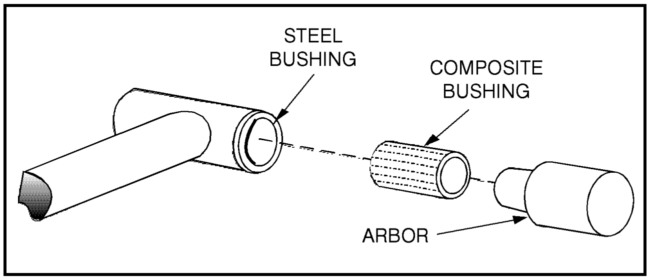


Figure 5-108. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

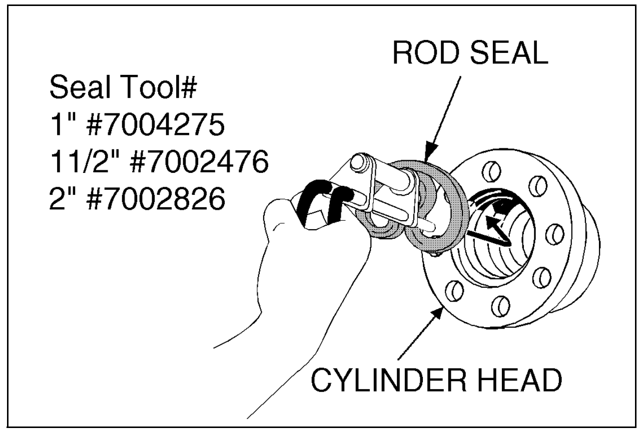


Figure 5-109. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

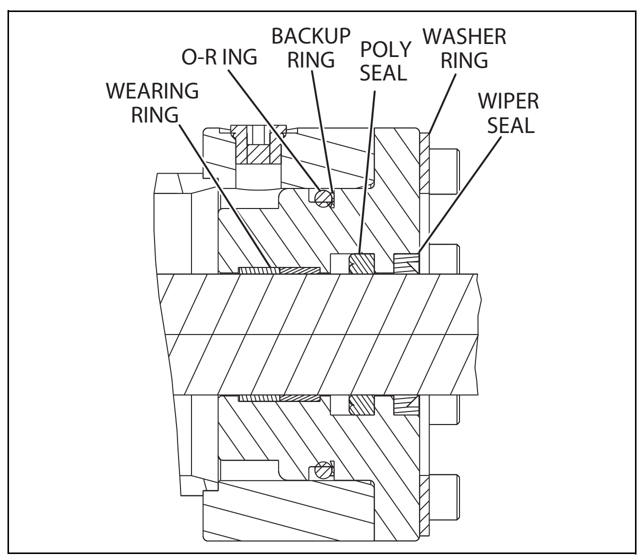
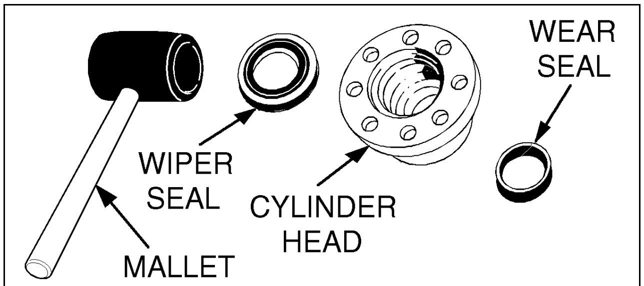


Figure 5-110. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-111. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

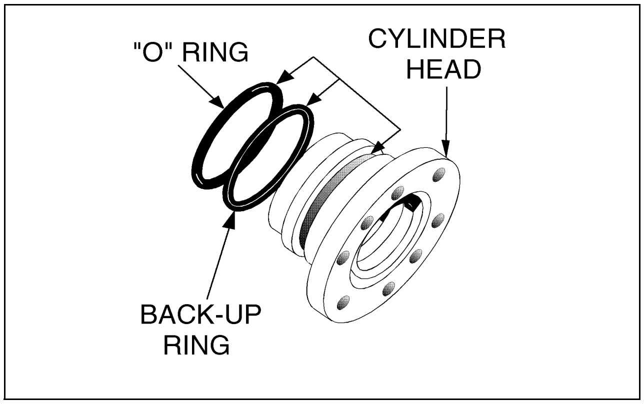


Figure 5-112. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
7. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

8. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

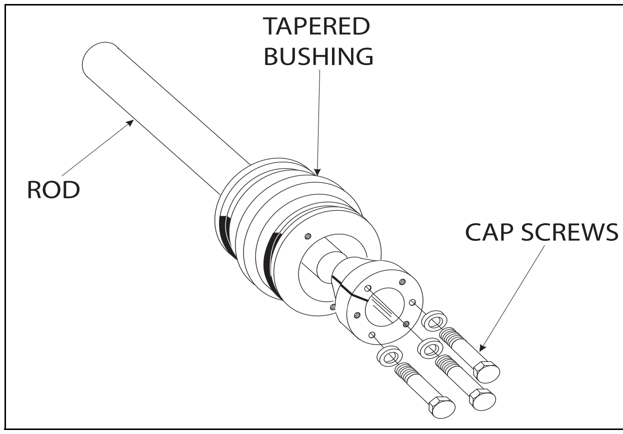


Figure 5-113. Tapered Bushing Installation

9. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).
10. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

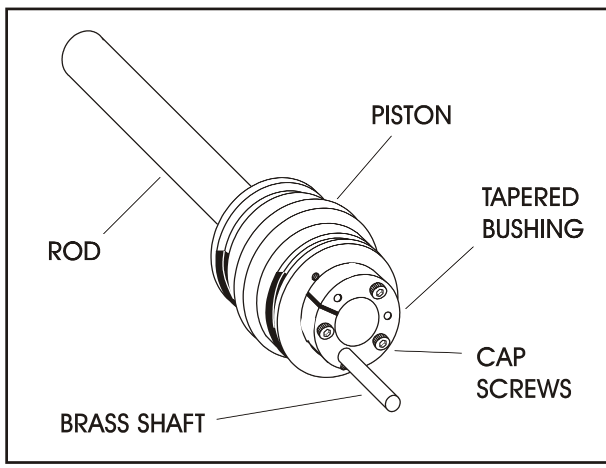


Figure 5-114. Seating the Tapered Bearing

11. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

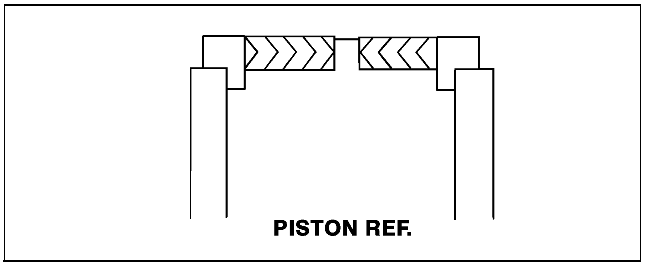


Figure 5-115. Hydrolock Piston Seal Installation

13. Place a new o-ring and back-up rings in the inner piston diameter groove.

14. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

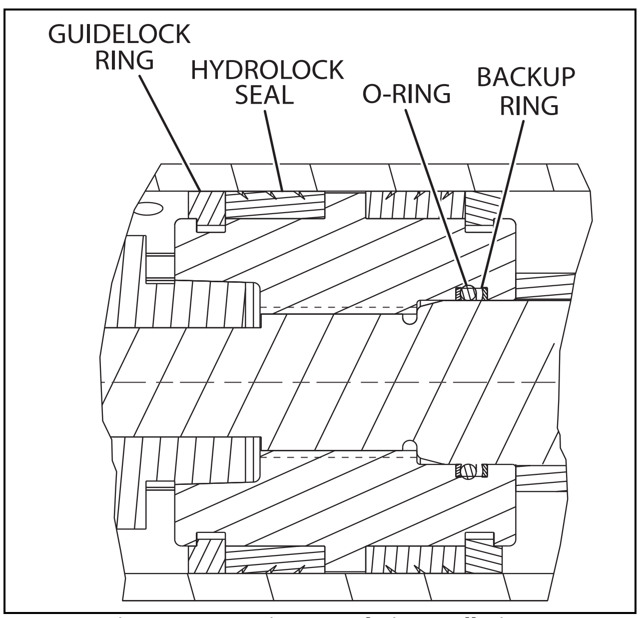


Figure 5-116. Piston Seal Kit Installation

15. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

16. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

17. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

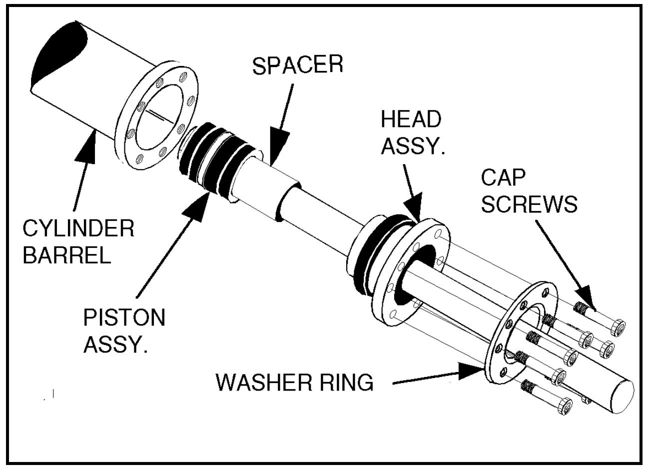


Figure 5-117. Rod Assembly Installation

18. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (47 Nm).

19. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

20. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Steer Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

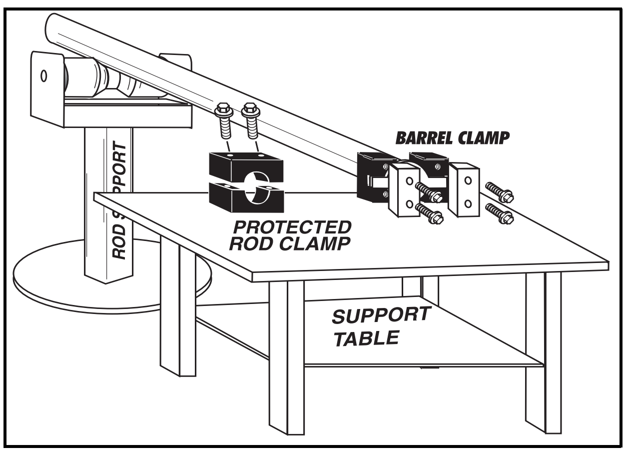


Figure 5-118. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

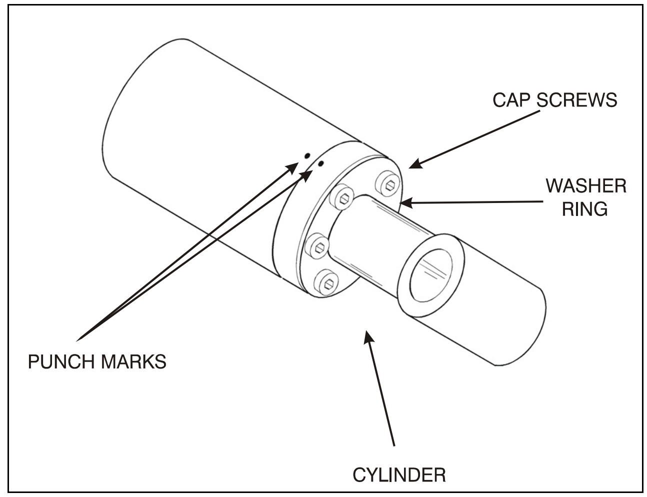
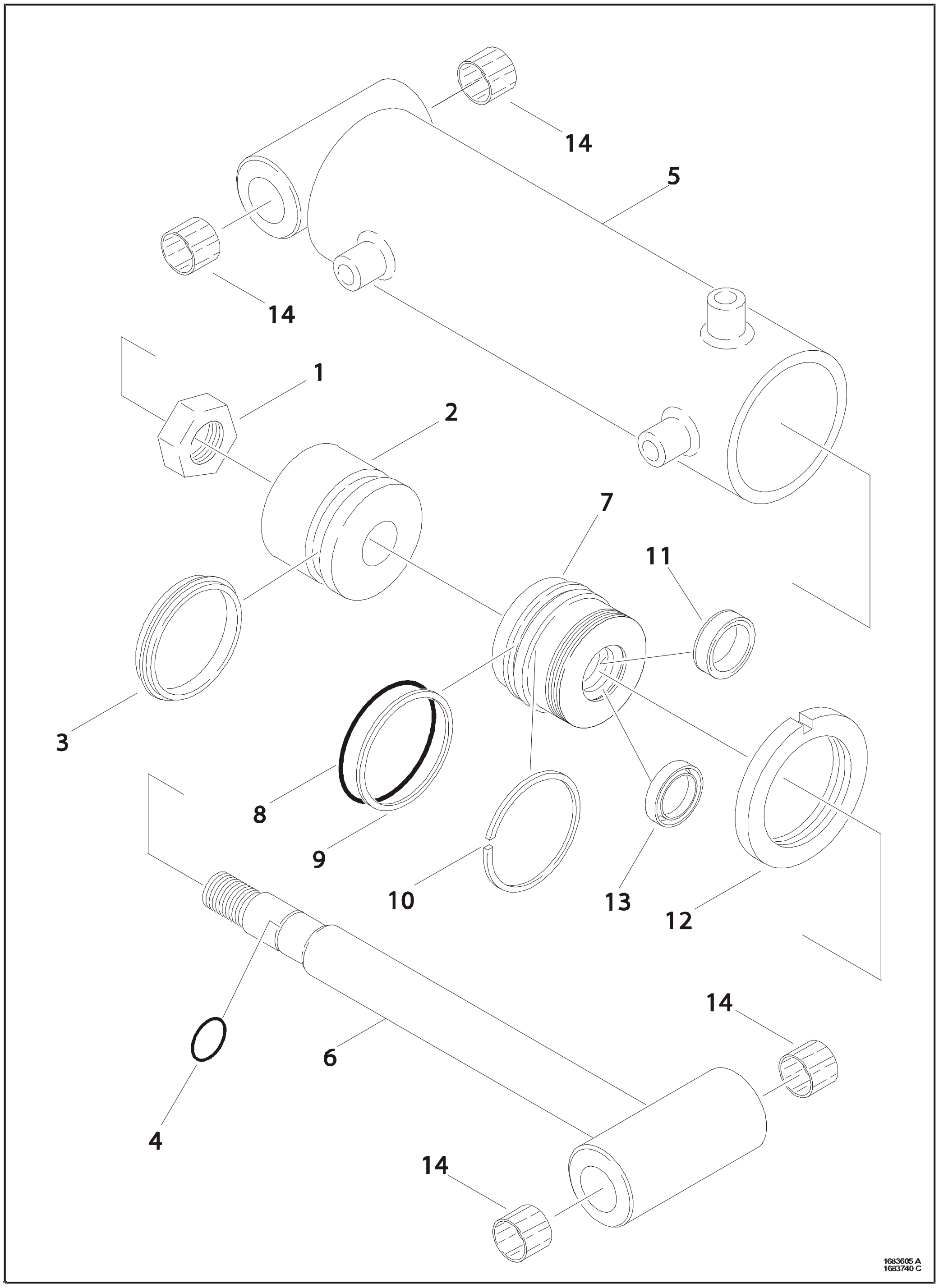


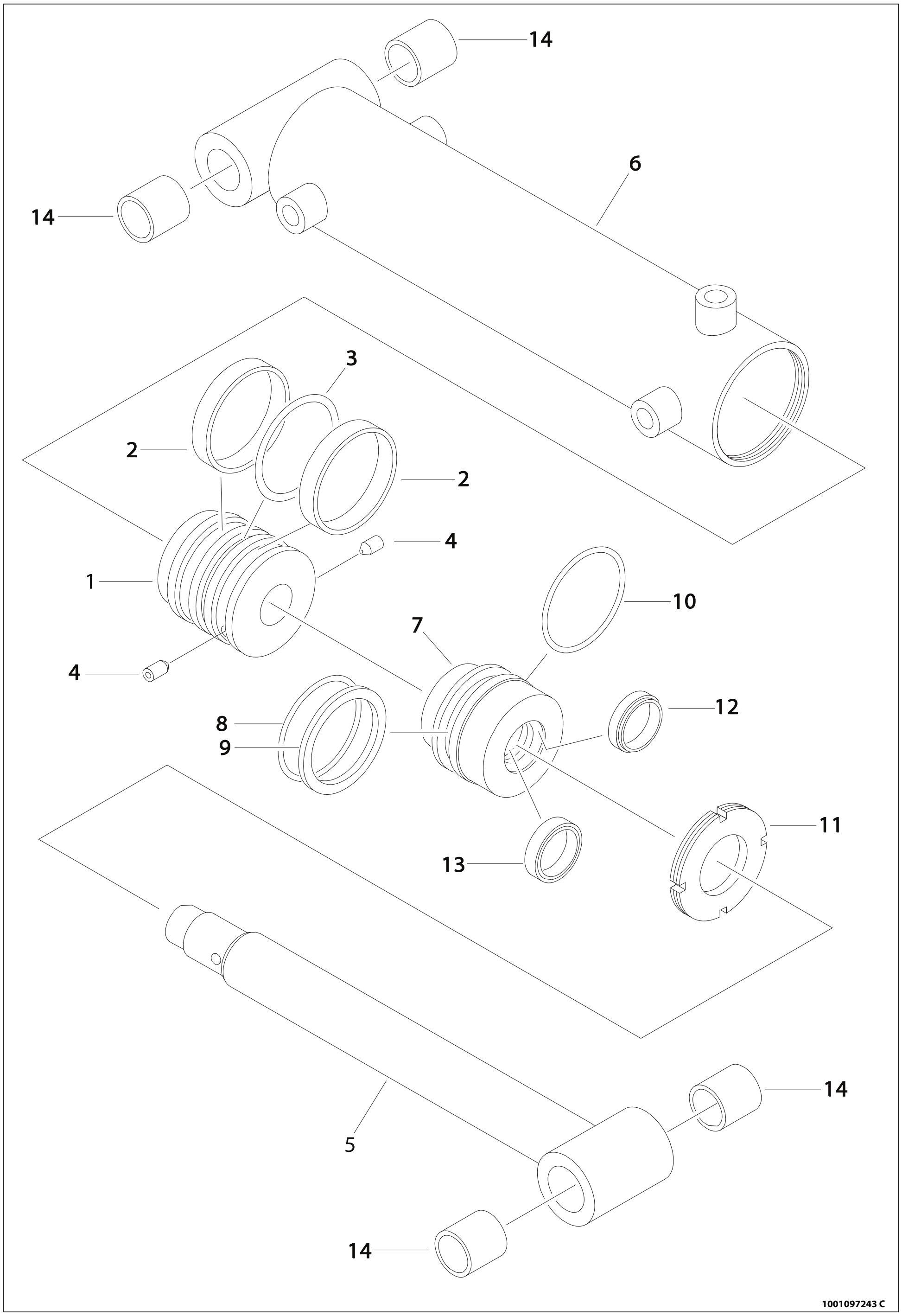
Figure 5-119. Capscrew Removal

6. Using a spanner wrench, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.
7. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Locknut
2. Piston
3. Seal
4. O-ring
5. Barrel
6. Rod
7. Head
8. O-ring
9. Backup Ring
10. Retainer Ring
11. Seal
12. Spanner Nut
13. Wiper
14. Bushing

Figure 5-120. Steer Cylinder (Prior to S/N 0300142664)



1. Piston	6. Barrel	11. Spanner Nut
2. Seal	7. Head	12. Seal
3. Seal	8. O-ring	13. Wiper
4. Setscrew	9. Backup Ring	14. Bushing
5. Rod	10. Retainer Ring	

Figure 5-121. Steer Cylinder (S/N 0300142664 to S/N 0300183033)

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

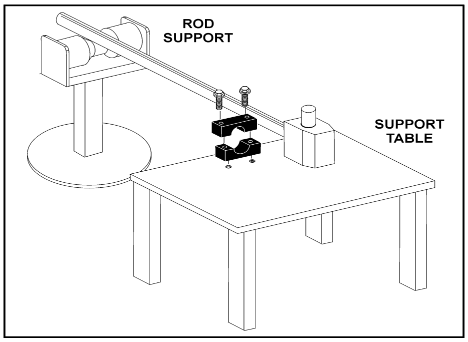


Figure 5-122. Cylinder Rod Support

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. Loosen and remove nut which attaches the piston to the rod.
11. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove piston spacer, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    - **a.** Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    - **b.** Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    - **c.** Lubricate inside of steel bushing with WD40 prior to bearing installation.
    - **d.** Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

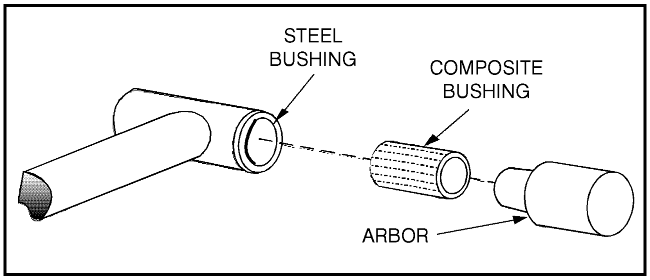


Figure 5-123. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.

15. If applicable, inspect port block fittings and holding valve. Replace as necessary.

16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

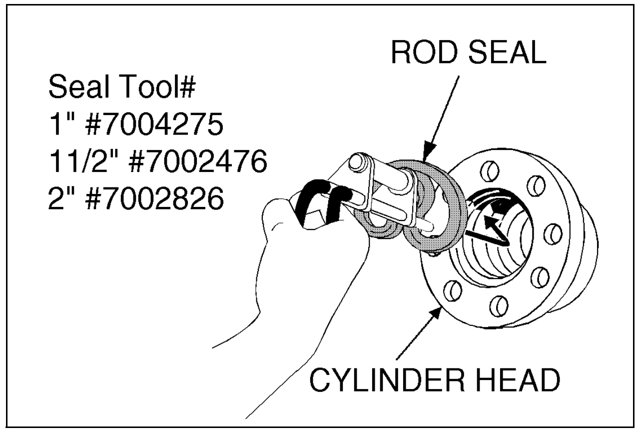


Figure 5-124. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

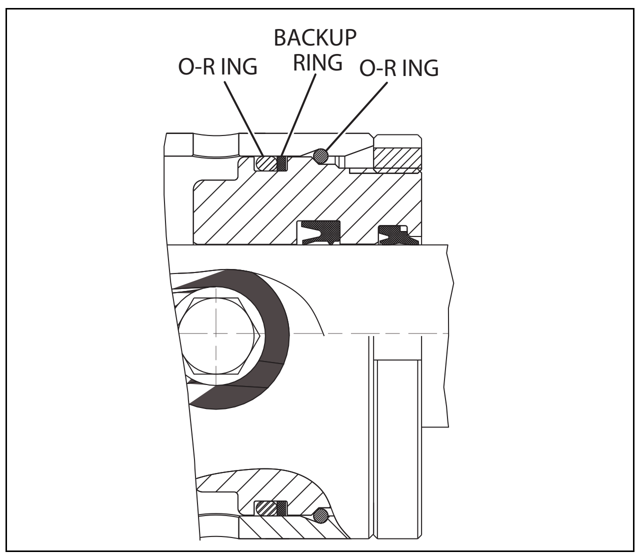
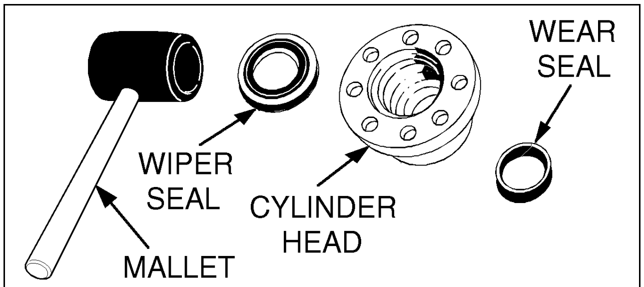


Figure 5-125. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-126. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

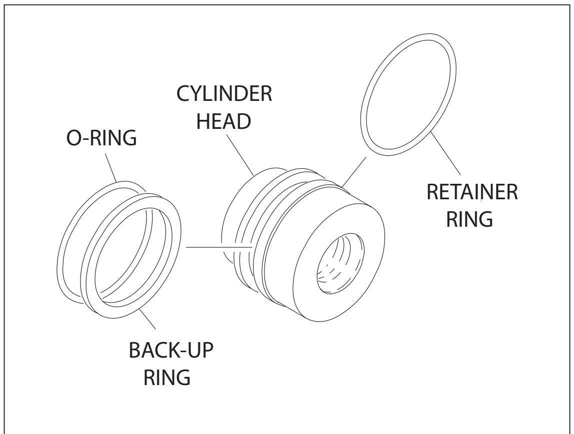


Figure 5-127. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
7. Remove the cylinder rod from the holding fixture.
8. Place a new o-ring in the inner piston diameter groove. (See Figure 5-128.)
9. Place new seals in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal). (See Figure 5-128. and Figure 5-129.)

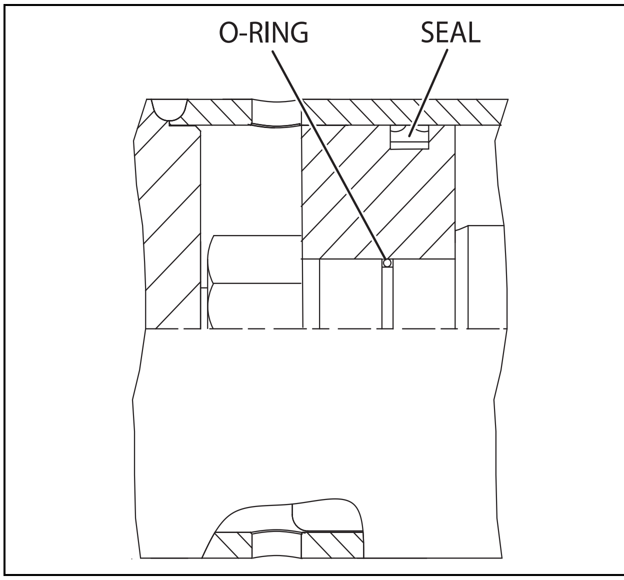


Figure 5-128. Piston Seal Kit Installation (Prior to S/N 0300142664)

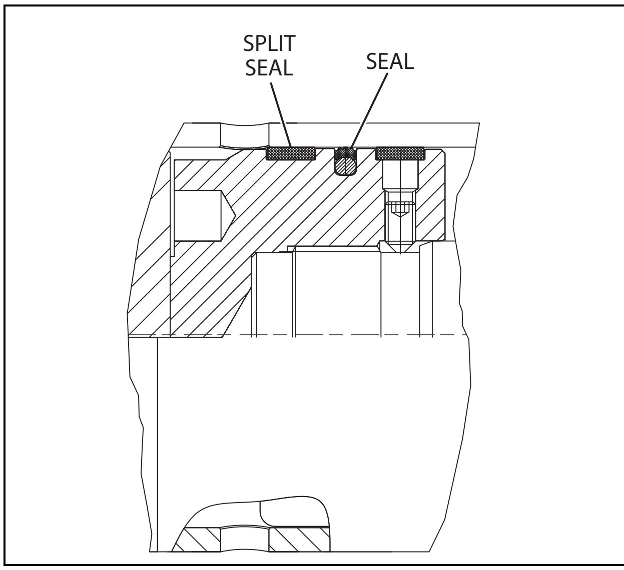


Figure 5-129. Piston Seal Kit Installation (S/N 0300142664 to S/N 0300183033)

10. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

11. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

12. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

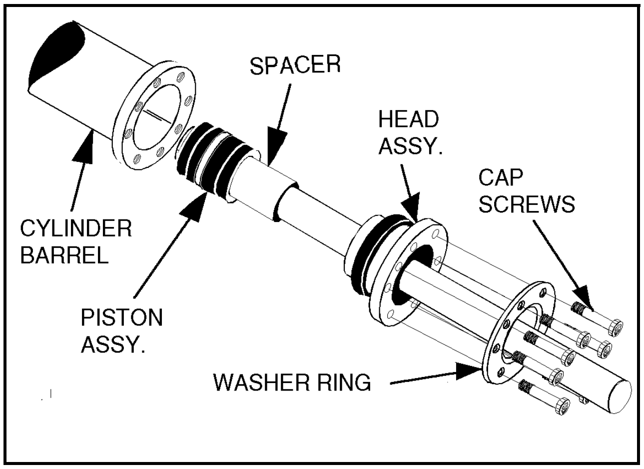


Figure 5-130. Rod Assembly Installation

13. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 275-300 ft.lbs. (372.8-406.7 Nm).

14. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

15. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

NOTE: **Steer cylinder spanner nut is tightened as per Spec. "CYR" Cylinder spanner nut tightening procedure. Pressurize cylinder on retract to 80/100 psi to push rod guide firmly against the round retaining ring. (Apply 1 drop of JLG Threadlocker P/N 0100011, 2 places, at 180° apart. Hand tighten nut, then tighten 1/4 turn with spanner wrench).*

Main Telescope Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

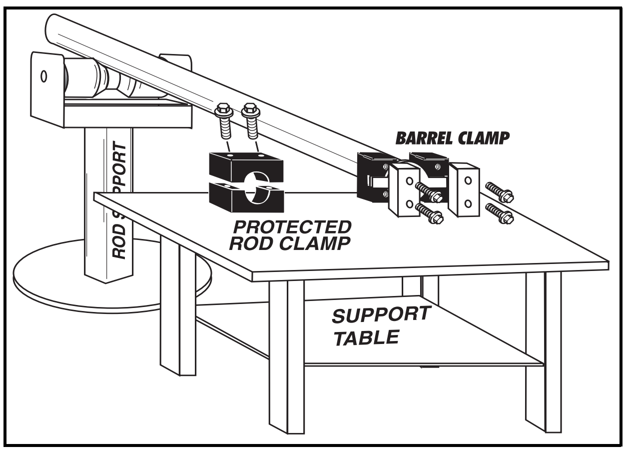


Figure 5-131. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

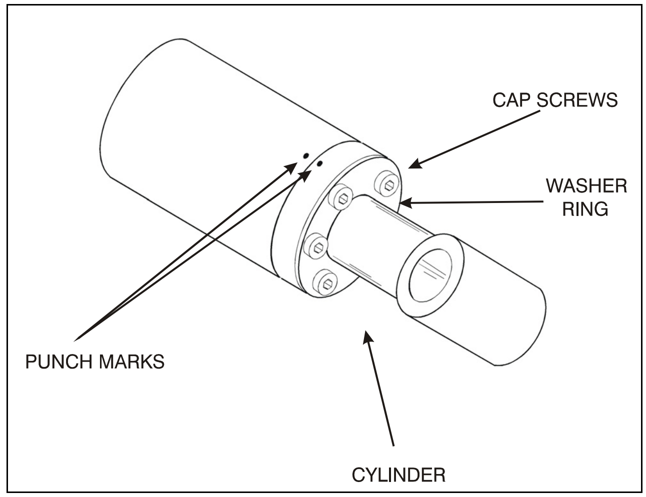
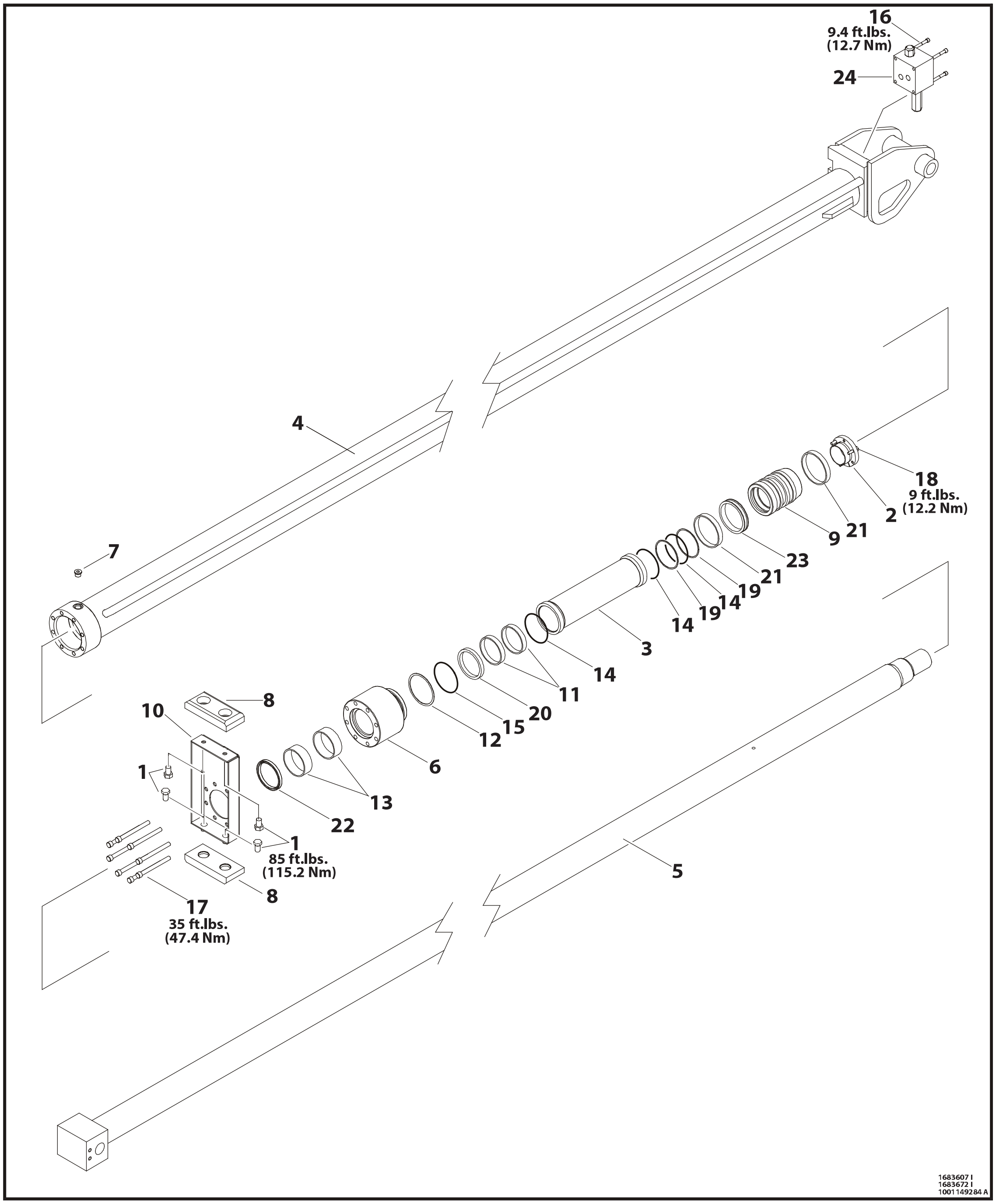


Figure 5-132. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Bolt	6. Head	11. Wear Ring	16. Capscrew	21. Wear Ring
2. Tapered Bushing	7. O-ring Plug	12. Backup Ring	17. Capscrew	22. Wiper
3. Tube Spacer	8. Wear Pad	13. Wear Ring	18. Bolt	23. T-Seal
4. Barrel	9. Piston	14. O-ring	19. Backup Ring	24. Valve Assembly
5. Rod	10. Plate	15. O-ring	20. Rod Seal	

Figure 5-133. Main Telescope Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

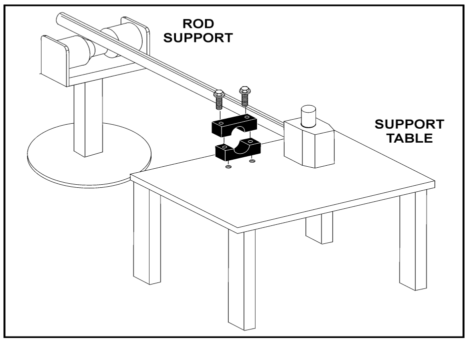


Figure 5-134. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

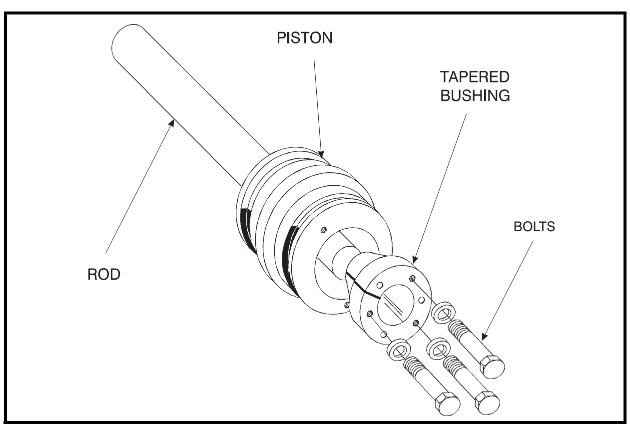


Figure 5-135. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

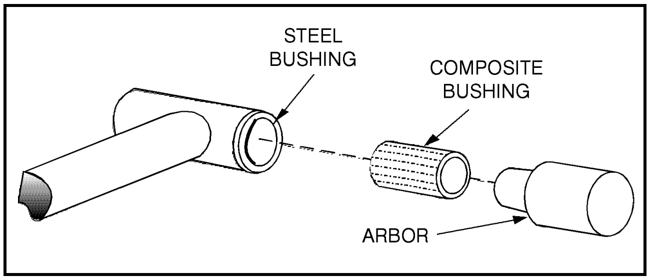


Figure 5-136. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

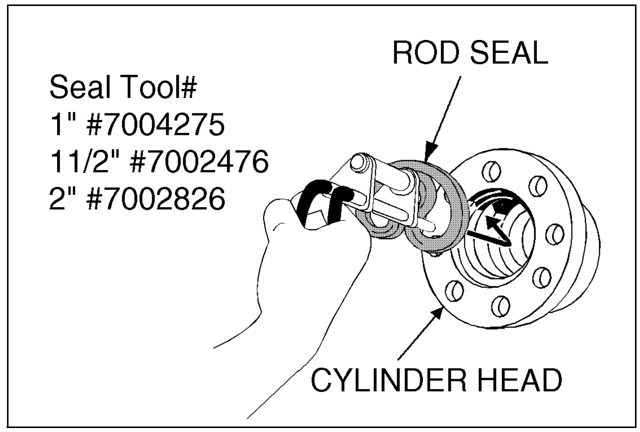


Figure 5-137. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

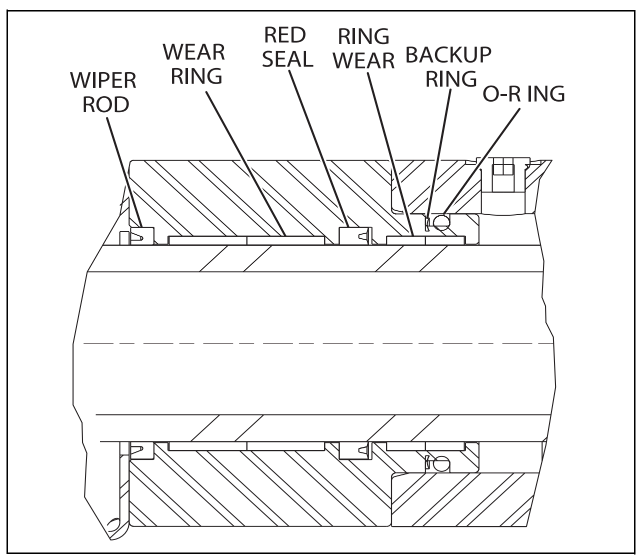


Figure 5-138. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.

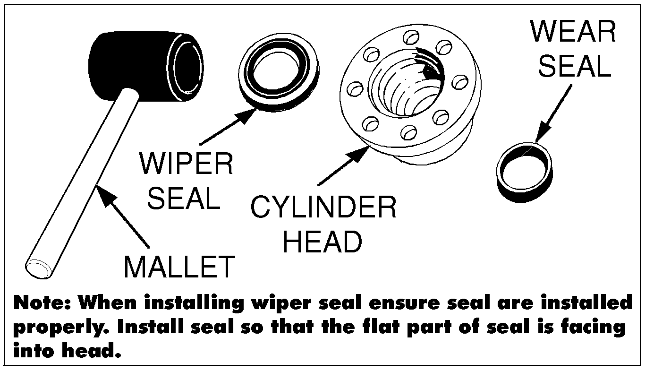


Figure 5-139. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

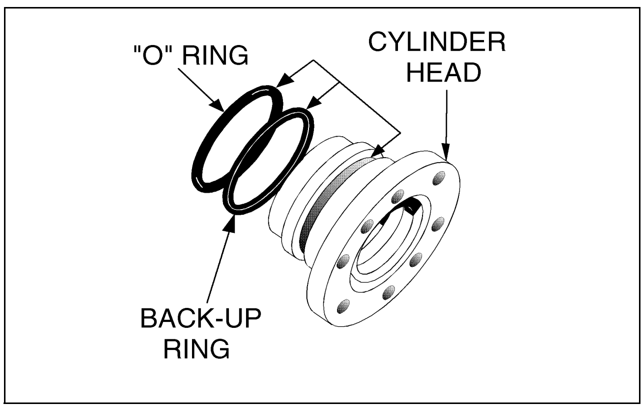


Figure 5-140. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the spacer on the rod.

NOTE: *Upper telescope cylinder piston has an o-ring installed inside the spacer.*

6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

8. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

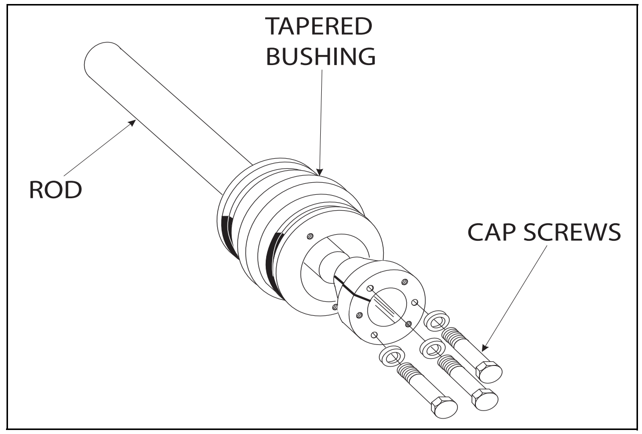


Figure 5-141. Tapered Bushing Installation

10. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

11. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

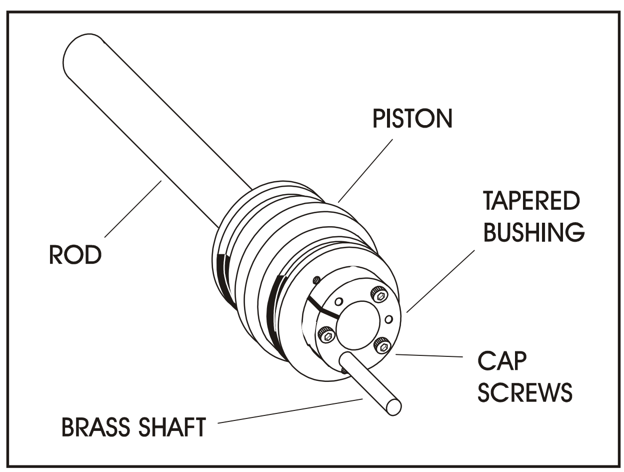


Figure 5-142. Seating the Tapered Bearing

12. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).
13. Remove the cylinder rod from the holding fixture.
14. Place a new o-ring and back-up rings in the inner piston diameter groove.
15. Place T-seal and wear rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

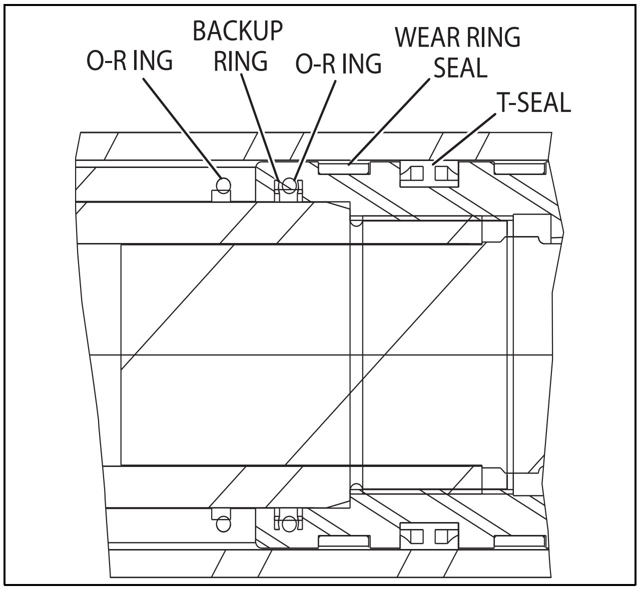


Figure 5-143. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

17. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
18. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

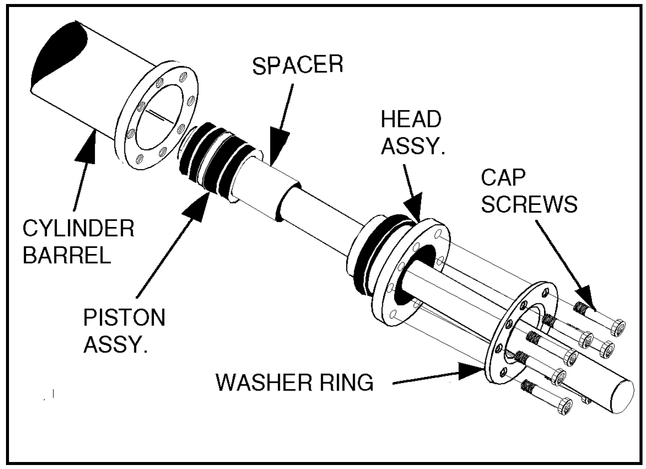


Figure 5-144. Rod Assembly Installation

19. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (47 Nm).
20. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Tower Telescope Cylinder

DISASSEMBLY

NOTICE

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO THE END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

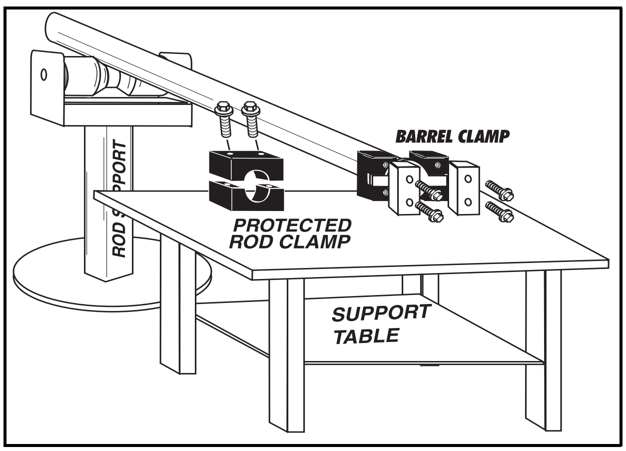


Figure 5-145. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

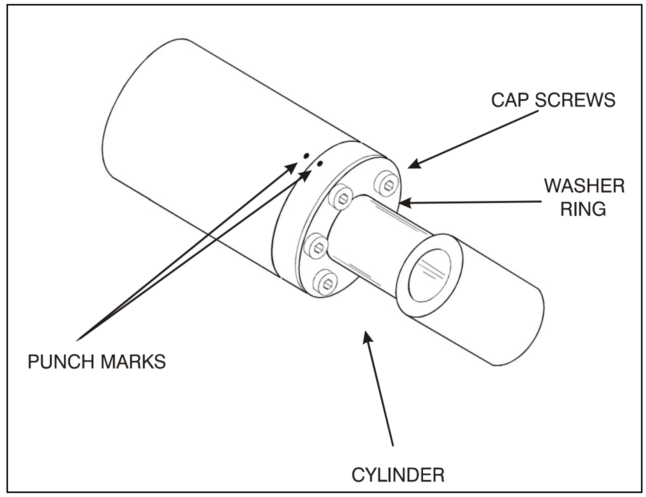
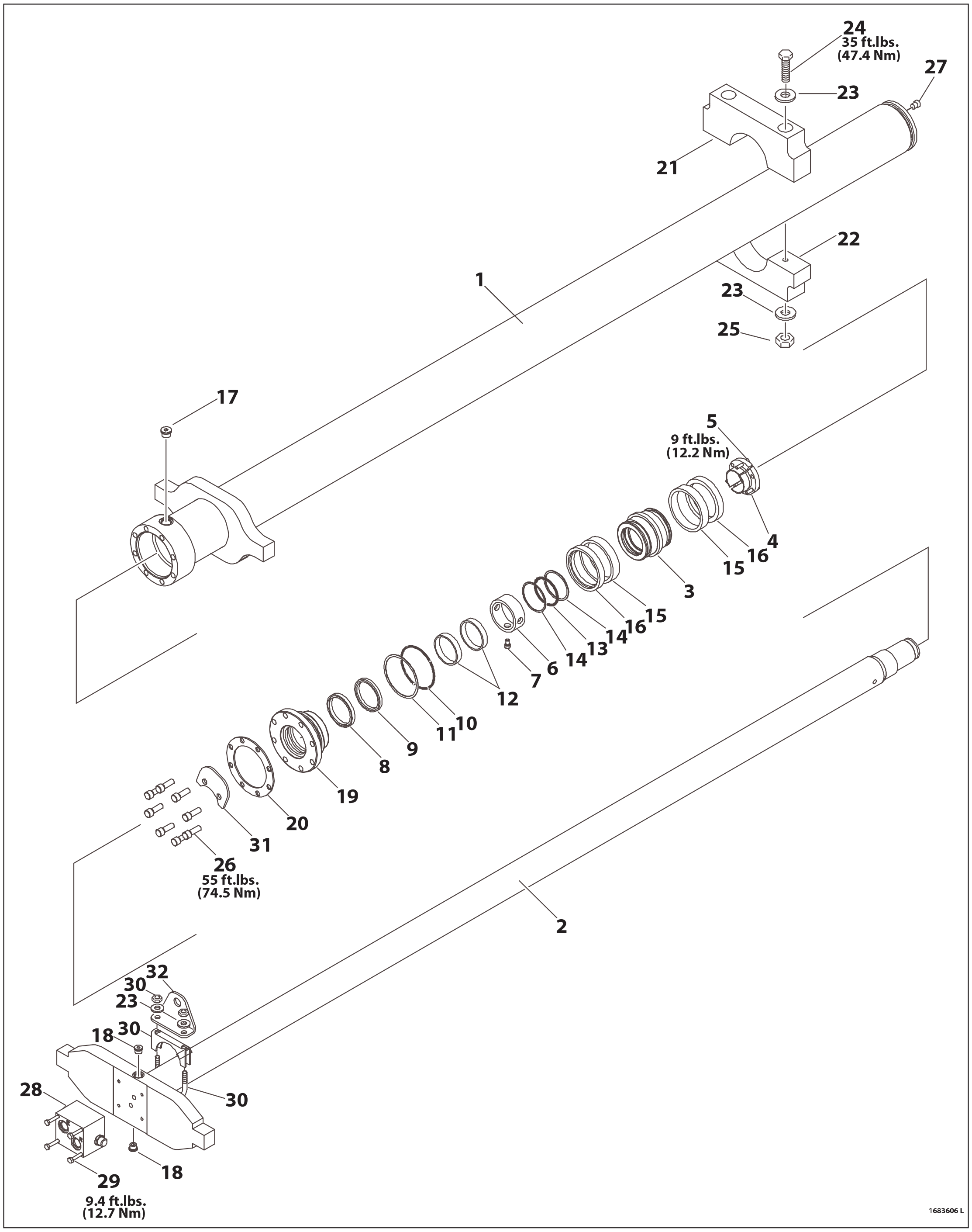


Figure 5-146. Capscrew Removal

6. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.



1. Barrel	8. Wiper	15. Seal	22. Support Pad	29. Capscrew
2. Rod	9. Seal	16. Lock Ring	23. Flatwasher	30. Clamp
3. Piston	10. O-ring	17. O-ring Plug	24. Bolt	31. Target Plate
4. Tapered Bushing	11. Backup Ring	18. O-ring Plug	25. Locknut	32. Target Plate
5. Bolt	12. Wear Ring	19. Head	26. Capscrew	
6. Tube Spacer	13. O-ring	20. Washer Ring	27. O-ring Plug	
7. Bolt	14. Backup Ring	21. Support Pad	28. Valve Assembly	

Figure 5-147. Tower Telescope Cylinder

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

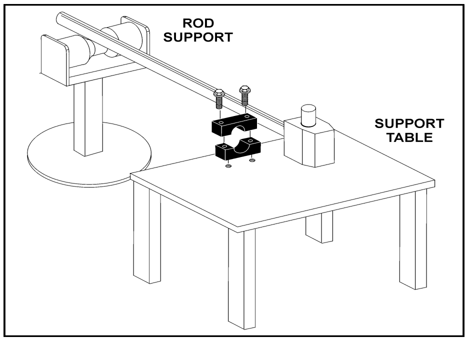


Figure 5-148. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
10. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrew(s) until the bushing is loose on the piston.
11. Remove the bushing from the piston.

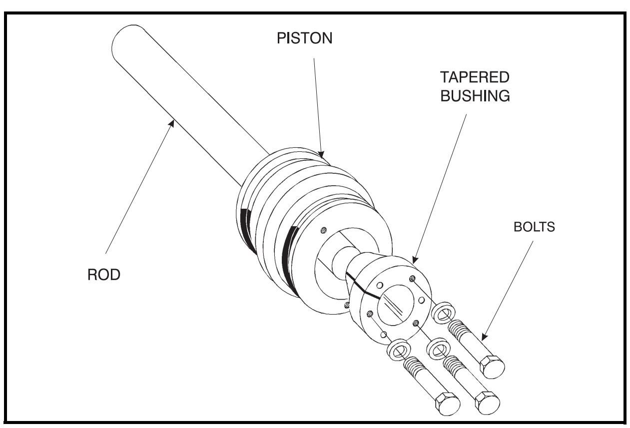


Figure 5-149. Tapered Bushing Removal

12. Screw the piston counter clockwise (CCW), by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston o-rings, seal rings, and backup rings.
14. Remove piston spacer, if applicable, from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, back-up rings, rod seals, and wiper seals.

CLEANING AND INSPECTION

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

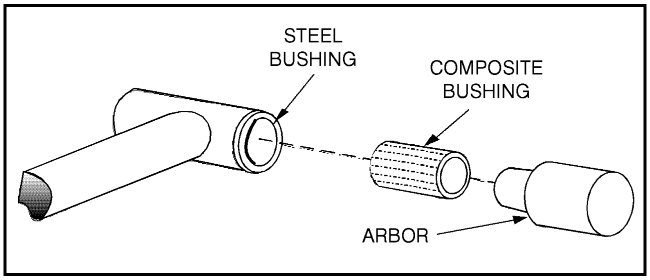


Figure 5-150. Composite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

NOTE: *Apply a light film of hydraulic oil to all components prior to assembly.*

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

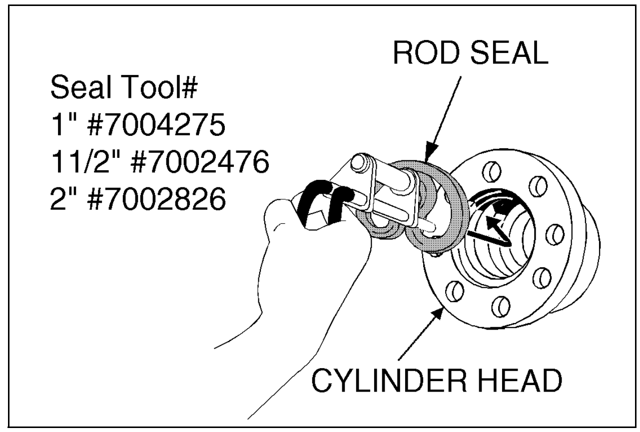


Figure 5-151. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

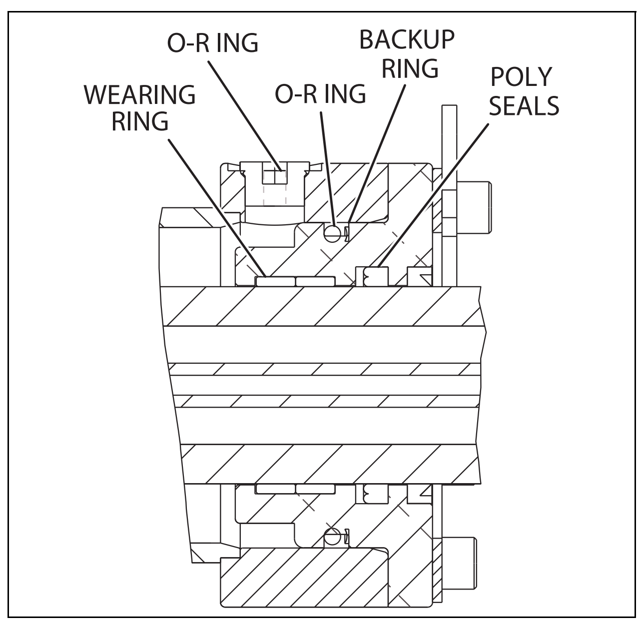
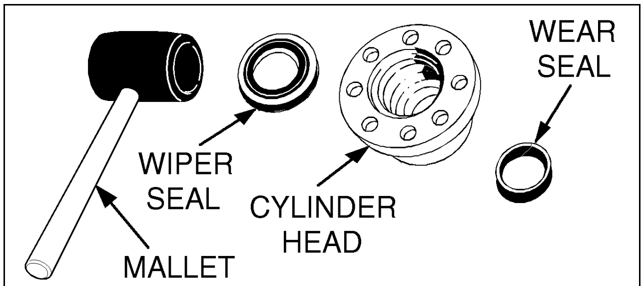


Figure 5-152. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.



Note: When installing wiper seal ensure seal are installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-153. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

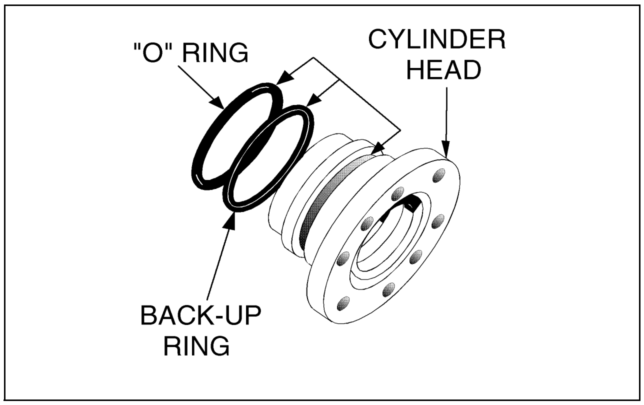


Figure 5-154. Installation Of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

NOTE: *Upper telescope cylinder piston has an o-ring installed inside the spacer.*

6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.

8. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

9. Install the bolts in tapered bushing.

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

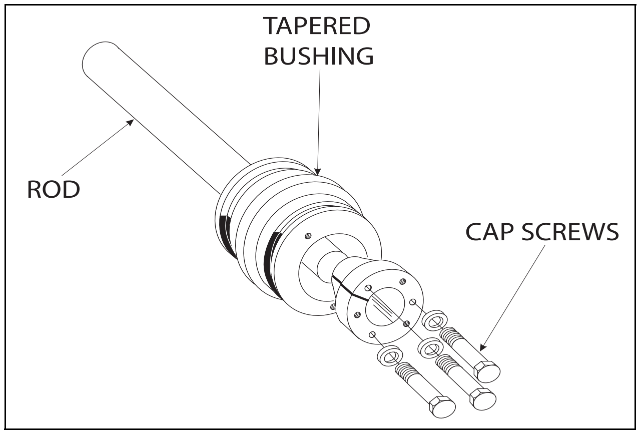


Figure 5-155. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;

    a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.

    b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

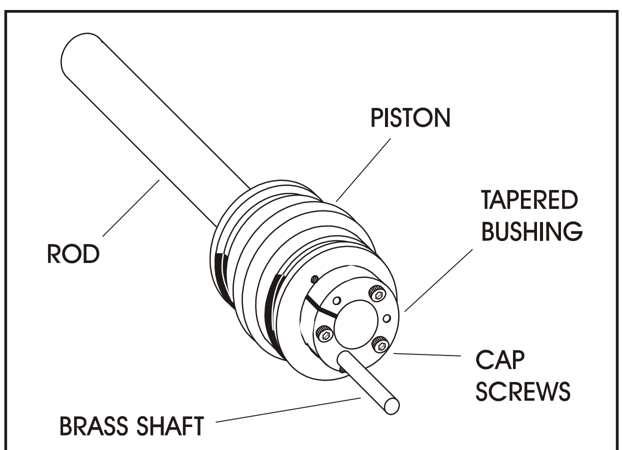


Figure 5-156. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).
14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

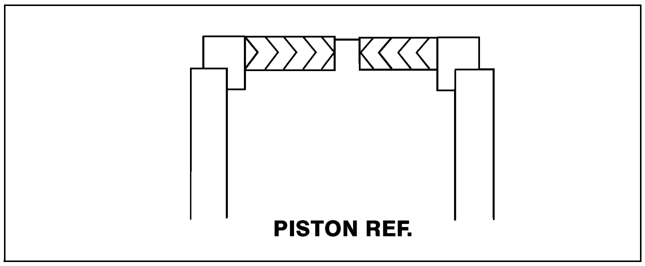


Figure 5-157. Hydrolock Piston Seal Installation

15. Place a new o-ring and back-up rings in the inner piston diameter groove.
16. Place new hydrolock seal and guidelock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

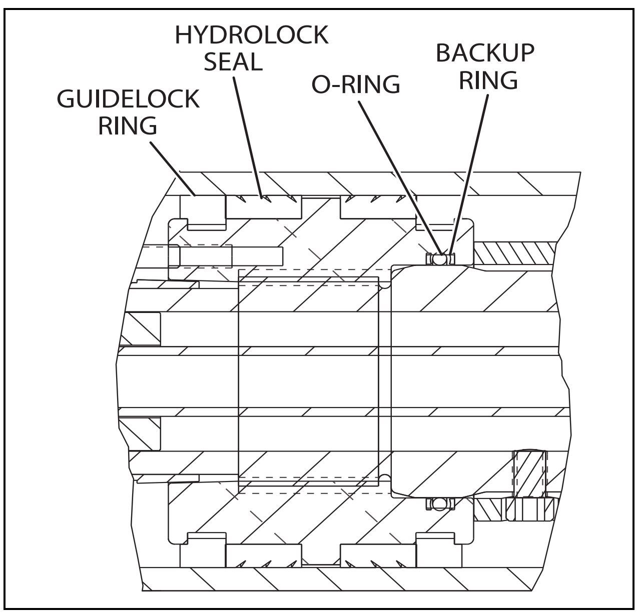


Figure 5-158. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

18. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
19. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

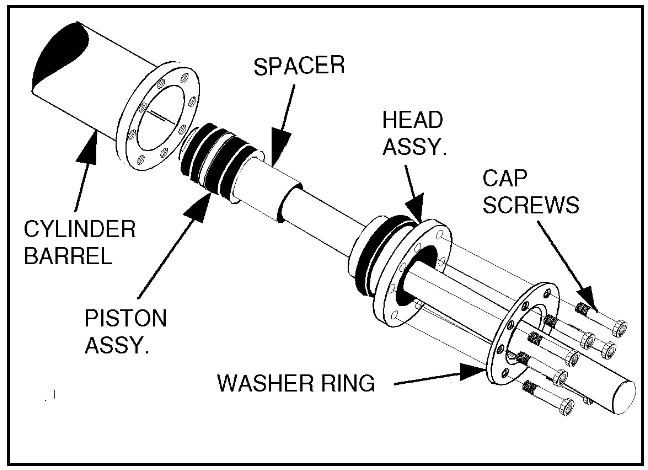


Figure 5-159. Rod Assembly Installation

20. Apply JLG Threadlocker (P/N 0100011) to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 55 ft.lbs. (74 Nm).
21. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

5.7 CYLINDER REMOVAL AND INSTALLATION

Main Boom Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.
2. Extend the boom to gain access to main fly boom telescope cylinder rod end pin.

NOTE: *The Main Boom weighs approximately 2528 lbs. (1147 kg).*

3. Using a suitable sling and lifting device, secure the platform end of the boom.
4. Place blocking under the cylinder to prevent it from falling when the attaching hardware is removed.
5. Remove the hardware securing the main lift cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
6. Using auxiliary power from ground controls, retract the lift cylinder rod completely.
7. Disconnect, cap, and tag the main boom lift cylinder hydraulic lines and ports.
8. Remove mounting hardware securing the telescope cylinder barrel to the main base boom.
9. Using an external pump, extend the cylinder as far as the hydraulic lines will allow to enable a lifting device to be attached to the telescope cylinder.

NOTICE

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

10. Tag and disconnect hydraulic lines from telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

NOTE: *The Telescope Cylinder weighs approximately 522 lbs. (237 kg).*

11. Secure the telescope cylinder with a suitable sling and lifting device.
12. Carefully remove the telescope cylinder from the main boom assembly and place in a suitable work area.

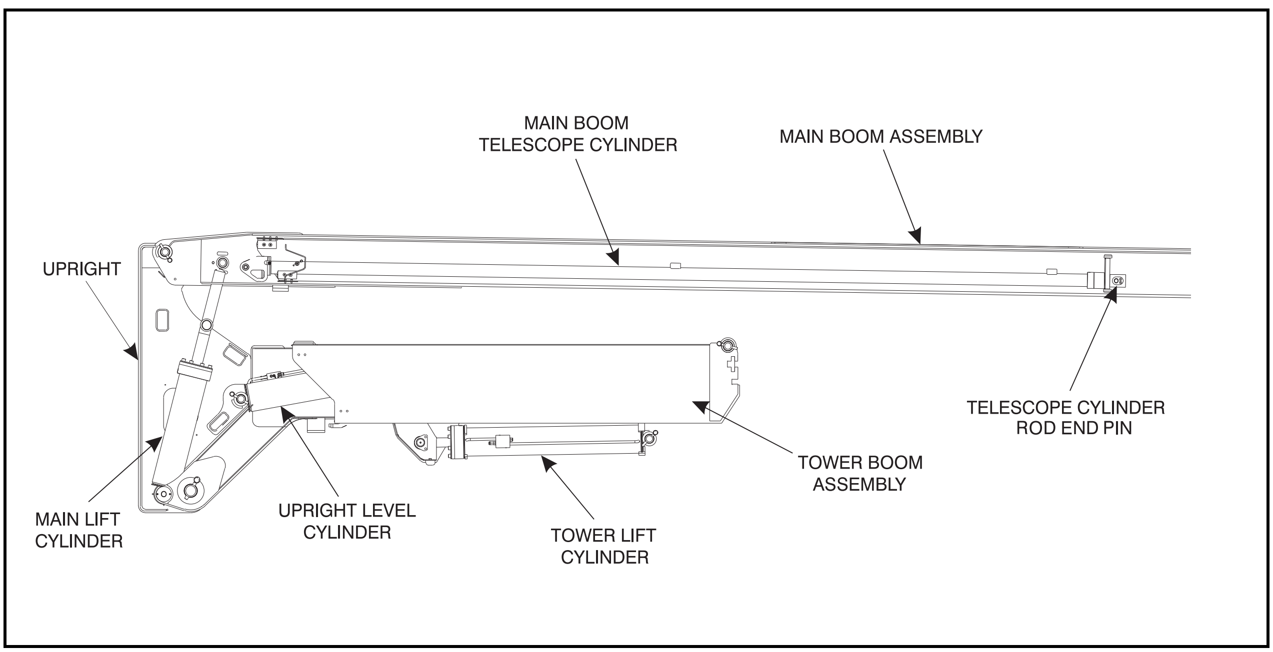


Figure 5-160. Components Upper Boom and Tower Boom

Main Boom Telescope Cylinder Installation

1. Using suitable lifting equipment, carefully insert the cylinder into the boom assembly.
2. Remove the lifting device from the telescope cylinder.
3. Carefully install telescope cylinder rod pin through the fly boom and secure it with the retaining rings.
4. Remove applicable hydraulic line and port caps and properly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
5. Carefully install the telescope cylinder barrel end support into mounting block in base boom and secure with blocks and torque the bolts to 35 ft.lbs. (48 Nm). Use JLG Threadlocker P/N 0100011 on bolts. Shim as necessary.
6. Remove lifting device.
7. Extend the main lift cylinder using the auxiliary control from the ground controls to align with rod end hole in main base boom.
8. Carefully insert the main lift cylinder rod end pin through the base boom and install the mounting hardware.
9. Using all applicable safety precautions, operate the boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
10. Check fluid level of hydraulic tank and adjust as necessary.

Main Lift Cylinder Removal

NOTE: *The Main Boom weighs approximately 2528 lbs. (1147 kg).*

1. Place the machine on a flat and level surface. Attach a suitable lifting device and sling, sufficient to lift the main boom assembly, to the approximate center of the main boom assembly.
2. Place blocking under the cylinder to prevent it from falling when the attaching hardware is removed.
3. Remove the hardware securing the main lift cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
4. Using auxiliary power from ground controls, retract the lift cylinder rod completely.
5. Disconnect, cap, and tag the main boom lift cylinder hydraulic lines and ports.
6. Attach a suitable lifting device and sling to the main lift cylinder.

NOTE: *The Main Lift Cylinder weighs approximately 445 lbs. (202 kg).*

7. Remove barrel end attach pin retaining hardware.
8. Using a suitable brass drift drive out the barrel end attach pin from the tower upright. Raise the main boom assembly with the lifting device and sling to allow enough space to remove the main lift cylinder from the upright top.
9. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.
10. Lower the boom assembly to the stowed position.

Main Lift Cylinder Installation

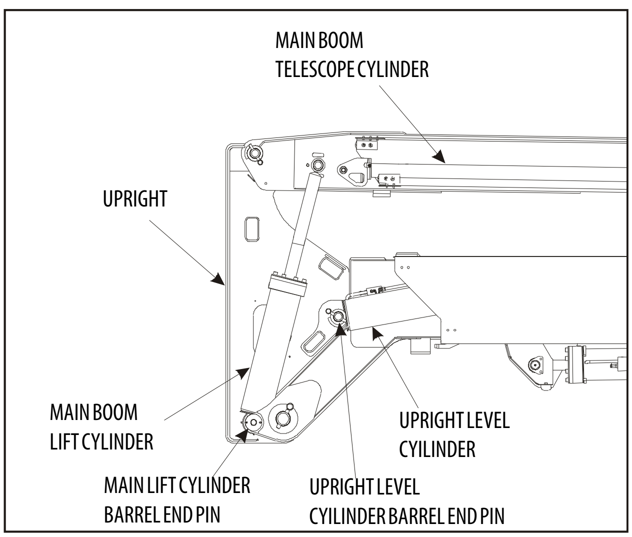
1. Lift the main boom to allow enough space to lower the upper lift cylinder to align with pin mounting holes of the tower fly boom and barrel end of main lift cylinder.
2. Using a suitable brass drift, drive barrel end attach pin through the mounting holes in the lift cylinder and the tower fly boom. Secure in place with the pin and torque the bolts to 35 ft. lbs. (48 Nm). Use Threadlocker P/N 0100011 on bolts.
3. Remove cylinder port plugs and hydraulic line caps and attach lines to cylinder ports as tagged during removal.
4. Using auxiliary power extend the cylinder rod until the attach pin hole aligns with those in the main boom. Using a suitable drift drive cylinder rod attach pin through the aligned holes, taking care to align the grooved pin holes. Secure the pin in place and torque the bolt to 285 ft. lbs. (388 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
5. Remove lifting device and sling. Activate hydraulic system.
6. Using all applicable safety precautions, operate the boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and adjust as necessary.

Upright Level Cylinder Removal

NOTICE

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

1. Remove the Main Boom. Refer to Main Boom removal.
2. Tag and disconnect hydraulic lines to the main lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Remove mounting hardware from the upper lift cylinder barrel end. Use a suitable brass drift and hammer to remove main lift cylinder barrel end pin from Upright and remove main lift cylinder.
4. Disconnect the Upright Level Cylinder as follows:
   a. Use a suitable lifting device to support the Upright.
   b. Remove mounting hardware securing the Upright Level Cylinder to the upright. Use a suitable brass drift and hammer to remove upright level cylinder barrel end pin from upright and disconnect the upright level cylinder from the Upright.



5. Use overhead sling to raise and support upright on the machine.

NOTE: *The Upright weighs approximately 1136 lbs. (515 kg).*

6. Before extending the tower boom, support the tower boom from the bottom.
7. Extend the Tower Boom to get access to the Upright level cylinder rod end pin by using an external auxiliary pump.
8. Tag, disconnect and cap the hydraulic lines of the Upright level Cylinder barrel.
9. Attach a suitable lifting device to support the Upright Level Cylinder.
10. Remove mounting hardware from the upright level cylinder rod end and remove the pin.
11. Remove the Upright Level Cylinder from the Tower Fly Boom. Place the Upright level Cylinder in a suitable work area.

Upright Level Cylinder Installation

1. Put the leveling cylinder in position in the tower boom, align holes in the tower boom and leveling cylinder rod end.
2. Secure the leveling cylinder rod end pin to tower boom and torque the bolts to 35 ft. lbs. (48 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
3. Remove Cylinder Port plugs and hydraulic line caps. Properly attach lines to Cylinder ports as tagged during removal.
4. Use all applicable safety precautions, operate the lifting device to move upright assembly into proper position.
5. Align holes in upright and barrel end of level cylinder. Use a suitable rubber mallet to install level barrel end pin. Secure pin and torque the bolt 285 ft. lbs. (388 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
6. Install Main Lift Cylinder.

7. Install Main Boom. Refer to Main Boom installation.
8. Remove hydraulic line caps and attach all the hydraulic and electrical lines as tagged during removal.
9. Use all applicable safety precautions, operate the boom functions. Check for proper operation and hydraulic leaks.
10. Check fluid level of hydraulic tank and add fluid, if required.

Tower Boom Lift Cylinder Removal

1. Place machine on a flat and level surface. Place the main boom in a horizontal position with the telescope cylinder fully retracted. Place the tower boom in a fully elevated and fully retracted position.

NOTE: *The Main Boom weighs approximately 2528 lbs. (114 kg), Upright weighs approximately 1136 lbs. (515 kg) & Tower Boom weighs approximately 2944 lbs. (1335 kg).*

2. Support the main boom, upright and tower boom with adequate overhead crane.

NOTE: *The Tower lift cylinder weighs approximately 544 lbs. (247 kg).*

3. Adequately support the tower lift cylinder.
4. Remove mounting hardware securing the lift cylinder rod pin to the tower boom. Using a suitable brass drift, drive out the tower lift cylinder rod attach pin.
5. Using all applicable safety precautions, operate auxiliary power, activate tower lift down and fully retract lift cylinder.
6. Tag, disconnect, and cap the tower lift cylinder hydraulic lines and ports.
7. Remove mounting hardware securing the tower lift cylinder barrel pin to the turntable. Using a suitable brass drift, drive out the tower lift cylinder barrel pin.
8. Carefully remove the tower lift cylinder from turntable. Place in a suitable work area.

Tower Lift Cylinder Installation

1. Support the main boom and tower boom, place the tower lift cylinder on the turntable and align the holes. Install the cylinder barrel pin and torque the bolt to 285 ft. lbs. (388 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
2. Remove caps from cylinder hydraulic lines properly and install lines to cylinder as previously tagged.
3. Using auxiliary power, activate tower lift function and extend cylinder rod until the cylinder rod bushing aligns with bushings on boom.
4. Using an appropriate brass drift, drive the tower lift cylinder rod end attach pin through the aligned bushings. Secure pin and torque the bolt 35 ft. lbs. (48 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
5. Remove main boom support and lifting device supporting the upright.
6. Using all applicable safety precautions, operate the boom functions. Check for proper operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and add fluid, if required.

Tower Telescope Cylinder Removal

1. Place machine on flat and level surface.
2. Remove the tower telescope cylinder rod end trunion hardware.
3. Using an external pump, extend the tower telescope cylinder as far enough to attach the lifting device.
4. Tag, disconnect and cap hydraulic hoses to Tower Telescope Cylinder. Plug cylinder ports. Remove the hoses.

NOTE: *The Tower Telescope Cylinder weighs approximately 233 lbs. (105kg).*

5. Properly secure the Tower Telescope Cylinder by using a suitable sling or support.
6. Remove the tower telescope cylinder barrel end trunion hardware.
7. Carefully remove the Tower Telescope Cylinder from the Boom. Place cylinder on a suitable work area.

Tower Telescope Cylinder Installation

1. Slide the telescope cylinder into the boom, aligning the cylinder port block end with slotted holes in Base Boom.
2. Secure the telescope cylinder barrel end to the fly boom by using retaining plate and torque the bolts 35 ft. lbs. (48Nm). Use JLG Threadlocker P/N 0100011 on bolts.
3. Secure telescope cylinder rod end and torque the bolts to 35 ft. lbs. (48 Nm). Use JLG Threadlocker P/N 0100011 on bolts.
4. Remove caps and plugs from hydraulic lines and ports. Properly connect hydraulic lines to cylinder. Reinstall cover plate.
5. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
6. Check fluid level of hydraulic tank and add fluid, if required.

Slave Cylinder Removal

1. Place the machine on a flat surface and lower the upper boom and tower boom to the lowest position.
2. Using auxiliary power, retract the slave cylinder rod completely.

NOTE: *Step 3 is applicable for 800AJ models only.*

3. Raise the JIB to gain access to the Slave Cylinder piston end Pin.

NOTE: *The Slave Cylinder weighs approximately 68 lbs (31 kg).*

4. Using a suitable lifting device, properly secure the platform to prevent the platform from tilting backward or forward during removal of the slave cylinder.
5. Tag and disconnect the slave cylinder hydraulic hoses. Cap hoses to prevent the hydraulic system from being contaminated.
6. Properly secure the slave cylinder by using a suitable sling or support.

NOTE: *The Slave cylinder weighs approximately 68 lbs (31 kg).*

7. Remove the slave cylinder pin retaining hardware. Using a suitable brass drift, remove the slave cylinder pins from the rod and barrel ends.
8. Carefully remove the slave cylinder.
9. Clean and inspect the cylinder pins and retaining hardware for reuse. Replace if necessary.

Slave Cylinder Installation

1. Remove caps from the hydraulic hoses and attach hoses to the proper cylinder ports.

NOTE: *The Slave cylinder weighs approximately 68 lbs (31 kg).*

2. Use suitable slings or support to position the Slave cylinder in place. Align barrel end mounting holes with the holes in main fly boom.
3. Use suitable mallet to install the barrel end attach pin and torque the bolts to 35 ft. lbs. (48 Nm).
4. Extend the slave cylinder rod until the rod attach pin hole aligns with holes in the platform pivot. Use suitable mallet and keeper to install the rod end pin.
5. Remove lifting device from the slave cylinder and support from the platform.
6. Use all applicable safety precautions, start the machine from the ground control. Fully raise and lower the upper boom through several cycles to bleed the platform level hydraulic circuit.
7. Check for proper operation and hydraulic leaks.
8. Check the fluid level of hydraulic tank. Fill the tank, if required.

5.8 HYDRAULIC PUMP W/HAYES PUMP DRIVE COUPLING LUBRICATION

Any time pump or pump drive coupling is removed coat, pump and drive coupling splines with Lithium Soap Base Grease (TEXACO CODE 1912 OR EQUIVALENT) coupling is greased prior to assembly.

5.9 PRESSURE SETTING PROCEDURES

Cold temperatures have a significant impact on pressure readings. JLG Industries Inc. recommends operating the machine until the hydraulic system has warmed to normal operating temperatures prior to checking pressures. JLG Industries Inc. also recommends the use of a calibrated gauge. Pressure readings are acceptable if they are within ± 5% of specified pressures.

FIRST: Set Up the Function Pump

(the pump that is mounted on the back of the drive pump).

MACHINES PRIOR TO S/N 0300121643

1. **Stand by pressure <u>or</u> load sense pressure**.

   Install a low pressure gauge at port **"MP"** of the main valve block. A gauge capable of reading **400 psi (27.58 bar)**. Remove the wires from the upper lift (upper lift), valve coils on the main valve block. Start the engine and activate upper lift up or down. Hold the function for 10-15 seconds. this bleeds the air out of the sense line. The gauge should be reading between **400-440 psi (28-30 bar)**. To make an adjustment to this pressure, go to the engine compartment, locate the variable pump. There are (2) adjustments at the top of the pump. The stand by adjustment is at the top. Using a 17 mm wrench, remove the cover nut. Be careful not to lose the "o" ring washer inside the cover nut. Loosen the jam nut at the set screw with the 17 mm wrench. Using a 3 mm allen wrench adjust clockwise to increase, or counterclockwise to decrease. After adjusting the pressure, tighten the jam nut and replace the cover nut. Reconnect the wires on the upper lift coils.

2. **High pressure relief**.

   Install a high pressure gauge at the **"MP"** port of the main valve block. Activate upper (main) telescope in. The gauge should read **2600 psi (179.26 bar)**. To make an adjustment to this pressure, go back to the engine compartment to the variable pump. The high pressure relief adjustment is on the lower one of the (2). Repeat the same procedure as setting the stand by pressure. This is the **<u>maximum</u>** relief pressure for all functions governed by this pump.

MACHINES S/N 0300121643 TO PRESENT

1. **Set Stand by pressure or load sense pressure.**

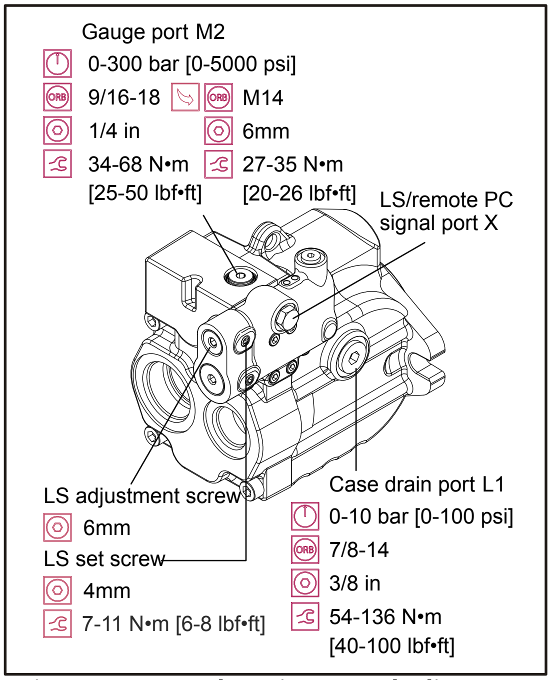


Figure 5-161. Load Sensing Control Adjustment

a. Install a low pressure gauge at port **"MP"** of the main valve block. A gauge capable of reading **400 psi (27.58 bar)**.

b. Remove the wires from the upper lift (main lift), valve coils on the main valve block. Start the engine and activate upper lift up or down. Hold the function for 10-15 seconds. This bleeds the air out of the sense line. The gauge should be reading between **400-440 psi (28-30 bar)**. To make an adjustment to this pressure, go to the engine compartment, locate the function pump.

c. There are (2) adjustments at the top of the pump. They are located on the pump compensator which has (4) bolts mounting it to the pump. The stand by adjustment is at the top.

d. To adjust this, a 4 mm and 6 mm Allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn. Then using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. The pressure should read between **400-440 psi (27.58-30.34 bar)**.

2. **Set High pressure relief**

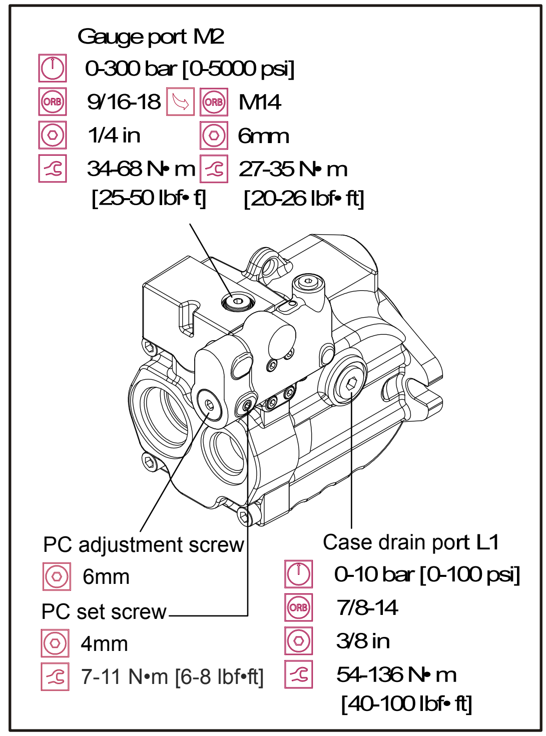


Figure 5-162. Pressure Compensation Control Adjustment

a. Install a high pressure gauge at the **"MP"** port of the main valve block.

b. Activate upper (main) telescope in. The gauge should read **2600 psi (179 bar)**.

c. To make an adjustment to this pressure, go back to the engine compartment to the function pump. The high pressure relief adjustment is the lower one of the (2) on the compensator. To adjust this, a 4 mm and 6 mm Allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine.

d. First, using the 4 mm wrench, loosen the setscrew on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

e. Then using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. This is the **maximum** relief pressure for all functions governed by this pump.

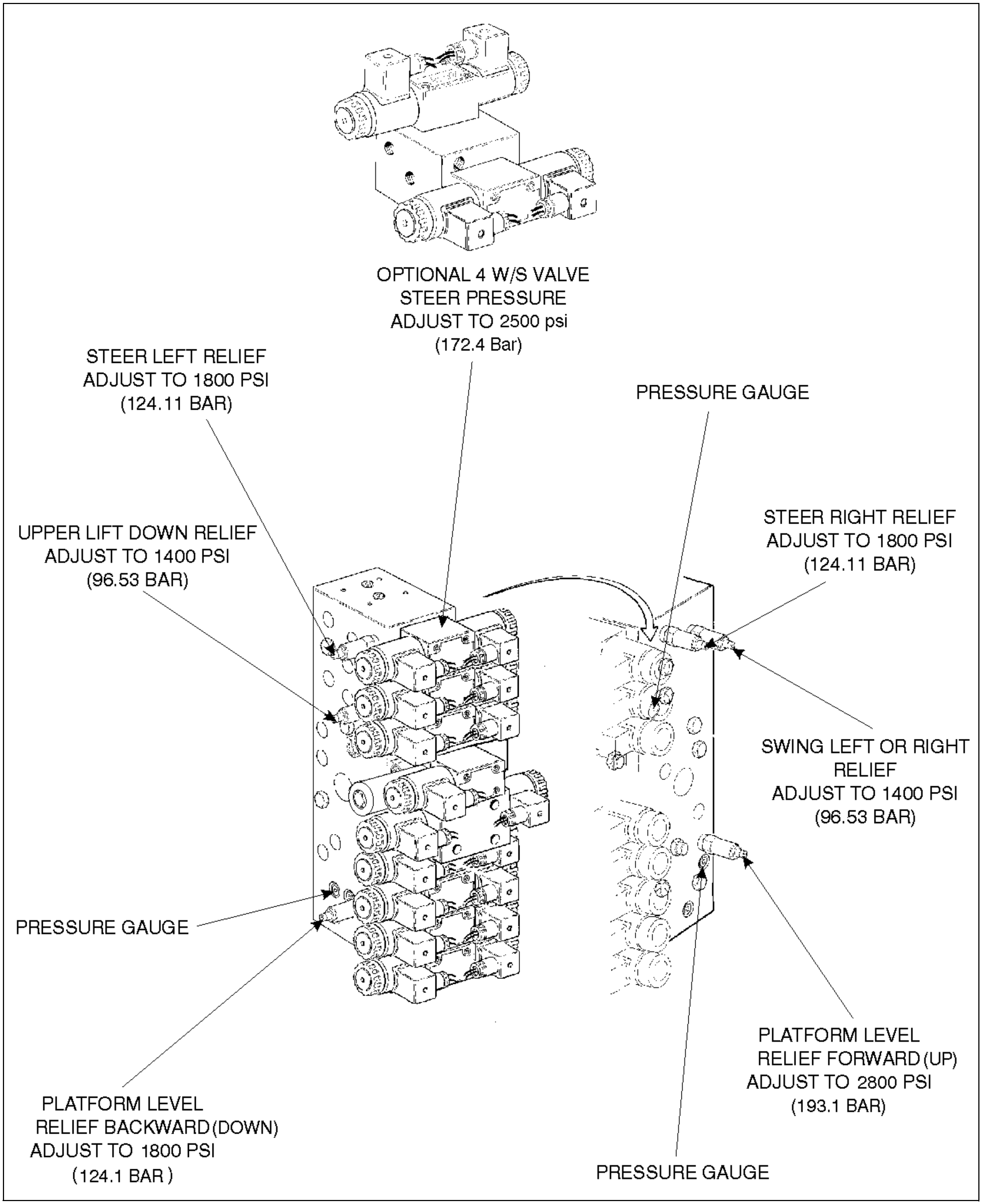
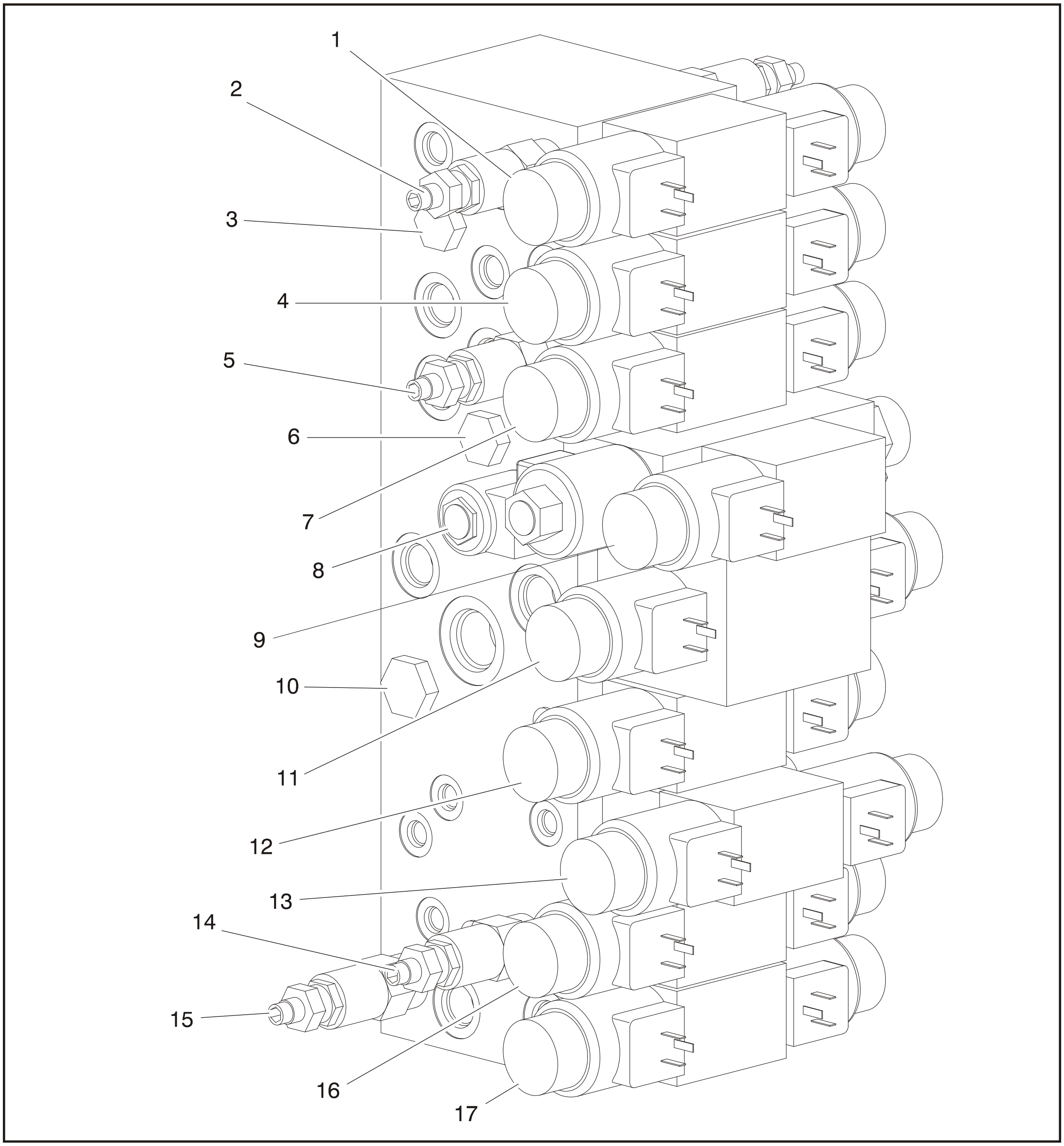
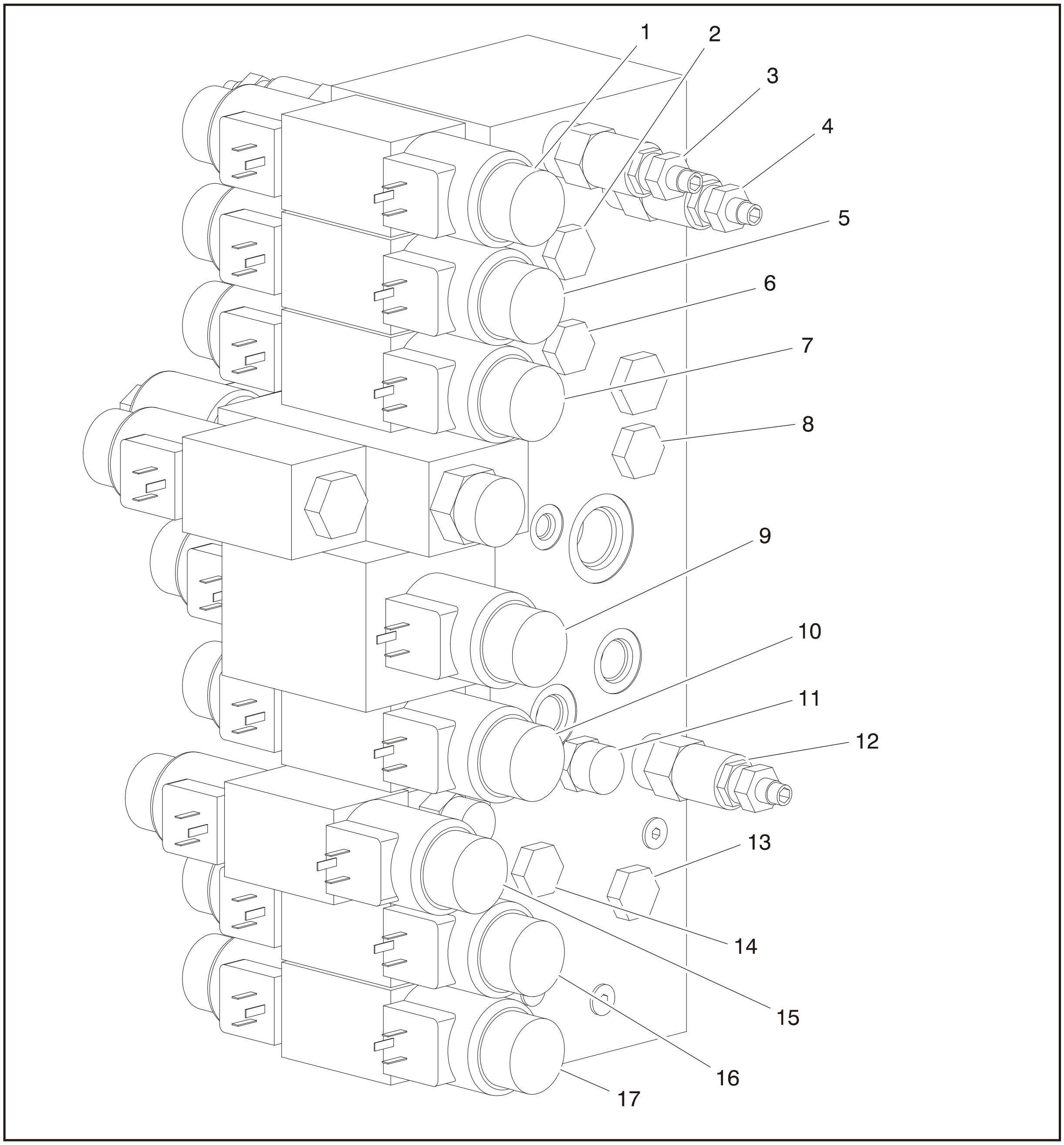


Figure 5-163. Main Control Valve Pressure Adjustments



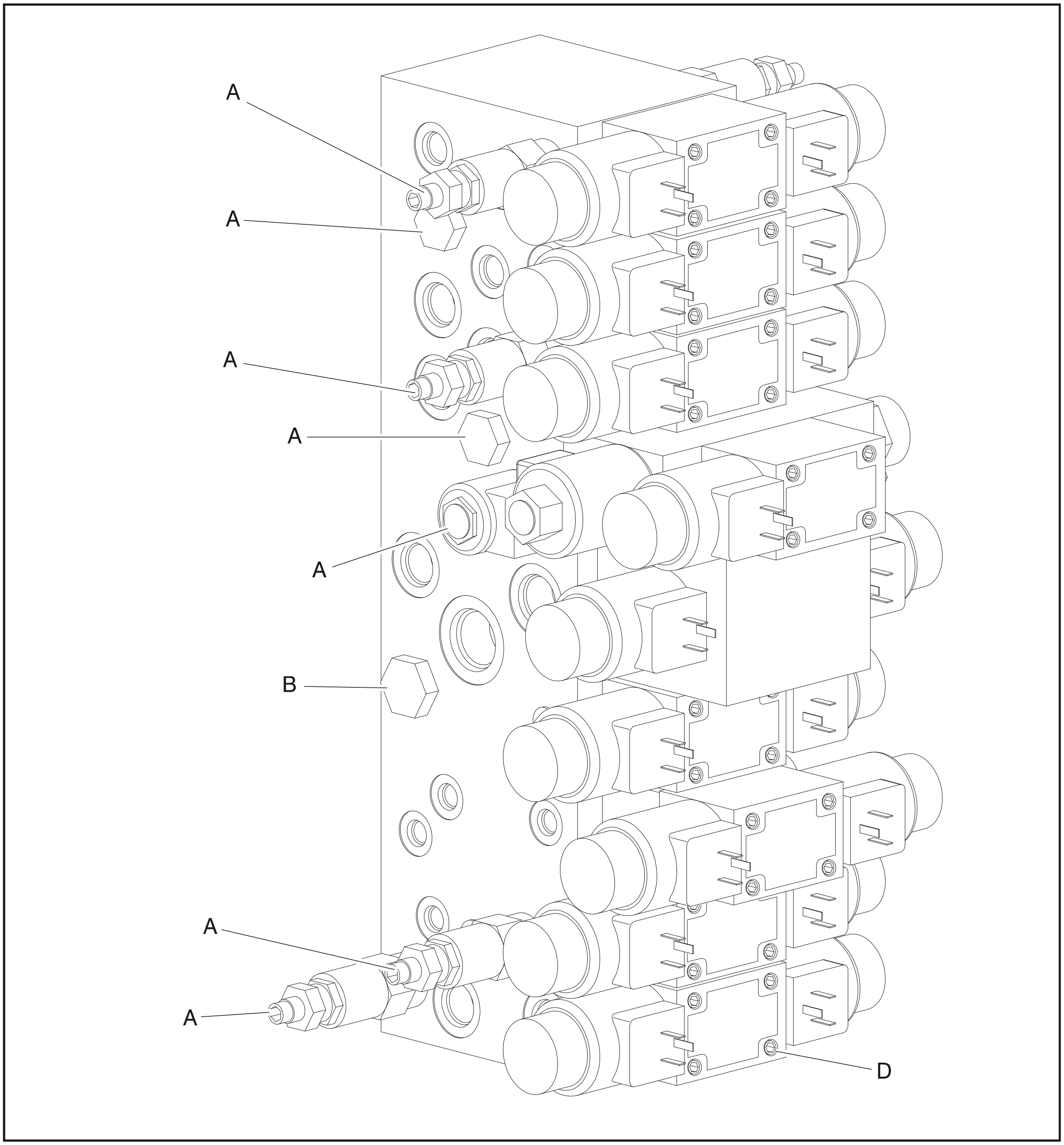
1. Front Steer Right Solenoid
2. Front Steer Relief
3. Load Sensing Cartridge
4. Swing Right Solenoid
5. Main Lift Relief
6. Load Sensing Cartridge
7. Main Lift Up Solenoid
8. Load Sensing Dump Valve
9. Flow Control Valve
10. Tower Lift Check
11. Main Tele In Solenoid
12. Tower Lift Down Solenoid
13. Platform Rotate Right
14. Platform Level Down Relief
15. Tower Tele Relief
16. Platform Level Up Solenoid
17. Tower Tele Out Solenoid

Figure 5-164. Main Valve Components - Sheet 1 of 2



1. Front Steer Left Solenoid
2. Load Sensing Cartridge
3. Front Steer Relief
4. Swing Relief
5. Swing Left Solenoid
6. Load Sensing Cartridge
7. Main Lift Down Solenoid
8. Load Sensing Cartridge
9. Main Tele Out Solenoid
10. Tower Lift Up
11. Platform Rotate Flow Regulator
12. Platform Level Up Relief
13. Orifice
14. Platform Level Check
15. Platform Rotate Left Solenoid
16. Platform Level Down Solenoid
17. Tower Tele In Solenoid

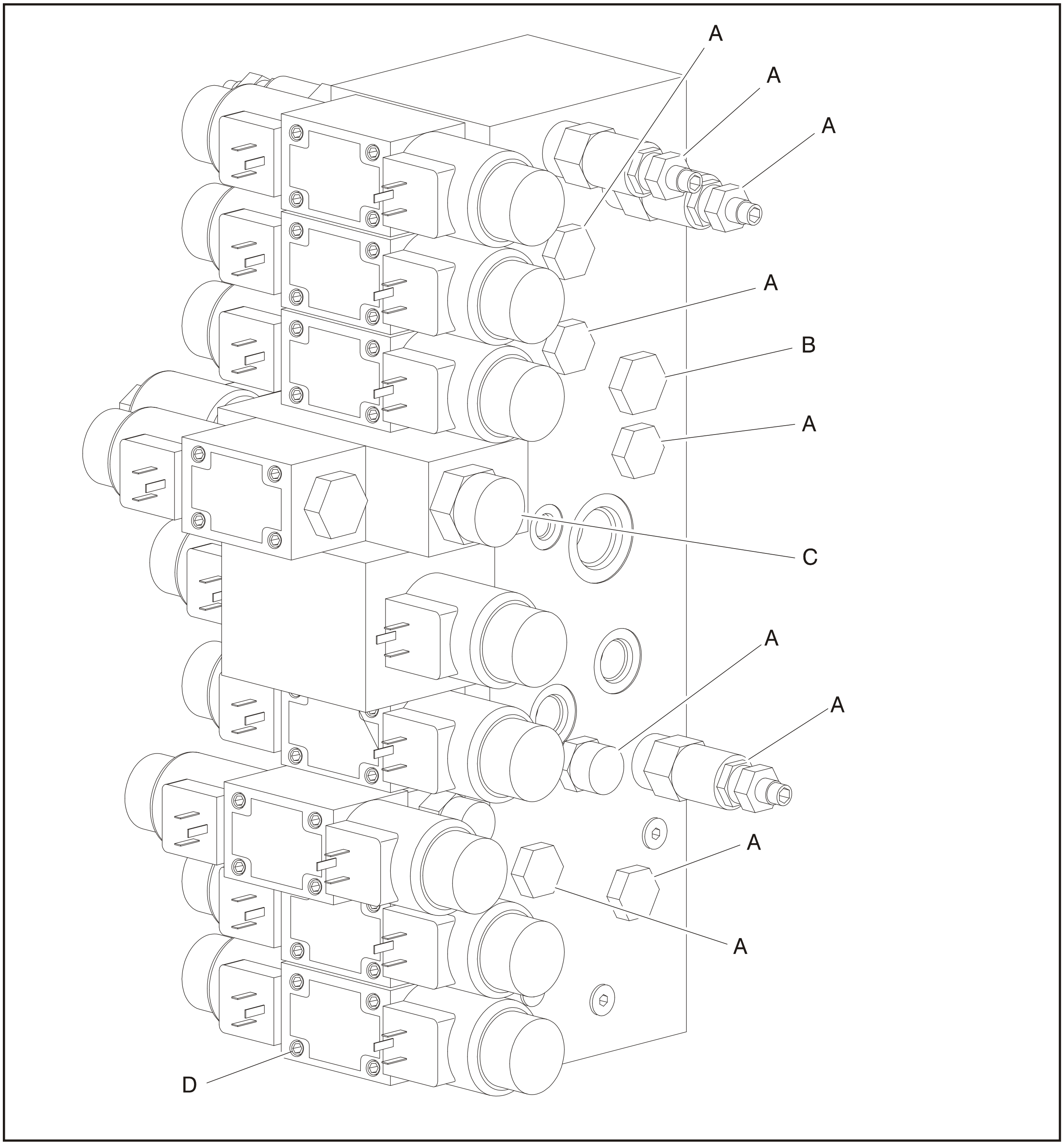
Figure 5-165. Main Valve Components - Sheet 2 of 2



	Ft. Lbs.	Nm
A	19-21	25.8-28.5
B	24-26	32.6-35.4
C	33-37	44.9-50.3
D	60 in. lbs.	6.7

NOTE: *When removing control valves from the manifold, it is important to observe the tag on the face of the valve, as the new valve must be installed with the tag facing the same way as the tag on the valve that was removed. The bolt pattern on the control valves is not symmetrical, so if the bolts seem difficult to turn when installing, it would indicate the valve is upside down and forcing the bolts will result in cross-threading. Check the tag, and if necessary, rotate the valve 180 degrees.*

Figure 5-166. Valve Component Torque - Sheet 1 of 2



	Ft. Lbs.	Nm
A	19-21	25.8-28.5
B	24-26	32.6-35.4
C	33-37	44.9-50.3
D	60 in. lbs.	6.7

NOTE: *When removing control valves from the manifold, it is important to observe the tag on the face of the valve, as the new valve must be installed with the tag facing the same way as the tag on the valve that was removed. The bolt pattern on the control valves is not symmetrical, so if the bolts seem difficult to turn when installing, it would indicate the valve is upside down and forcing the bolts will result in cross-threading. Check the tag, and if necessary, rotate the valve 180 degrees.*

Figure 5-167. Valve Component Torque - Sheet 2 of 2

SECOND: Adjustments Made at the Main Valve Block

MAIN RELIEF, STEER, SWING AND LIFT DOWN

1. **Upper (main) lift down**

   Install a high pressure gauge at the "MP" port of the main valve block. Activate upper lift down. The gauge should read **1400 psi (97 bar)**. The adjustment cartridge is located to the right of port #11. Turn clockwise to increase, counterclockwise to decrease.

2. **Swing** (left and right are done with one adjustment)

   Using the same gauge at the same port, lock the turntable lock pin. Activate swing, the gauge should read **1400 psi (97 bar)**. The adjustment cartridge is located on the right side of the block, the second relief valve cartridge down from the top. (Note: the front of the block has the bolt on valves on that face.) Turn clockwise to increase, and counterclockwise to decrease.

3. **Steer**

   Using the same gauge at the same port. Activate steer left or right. The gauge should read **1800 psi (124 bar)**. (2-wheel steer) both directions. One relief cartridge is located on the right side of the block, at the top. The other one is located on the left side next to port #15. Turn clockwise to increase, counterclockwise to decrease.

4. **Platform Level Up**

   Install a high pressure gauge at port **"M3"**, located on the right side of the block at the bottom. There is pressure trapped at this test port. To release this pressure, activate level down to the end of stroke (the pressure in the up side goes to 0). This will allow you to snap a gauge on this port. Activate level up to the end of stroke, you should read **2600 psi (179 bar)**. This is what the pump high pressure valve is set at. We want level up to read **2800 psi (193 bar)**. The level up relief valve is located in front of the **"M3"** gauge port. When activating level up, and reading **2600 psi (179 bar)**, turn the adjustment counterclockwise until the pressure drops below **2600 psi (179 bar)**, turn clockwise (slowly) until the gauge stops moving. It should stop at **2600 psi (179 bar)**, turn clockwise 1/2 turn and lock. This will give you **2800 psi (193 bar)** on level up. This pressure is required to keep the platform level when the boom is being lowered.

5. **Platform Level Down**

   Install a high pressure gauge at the **"M4"** port located on the left of the valve near the bottom. To get a gauge on this point, activate level up to the end of stroke (the pressure in the down side will go to 0, allowing you to snap a gauge on). Activate level down to the end of stroke, reading **1800 psi (124 bar)**. The level down relief valve is located on the right side of the block above the **"M4"** port. Turn clockwise to increase, and counterclockwise to decrease.

6. **Tower Telescope Out**

   Install a high pressure gauge at gauge port **"M2"** located on the right side of the valve block, at the bottom. Activate tower telescope out, the gauge should read **2200 psi (152 bar)**. This can be done with the tower lift down or up. If the tower lift is up, you must run tower telescope out to the end of stroke. The tower telescope out relief valve is located on the left side, at the bottom, next to port #2. Turn clockwise to increase, counterclockwise to decrease.

7. **Articulating Jib Up**

   Install a high pressure gauge on the gauge port of the jib block located on the top of the main valve block. The gauge port has a 12" hose plumbed into it for easy access. Activate jib up, you should read **2500 psi (172 bar)**. The up relief valve is located on the right side of the jib block toward the front. Turn clockwise to increase, and counterclockwise to decrease.

8. **Articulating Jib Down**

   Install a high pressure gauge on the gauge port of the jib block located on top of the main valve block. The gauge port has a 12" hose plumbed into it for easy access. Activate jib down, you should read **1200 psi (82 bar)**. The down relief valve is located on the right side of the jib block toward the back. Turn clockwise to increase, and counterclockwise to decrease.

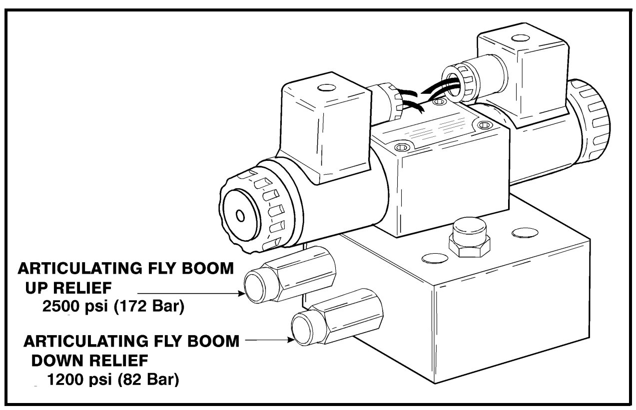


Figure 5-168. Articulating Jib Boom Pressure adjust.

4 WHEEL STEER (IF EQUIPPED)

1. At the platform console using the steer select switch activate "4 wheel steer".
2. Install a pressure gauge in port **"G"** on the control valve.
3. With the aid of an assistant, activate steer left and right, adjust front steer relief valve to **2500 psi (172.4 bar)**. This pressure only affects the front axle.

4. At the platform console using the steer select switch activate “crab” or “coordinated” steer.
5. At the main control valve block disconnect the wire din connectors on the front steer valve. When steer is activated only the rear steer will work.
6. Install a pressure gauge in port **"G"** on the control valve.
7. With the aid of an assistant, activate steer left and right, adjust rear steer relief valve to **2500 psi (172 bar)** Reading at the valve bank. **2500 psi (172 bar)** will give you **2000 psi (138 bar)** at the cylinders.
8. Re-connect the front steer din connectors at the valve bank.

5.10 HYDRAULIC OIL CHANGE-OUT PROCEDURE

This procedure is written to change out JLG std. hydraulic oil (Mobile 424) to cold weather fluid for machines operating in temperatures below -20°F (-29°C). JLG recommends (Mobil DTE 13). This procedure also applies to change-out of cold weather oil to std. Mobil 424 hydraulic oil.

NOTE: *This is not a procedure for changing from a petroleum based fluid to a water based fluid. Stricter guidelines are required when fluids are not compatible.*

1. All booms stowed, (jib also), drain the hydraulic oil tank, (approx. 40 gallons [150 L]).
2. Disconnect the main drive lines (A & B) from the right rear drive motor, and right front motor if 4 wheel drive. Drain into a container.
3. Disconnect the case drain lines from each of these motors and drain. This will drain most of the drive system. After they have been drained, reconnect them.
4. Refill the hydraulic oil tank with the appropriate fluid as recommended.
5. Remove the o-ring plug, (#10 size) on top of the Rexroth load sense pump. The plug is removed until the oil flows out of the pump. This insures that the pump cases are full of oil before starting. Install the plug after there is a steady flow of oil.
6. Jog the Auxiliary power pump 2-3 times (not energizing a function, only the Aux. Pump switch). Then activate the Aux. switch for approx. 20 seconds. This will flush the Aux. system.
7. Start the engine and let idle for a couple of minutes. Shut off engine.
8. If the machine has a jib: Remove the hose connected to port #17 on the main valve block and drain into a container that will hold at least 2 gallons (8 L) of oil. Plug port #17. Start the engine and activate jib up to the end of stroke. Stop, reconnect the hose to port#17, and cycle the jib function.
9. Remove the hose at port #8 on the main valve block. Place this hose inside a container that will hold approx. 10 gallons (38 L). Activate tower lift up to the end of stroke. Reconnect the hose on port #8 and lower the tower boom.

NOTE: *Depending on the ceiling height, the upper boom might have to be lowered while lifting the tower.*

10. Locate the manual pull valve on the side of the oil tank (red knob). Disconnect the 1/4" hose (port #1) where it connects to the side of the hyd. return filter (plug the port) and place into a container that will hold approx. 10 gallons (38 L). Start the engine. Pull the red knob and hold it open, while tower is lifting up. Raise the tower 7-8 ft. (2-2.5 m) and stop. Release the red knob, and lower the tower boom. At the end of stroke, hold the switch in the down position. You will hear a hissing sound coming from the upright. this is oil being replenished in the tower circuit. Hold the switch until the sound stops. (approx. 15-20 secs.) Repeat this procedure 2 more times. Reconnect port #1 hose to the hyd. return filter.
11. Disconnect the 1/4" hose at the port marked "MT" (plug the port). Drain the hose into a container that will hold approx. 2 gallons (8 L). Activate platform rotate and hold for approx. 60 seconds each direction. Reconnect the hose to port "MT".
12. Raise the tower boom to the end of stroke. Disconnect the hose from port #1 (plug the port) and drain into a container that will hold approx. 3 gallons (11.5 L). Activate tower telescope out. At end of stroke, reconnect the hose and retract the tower telescope cylinder.
13. Disconnect the hose at port #9 (plug the port), and drain into a container that will hold approx. 4 gallons. Activate main telescope out. At end of stroke, reconnect the hose and retract the telescope function.
14. From the ground control, tilt the platform back to the end of stroke. Turn off the engine. Locate the master cylinder and disconnect the rod end hose (plug the port). NOTE: THERE WILL BE PRESSURE IN THIS CIRCUIT. Drain this hose into a container that will hold approx. 2 gallons, and activate platform level down, to end of stroke. Reconnect hose. Cycle platform level, 2 more times.Raise the tower boom to full height. Disconnect the hose at port #12 and drain into a container that will hold approx. 10 gallons. Activate upper lift down to the end of stroke. Reconnect the hose to port #12. Disconnect the hose on port #11 (plug the port) and drain into a container that will hold approx. 10 gallons (38 L). Activate lift up to end of stroke. Reconnect the hose to port #11.

NOTE: *After all functions have been cycled 2-3 times, check the hydraulic oil tank level.*

5.11 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

From a hydrostatic component standpoint, the goal at system start up is to put into functional operation, the hydrostatic system in such a way as to preserve the designed life span of the system. The following start-up procedure should be adhered to whenever a new pump or motor is initially installed into a machine, or a system is restarted after either a pump or motor has been removed and/or replaced.

⚠ WARNING

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTIONS DISCONNECTED, ETC.). WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE VEHICLE/MACHINE.

Prior to installing the pump and/or motor, inspect the unit(s) for damage that may have been incurred during shipping and handling. Make certain that all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.

NOTE: *If a pump or motor is being replaced due to internal damage, the remaining units (pump or motors) need to be inspected for damage and contamination, and the entire hydraulic system will need to be flushed and the fluid replaced. Failure to do so may cause considerable damage to the entire system.*

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for property tightened fittings and make sure it is free of restrictions and air leaks.

NOTE: *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to assure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the upper case drain port.

NOTE: *It is highly recommended to use the highest possible case drain port, this ensures that the housing contains as much oil as possible and offers the greatest amount of lubrication to the internal components.*

NOTE: *In initial start-up conditions, it may be convenient to fill the housing, just prior to installing the case drain line. Component, (especially motor), location may be such that access to the case drain port after installation is not realistic.*

NOTE: *Make certain that the oil being used to fill the component housing is as clean as possible, and store the fill container in such a way as to prevent it from becoming contaminated.*

Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.

It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

⚠ WARNING

DO NOT START THE ENGINE UNLESS PUMP IS IN THE NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

"Jog" or slowly rotate the engine until charge pressure starts to rise. Start the engine and run at the lowest possible RPM until charge pressure has been established. Excess air should be bled from the system lines as close to the motors as possible.

NOTE: *With the engine on low idle, "crack", (loosen-don't remove), the system lines at the motor(s). Continue to run the engine at low idle and tighten the system lines as soon as oil is observed to leak from them. When oil is observed to "leak" at the motor the line is full, the air has been purged, and the system hoses should be retightened to their specified torque.*

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code. If charge pressure is inadequate, shut down and determine the cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.

Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.

Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down engine, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

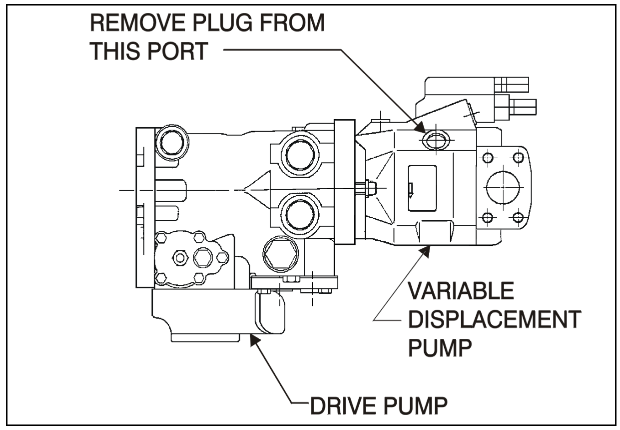
The machine is now ready for operation.

5.12 REXROTH VARIABLE DISPLACEMENT PUMP (PRIOR TO S/N 0300121643)

The variable displacement axial piston pump is a swashplate design for hydrostatic drives in open circuits. The flow is proportional to the speed and the displacement. By adjusting the swashplate, it is possible to vary the flow steplessly. See Figure 5-169. for pressure settings and schematic.

1. Variable, swashplate design SAE nominal pressure 3600 psi (248 bar), peak pressure 4600 psi (317 bar).
2. Pump, open circuit.
3. Displacement Vgmax 2.75 in^3 (45 cm^3).
4. Pressure and flow control (DFR1).
5. Series 52.
6. Clockwise rotation.
7. NBR seals (Nitrile rubber to DIN ISO 1629).
8. SAE 1.00 in. (2.54 cm) splined shaft (not suitable for through drive).
9. SAE 2 bolt mounting Flange - SAE 101-2 (B).

NOTE: *The Drive Pump and Displacement Pump must be filled with oil before starting the engine. As the tank is being filled, remove the specified plug from the Variable Displacement Pump. As oil enters the tank it flows to the pumps, fills them and flows out the port where the plug was removed. Removing the plug gives the air a place to escape. In approx. 5 min.,oil should flow out the port. Replace the plug, the procedure is completed.*



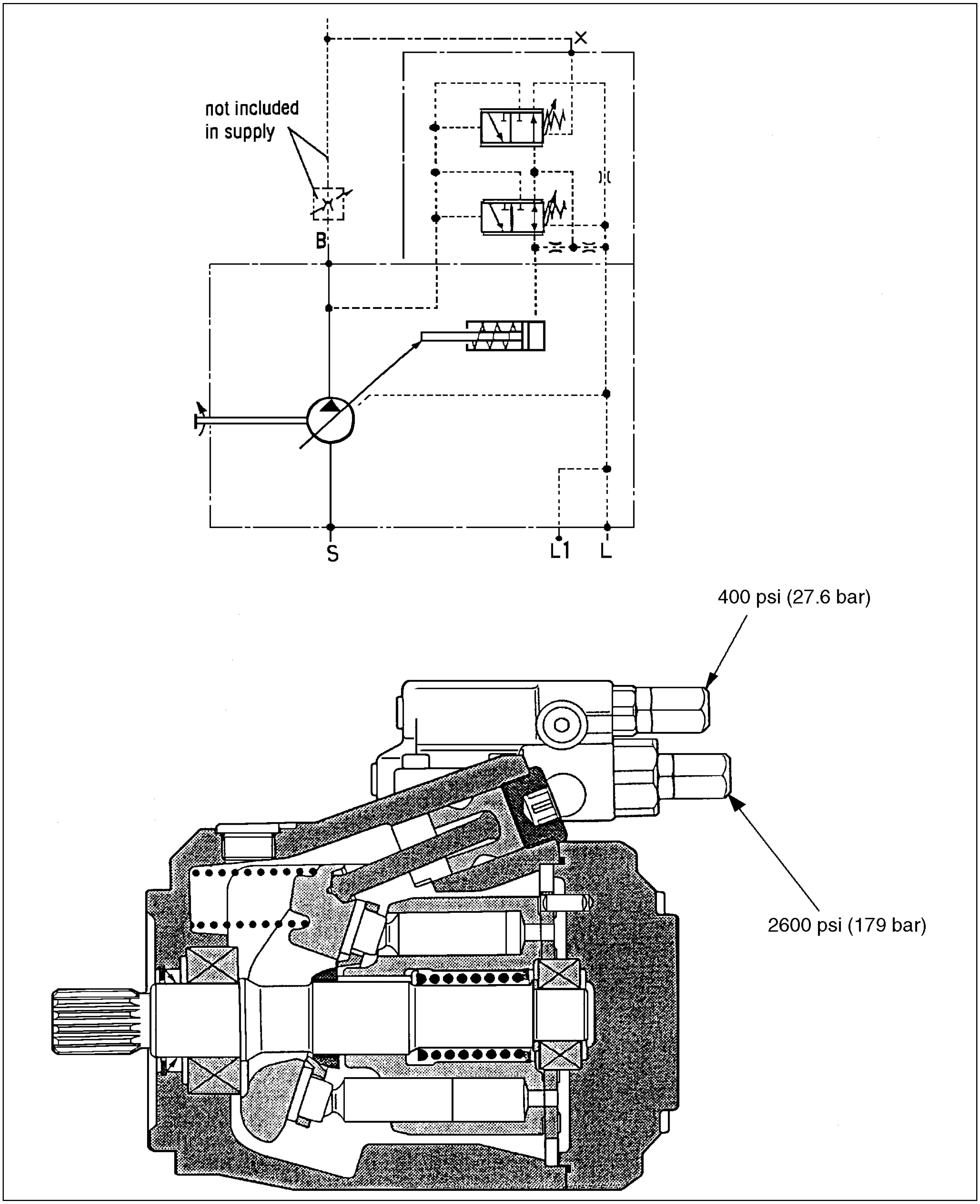


Figure 5-169. Variable Displacement Pump (Rexroth)

5.13 SAUER PISTON PUMP (S/N 0300121643 TO S/N 0300183033)

Table 5-1. Symbols Used

Symbol	Meaning	Symbol	Meaning
	Non-reusable part, use a new part		Inspect for wear or damage
	Option - either part may exist		Note correct orientation
	Internal hex head		Torque specification
ORB	O-ring boss port		Pull out with tool - press fit
	Lubricate with hydraulic fluid		Cover splines with installation sleeve
	Apply grease /petroleum jelly		Pressure measurement / gauge location or specification

The symbols above can be found in the pump illustrations. The legend above is provided to define each symbol and explain its purpose.

Table 5-2. Gauge and Port Information

Port	Purpose	Range of Pump	Fitting
M2	System pressure	0-5000 psi [0-300 bar]	7/16 - 20 o-ring fitting
M4	Servo pressure	0-5000 psi [0-300 bar]	7/16 - 20 o-ring fitting
L1,L2	Case pressure	0-100 psi [0-10 bar]	7/8 - 14 o-ring fitting
X1	Load Sense signal	0-5000 psi [0-300 bar]	7/16 - 20 o-ring fitting (tee into Load Sense signal line)

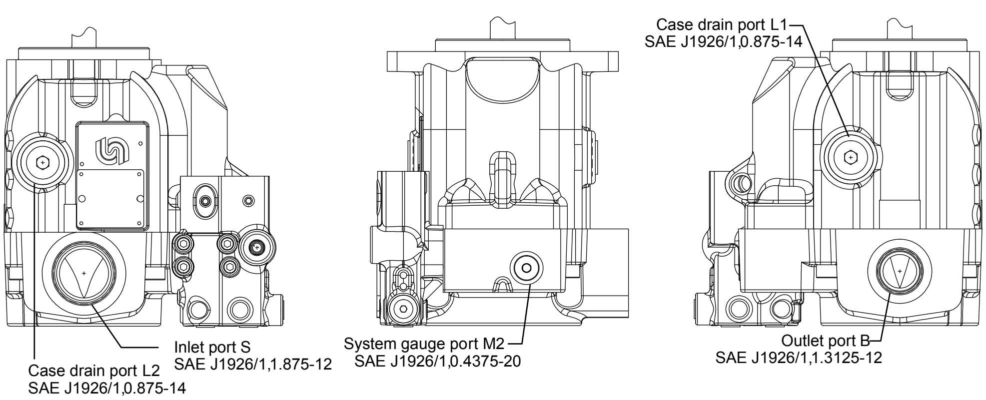


Figure 5-170. Gauge Port Locations

Initial start-up procedures

Follow this procedure when starting-up a new pump or when the pump has been removed.

1. Install the pump on the engine. Ensure the pump shaft is properly aligned.

CAUTION

INCORRECT SHAFT ALIGNMENT MAY RESULT IN DAMAGE TO DRIVE SHAFT, BEARINGS, OR SEAL WHICH CAN CAUSE EXTERNAL OIL LEAKAGE.

2. Fill the main pump housing with clean hydraulic fluid. Pour filtered oil directly into the upper most case drain port.
3. 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.
4. To ensure the pump stays filled with oil, install the case drain line in the upper most case drain port.
5. Install a gauge at port M2 to monitor system pressure during start up.
6. While watching the pressure gauge installed at M2, jog the engine or run 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, shutdown the engine, determine cause, and take corrective action. Refer to Troubleshooting.
7. Operate the hydraulic system for at least fifteen minutes under light load conditions.
8. Check and adjust control settings as necessary after installation. Refer to Adjustments.
9. Shut down the engine and remove the pressure gauge. Replace plug at port M2.
10. Check the fluid level in the reservoir; add clean filtered fluid if necessary. The pump is now ready for operation.

Troubleshooting

Table 5-3. Excessive Noise and/ or Vibration

Item	Description	Action
Check fluid level in reservoir.	Insufficient hydraulic fluid will cause cavitation.	Fill the reservoir to proper level.
Check for air in system.	Air in system will cause noisy, erratic control.	Purge air and tighten fittings. Check inlet for leaks.
Check pump inlet pressure / vacuum.	Improper inlet conditions will cause erratic behavior and low output flow.	Correct pump inlet pressure / vacuum conditions. Refer to Hydraulic parameters.
Inspect shaft couplings.	A loose or incorrect shaft coupling will cause excessive noise and/or vibration.	Repair or replace coupling and ensure that correct coupling is being used.
Check shaft alignment.	Misaligned shafts will create excessive noise and/or vibration.	Correct shaft misalignment.
Hydraulic fluid viscosity above acceptable limits.	Hydraulic fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operation or use fluid with the appropriate viscosity grade for expected operating temperatures.

Table 5-4. Actuator Response Is Sluggish

Item	Description	Action
Check external system relief valve setting.	Low external relief valve setting will slow down system.	Adjust external relief valve setting per manufacturer's recommendations. External relief setting must be above Pressure Compensator setting for proper operation.
Check Pressure Compensator and LS control setting.	Low Pressure Compensator setting will prevent the pump from achieving full stroke. Low Load Sense setting will limit output flow.	Adjust Pressure Compensator and Load Sense setting. Refer to Adjustments.
Check Load Sense control signal pressures.	Incorrect Load Sense signal will not allow pump to operate correctly.	Inspect system, ensure that proper Load Sense signal is transmitted to the pump.
Internal system leaks.	Worn internal parts will not allow the pump to operate properly.	Refer to Authorized Service Center for repairs as required.
Hydraulic fluid viscosity above acceptable limits.	Hydraulic fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operation or use fluid with the appropriate viscosity grade for expected operating temperatures.
Check external system valving.	Malfunctioning valving may not allow system to respond properly.	Repair or replace system valving as required.
Check pump case pressure.	High case pressure will cause the system to be sluggish.	Correct case drain line restrictions.
Check pump inlet pressure / vacuum.	High inlet vacuum will cause low output flow.	Correct inlet pressure conditions.

Table 5-5. System Operating Hot

Item	Description	Action
Check fluid level in reservoir.	Insufficient volume of hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level. Verify proper size of reservoir.
Inspect heat exchanger. Check air flow and input air temperature for the heat exchanger.	Insufficient air flow, high input air temperature, or undersized heat exchanger will not meet cooling demands of the system.	Clean, repair, or replace heat exchanger as required. Verify proper size of heat exchanger.
Check external system relief valve setting.	Fluid passing through relief valve adds heat to system.	Adjust external system relief valve setting per manufacturer's recommendations. External relief valve setting must be above Pressure Compensator setting for proper operation.
Check pump inlet pressure / vacuum.	High inlet vacuum adds heat to system.	Correct inlet pressure / vacuum conditions.

Table 5-6. Low Pump Output Flow

Item	Description	Action
Check fluid level in reservoir.	Insufficient hydraulic fluid will limit output flow and cause internal damage to pump.	Fill the reservoir to proper level.
Hydraulic fluid viscosity above acceptable limits.	Fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operation or use fluid with the appropriate viscosity grade for expected operating temperatures.
Check external system relief valve setting.	External relief valve set below Pressure Compensator setting will cause low output flow.	Adjust external relief valve per manufacturer's recommendation. External relief valve setting must be above Pressure Compensator setting for proper operation.
Check Pressure Compensator and Load Sense control setting.	Low Pressure Compensator setting will prevent the pump from achieving full stroke. Low Load Sense setting will limit output flow.	Adjust Pressure Compensator and Load Sense setting. Refer to Adjustments.
Check pump inlet pressure / vacuum.	High inlet vacuum will cause low output flow.	Correct inlet pressure conditions.
Check input speed.	Low input speeds decrease flow.	Adjust input speed.
Check pump rotation.	Incorrect rotational configuration will cause low flow.	Use pump with appropriate rotational configuration.

Table 5-7. Pressure or Flow Instability

Item	Description	Action
Check for air in system.	Air in system will cause erratic operation.	Activate Pressure Compensator, allowing system to bleed air. Check inlet line for leaks and eliminate source of air ingression.
Check control spools.	Sticking control spools will cause erratic operation.	Inspect spools for free movement in bore. Clean or replace as needed.
Check Load Sense setting.	Low Load Sense setting may cause instability.	Adjust Load Sense setting to proper level. See Adjustments.
Check Load Sense signal line.	Blocked Load Sense signal line will interfere with proper Load Sense operation.	Remove blockage.
Check external relief valve and Pressure Compensator setting.	Insufficient pressure differential between Pressure Compensator Pressure Compensator setting and external relief valve.	Adjust external relief valve or Pressure Compensator control settings to appropriate level. Relief valve setting must be above Pressure Compensator setting for proper operation.
Check external relief valve.	Chattering external relief valve may cause unstable feedback to pump control.	Adjust or replace relief valve.

Table 5-8. System Pressure Not Reaching Pressure Compensator Setting

Item	Description	Action
Check Pressure Compensator control setting.	System pressure will not rise above Pressure Compensator setting.	Adjust Pressure Compensator to appropriate setting.
Check external relief valve.	External relief valve setting below Pressure Compensator setting will prevent pressure compensation.	Adjust external relief valve per manufacturer's recommendations. External relief valve must be set above Pressure Compensator setting for proper operation.
Inspect Pressure Compensator control spring.	Broken, damaged, or missing spring will cause erratic operation.	Replace spring as required.
Inspect Pressure Compensator spool for wear.	Wear of the Pressure Compensator spool will cause internal leakage in the control.	Replace the spool as required.
Inspect Pressure Compensator spool for proper orientation.	Improper orientation will result in poor operation.	Correct orientation of spool.
Check Pressure Compensator control for contamination.	Contamination may interfere with movement of the Pressure Compensator Spool.	Clean Pressure Compensator control components, take appropriate action to eliminate contamination.

CAUTION

HIGH INLET VACUUM CAUSES CAVITATION WHICH CAN DAMAGE INTERNAL PUMP COMPONENTS.

Table 5-9. High Inlet Vacuum

Item	Description	Action
Check fluid temperature.	Low temperature increases viscosity. High fluid viscosity causes high inlet vacuum.	Allow system to warm up before operation.
Inspect inlet screen.	Blocked or restricted inlet screen will cause high inlet vacuum.	Clean screen / remove blockage.
Check inlet piping.	Too many fittings, bends, or long piping will cause high inlet vacuum.	Eliminate fittings to make path more direct.
Hydraulic fluid viscosity above acceptable limits.	High fluid viscosity causes high inlet vacuum.	Select fluid with appropriate viscosity for expected operating temperature.

Shaft Seal Replacement

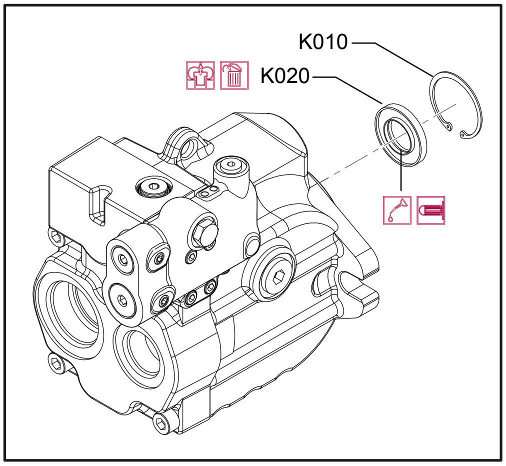


Figure 5-171. Shaft Seal and Retaining Ring

A lip type shaft seal is used in the pump and can be replaced without major disassembly of the unit. Replacement of the shaft seal requires removal of the pump from the machine.

REMOVAL

1. Using the appropriate snap-ring pliers, remove the retaining ring (K010) from the housing.
2. Remove the shaft seal (K020) from the bore in the pump housing and discard. Avoid damaging the pump housing or shaft. Puncture the face of the seal with a packing hook, or use a slide-hammer type puller to remove the seal.

INSTALLATION

1. Inspect the pump housing and new seal for damage. Inspect the sealing area on the shaft for rust, wear, or contamination. Polish the sealing area on the shaft if necessary.
2. Lubricate the lip of the new shaft seal with clean hydraulic fluid. Place a protective sleeve over the shaft end to prevent damage to the seal during installation.

CAUTION

PREMATURE BEARING FAILURE CAN RESULT IF THE SHAFT SEAL CONTACTS THE SHAFT BEARING. PRESS THE SEAL INTO THE HOUSING ONLY FAR ENOUGH TO CLEAR THE RETAINING RING GROOVE.

3. Keeping the seal perpendicular to the shaft, press the new seal into the housing just far enough to clear the retaining ring groove. Install seal with the cupped side toward the shaft bearing. Do not damage the seal during installation.
4. Using the appropriate snap ring pliers, install the seal retaining ring.
5. Remove the installation sleeve.

Control Assembly

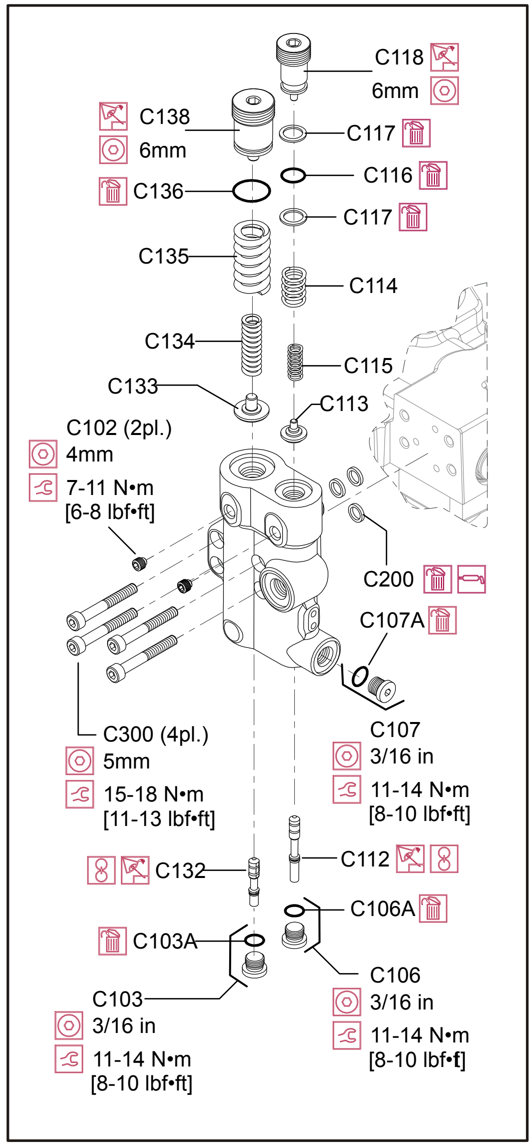


Figure 5-172. Control Assembly

DISASSEMBLY

1. Remove the four screws (C300) holding the control housing onto the end cap.
2. Remove the control and discard the three interface o-rings (C200).
3. Remove the Pressure Compensator set screw (C102), Pressure Compensator adjustment screw (C138), o-ring (C136), springs (C135, C134), and seat (C133). Discard the o-ring.
4. Remove the plug (C103), o-ring (C103A),and Pressure Compensator spool (C132) from the control housing; discard the o-ring. Note orientation of the spool for reassembly.
5. Remove the plug (C107) and o-ring (C107A); discard the o-ring.

NOTE: *For Pressure Compensator only controls, skip steps 6 and 7.*

6. Remove the Load Sense set screw (C102), Load Sense adjustment screw (C118), o-ring (C116), back-up rings (C117), springs (C114, C115), and seat (C113); discard the o-ring.
7. Remove the plug (C106), o-ring (C106A), and Load Sense spool (C112) from the control housing; discard the o-ring. Note orientation of the spool for reassembly.

INSPECTION

1. Inspect the adjustment screws for wear at the tips and where they contact the springs; replace as necessary.
2. Inspect the springs and spring guides for wear or damage; replace as necessary.
3. Carefully inspect the spools. Ensure the sealing lands are free of nicks and scratches. Check the ends that contact the spring guides for wear. Replace spools as necessary.
4. Inspect the control housing for damage. Check the spool bores for excessive wear.
5. Clean all parts and lubricate spools, springs, guides and new o-rings with clean hydraulic fluid.

REASSEMBLY

1. Install the Pressure Compensator spool, spherical end first, into the Pressure Compensator bore. The Pressure Compensator spool is the shorter of the two. Using a new o-ring, install the plug (C103). Torque to 8-10 ft.lb. [11-14 Nm].
2. Place the two Pressure Compensator springs onto the spring guide and install into the Pressure Compensator bore. Place a new o-ring onto the Pressure Compensator adjustment screw and thread it into the Pressure Compensator bore until flush, then make another full turn. Install and torque the set screw to 6-8 ft.lb. [7-11 Nm].

NOTE: *For Pressure Compensator only controls, skip steps 15 and 16.*

3. Install the Load Sense spool, spherical end first, into the Load Sense bore. The Load Sense spool is the longer of the two. Using a new o-ring, install the plug (C106). Torque to 8-10 ft.lb. [11-14 Nm].
4. Place the two Load Sense springs onto the spring guide and install into the Load Sense bore. Place a new o-ring and backup rings onto the Load Sense adjustment screw and thread it into the Load Sense bore until flush, then make another full turn. Install and torque the set screw to 6-8 ft.lb. [7-11 Nm].
5. Using a new o-ring, install the plug (C107). Torque to 8-10 ft.lb. [11-14 Nm].
6. Using petroleum jelly to retain them, install the three interface o-rings (C200) in the recesses on the control housing.
7. Install the control assembly onto the endcap using the four screws (C300). Torque to 11-13 ft.lb. [15-18 Nm]. Torque screws in a criss-cross pattern and re-torque the first screw to ensure proper torque retention.

Plug and Fitting Sizes and Torques

If any plugs or fittings are removed from the unit during service, install and torque as indicated here. This drawing is a composite. Your configuration may differ but the appropriate wrench size and torque can be found here.

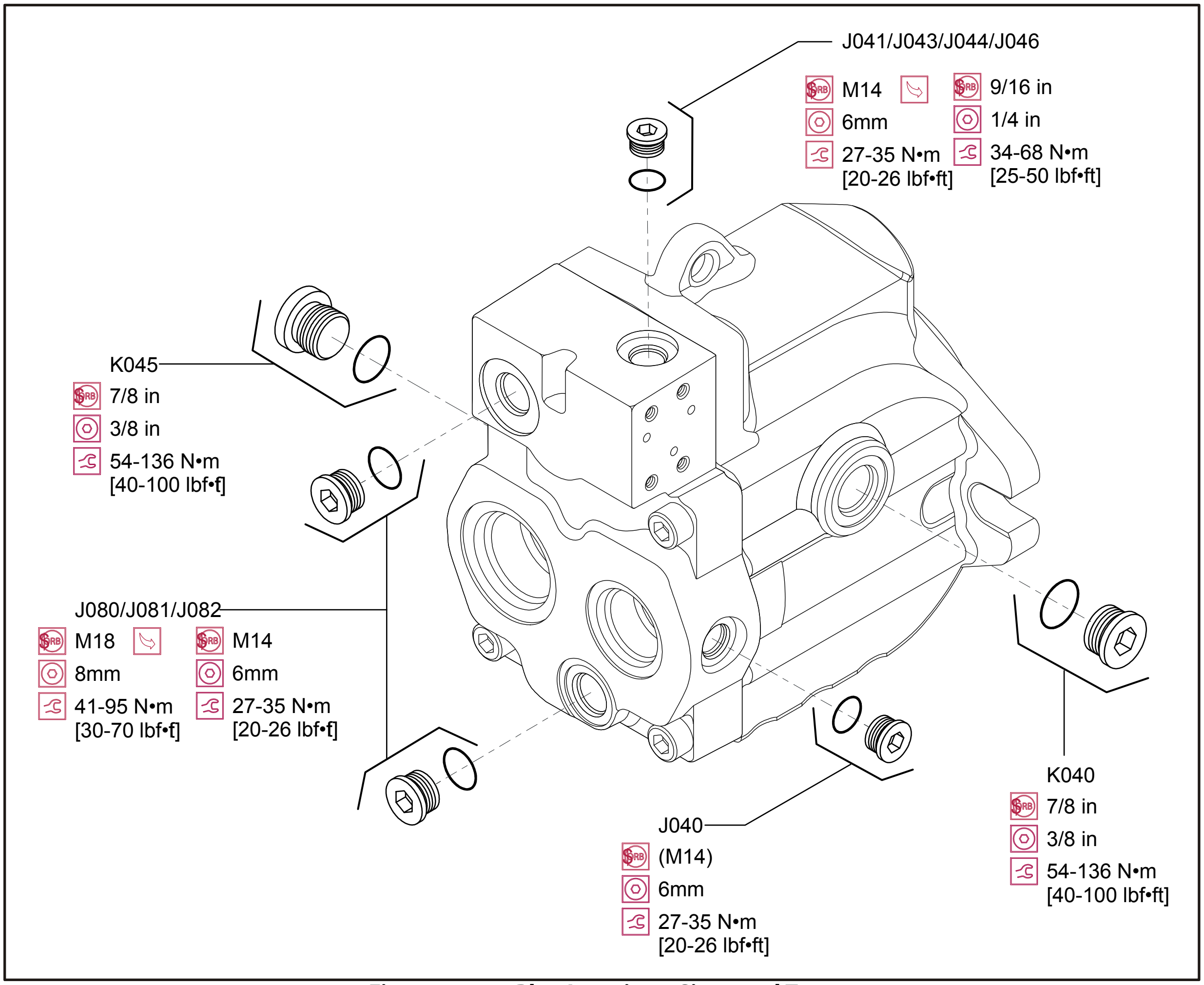


Figure 5-173. Plug Locations, Sizes, and Torques

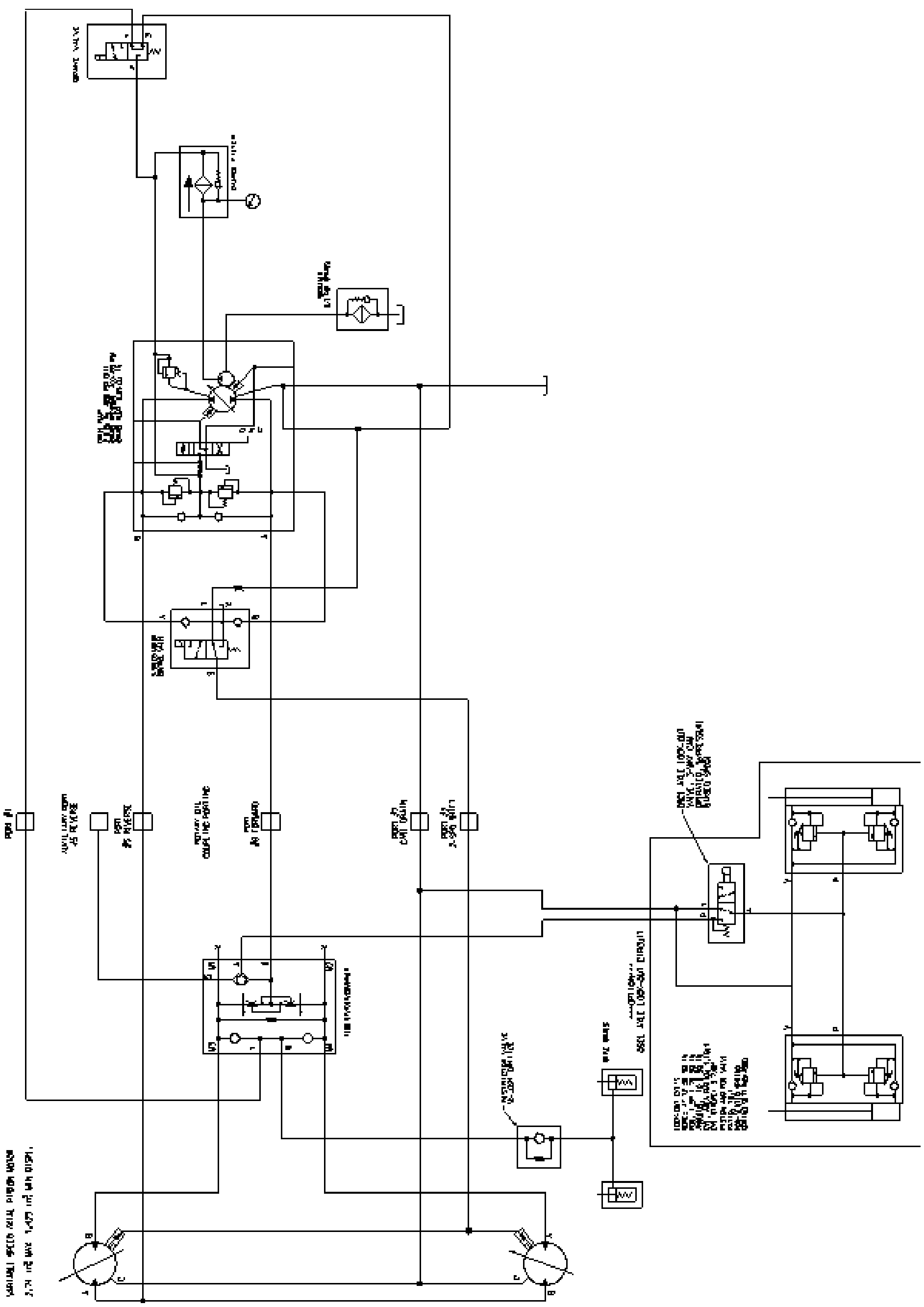


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Figure 5-174. Hydraulic Schematic 2 Wheel Drive (Prior to S/N 0300083332)

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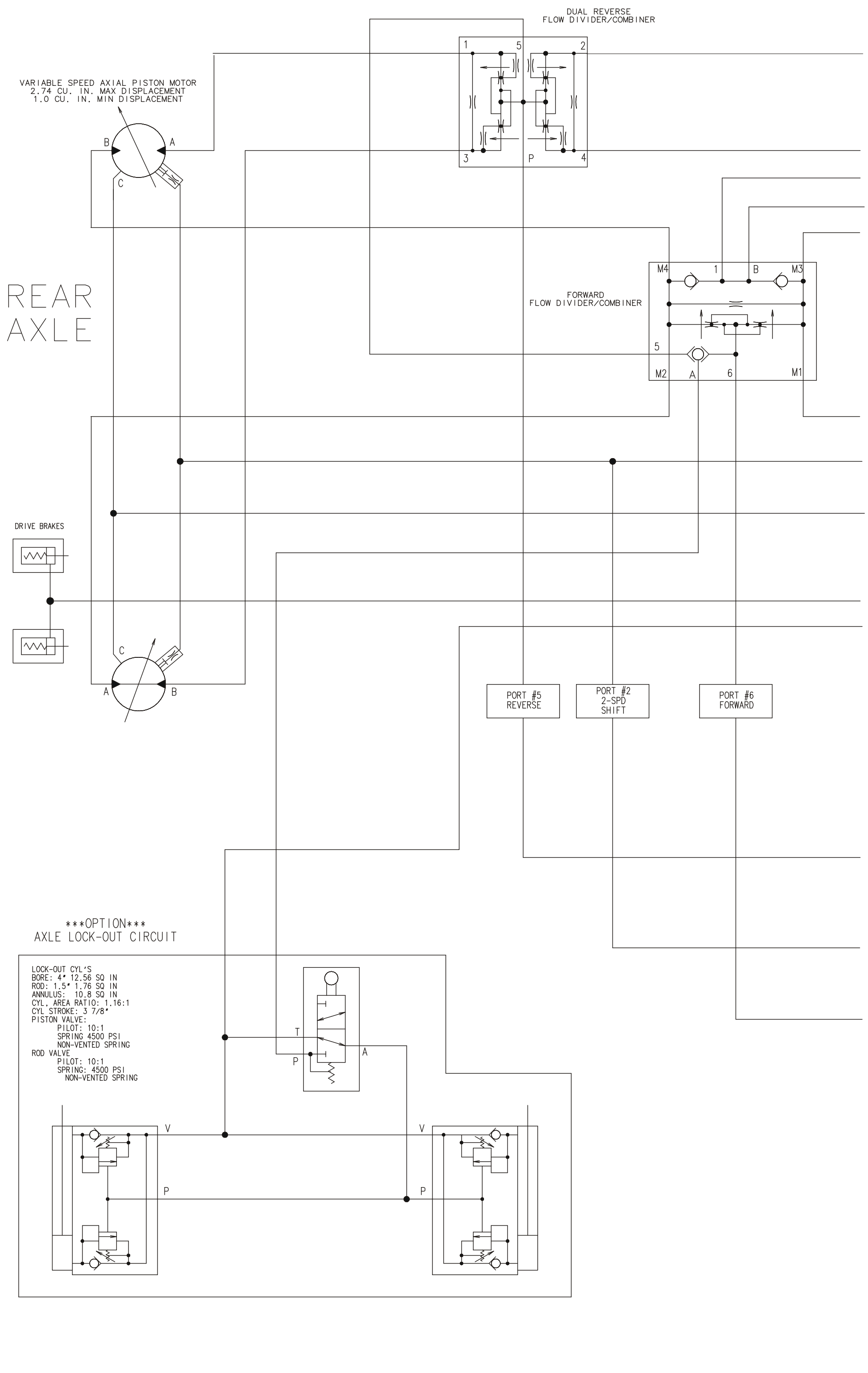


Figure 5-175. Hydraulic Schematic 4 Wheel Drive - (Prior to S/N 0300083332) - Sheet 1 of 2

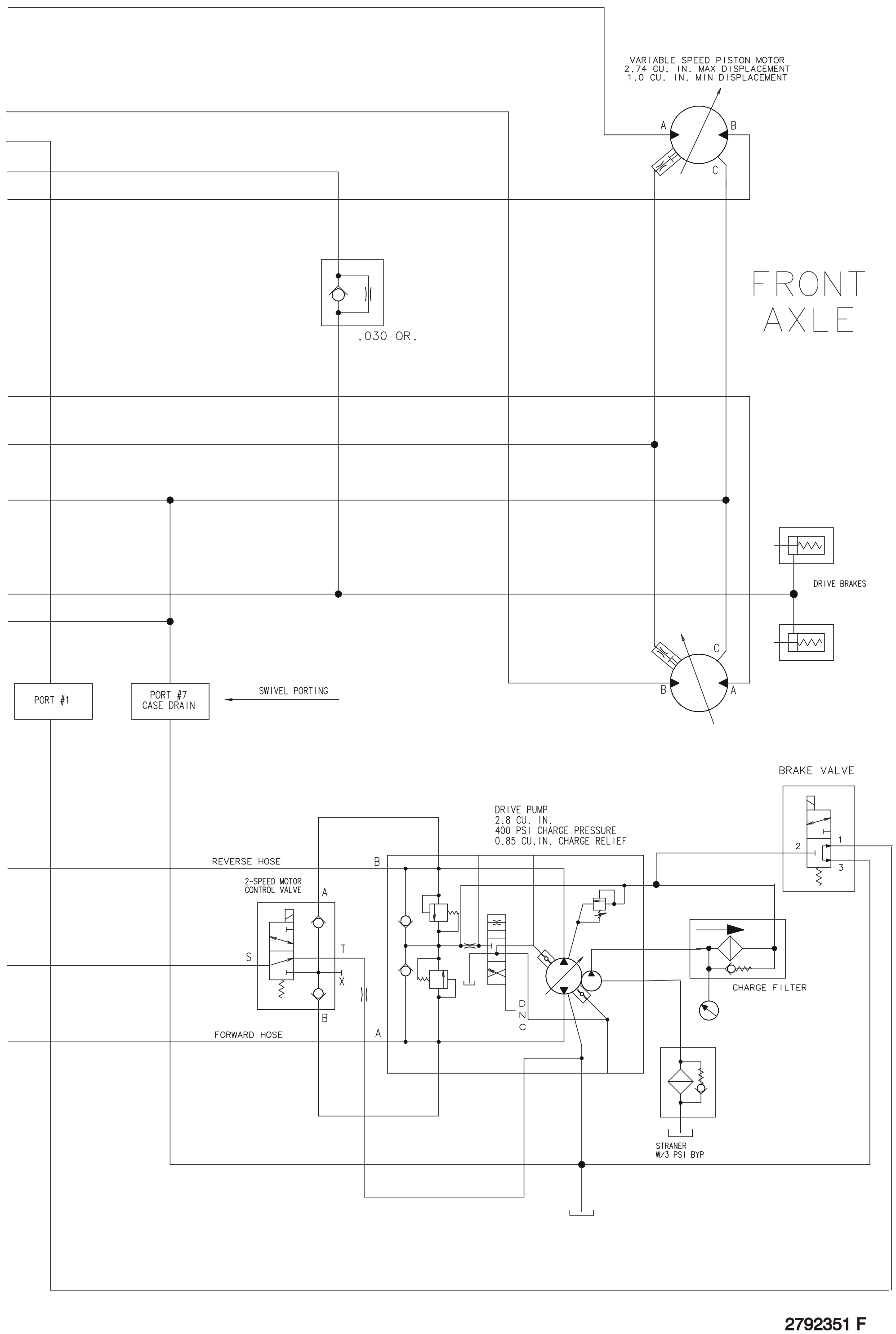


Figure 5-176. Hydraulic Schematic 4 Wheel Drive (Prior to S/N 0300083332) - Sheet 2 of 2

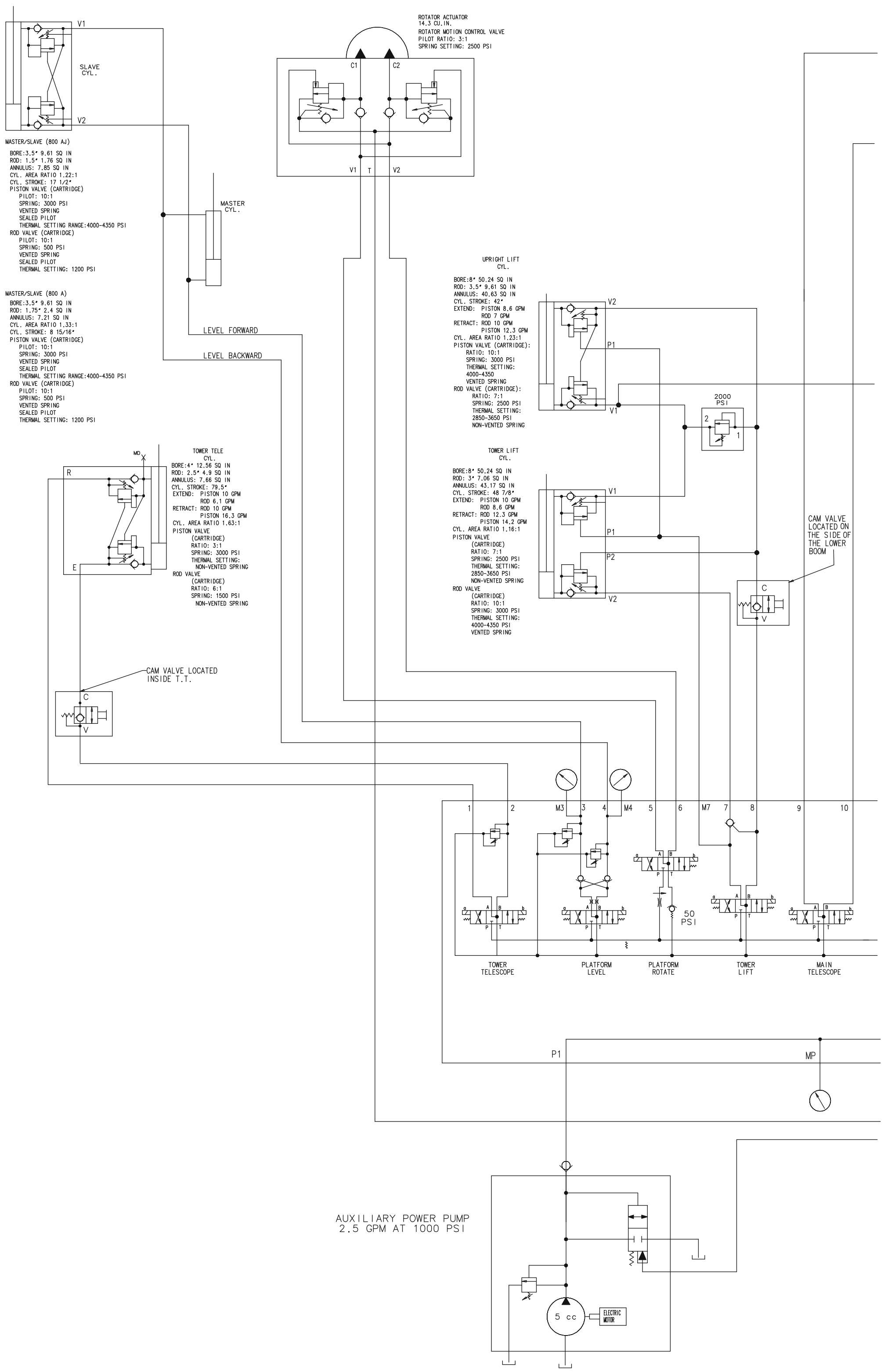


Figure 5-177. Hydraulic Schematic (Prior to S/N 0300083332) - Sheet 1 of 2

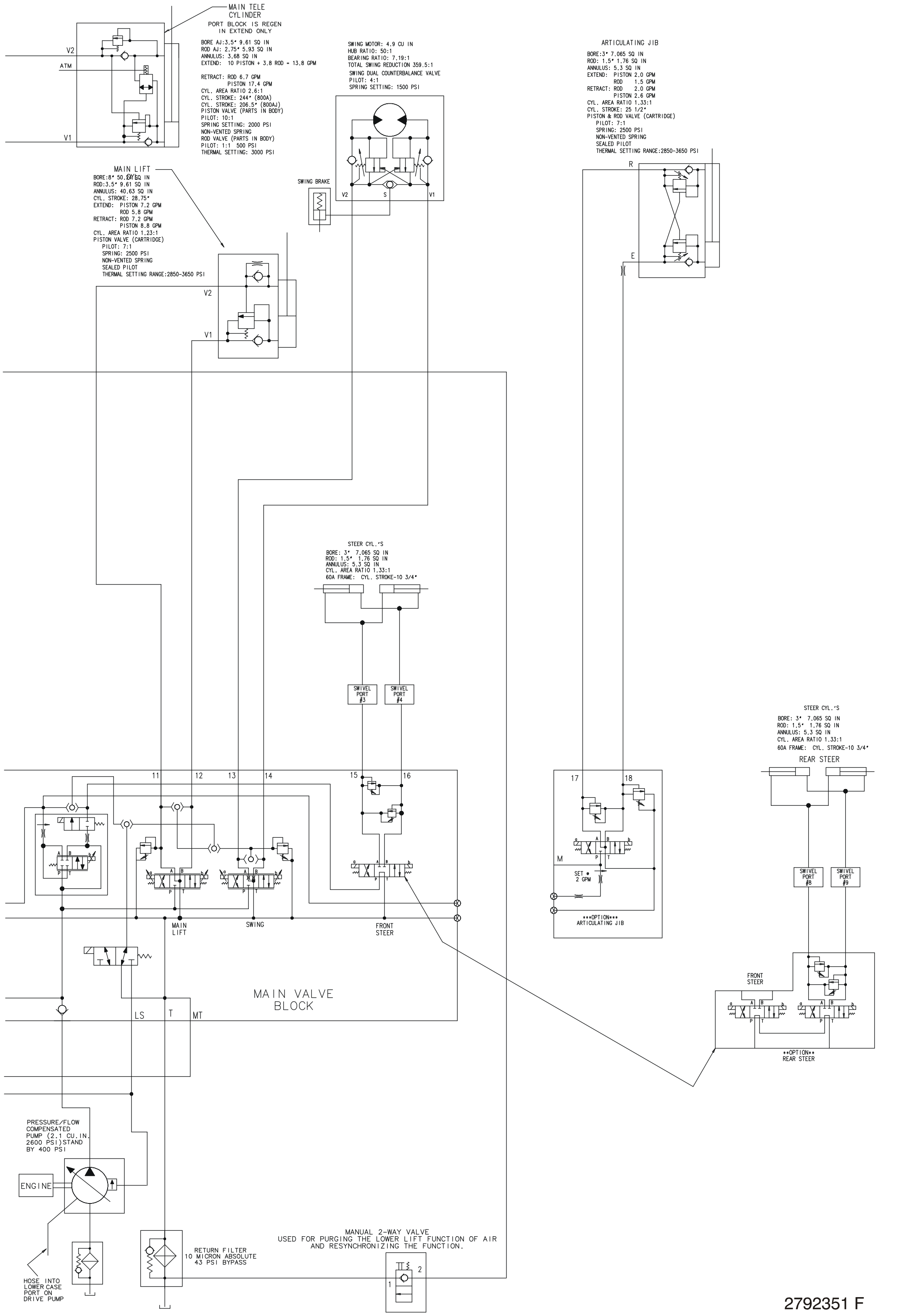


Figure 5-178. Hydraulic Schematic (Prior to S/N 0300083332) - Sheet 2 of 2

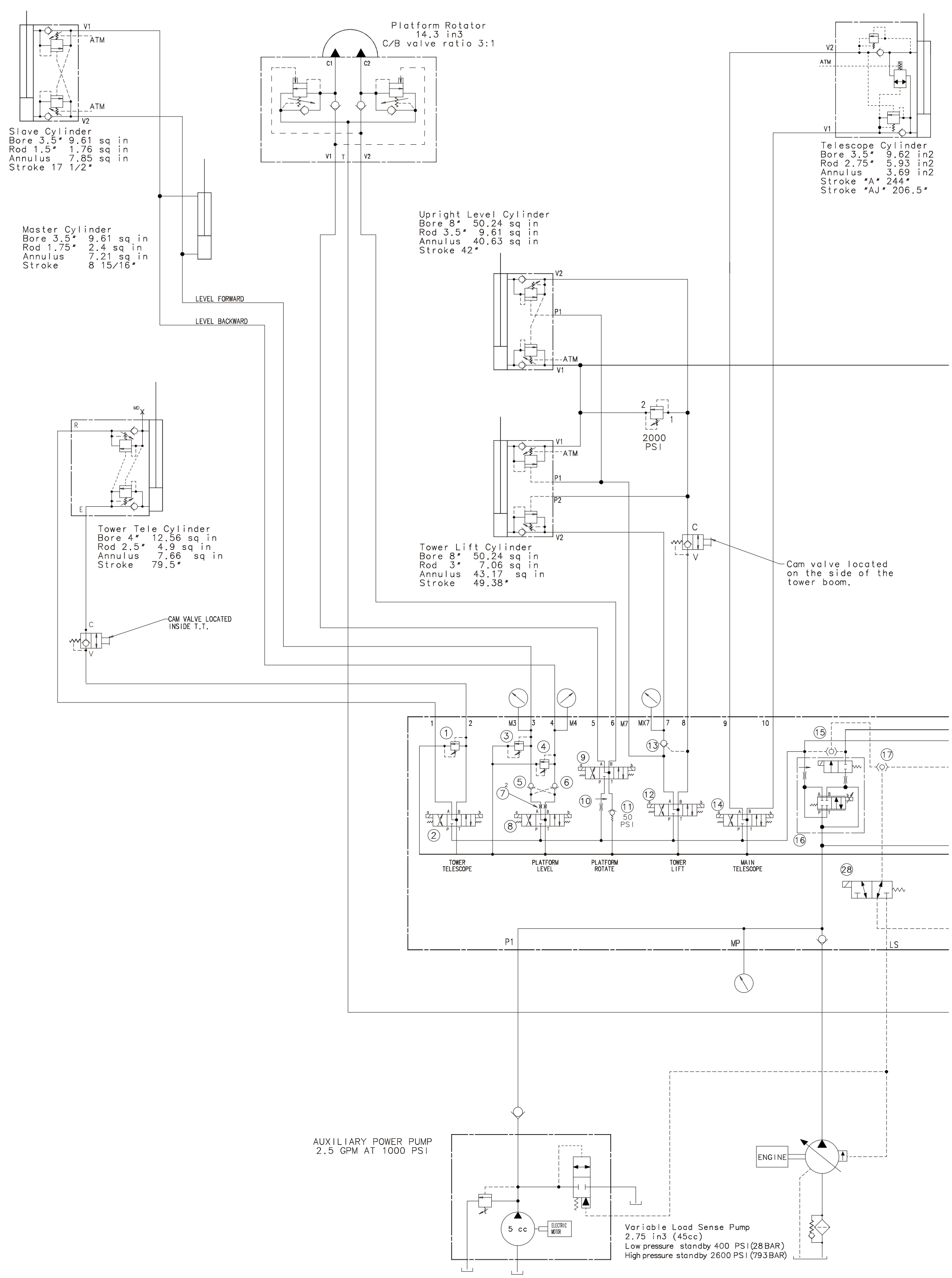


Figure 5-179. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 1 of 6

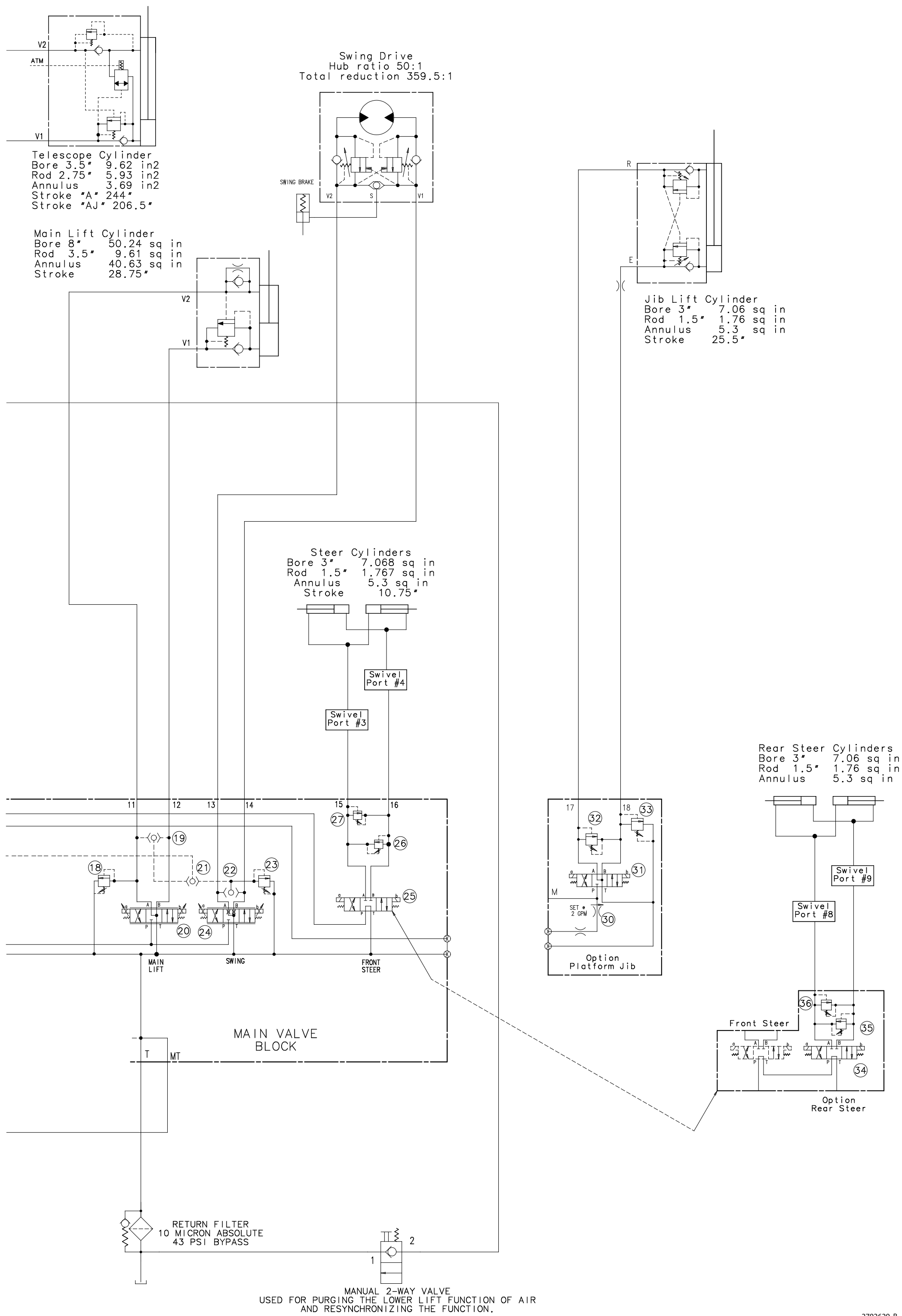


Figure 5-180. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 2 of 6

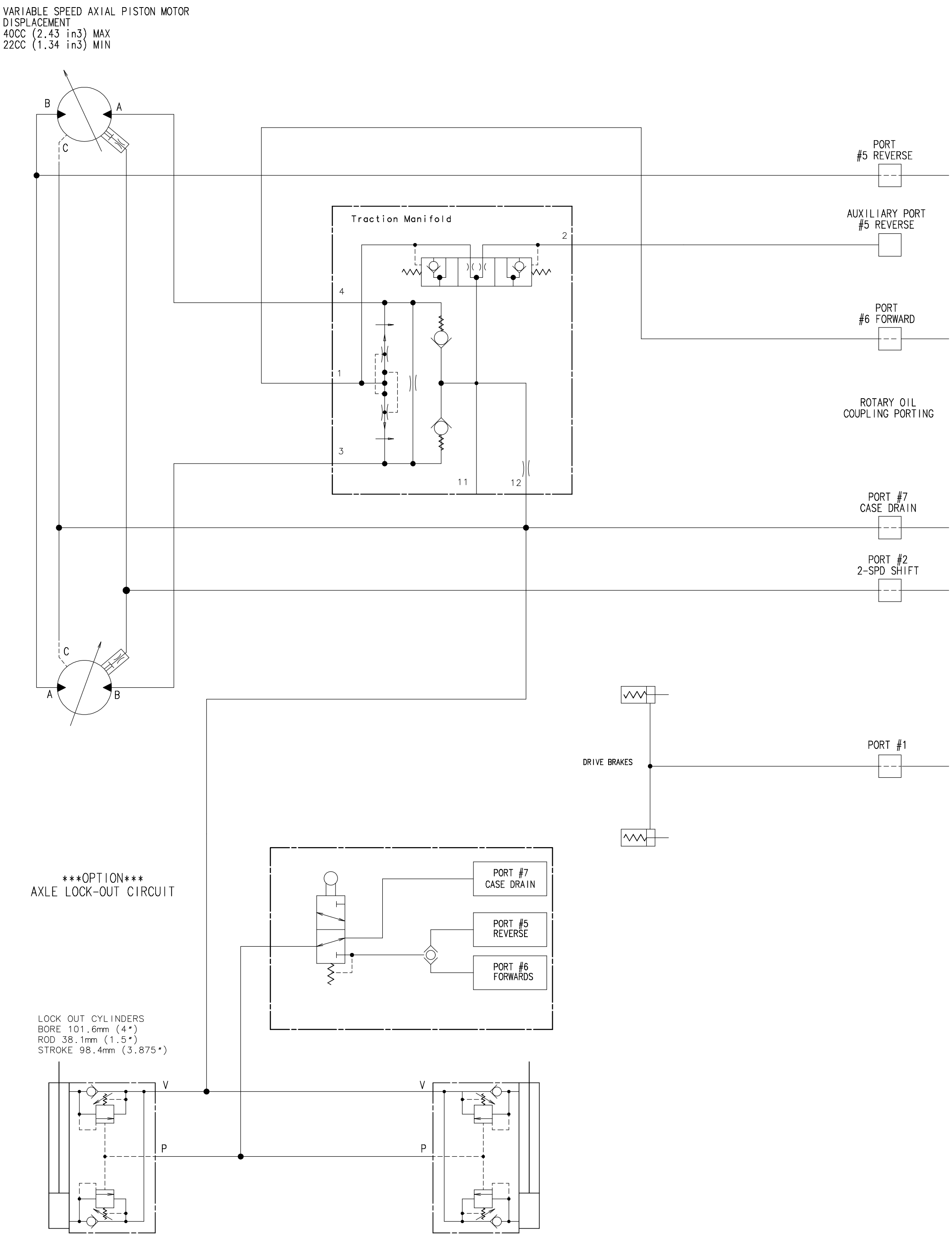


Figure 5-181. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 3 of 6

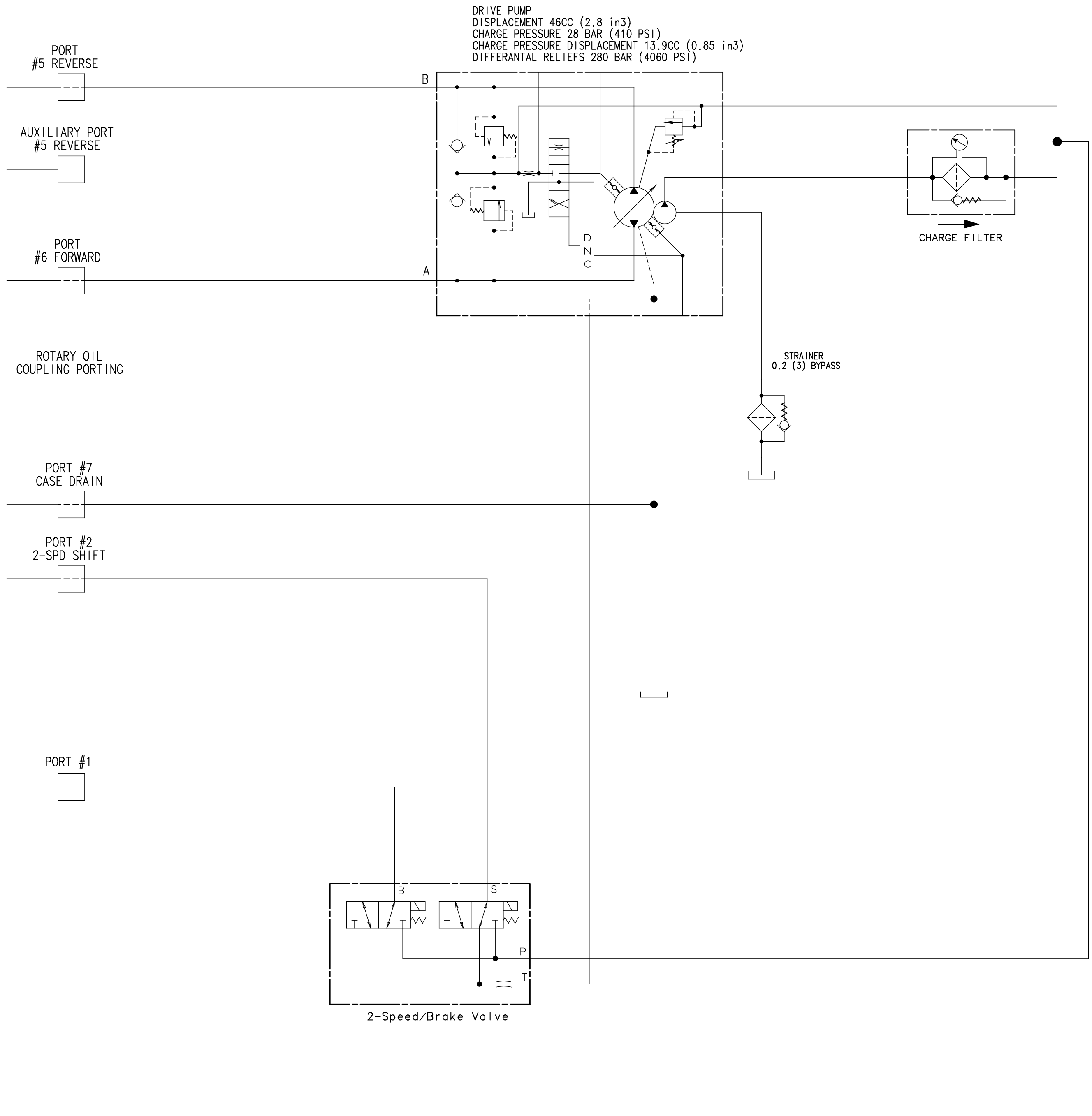


Figure 5-182. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 4 of 6

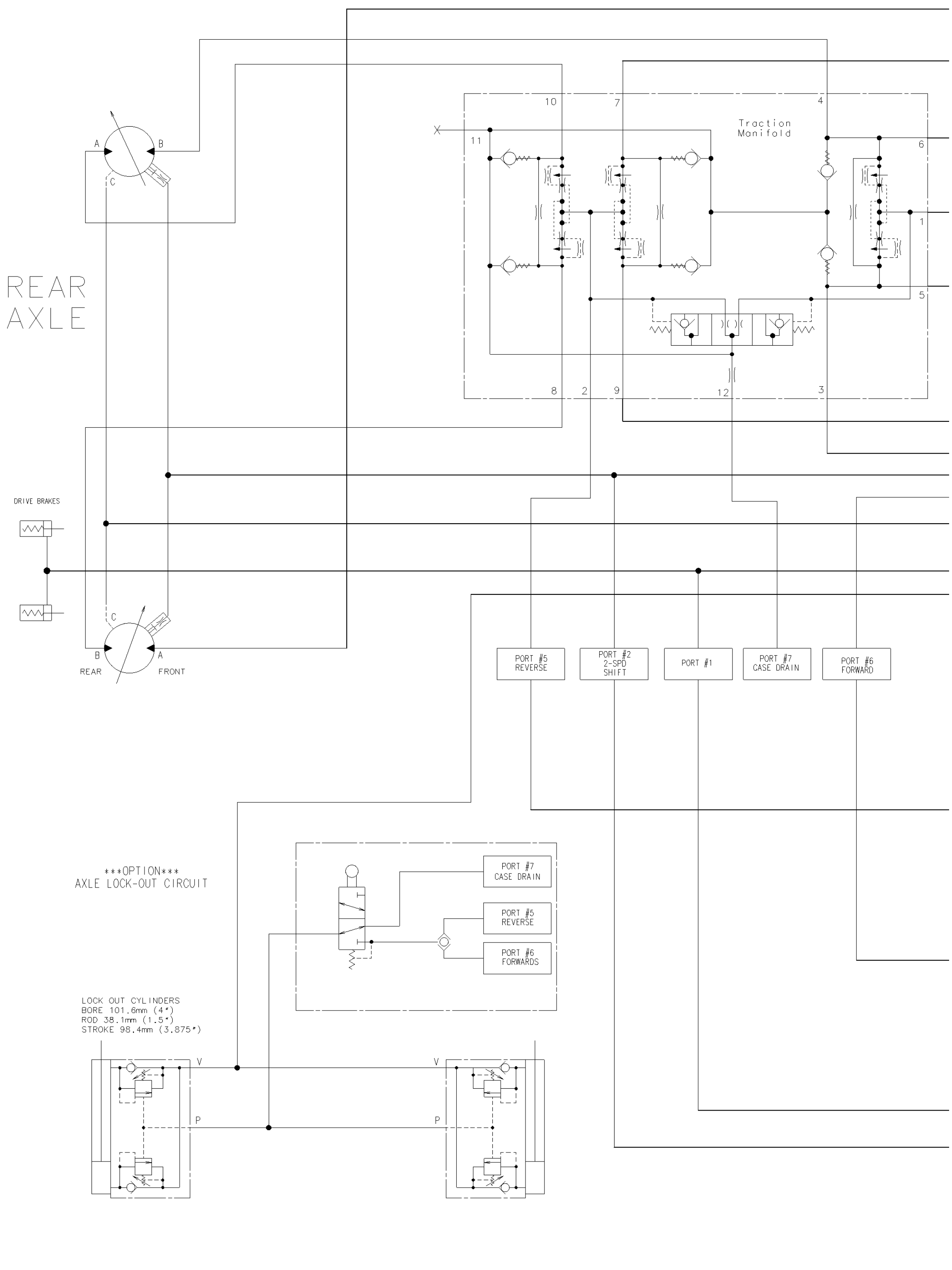


Figure 5-183. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 5 of 6

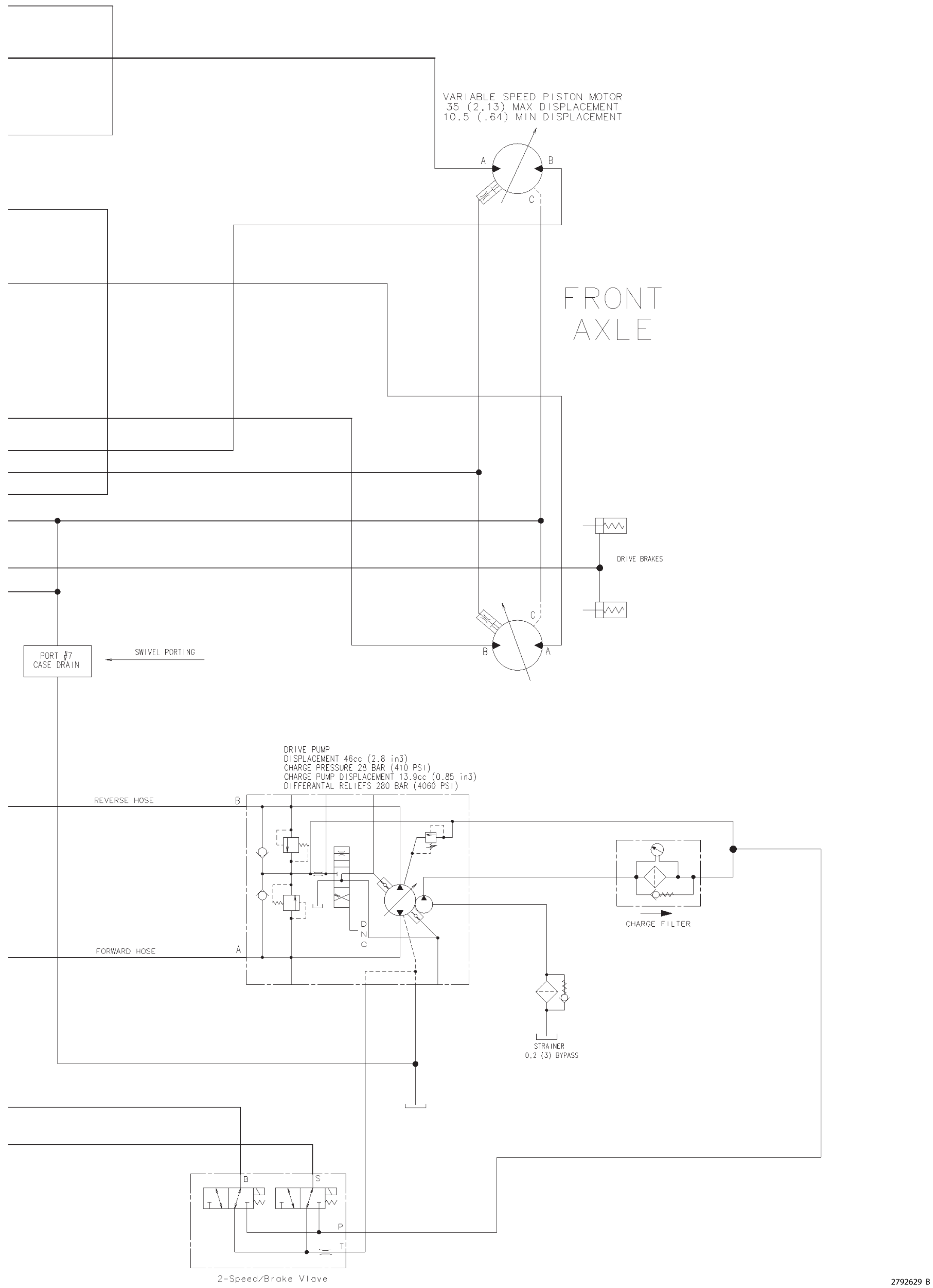


Figure 5-184. Hydraulic Schematic (S/N 0300083332 to S/N 0300183033) - Sheet 6 of 6

NOTES:

SECTION 6. JLG CONTROL SYSTEM (S/N 0300065534 TO S/N 0300183033)

6.1 INTRODUCTION

NOTE: *All 800A and 800AJ machines from S/N 0300065534 incorporate ADE (JLG Control System). The following machine serial numbers prior to S/N 65534 also utilize ADE: 62045, 62797, 63013, 63665, 63975, 64000, 64007, 64009, 64015, 64017, 64390, 64392, and 64411.*

NOTICE

WHEN INSTALLING ANY NEW MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS AND PROPERLY CALIBRATE THE TILT SENSOR.

NOTICE

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED,SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The JLG designed Control System is a 12 volt based control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep, min speed, and max.-speed for all boom, drive, and steering functions.

The upper lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The control system will control the voltage output to the valves and pump, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the control system.

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes a soft touch system, head and tail lights, and ground alarm. These options may be added later but must be programmed into the control system when installed.

The Control System may be accessed utilizing a custom designed, hand held analyzer (Analyzer Kit, JLG part no. 2901443) which will display two lines of information at a time, by scrolling through the program.

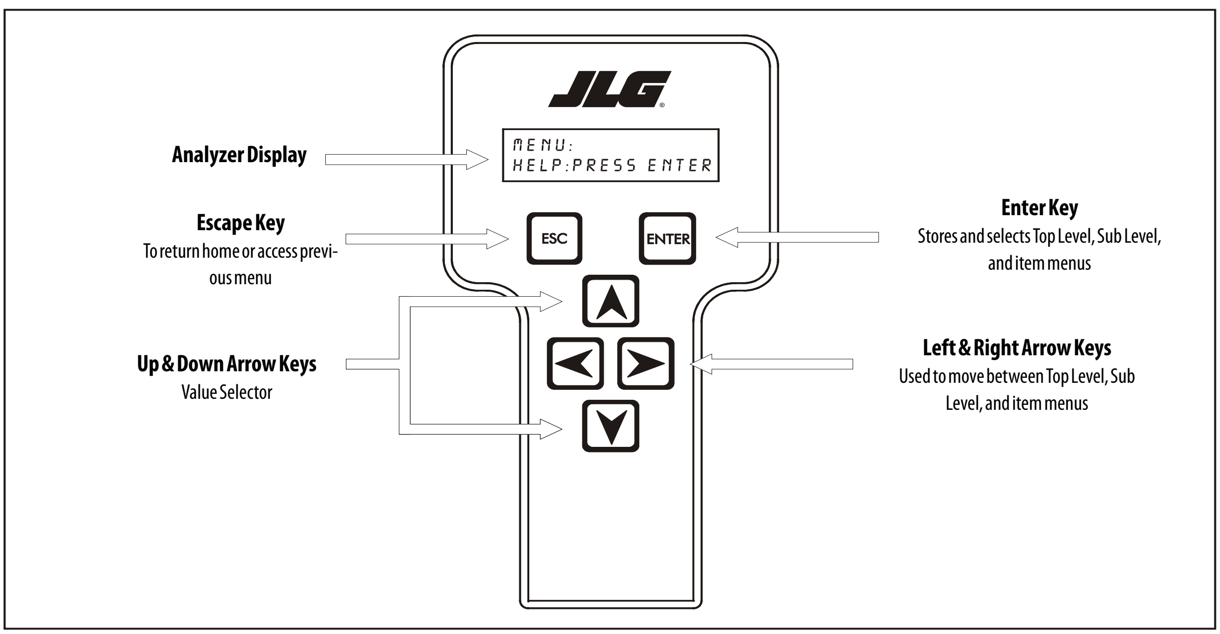


Figure 6-1. Hand Held Analyzer

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT OUT
CONT(S)	CONTRACTOR(S)
COOR	COORDINATED
CRK PT	CRACK POINT
CRP	CREEP
CUT	CUTOUT
CYL	CYLINDER
DECEL	DECELERATE
D	DOWN
DN	DOWN
DWN	DOWN
DEG.	DEGREE
DOS	DRIVE ORIENTATION SYSTEM
DRV	DRIVE
E	ERROR
E&T	ELEVATED & TILTED
ELEV	ELEVATION
ENG	ENGINE
EXT	EXTEND
F	FRONT
FL	FLOW
FNT	FRONT
FOR	FORWARD
FWD	FORWARD
FSW	FOOT SWITCH
FUNC	FUNCTION
G	GROUND
GND	GROUND

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
GRN	GREEN
GM	GROUND MODULE
H	HOURS
HW	HARDWARE
HWFS	HARDWARE FAILSAFE
I	IN or CURRENT
JOY	JOYSTICK
L	LEFT
LB	POUND
LEN	LENGTH
LIM	LIMIT
LT	LEFT
LVL	LEVEL
M	MINUTES
MIN	MINIMUM
MAX	MAXIMUM
M	MAIN
MN	MAIN
NO	NORMALLY OPEN or NO
NC	NORMALLY CLOSED
O	OUT
O/C	OPEN CIRCUIT
OP	OPEN
O/R	OVERRIDE or OUTRIGGER
O//R	OVERRIDE
OSC	OSCILLATING
OVRD	OVERRIDE
P	PLATFORM
P	PRESSURE
PCV	PROPORTIONAL CONTROL VALVE
PLAT	PLATFORM
PLT	PLATFORM
PM	PLATFORM MODULE
POT	POTENTIOMETER
PRES	PRESSURE
PRS	PRESSURE
PT	POINT
R	REAR or RIGHT
REV	REVERSE or REVISION
RET	RETRACT
ROT.	ROTATE
RT	RIGHT
S/C	SHORT CIRCUIT
SEL	SELECTOR

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
SN	SERIAL NUMBER
SPD	SPEED
STOW	STOWED
STOWD	STOWED
SW	SWITCH or SOFTWARE
TELE	TELESCOPE
TEMP	TEMPERATURE
TORQ.	TORQUE
TRN	TRANSPORT
T/T	TURNTABLE
T	TOWER
TURNTBL	TURNTABLE
TWR	TOWER
U	UPPER or UP
V	VOLT
VER	VERSION
VLV	VALVE
WIT	WITNESS
YEL	YELLOW

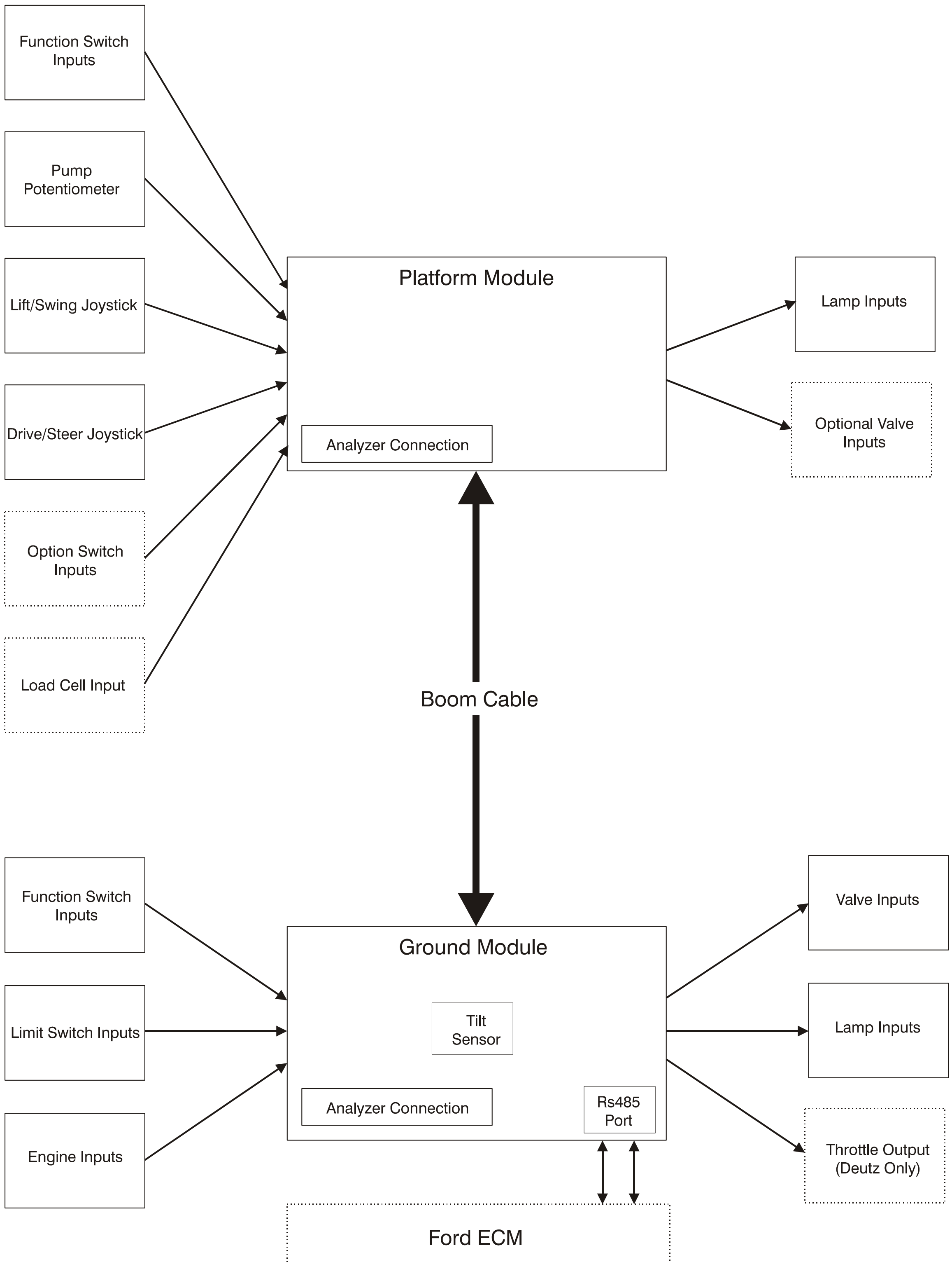


Figure 6-2. ADE Block Diagram

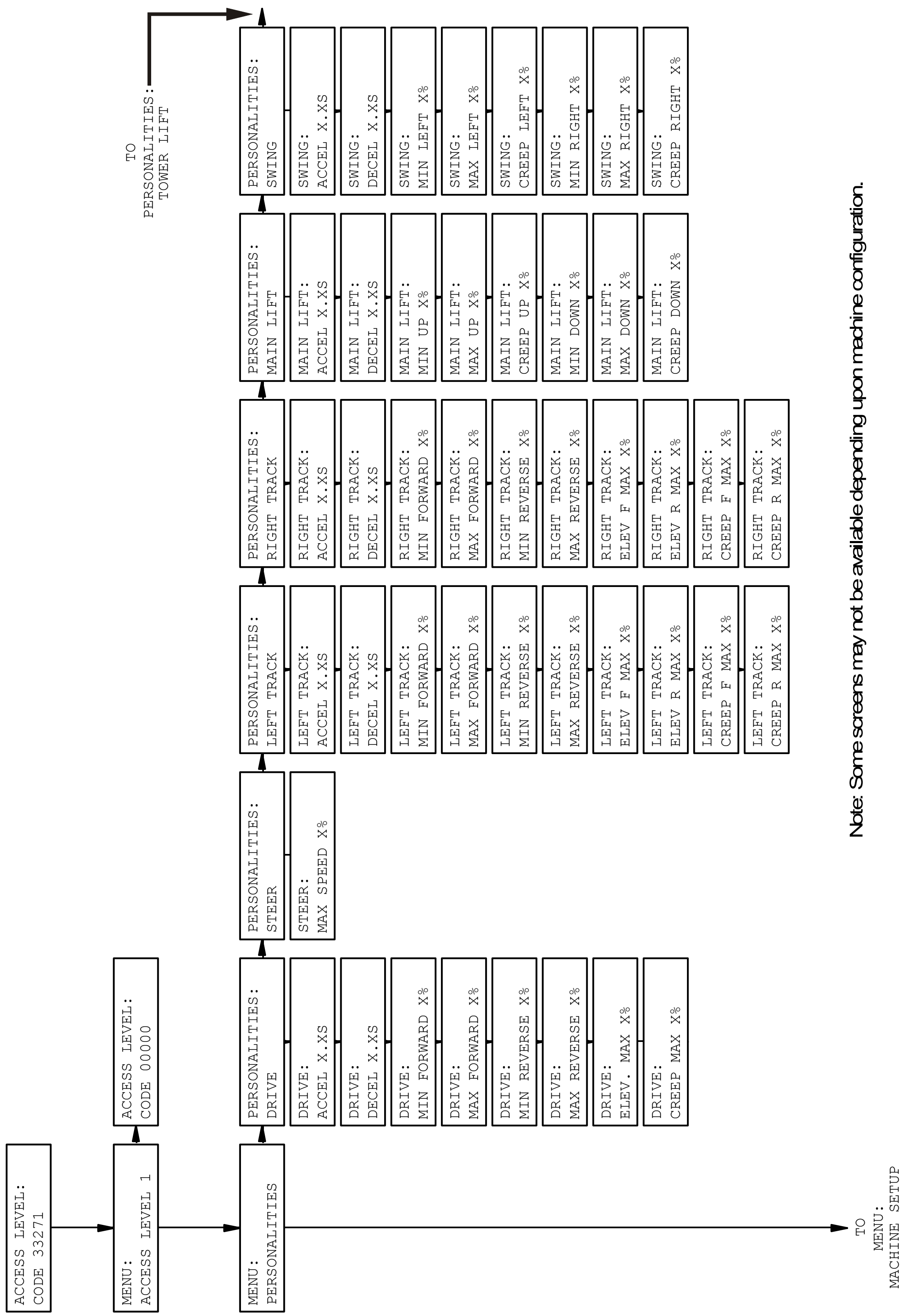


Figure 6-3. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 1 of 4

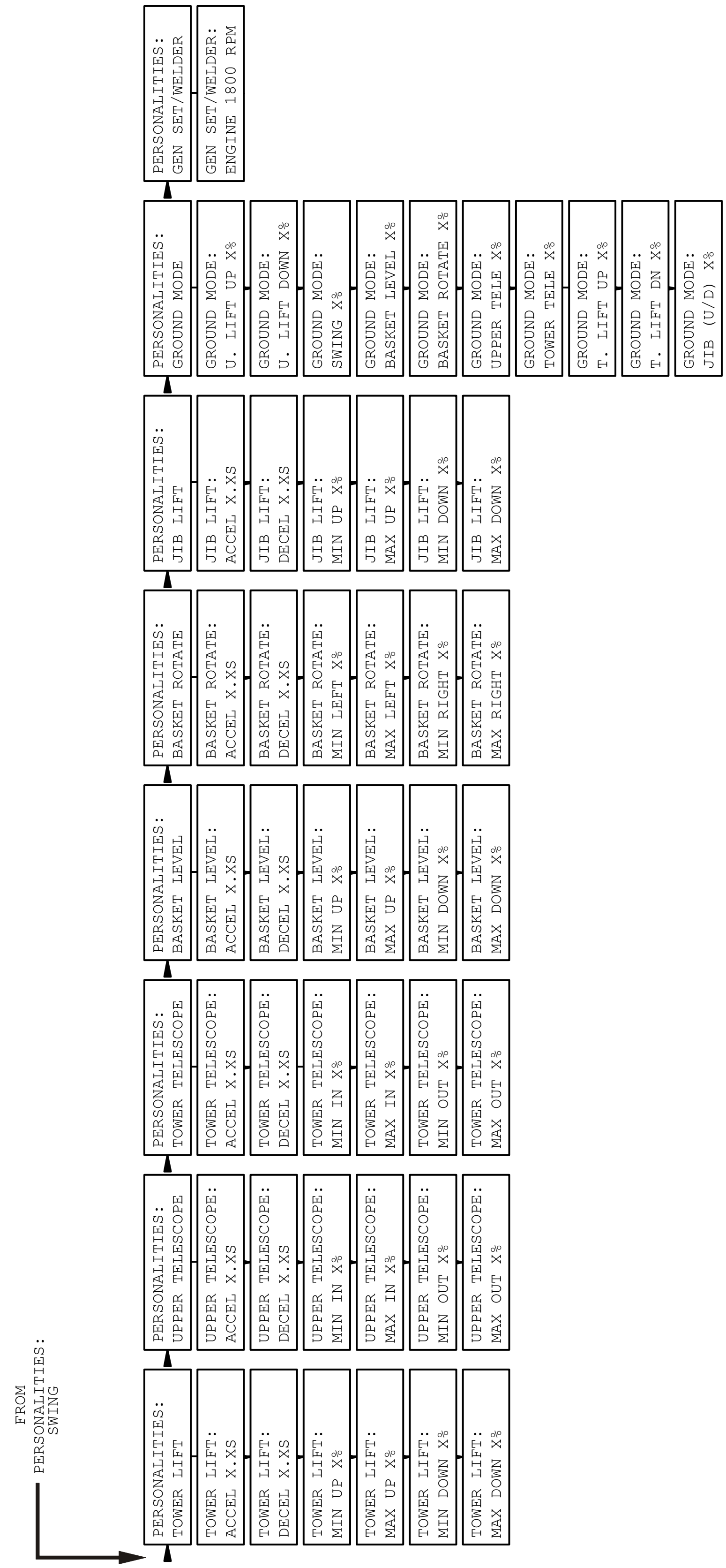


Figure 6-4. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 2 of 4

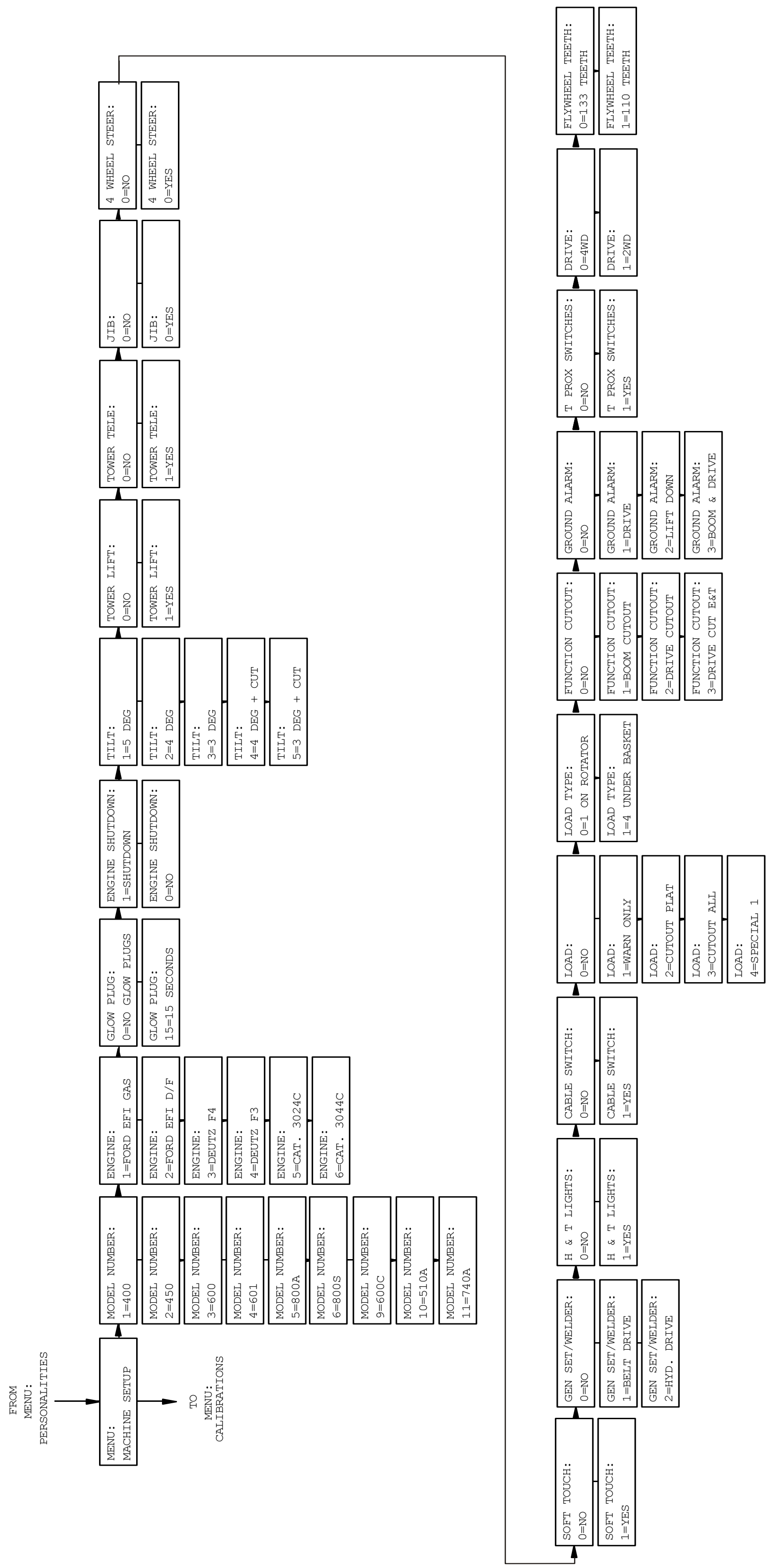


Figure 6-5. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 3 of 4

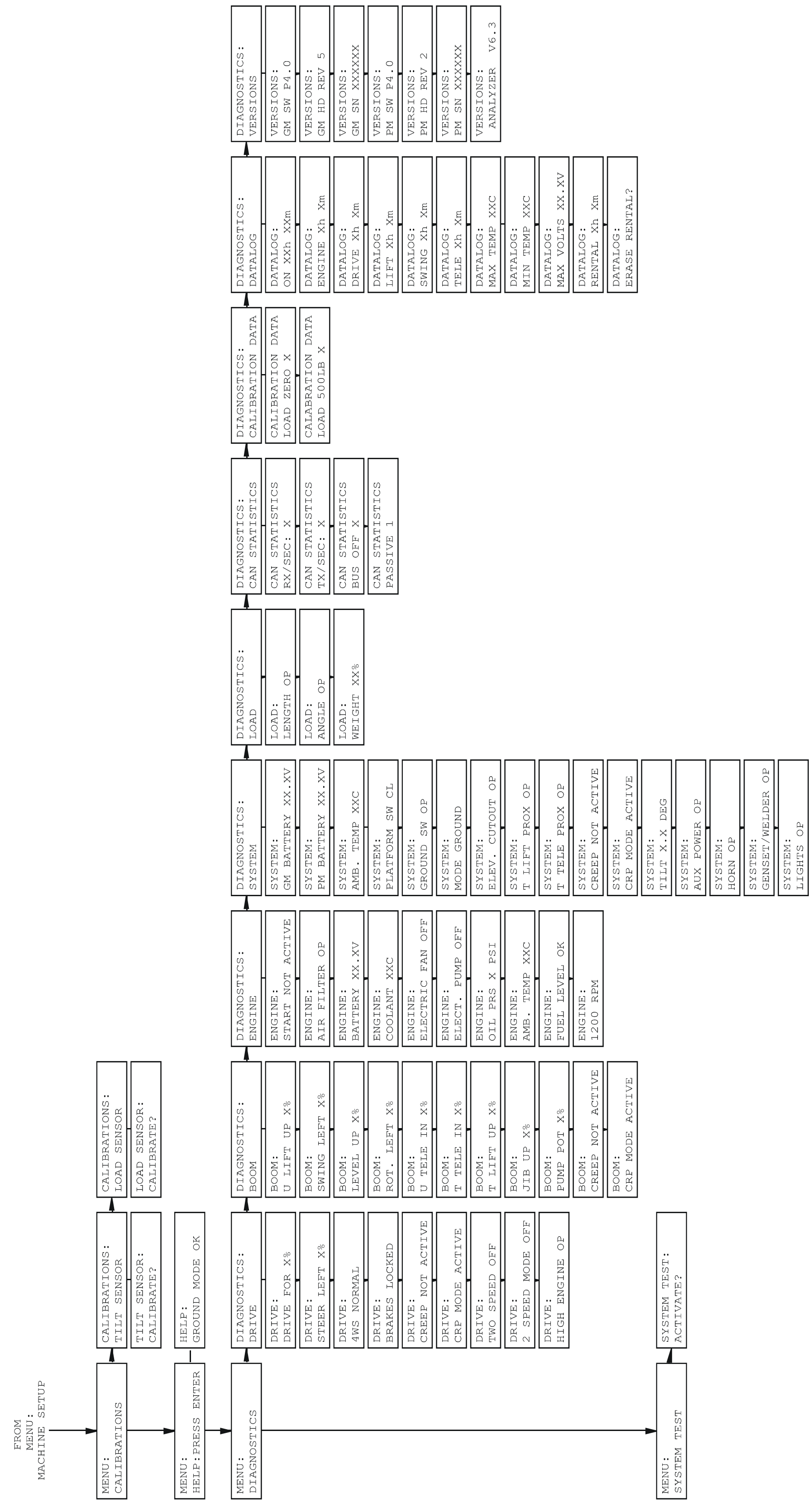
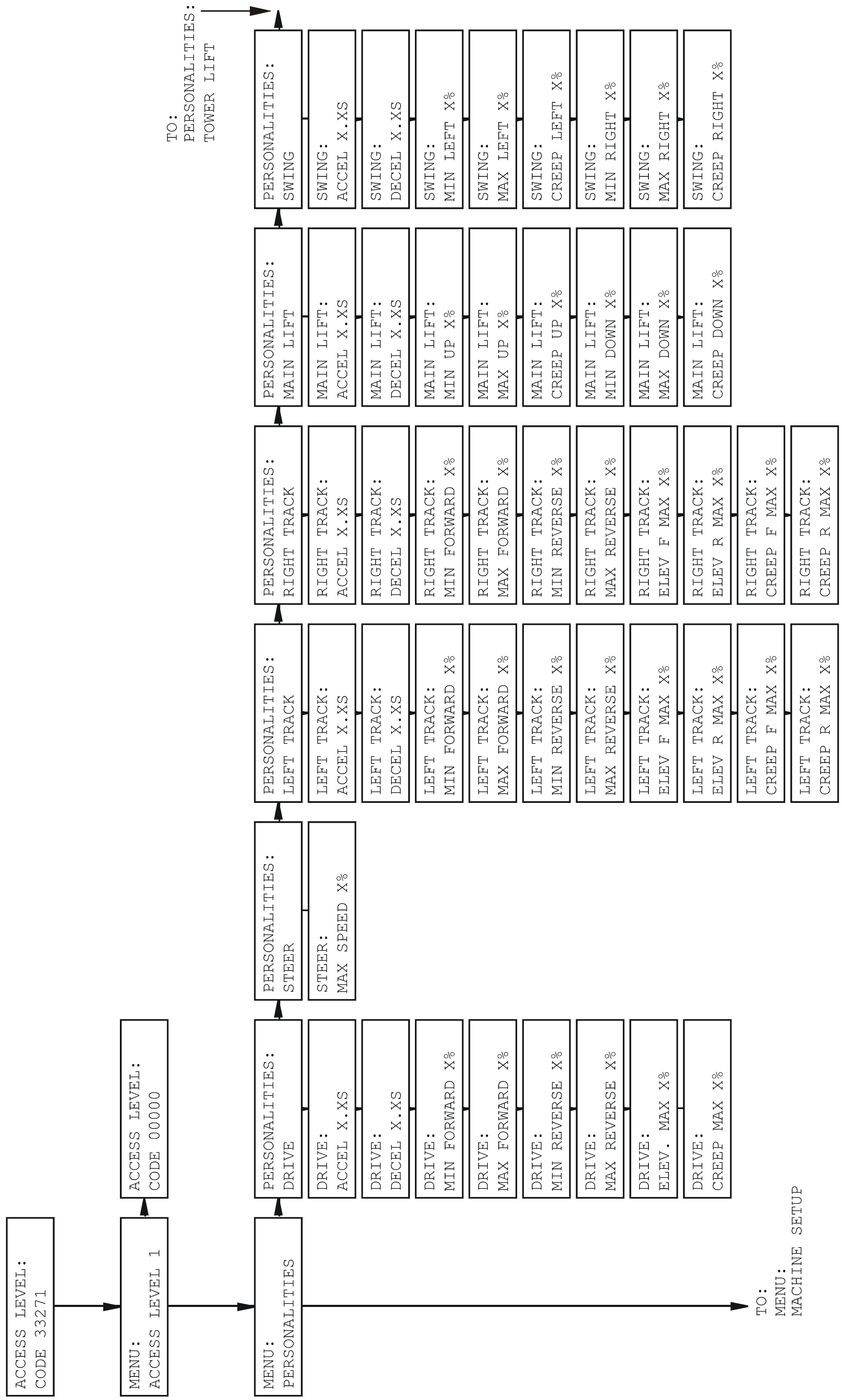


Figure 6-6. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 4 of 4



NOTE: *Some screens may not be available depending upon machine configuration.*

Figure 6-7. Analyzer Flow Chart, Version 5.X Software - Sheet 1 of 4

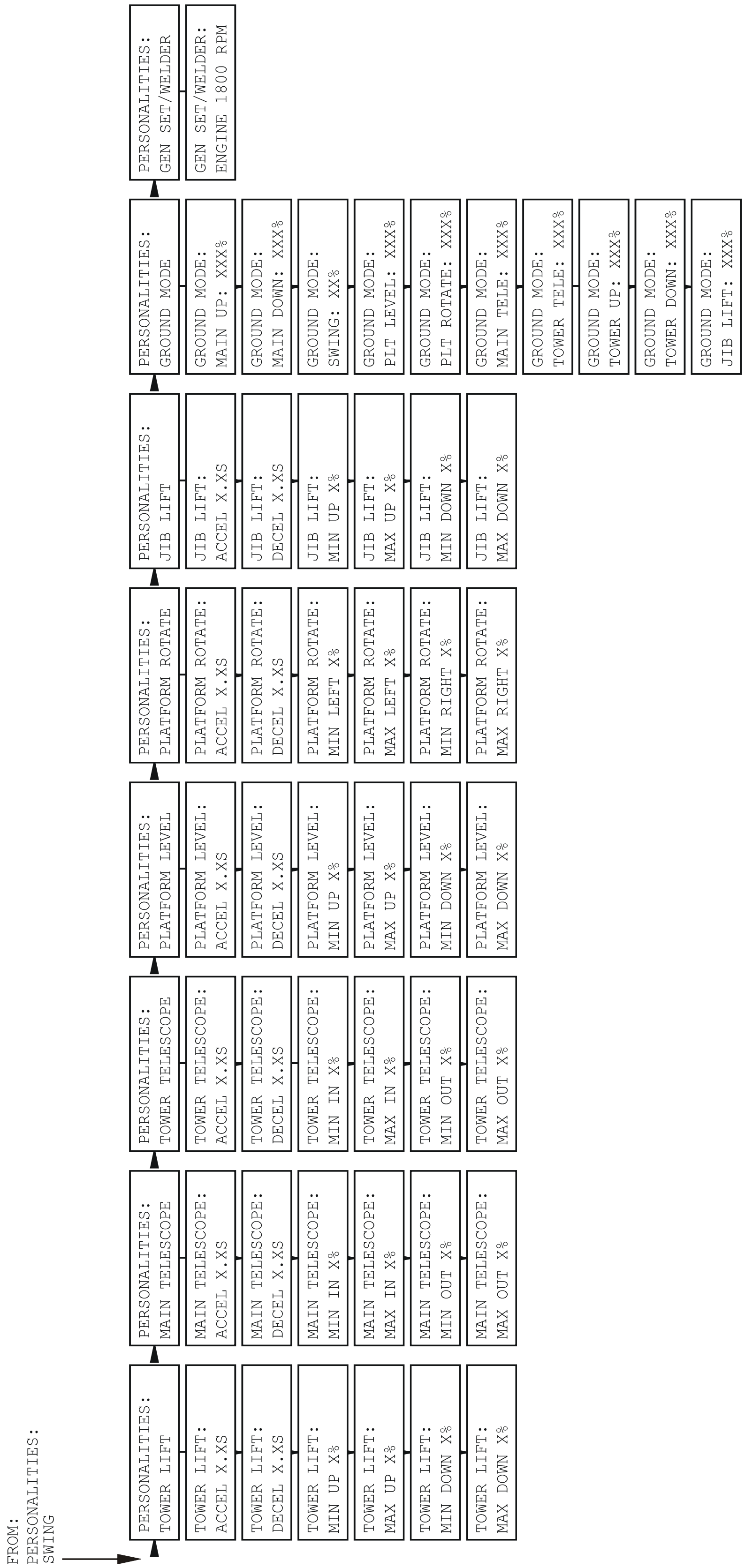


Figure 6-8. Analyzer Flow Chart, Version 5.X Software - Sheet 2 of 4

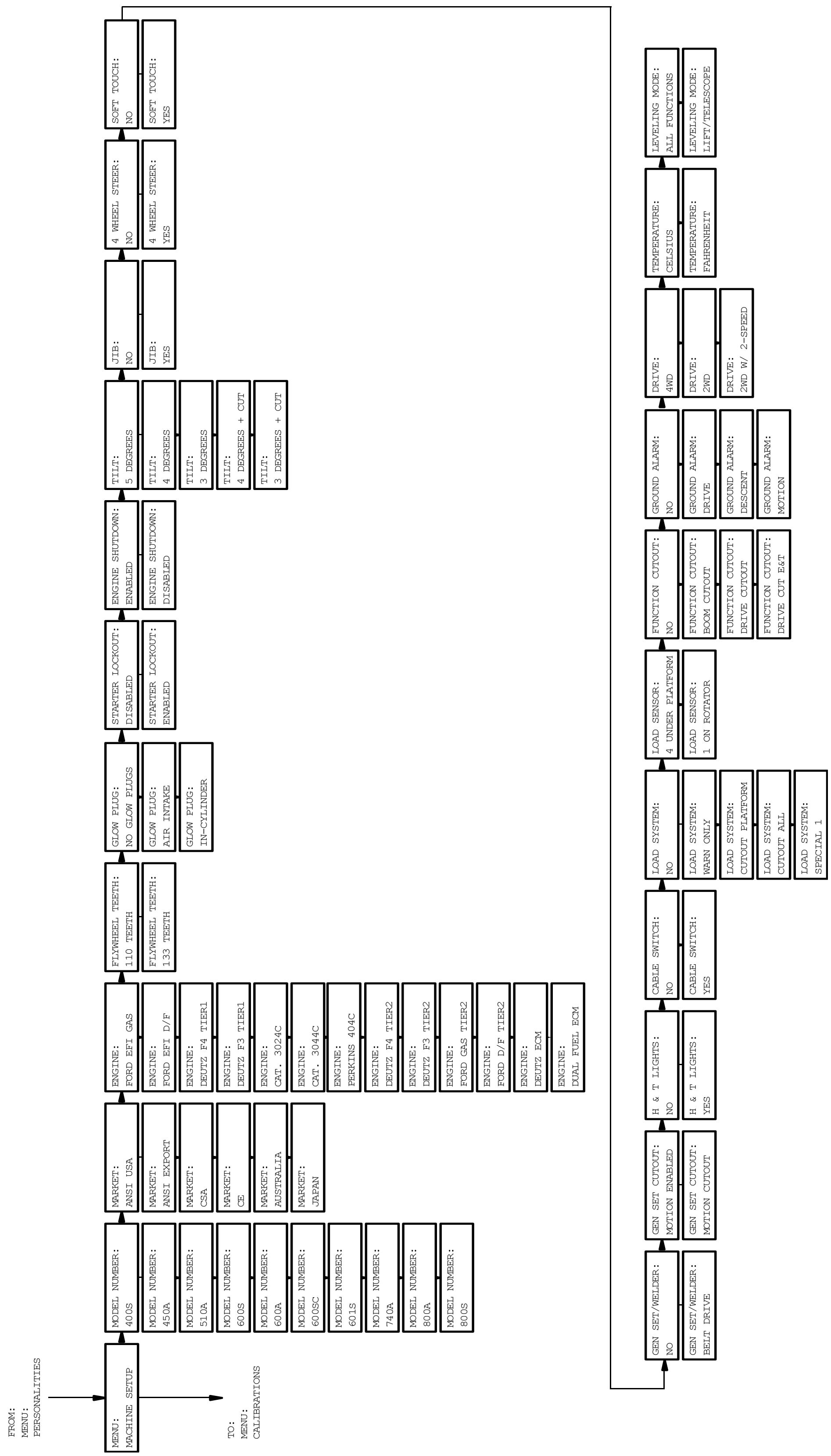


Figure 6-9. Analyzer Flow Chart, Version 5.X Software - Sheet 3 of 4

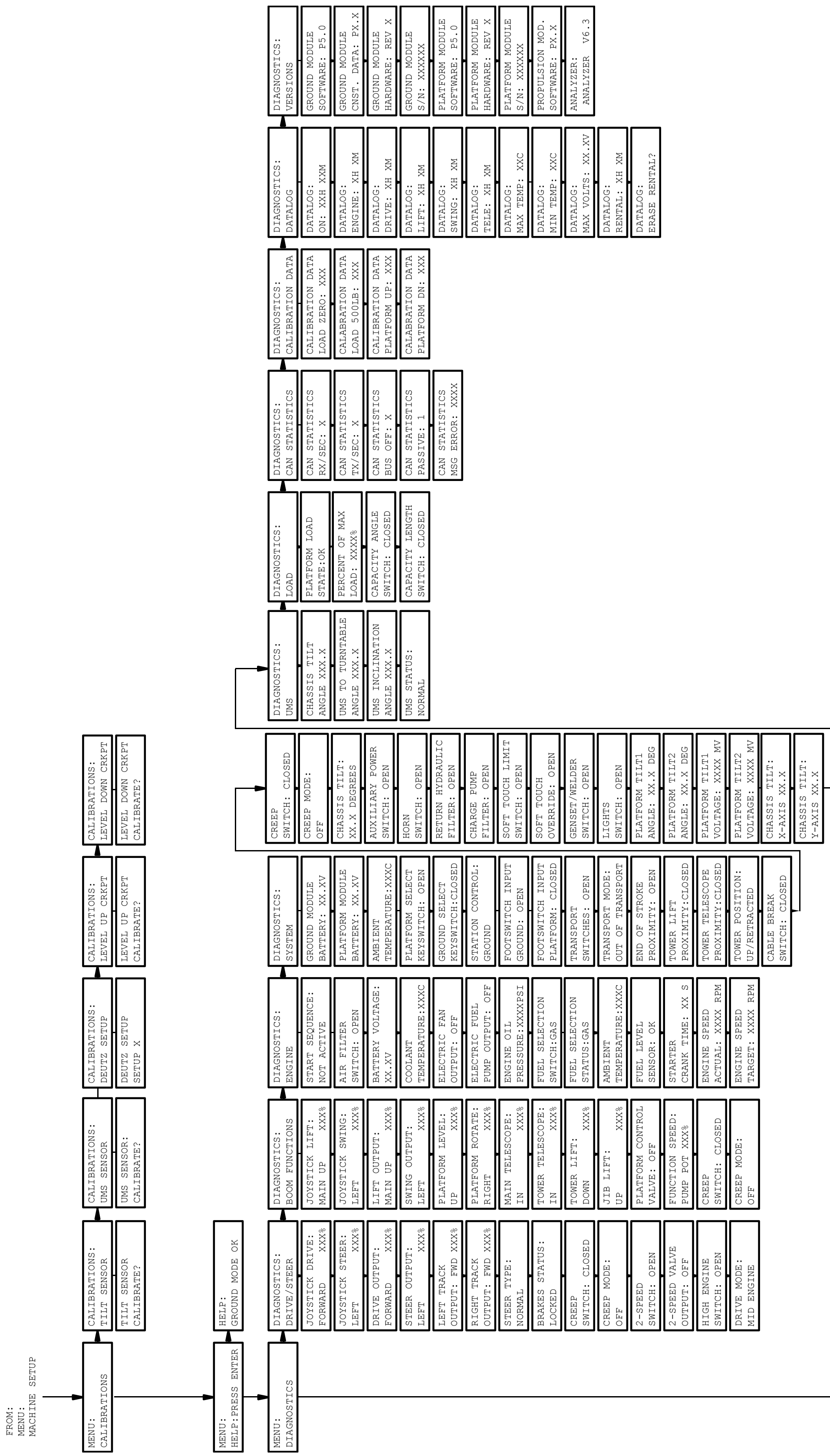
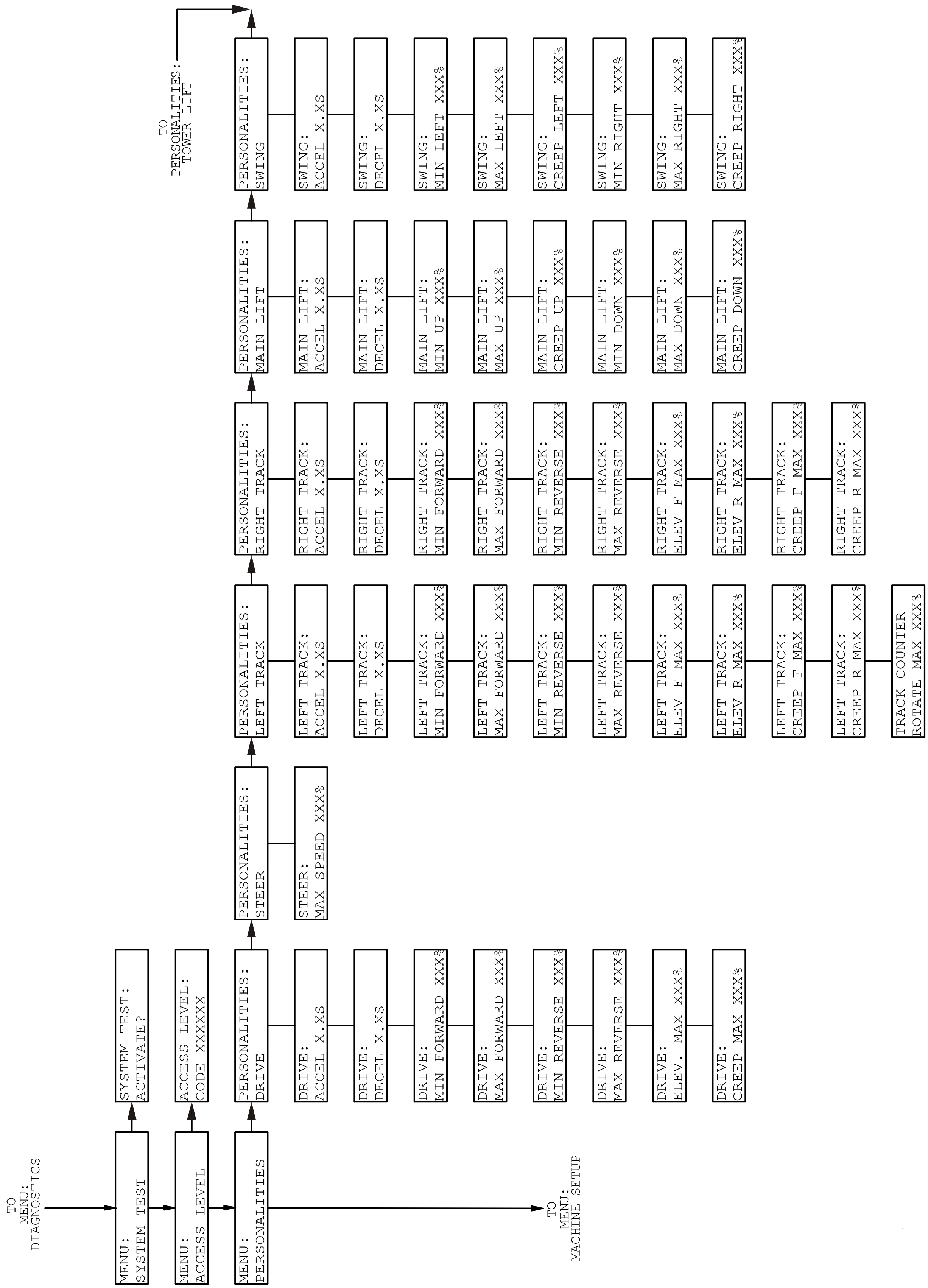


Figure 6-10. Analyzer Flow Chart, Version 5.X Software - Sheet 4 of 4



NOTE: *Some screens may not be available depending upon machine configuration.*

Figure 6-11. Analyzer Flow Chart, Version 6.X Software - Sheet 1 of 5

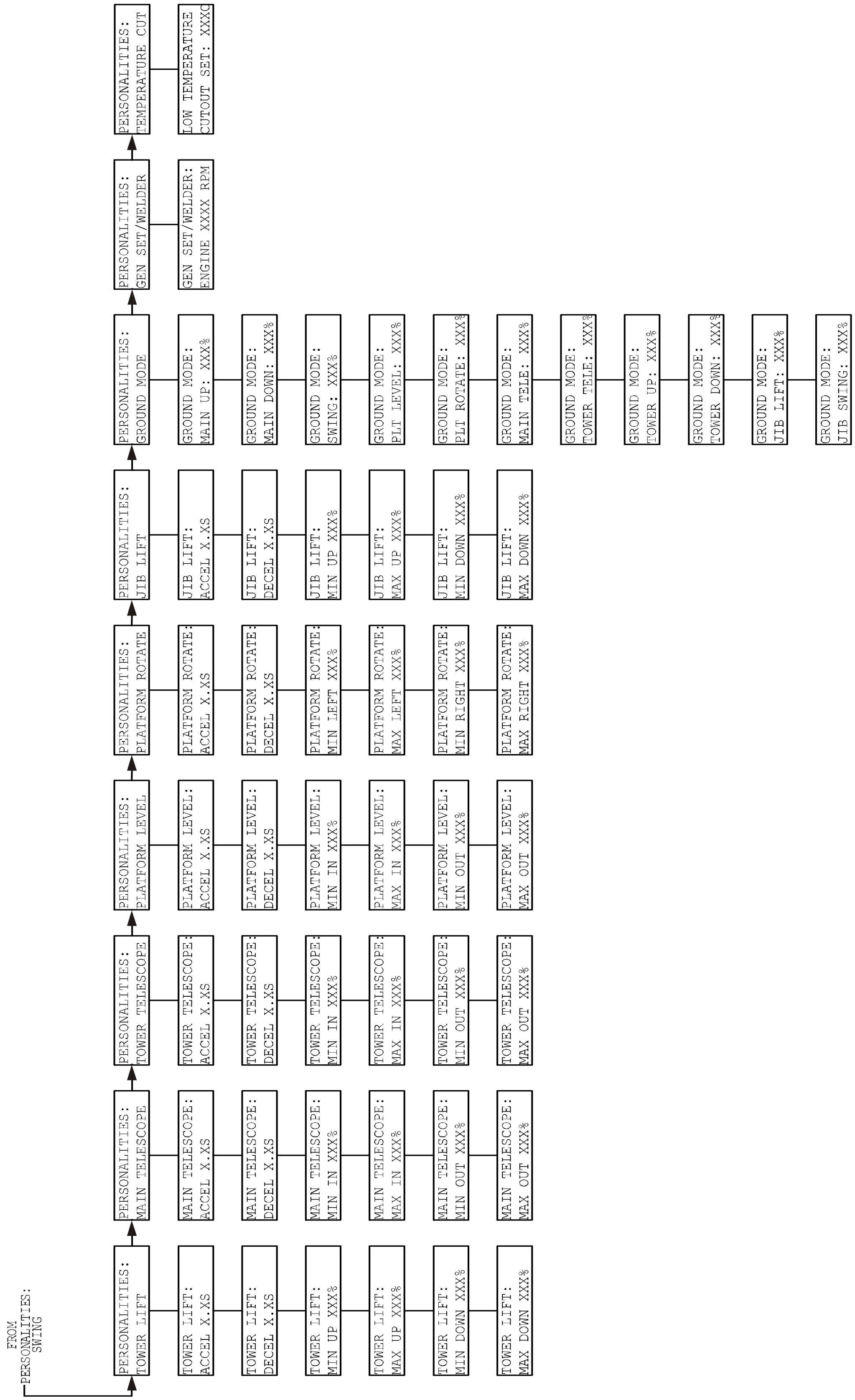


Figure 6-12. Analyzer Flow Chart, Version 6.X Software - Sheet 2 of 5

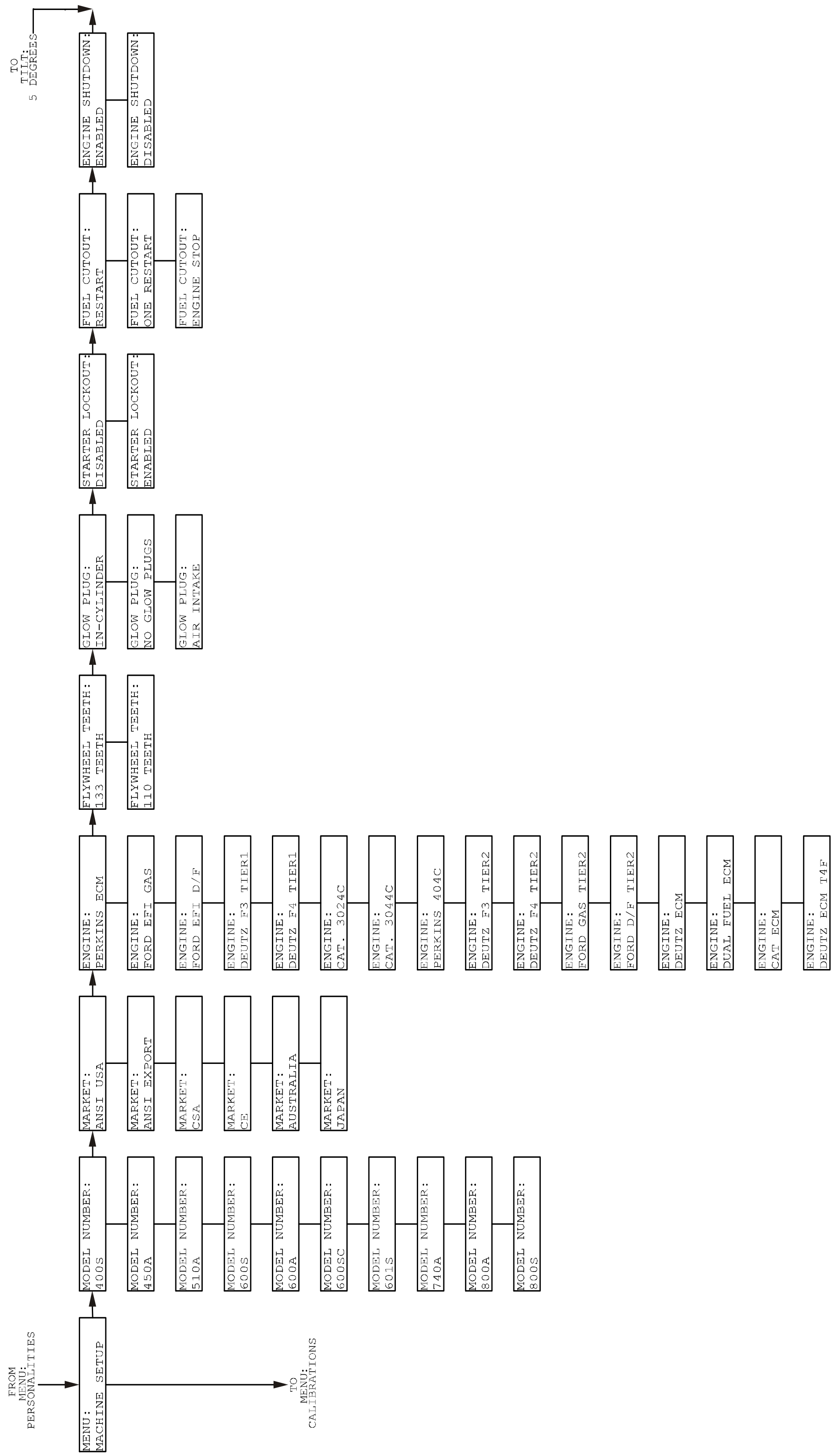


Figure 6-13. Analyzer Flow Chart, Version 6.X Software - Sheet 3 of 5

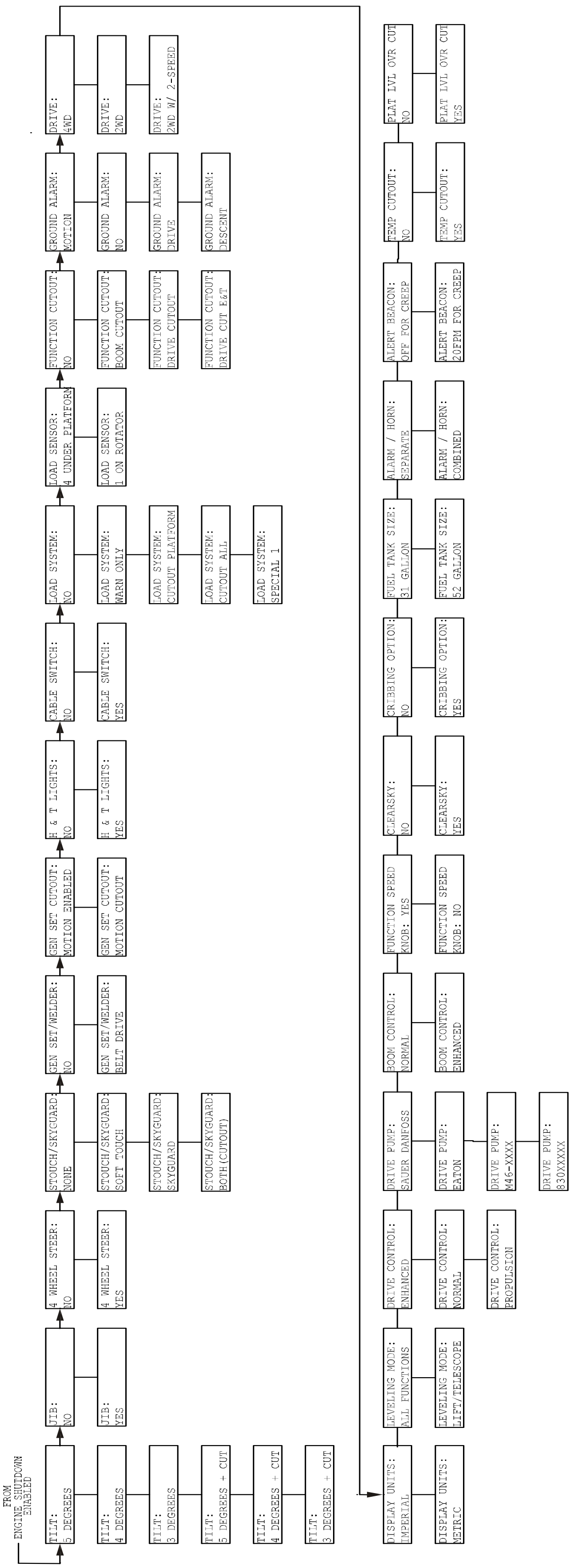


Figure 6-14. Analyzer Flow Chart, Version 6.X Software - Sheet 4 of 5

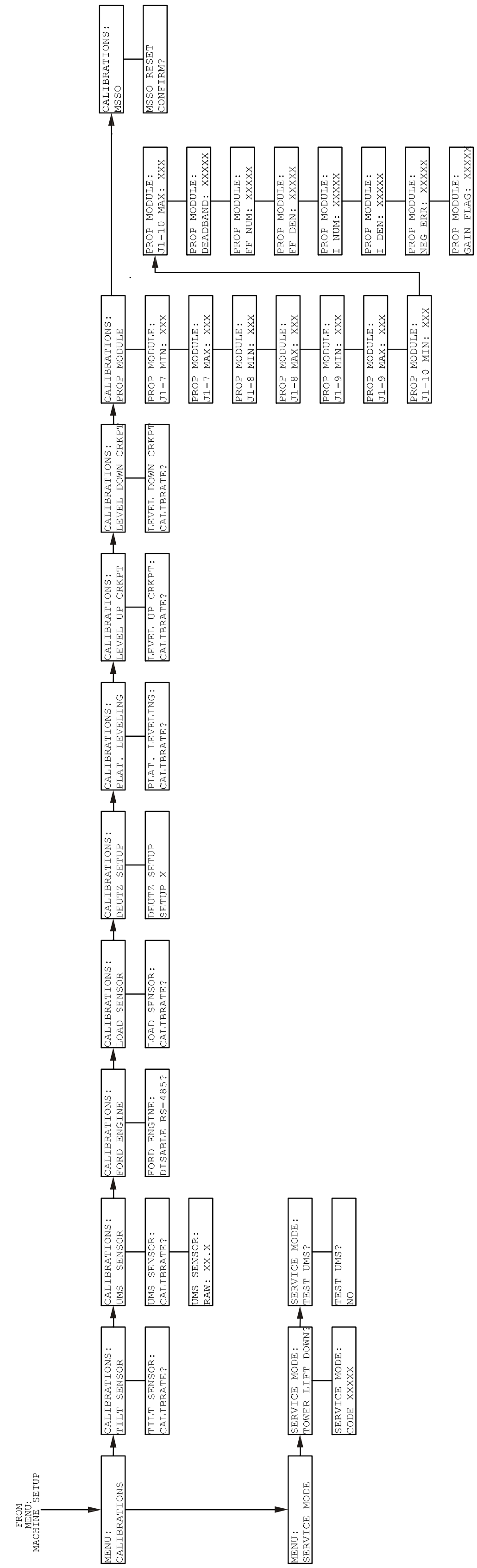


Figure 6-15. Analyzer Flow Chart, Version 6.X Software - Sheet 5 of 5

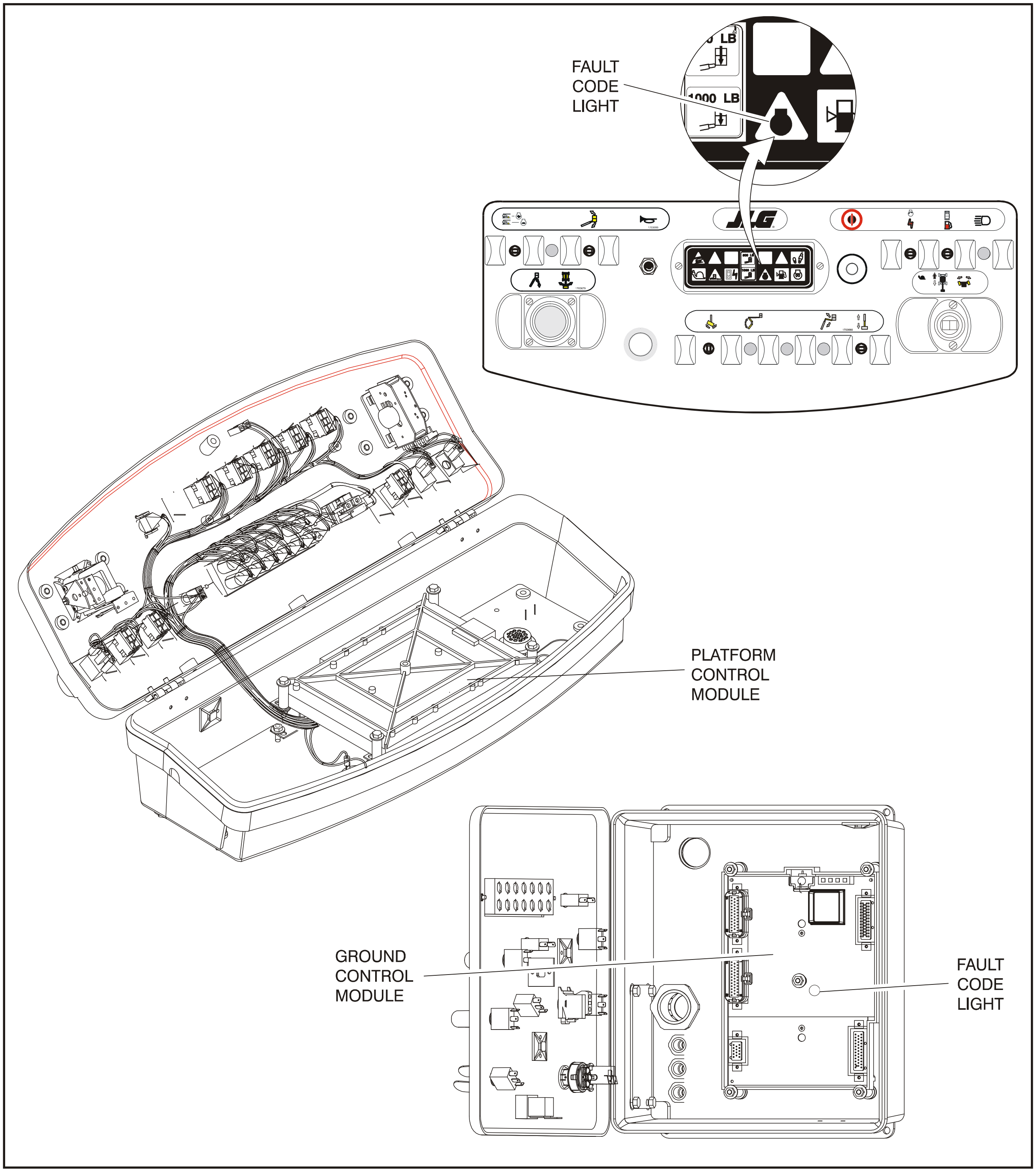
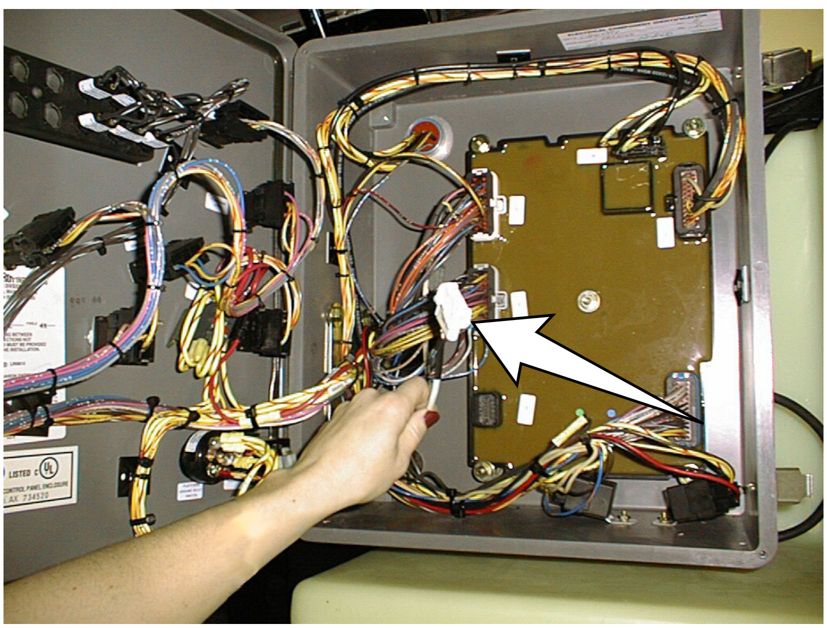


Figure 6-16. Control Module Location

PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-17. Analyzer Connecting Points

6.2 CANBUS COMMUNICATIONS

CANbus: CAN (Control Area Network) is a two wire differential serial link between the Platform Module and Ground Module providing bi-directional communications.

Two-wire: One wire (red) is driven high (5v) and the other low (black) (0v) to send a signal; both wires ”float” (2.5v) when no signal is being sent.

Differential: Any electrical line noise can affect the high or the low wires but never both, so communications is not corrupted.

Serial Link: Messages are being sent bit by bit along the wires; the high bus speed allow all modules to be constantly updated around 20 times per second. Typical traffic is 300 - 500 messages per second.

A complete CANbus circuit is approximately 60 ohms, which can be verified at the ”T” fitting inside the ground station. Each individual circuit from the modules is approximately 120 ohms.

6.3 TO CONNECT THE JLG CONTROL SYSTEM ANALYZER

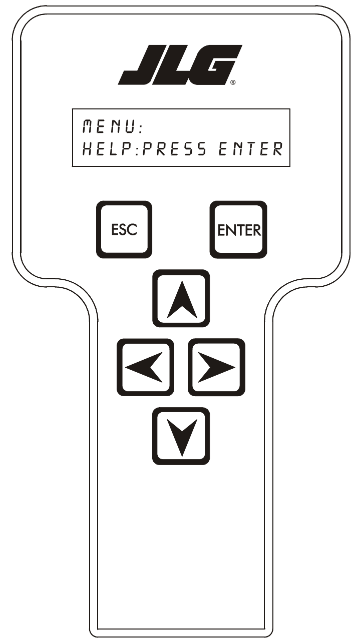
1. Connect the four pin end of the cable supplied with the analyzer, to the controller module located in the platform box or at the controller module in the ground control box and connect the remaining end of the cable to the analyzer.

NOTE: *The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.*

2. Power up the Control System by turning the lower key to the platform or ground position and pulling both emergency stop buttons on.

6.4 USING THE ANALYZER

With the machine power on and the analyzer connected properly, the analyzer will display the following:



HELP:
PRESS ENTER

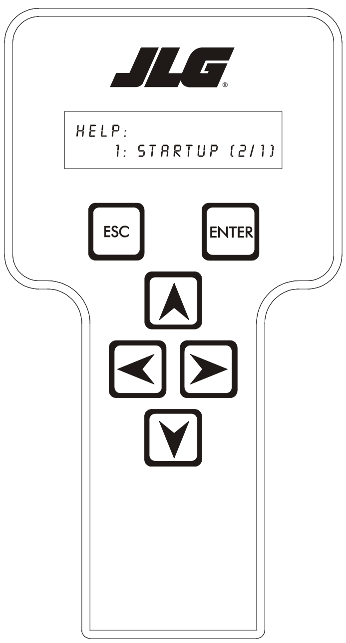
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER**. To cancel a selected menu item, press **ESC**.; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
SYSTEM TEST
ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
CALIBRATIONS (view only)
LEVEL VEHICAL (level 1 only)

If you press **ENTER**, at the **HELP: PRESS ENTER** display, and a fault is present, the analyzer display will scroll the fault across the screen. If there was no fault detected, the display will read: **HELP: EVERYTHING OK.** If powered up at the ground station, the display will read: **GROUND OK.**

If **ENTER** is pressed again, the display moves to the following display:



LOGGED HELP
1: STARTUP (2/1)

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC.** two times. **STARTUP (2/1)** indicates a power up.

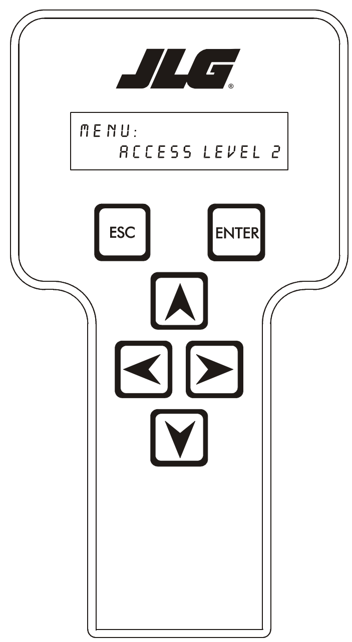
When a top level menu is selected, a new set of menu items may be offered: for example:

DRIVE
BOOM
SYSTEM
DATALOG
VERSIONS

Pressing **ENTER** with any of the above displayed menus, will display additional sub-menus within the selected menu. In some cases, such as **DRIVE**, the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected menus while in access level 2. Remember, you may always cancel a selected menu item by pressing the **ESC.** key.

6.5 CHANGING THE ACCESS LEVEL OF THE HAND HELD ANALYZER

When the analyzer is first connected, you will be in access level 2 which enables you to only view most settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:



MENU:
ACCESS LEVEL 2

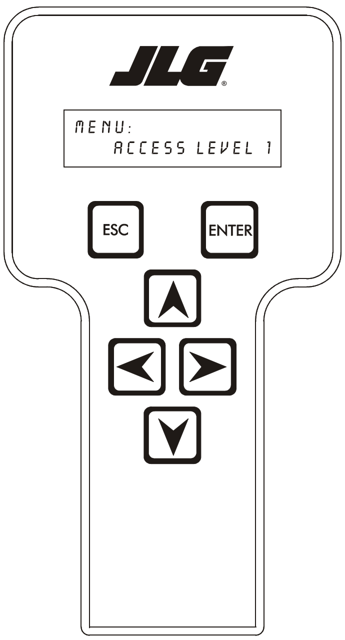
Press **ENTER** to select the **ACCESS LEVEL** menu.

Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 33271.

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:

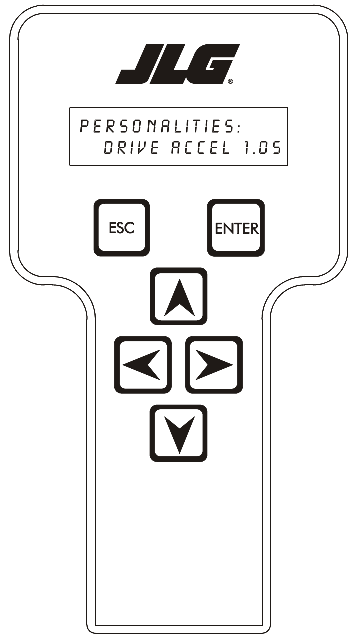


MENU:
ACCESS LEVEL 1

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

6.6 ADJUSTING PARAMETERS USING THE HAND HELD ANALYZER

Once you have gained access to level 1, and a personality item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

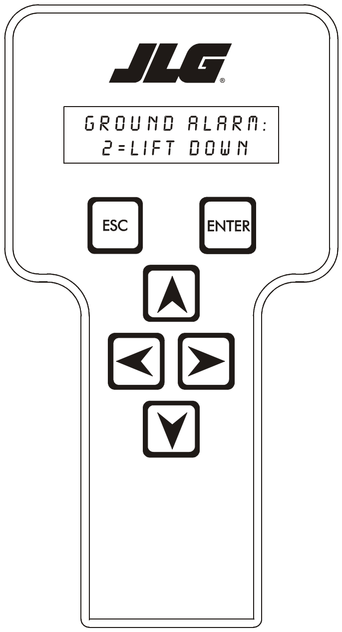


PERSONALITIES:
DRIVE ACCEL 1.0s

There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and won arrows, check the access level to ensure you are at access level 1.

6.7 MACHINE SETUP

When a machine digit item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:



GROUND ALARM:
2 = LIFT DOWN

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when lifting down. There are certain settings allowed to install optional features or select the machine model.

When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

NOTE: *Refer to Table 6-9, Personality Ranges/Defaults, and in this Service Manual for the recommended factory settings.*

NOTE: *Password 33271 will give you access to level 1, which will permit you to change all machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

ELEVATION CUTBACK

⚠ WARNING

CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

NOTICE

ITS IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

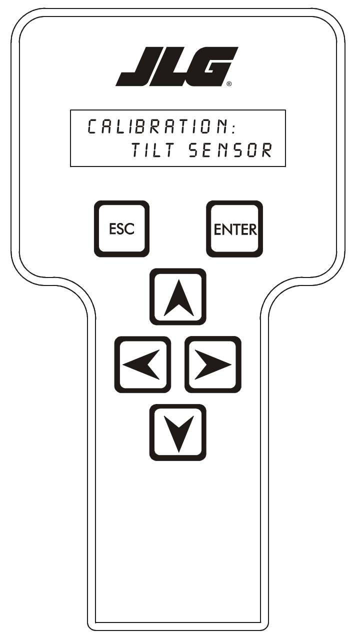
6.8 LEVEL VEHICLE DESCRIPTION

NOTICE

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.

⚠ WARNING

DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.



Place machine in stowed position with the boom between the rear wheels.

To level machine chose:

CALIBRATION:
TILT SENSOR

Press ENTER.

When prompted, swing machine 180°

Press ENTER.

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
MODEL NUMBER: 1	1 2 3 4 5 6 7 8 9 10	400S 450A 510A 600S 600A 600SC 601S 740A 800A 800S	1
MARKET: 2	0 1 2 3 4 5	ANSI USA ANSI EXPORT CSA CE AUSTRALIA JAPAN	0
ENGINE: 3* * Engine selections vary depending on model selection.	1 2 3 4 5 6 7 8 9 10 11	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1) FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1) DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1) DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1) CAT. 3024C: CAT 3024C Diesel (Tier 2) CAT. 3044C: CAT 3044C Diesel (Tier 2) DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2) DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2) FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2) FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2) DEUTZ ECM: Engine Control Module - ECM	11
FLYWHEEL TEETH: 4* * This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0 1	133 TEETH: 133 flywheel teeth. 110 TEETH: 110 flywheel teeth.	1

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
GLOW PLUG: 5	0 1 2	NO GLOW PLUGS: No glow plugs installed. W/O STARTER LOCK: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow. W/ STARTER LOCK: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	2
ENGINE SHUTDOWN: 6	0 1	DISABLED: No engine shutdown. ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 psi.	1
TILT: 7* *Certain market selections will limit tilt options.	1 2 3 4 5	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. *Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.*	1
JIB: 8* *Only visible under certain model selections	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 9* *Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0
SOFT TOUCH: 10* *Only visible under certain model selections.	**0** 1 2 3	**None: No Soft touch or SkyGuard system installed.** SOFT TOUCH: Soft touch only installed. SKYGUARD: SkyGuard only installed. BOTH(CUTOUT): Soft touch and SkyGuard only installed.	0
GEN SET/WELDER: 13	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
GEN SET CUTOUT: 12* * Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0
H & T LIGHTS: 13	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 14* * Only visible under certain model selections. * Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 15* * Only visible under certain model selections. * Certain market selections will limit load system options or alter default setting.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0
LOAD SENSOR: 16* * Only visible if Load Sensor Menu selection is not 0. * Market selections will limit certain load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1
FUNCTION CUTOUT: 17* * Only visible under certain market selections. * Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive cutout above elevation. DRIVE CUT E&T: Drive cutout above elevation and tilted.	0
GROUND ALARM: 18* * Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	0
DRIVE: 19* * Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
TEMPERATURE: 20	0 1	CELSIUS: Celsius unit selection. FAHRENHEIT: Fahrenheit unit selection.	1
LEVELING MODE: 21* * Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0

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Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
MODEL NUMBER: 1	1	400S	1
	2	450A	
	3	510A	
	4	600S	
	5	600A	
	6	600SC	
	7	601S	
	8	740A	
	9	800A	
	10	800S	
MARKET: 2	0	ANSI USA	0
	1	ANSI EXPORT	
	2	CSA	
	3	CE	
	4	AUSTRALIA	
	5	JAPAN	

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
ENGINE: 3* * Engine selections vary depending on model selection.	1	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1)	7
	2	FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1)	
	3	DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1)	
	4	DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1)	
	5	CAT. 3024C: CAT 3024C Diesel (Tier 2)	
	6	CAT. 3044C: CAT 3044C Diesel (Tier 2)	
	7	PERKINS 404C (Tier 2)	
	8	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	9	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	10	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	11	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	12	DEUTZ ECM: Engine Control Module - ECM	
	13	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
FLYWHEEL TEETH: 4* * This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0	133 TEETH: 133 flywheel teeth.	1
	1	110 TEETH: 110 flywheel teeth.	
GLOW PLUG: 5	0	NO GLOW PLUGS: No glow plugs installed.	2
	1	AIR INTAKE: Glow plugs installed in the air intake on the manifold.	
	2	IN-CYLINDER: Glow plugs installed in each cylinder.	
STARTER LOCKOUT: 6	0	DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.	0
	1	ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
ENGINE SHUTDOWN: 7	0 1	DISABLED: No engine shutdown. ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.	1
TILT: 8* *Certain market selections will limit tilt options and alter default setting. *Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.*	1 2 3 4 5	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up.	1
JIB: 9* *Only visible under certain model selections.	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 10* *Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0
SOFT TOUCH: 11* *Only visible under certain model selections.	0 1	NO: No soft touch system installed. YES: Soft touch system installed.	0
GEN SET/WELDER: 12	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0
GEN SET CUTOUT: 13* *Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
H & T LIGHTS: 14	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 15* *Only visible under certain model selections. *Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 16* *Only visible under certain market selections. *Certain market selections will limit load system options or alter default setting.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0
LOAD SENSOR: 17* *Only visible if Load Sensor Menu selection is not 0 and under certain market selections. *Certain market selections will limit load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1
FUNCTION CUTOUT: 18* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive & steer cutout above elevation. DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	0

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
GROUND ALARM: 19* * Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	3
DRIVE: 20* * Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0
TEMPERATURE: 21* * Certain market selections will alter default setting.	0 1	CELSIUS: Celsius unit selection. FAHRENHEIT: Fahrenheit unit selection.	1
LEVELING MODE: 22* * Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0

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Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
MODEL NUMBER: 1	1	400S	1
	2	450A	
	3	510A	
	4	600S	
	5	600A	
	6	600SC	
	7	601S	
	8	740A	
	9	800A	
	10	800S	
MARKET: 2	0	ANSI USA	0
	1	ANSI EXPORT	
	2	CSA	
	3	CE	
	4	AUSTRALIA	
	5	JAPAN	

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
ENGINE: 3* * Engine selections vary depending on model selection.	1	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1)	14
	2	FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1)	
	3	DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1)	
	4	DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1)	
	5	CAT. 3024C: CAT 3024C Diesel (Tier 2)	
	6	CAT. 3044C: CAT 3044C Diesel (Tier 2)	
	7	PERKINS 404C (Tier 2)	
	8	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	9	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	10	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	11	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	12	DEUTZ ECM: Engine Control Module - ECM (Tier 2 and Tier 3)	
	13	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
	14	PERKINS ECM	
	15	CAT ECM	
	16	DEUTZ ECM T4F: Deutz Engine Control Module (Tier 4 Final)	
FLYWHEEL TEETH: 4* * This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0	133 TEETH: 133 flywheel teeth.	1
	1	110 TEETH: 110 flywheel teeth.	
GLOW PLUG: 5	0	NO GLOW PLUGS: No glow plugs installed.	2
	1	AIR INTAKE: Glow plugs installed in the air intake on the manifold.	
	2	IN-CYLINDER: Glow plugs installed in each cylinder.	
STARTER LOCKOUT: 6	0	DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.	0
	1	ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
FUEL CUTOUT 7 * This menu item is only visible if non dual fuel engines are selected.	0 1 2	RESTART: Engine allowed to be restarted multiple times when very low fuel level is reached. ONE RESTART: Engine allowed to be restarted once for 2 minutes when very low fuel level is reached. ENGINE STOP: Engine not able to restart when very low fuel level is reached.	0
ENGINE SHUTDOWN: 8	0 1	DISABLED: No engine shutdown. ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.	1
TILT: 9* * Certain market selections will limit tilt options and alter default setting. *Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.*	1 2 3 4 5 6	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up.	1
JIB: 10* * Only visible under certain model selections.	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 11* * Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
ST TOUCH / SKYGUARD: 12	0 1 2 3	NONE: No soft touch or skyguard system installed. SOFT TOUCH - Soft touch only installed. SKYGUARD - Skyguard only installed. BOTH (CUTOUT) - Soft touch and Skyguard installed.	0
GEN SET/WELDER: 13	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0
GEN SET CUTOUT: 14* * Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0
H & T LIGHTS: 15	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 16* * Only visible under certain model selections. * Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 17* * Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting. * LOAD SYSTEM will not be visible in CE and defaulted to CUTOUT ALL for machines equipped with MSSO.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
LOAD SENSOR: 18* *Only visible if Load Sensor Menu selection is not 0 and under certain market selections. *Certain market selections will limit load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1
FUNCTION CUTOUT: 19* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive & steer cutout above elevation. DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	0
GROUND ALARM: 20* *Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	3
DRIVE: 21* *Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0
DISPLAY UNITS: 22* *Certain market selections will alter default setting.	0 1	IMPERIAL: DEG F , PSI, LBS. METRIC: DEG C, KPA, KGS	1
LEVELING MODE: 23* *Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0
DRIVE CONTROL: 24	0 1 2	NORMAL: Drive coils are energized from the Ground Module. PROPULSION: Drive coils are energized from the Propulsion Module. ENHANCED: Drive coils are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns.	2

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
DRIVE PUMP 25 *Only visible on 600A, 600S, and 800S models.	0 1 2 3	SAUER DANFOSS: MAchine equiped with Sauer Danfoss drive pump EATON: Machine equiped with Eaton drive pump M46 - XXXX:Machine equiped with M46 - XXXX drive pump 830XXXXX: Machine equiped with 830XXXXX: drive pump	0
BOOM CONTROL: 26	0 1	NORMAL: Boom function coils are energised from the Ground Module. ENHANCED: Boom function are energised from the Ground Module and the ground side of the drive coils and brought back to current feedback returns.	0
FUNCTION SPEED KNOB 27	0 1	YES: Machine is equiped with Function Speed Knob. NO: Machine is equiped with Operation Speed Switch.	0
CLEARSKY: 28	0 1	NO: Clearsky (telematics) option is disabled. YES: Clearsky (telematics) option is enabled.	0
CRIBBING OPTION: 29	0 1	NO: Cribbing Option is disabled. YES: Cribbing Option is enabled.	0
FUEL TANK SIZE: 30	0 1	31 Gallon Tank 52 Gallon Tank	0
ALARM / HORN: 31	0 1	SEPERATE: Seperate alarm and horn. COMBINED: Combination alarm / horn.	0
ALERT / BEACON: 32	0 1	OFF FOR CREEP : Alert beacon will not flash while in Creep. 20FPS FOR CREEP: Alert beacon will flash at 20FPS while in Creep.	0

Table 6-4. Machine Configuration Programming Information Software Version P6.1 (S/N 0300065534 to S/N 0300183033)

Configuration Label/Digit	Number	Description	Default Number
TEMP CUTOUT: 33	0 1	NO: Temp Cutout is Disabled YES: Temp Cutout is Enabled	0
PLAT LVL OVR CUT: 34	0 1	NO: Platform Level Override will always be functional. YES: Platform Level Override will only be functional when In Transport.	0

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Table 6-5. 800A Machine Configuration Programming Settings

800 A	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Model Number	**9**	**9**	**9**	**9**	**9**	**9**
Market	**0**	**1**	**2**	**3**	**4**	**5**
Engine	**12**	**12**	**12**	**12**	**12**	**12**
Flywheel Teeth	0	0	0	0	0	**0**
	1	**1**	**1**	**1**	**1**	**1**
Glow Plugs	0	0	0	0	0	0
	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Starter Lockout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Fuel Cutout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
Engine Shutdown	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**
Tilt	**1**	**1**	**1**	X	X	**1**
	2	2	2	X	**2**	2
	3	3	3	X	3	3
	4	4	4	4	4	4
	5	5	5	**5**	5	5
	6	6	6	X	X	6
Jib	**0**	**0**	**0**	**0**	**0**	**0**
4 Wheel Steer	**0**	**0**	**0**	**0**	**0**	**0**
Soft Touch/Skyguard	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
Gen Set / Welder	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Gen Set Cutout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Head & Taillights	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Cable Breaks Switch	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Load System	**0**	**0**	**0**	0	0	0
	X	*1*	X	X	X	**1**
	X	2	X	2	**2**	2
	X	3	X	**3**	X	3
	X	4	X	X	X	4
Load Sensor	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**

Table 6-5. 800A Machine Configuration Programming Settings

800 A	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Function Cutout	**0**	**0**	**0**	0	**0**	**0**
	X	1	1	**1**	1	1
	2	2	2	X	2	2
	X	3	3	X	3	3
Ground Alarm	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	**3**	**3**	**3**	**3**	**3**
Drive Type	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
Display Units	**0**	**0**	0	0	0	0
	1	1	**1**	**1**	**1**	**1**
Leveling Mode	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Drive Control	0	0	0	0	0	0
	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Drive Pump	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	X	X	X	X	X	X
	X	X	X	X	X	X
Boom Control	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Function Speed Knob	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Clearsky	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Cribbing Option	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Fuel Tank Size	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Alarm / Horn	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Alert Beacon	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Temp Cutout	X	**0**	X	**0**	X	X
	X	1	X	1	X	X
Plat Lvl Ovr Cut	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1

BOLD TEXT indicates the default setting. Plain text indicates another available selection. ***ITALIC TEXT*** indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

Table 6-6. 800 AJ Machine Configuration Programming Settings

800 AJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Model Number	**9**	**9**	**9**	**9**	**9**	**9**
Market	**0**	**1**	**2**	**3**	**4**	**5**
Engine	**12**	**12**	**12**	**12**	**12**	**12**
Flywheel Teeth	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**
Glow Plugs	0	0	0	0	0	0
	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Starter Lockout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Fuel Cutout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
Engine Shutdown	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**
Tilt	**1**	**1**	**1**	X	X	**1**
	2	2	2	X	**2**	2
	3	3	3	X	3	3
	4	4	4	4	4	4
	5	5	5	**5**	5	5
	6	6	6	X	X	6
Jib	**1**	**1**	**1**	**1**	**1**	**1**
4 Wheel Steer	**0**	**0**	**0**	**0**	**0**	**0**
Soft Touch/Sky-guard	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
Gen Set / Welder	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Gen Set Cutout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Head & Taillights	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Cable Breaks Switch	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Load System	**0**	**0**	**0**	0	**0**	0
	X	*1*	X	X	X	**1**
	X	2	X	2	**2**	2
	X	3	X	**3**	X	3
	X	4	X	X	X	4
Load Sensor	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**

Table 6-6. 800 AJ Machine Configuration Programming Settings

800 AJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Function Cutout	**0**	**0**	**0**	0	**0**	**0**
	X	1	1	**1**	1	1
	2	2	2	X	2	2
	X	3	3	X	3	3
Ground Alarm	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	**3**	**3**	**3**	**3**	**3**
Drive Type	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
Display Units	**0**	**0**	0	0	0	0
	1	1	**1**	**1**	**1**	**1**
Leveling Mode	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Drive Control	0	0	0	0	0	0
	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Drive Pump	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	X	X	X	X	X	X
	X	X	X	X	X	X
Boom Control	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Function Speed Knob	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Clearsky	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Cribbing Option	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Fuel Tank Size	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Alarm / Horn	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Alert Beacon	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Temp Cutout	X	**0**	X	**0**	X	X
	X	1	X	1	X	X
Plat Lvl Ovr Cut	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1

BOLD TEXT indicates the default setting. Plain text indicates another available selection. *ITALIC TEXT* indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

Table 6-7. Machine Configuration Parameters

Configuration Digit	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description	Range	Definition	Data Increment	Default Value
1	Model Number:	1=400 2=450 3=600 4=601 5=800	Displays/adjusts machine model	1 2 3 4 5	400 450 600 601 800	1	1
2	Engine:	1=FORD EFI GAS 2=FORD EFI D/F 3=DEUTZ F4 4=DEUTZ F3	Displays/adjusts engine manufacturer/ type	1 2 3	Ford LRG425EFI Gas Ford LRG425EFI Gas with dual fuel Deutz F4M1011F Diesel Deutz F3M1011F Diesel	1	1
3	Glow Plug:	0=NO 1="NUMBER OF MINUTES"	Display/adjusts glow plug presence and on-time	0 1-10	No glow plugs installed Setting this number tells the controller how many minutes after the EMS is pulled to output to the glow plugs before permitting the engine to be started.	1	0
4	ENG SHUTDOWN:	0=NO 1=SHUTDOWN	Displays/adjusts presence of the engine shutdown feature.	0 1	No engine shutdown Shutdown engine when coolant temperature is greater than 130° C (266° F)or the oil pressure is less than 0.5 bar (8 psi).	1	0
5	JOYSTICK TYPE:	1=RESISTIVE 2=INDUCTIVE	Displays/adjusts joystick type	1 2	Resistive Inductive	1	0

Table 6-7. Machine Configuration Parameters

6	Tilt:	1=5Deg 2=4Deg 3=3Deg	Displays/adjusts tilt sensor function	1 2 3	5 degree – reduces the maximum speed of all boom functions to creep when tilted and above elevation. Reduces drive speed to creep when tilted ANSI (US); ANSI (EXPORT); CSA; JAPAN-All Models 4 degree - reduces the maximum speed of all boom functions to creep when tilted and above elevation. Reduces drive speed to creep when tilted. CE; AUSTRALIA - Model 400S Only 3 degree – reduces the maximum speed of all boom functions to creep when titled and above elevation. Reduces drive speed to creep when tilted. CE; AUSTRALIA - Models 450, 600, 601, and 800.	1	1
7	Tower Lift:	0=NO 1=YES	Displays/adjusts tower lift presence	0 1	No Tower Lift installed Yes	1	0
8	Tower Tele:	0=NO 1=YES	Displays/adjusts tower telescope presence	0 1	No Tower Telescope installed Yes	1	0
9	Jib:	0=NO 1=YES 2=SIDESWING	Displays/adjusts jib presence	0 1 2	No Jib installed Jib installed which has up and down movements only Jib installed which has up and down movements and side to side movements	1	0
10	4ws	0=NO 1=YES	Displays/adjusts 4 wheel steer presence	0 1	No 4 wheel steer installed Yes	1	0
11	soft touch	0=NO 1=YES	Displays presence of soft touch system	0 1	No Soft Touch System installed Yes	1	0
12	generator	0=NO 1=YES	Displays presence of generator	0 1	No Generator installed Yes	1	0

Table 6-7. Machine Configuration Parameters

13	Head & Tail LIGHTS	0=NO 1=YES	Displays presence of head and tail lights	0 1	No Head and Tail Lights installed Yes	1	0
14	BROKEN Cable switch	0=NO 1=YES	Displays presence of broken cable switch	0 1	No Broken Cable Switch installed Yes	1	0
15	load SENSOR	0=NO 1=WARN ONLY 2=WARN & CUTOUT	Displays presence/ function of load sensor	0 1 2	No Load Sensor installed Functions in Creep, Overload Lamp Lit, Platform Alarm Beeps Continuously All functions cutout, flash overload light (500mS on, 500mS off), Platform Alarm beeps (5 sec on, 55 sec off, 5 sec on)	1	0
16	angle SENSOR	0=NO 1=DIGITAL 2=ANALOG	Displays presence/ function of angle sensor	0 1 2	No Angle Sensor installed Limit switches are installed An analog sensor is installed	1	0
17	length SENSOR	0=NO 1=DIGITAL 2=ANALOG	Displays presence/ function of length sensor	0 1 2	No Length Sensor Installed Limit switch installed An analog sensor is installed	1	0
18	FUNCTION CUTOUT	0=NO 1=BOOM CUTOUT 2=DRIVE CUTOUT 3=DRIVE CUT E & T	Displays presence/ function of drive cutout.	0 1 2 3	No Drive Cutout Boom Function Cutout While Driving Above Elevation. (CE) Drive Cutout Above Elevation Drive Cutout Above Elevation And Tilted	1	0
19	ground alarm	0=NO 1=DRIVE 2=LIFT DOWN 3=BOOM & DRIVE	Displays/adjusts ground alarm presence/function	0 1 2 3	No Ground Alarm installed Travel alarm – sounds when the drive function is active. (Option) Descent alarm – sounds when either lift down is active. (Option) Motion alarm – sounds when any function is active. (Option)	1	0

Table 6-7. Machine Configuration Parameters

20	PLATFORM ALARM	0=NO 1=FAULT CODE	Displays/adjusts platform alarm presence/ functions	0 1	Sounds Continuously When Above Elevation And Tilted Only. Sounds Continuously When Above Elevation And Tilted, And In Conjunction With Fault Code Flashes. (Option)	1	0
21	Tower Prox Switches	0=NO 1=YES	Displays presence/ function of Tower Proximity switches for the models specified.	0 1	No Tower Prox Switches Installed Tower Prox Switches Installed	1	0

6.9 MACHINE PERSONALITY SETTINGS

Function Speeds

Machine Orientation When Doing Speed Tests

Tower Lift: Upper Boom Horizontal, Telescoped In. Tower Lift Up, Record Time. Tower Lift Down, Record Time.

Tower Telescope: Tower Lift Fully Elevated, Upper Boom Horizontal, Telescoped In. Tower Tele Out, Record Time. Tower Tele In, Record Time.

Lift: Tower Lift Fully Elevated, Tower Telescope Fully Extended, Main Telescope Fully Retracted.

Swing: Boom at Full Elevation. Telescope Retracted. Swing the Turntable off center and stop. Swing the opposite direction and start the test when the turntable is centered up. This eliminates ramp up and down on the controller affecting times.

Telescope: Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.

Drive (Forward/Reverse): Test should be done on a smooth level surface. Drive Select Switch should be set to High Engine. Start approximately 25 ft. (7.62 m) from the starting point so that the unit is at maximum speed when starting the test. Results should be recorded for a 200 ft. (60.96 m) course. Drive Forward, Record Time. Drive Reverse, Record Time.

Drive (Above Horizontal): Test should be done on a smooth, level surface. Drive Select Switch should be set to Low Engine, Low Drive. The Platform Speed Knob control should be positioned to Creep Speed. This simulates machine speed when the boom is above horizontal. Results should be recorded for a 50 ft. (15.2 m) course. Drive Forward, Record Time. Drive Reverse, Record Time.

Platform Rotate: Platform level and completely rotated one direction. Rotate the opposite direction, Record Time. Rotate the other direction, Record Time.

Articulating Jib: Platform level and centered with the boom. Start with the Jib down. Jib Up, Record Time. Jib Down, Record Time.

Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. Drive test results reflect 15x19.5 or 18x19.5 tires, pneumatic or foam filled.
3. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
4. The platform speed knob control must be at full speed (turned clockwise completely).
5. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).
6. Some flow control functions may not work with the speed knob clicked into the creep position.

Table 6-8. Function Speeds

Function	Speed (In Seconds)
Main Lift Up	45 - 50
Main Lift Down	45 - 50
Swing Right & Left	79 - 101
NOTE: *No more than 10% difference between swing left and swing right.*	
Main Telescope In 800A 800AJ	 30-40 24-34
Main Telescope Out 800A 800AJ	 35-45 30-40
Platform Rotate Right & Left	19 - 30
NOTE: *No more that 15% difference between rotator left and rotator right.*	
Jib Up	20-30
Jib Down	30-40
Tower Lift Up	57 - 70
Tower Lift Down	44 - 53
Tower Telescope Out	24 - 32
Tower Telescope In	15-25
Drive (2WD) Forward & Reverse	33-45
Drive (4WD) Forward & Reverse	33-45
Drive Horizontal Above Elevation 2WD Forward & Reverse	61-70
Drive Horizontal Above Elevation 4WD Forward & Reverse	122 Min

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Table 6-9. Personality Ranges/Defaults

	PERSONALITY	RANGE	DEFAULTS (800A Sauer Danfoss)	DEFAULTS (800A Eaton)
DRIVE	ACCELeration	0.0 to 5.0s	2.0	2.0
	DECELeration	0.0 to 3.0s	2.0	2.0
	FORward MINimum speed	1 to 35%	4	15
	FORward MAXimum speed	1 to 100%	30	55
	REVerse MINimum speed	1 to 35%	4	15
	REVerse MAXimum speed	1 to 100%	34	55
	ELEVATED MAXimum speed	1 to 50%	15	28
	CREEP MAXimum speed	1 to 90%	15	32
STEER	MAXimum speed	1 to 100%	100	100
UPPERLIFT	ACCELeration	0.0 to 5.0s	2.9	2.9
	DECELeration	0.0 to 3.0s	1.0	1.0
	MINimum UP speed	1 to 60%	26	26
	MAXimum UP speed	1 to 100%	88	88
	CREEP Maximum UP speed	1 to 65%	62	62
	MINimum DOWN speed	1 to 60%	25	25
	MAXimum DOWN speed	1 to 100%	95	95
	CREEP maximum DOWN speed	1 to 75%	69	69
TOWERLIFT	ACCELeration	0.0 to 5.0s	2.8	2.8
	DECELeration	0.0 to 3.0s	0.8	0.8
	MINimum UP speed	1 to 60%	53	53
	MAXimum UP speed	1 to 100%	90	90
	MINimum DOWN speed	1 to 60%	53	53
	MAXimum DOWN speed	1 to 100%	90	90
	Medium Speed	0.01 to 1.00	0.30	0.30

Table 6-9. Personality Ranges/Defaults

	PERSONALITY	RANGE	DEFAULTS (800A Sauer Danfoss)	DEFAULTS (800A Eaton)
SWING	ACCELeration	0.0 to 5.0s	2.8	2.8
	DECELeration	0.0 to 3.0s	2.5	2.5
	MINimum LEFT speed	1 to 50%	25	25
	MAXimum LEFT speed	1 to 100%	70	70
	CREEP maximum LEFT speed	1 to 65%	62	62
	MINimum RIGHT speed	1 to 50%	25	25
	MAXimum RIGHT speed	1 to 100%	73	73
	CREEP maximum RIGHT speed	1 to 65%	62	62
TELEscope-UPPER	ACCELeration	0.0 to 5.0s	3.5	3.5
	DECELeration	0.0 to 3.0s	0.8	0.8
	MINimum IN speed	1 to 65%	40	40
	MAXimum IN speed	1 to 100%	75	75
	MINimum OUT speed	1 to 65%	40	40
	MAXimum OUT speed	1 to 100%	70	70
	Medium Speed	0.01 to 1.00	0.50	0.50
TELEscope-TOWER	ACCELeration	0.0 to 5.0s	1.0	1.0
	DECELeration	0.0 to 3.0s	0.5	0.5
	MINimum IN speed	1 to 65%	45	45
	MAXimum IN speed	1 to 100%	90	90
	MINimum OUT speed	1 to 65%	55	55
	MAXimum OUT speed	1 to 100%	90	90
	Medium Speed	0.01 to 1.00	0.40	0.40
PLATFORM LEVEL	ACCELeration	0.0 to 5.0s	2.5	2.5
	DECELeration	0.0 to 3.0s	1.0	1.0
	MINimum UP speed	1 to 65%	45	45
	MAXimum UP speed	1 to 100%	55	55
	MINimum DOWN speed	1 to 65%	45	45
	MAXimum DOWN speed	1 to 100%	55	55
	Medium Speed	0.01 to 1.00	0.60	0.60

Table 6-9. Personality Ranges/Defaults

	PERSONALITY	RANGE	DEFAULTS (800A Sauer Danfoss)	DEFAULTS (800A Eaton)
PLATFORM ROTATE	ACCELeration	0.0 to 5.0s	1.8	1.8
	DECELeration	0.0 to 3.0s	0.5	0.5
	MINimum LEFT speed	1 to 100%	25	25
	MAXimum LEFT speed	1 to 100%	60	60
	MINimum RIGHT speed	1 to 100%	25	25
	MAXimum RIGHT speed	1 to 100%	60	60
	Medium Speed	0.01 to 1.00	0.35	0.35
JIB LIFT	Lift ACCELeration	0.0 to 5.0s	2.5	2.5
	Lift DECELeration	0.0 to 3.0s	1.0	1.0
	MINimum UP speed	1 to 65%	27	27
	MAXimum UP speed	1 to 100%	50	50
	MINimum DOWN speed	1 to 65%	26	26
	Max Down	1 to 100%	45	45
	Medium Speed	0.01 to 1.00	0.35	0.35
GROUND MODE	Tower LIFT UP speed	1 to 100%	89	89
	Tower LIFT DOWN speed	1 to 100%	89	89
	Main LIFT UP speed	1 to 100%	87	87
	Main LIFT DOWN speed	1 to 100%	94	94
	SWING speed	1 to 100%	65	65
	Main TELEscope speed	1 to 100%	69	69
	Tower TELEscope speed	1 to 100%	89	89
	PLATFORM ROTATE speed	1 to 100%	59	59
	PLATFORM LEVEL speed	1 to 100%	54	54
	JIB LIFT speed	1 to 100%	44	44

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Table 6-10. Help Fault Codes, Displayed Faults, and Descriptions - (Prior to S/N 0300066931)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
None	**No flash code is indicated for the following help messages. They are intended to hint at a possible problem if the vehicle is not behaving as expected.**		1
	EVERYTHING OK	The "normal" help message in platform mode	
	GROUND MODE OK	The "normal" help message in ground mode	
	DRIVING AT CREEP - TILTED	Drive speed is limited to creep because the vehicle is tilted.	
	FSW OPEN	A drive or boom function has been selected but footswitch is open.	
	RUNNING AT CREEP - CREEP SWITCH OPEN	All function speeds are limited to creep because the creep switch is open.	
	RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	All function speeds are limited to creep because the vehicle is tilted and above elevation.	
	RUNNING AT CUTBACK - ABOVE ELEVATION	Drive speed is limited to "ELEVATED MAX" because the vehicle is above elevation.	
	TESTS ACTIVE – RECYCLE EMS TO END	The system tests have been activated; normal vehicle operation is not allowed.	
1/1	**Flash code 1/1 indicates a "sleep" mode.** **NOT REQUIRED**		
2/1	**Flash code 2/1 indicates problems with footswitch.**		2
	FSW FAULTY	The two foot switch signals do not agree. EMS recycle required.	
	KEYSWITCH FAULTY	Both platform and ground modes are selected simultaneously	
2/2	**Flash code 2/2 indicates problems with drive & steer selection.**		3
	DRIVE JOYSTICK FAULTY	The drive joystick center tap is out of valid range, or the wiper is wire-off.	
	DRIVE LOCKED – JOYSTICK MOVED BEFORE EMS/FSW	Drive was selected before and during footswitch closure.	
	FSW INTERLOCK TRIPPED	Footswitch was closed for seven seconds with no function selected.	
	STEER LOCKED – SELECTED BEFORE EMS/FSW	Steer was selected before and during footswitch closure.	
	STEER SWITCHES FAULTY	Both steer switches are active together.	
	WAITING FOR FSW TO BE OPEN	Footswitch was closed when platform mode was selected.	
	JOYSTICK FAULTS – CHECK PLATFORM BOX WIRING	More than one of the drive, lift, and swing joystick center tap or wiper voltages is out of range. This is probably due to a short-circuit across a joystick pot.	
	FUNCTION LOCKED OUT - TOWER LIFT DOWN PERMANENTLY CLOSED	The control system detected the TOWER LIFT DOWN input high during startup.	

Table 6-10. Help Fault Codes, Displayed Faults, and Descriptions - (Prior to S/N 0300066931)

2/3	**Flash code 2/3 indicates problems with boom function selection.**		3
	LIFT/SWING JOYSTICK FAULTY	The lift or swing joystick center tap is out of valid range, or the wiper is wire-off.	
	LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE EMS/FSW	Platform upper lift or swing was selected before and during footswitch closure.	
	PUMP POT FAULTY	The pump pot is open-circuit; all platform boom functions except upper lift & swing will run at creep.	
	PUMP SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	A boom function (lower lift, telescope, basket level, basket rotate, jib) has both directions selected together.	
	PUMP SWITCHES LOCKED - SELECTED BEFORE EMS/FSW	A platform boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before key switch or footswitch closure.	
	PUMP SWITCHED LOCKED - SELECTED BEFORE EMS	A ground boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before key switch.	
	SWING/LIFT JOYSTICK FAULTY	The swing joystick center tap is out of valid range, or the wiper is wire-off.	
2/4	**Flash code 2/4 indicates that steering digital inputs are faulty.** **NOT REQUIRED**		
2/5	**Flash code 2/5 indicates that a function is prevented due to a cutout.**		4
	BOOM PREVENTED - DRIVE SELECTED	A boom function is selected while a drive function is selected and drive cutout is configured to prevent simultaneous drive & boom operation.	
	DRIVE PREVENTED - ABOVE ELEVATION	Drive is selected while above elevation and drive cutout is configured to prevent drive.	
	DRIVE PREVENTED - BOOM MOVEMENT SELECTED	Drive is selected while a boom function is selected and drive cutout is configured to prevent simultaneous drive & boom operation.	
	DRIVE PREVENTED - TILTED & ABOVE ELEVATION	Drive is selected while tilted and above elevation and tilt is configured to cutout drive.	
	BOOM PREVENTED – FUNCTION CUTOUT ACTIVE	A boom function is selected while function cutout is active and configured to cutout boom functions.	
	BOOM & DRIVE PREVENTED-FUNCTION CUTOUT ACTIVE	Drive or a boom function is selected while function cutout is active and configured to cutout all functions.	
	UMS SENSOR BACKWARD LIMIT REACHED	The upright angle relative to the turntable is higher than +2.5°.	
	UMS SENSOR FORWARD LIMIT REACHED	The upright angle relative to the turntable is less than –4.0°.	
	UMS SENSOR OUT OF USABLE RANGE	Both the Turntable tilt sensor and the UMS sensor read greater then ±10° in the same direction.	
2/7	**Flash code 2/7 indicates that the accelerator input is faulty.** **NOT REQUIRED**		
2/8	**Flash code 2/8 indicates that the hydraulic filter is being bypassed.**		5
	RETURN FILTER BYPASSED	Hydraulic return filter clogged	
	CHARGE PUMP FILTER BYPASSED	Charge pump filter clogged	
3/1	Flash code 3/1 indicates that a contactor did not close when energized. NOT REQUIRED		

Table 6-10. Help Fault Codes, Displayed Faults, and Descriptions - (Prior to S/N 0300066931)

3/2	**Flash code 3/2 indicates that a contactor did not open when energized. NOT REQUIRED**		
3/3	**Flash code 3/3 indicates that a driver is short-circuit.**		6
	ADD DRIVER FAULTS		
3/5	**Flash code 3/5 indicates a brake pressure problem. NOT REQUIRED**		7
4/2	**Flash code 4/2 indicates that the engine is over temperature. NOT REQUIRED**		8
4/3	**Flash code 4/3 indicates problems with the engine**		9
	ENGINE TEMP GREATER THAN 130°C (266° F)		
	AIR FILTER BYPASSED	Air filter clogged	
	NO ALTERNATOR OUTPUT	The measured battery voltage is less than 12.5 VDC	
	OIL PRESSURE LESS THAN 0.5 BAR (8PSI)		
4/4	**Flash code 4/4 indicates problems with the battery supply.**		7
	BATTERY LOW	Battery voltage is below 11V. This is a warning - the controller does not shut down.	
	BATTERY TOO HIGH - SYSTEM SHUT DOWN	Battery voltage is above 18V. EMS recycle required.	
	BATTERY TOO LOW - SYSTEM SHUT DOWN	Battery voltage is below 6V. EMS recycle required.	
	SYSTEM VOLTS LOW	Battery voltage is below 9V.	
	SYSTEM VOLTS HIGH	Battery voltage is above 16V.	
5/5	**Flash code 5/5 indicates problems with vehicle engine RPM or the encoder.**		8
	SPEED SENSOR READING INVALID SPEED	Speed sensor is indicating an impossible number of pulses. This is probably due to a faulty speed sensor.	
	SPEED INPUT LOST	This indicates that the control system has determined that the diesel engine speed input to the system has been lost. This is probably due to wiring problems at the ground module or a faulty speed sensor.	
	ENGINE SPEED DOES NOT MATCH COMMAND	This indicates that the control system has determine that the diesel engine governor has stuck. This is probably due to electrical or mechanical problems with the governor.	
6/6	**Flash code 6/6 indicates problems with the CAN bus.**		10
	CAN BUS FAILURE:	The ground module or platform module is not receiving. This is probably due to wiring problems between the platform and ground modules.	
7/7	**Flash code 7/7 indicates problems with a motor. NOT REQUIRED**		

Table 6-10. Help Fault Codes, Displayed Faults, and Descriptions - (Prior to S/N 0300066931)

8/1	**Flash codes 8/1 indicate sensor issues.**		11
	UMS SENSOR NOT CALIBRATED	The control system detects a sensor out of range condition or a not calibrated fault with the UMS angle sensor	
	UMS SENSOR FAULTED	The system detects that the UMS sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range	
	TOWER LIFT DOWN OUTPUT SHORT TO GROUND OR OPEN CIRCUIT	Short to Ground or open circuit has been detected on the Tower Lift Down output.	
	TOWER LIFT DOWN OUTPUT SHORT TO BATTERY	Short to battery has been detected on the Tower Lift Down output	
	PLATFORM INDICATOR OUTPUT SHORT TO GROUND OR OPEN CIRCUIT	Short to Ground or open circuit has been detected on the Platform Indicator output	
	PLATFORM INDICATOR OUTPUT SHORT TO BATTERY	Short to battery has been detected on the Platform Indicator output	
	GROUND INDICATOR OUTPUT SHORT TO GROUND OR OPEN CIRCUIT	Short to Ground or open circuit has been detected on the Ground Indicator output	
	GROUND INDICATOR OUTPUT SHORT TO BATTERY	Short to battery has been detected on the Ground Indicator Output	11
	TURNTABLE SENSOR NOT CALIBRATED	The control system detects that the Chassis Tilt sensor is not calibrated or there is an internal fault with the sensor	
	TURNTABLE FAULTED	The system detects that the Chassis tilt sensor frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range the control	
9/9	**Flash code 9/9 indicates problems with the controller or memory issues.**		11
	PLATFORM MODULE FAILURE: hwfs CODE 1	Platform module V(Low) FET has failed	
	GROUND MODULE FAILURE: hwfs CODE 1	Ground module V(Low) FET has failed	
	EEPROM FAILURE – CHECK ALL SETTINGS	A critical failure occurred with the EEPROM	12

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
None	**No flash code is indicated for the following help messages. They are intended to hint at a possible problem if the vehicle is not behaving as expected.**		**1**
	EVERYTHING OK	The "normal" help message in platform mode	
	GROUND MODE OK	The "normal" help message in ground mode	
	FSW OPEN	A drive or boom function has been selected but footswitch is open.	
	RUNNING AT CREEP – CREEP SWITCH OPEN	All function speeds are limited to creep because the creep switch is open.	
	RUNNING AT CREEP – TILTED AND ABOVE ELEVATION	All boom function speeds are limited to creep because the vehicle is tilted and above elevation.	
	RUNNING AT CUTBACK – ABOVE ELEVATION	Drive speed is limited to "ELEVATED MAX" because the vehicle is above elevation.	
	TILT SENSOR OUT OF RANGE	The tilt sensor has indicated a tilt angle greater than 19 degrees for more than 4 seconds. Not reported during 2 second power-up.	
	LOAD SENSOR READING UNDER WEIGHT	The load sensor is reading 20% or more under the calibrated zero point. This fault may occur if the basket is resting on the ground. Not reported during 2 second power-up.	
1/1	**Flash code 1/1 indicates a "sleep" mode.** **NOT REQUIRED**		
2/1	**Flash code 2/1 indicates problems with footswitch.**		**2**
	FSW FAULTY	The two footswitch inputs have read the same state for more than one second.	
	KEYSWITCH FAULTY	Both platform and ground modes are selected simultaneously	

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/2	**Flash code 2/2 indicates problems with drive & steer selection. Except where noted, these faults are not reported during 2 second power-up sequence.**		**3**
	DRIVE LOCKED – JOYSTICK MOVED BEFORE FOOTSWITCH	Drive was selected before and during footswitch closure. Can be reported during power-up sequence.	
	FSW INTERLOCK TRIPPED	Footswitch was closed for seven seconds with no function selected. Can be reported during power-up sequence.	
	STEER LOCKED – SELECTED BEFORE FOOTSWITCH	Steer was selected before and during footswitch closure.	
	STEER SWITCHES FAULTY	Both steer switches are active together.	
	DRIVE / STEER WITH NO QPROX	This fault only occurs with inductive joysticks. It occurs if the joystick is moved out of the neutral position with no Qprox sensors active.	
	D/S JOY. QPROX BAD	These faults only occur with inductive joysticks. They indicate that the Q-Prox sensor is reading above 3.18 volts.	
	D/S JOY. OUT OF RANGE LOW	Resistive joysticks: These faults do not occur. Inductive joysticks: The trigger points for these faults are dependent on the centertap voltage reading. These faults will be triggered when the voltage is less than the centertap voltage minus half the center tap voltage minus 0.3 volts. If the centertap is at the high end of the range, these faults will be triggered below 1.05 volts. If the centertap is at the low end of the range, these faults will be triggered below 0.79 volts.	
	D/S JOY. OUT OF RANGE HIGH	Resistive joysticks: These faults do not occur if the Vref voltage is below 8.1 volts. If Vref is above 7.7 volts, Vref is operating out of tolerance or a short to battery has occurred. Inductive joysticks: The trigger points for these faults are dependent on the centertap voltage reading. These faults will be triggered when the voltage is more than the centertap voltage plus half the centertap voltage plus 0.3 volts. If the centertap is at the high end of the range, these faults will be triggered above 4.35 volts. If the centertap is at the low end of the range, these faults will be triggered above 3.8 volts.	
	D/S JOY. CENTER TAP BAD	Resistive joysticks: These faults occur when the center tap voltage is not between 3.08 volts and 3.83 volts. Due to resistor tolerances there is a +/-.1 volt range around these values where the fault may be indicated. Inductive joysticks: These faults occur when the center tap voltage is not between 2.18 volts and 2.70 volts. Due to resistor tolerances there is a +/-.1 volt range around these values where the fault may be indicated.	
	WAITING FOR FSW TO BE OPEN	Footswitch was closed when platform mode was selected. Can be reported during power-up sequence.	

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/3	**Flash code 2/3 indicates problems with boom function selection.**		**3**
	LIFT/SWING LOCKED – JOYSTICK MOVED BEFORE FOOTSWITCH	Platform upper lift or swing was selected before and during footswitch closure.	
	PUMP SWITCHES FAULTY – CHECK DIAGNOS-TICS/BOOM	A boom function (lower lift, telescope, basket level, basket rotate, jib) has both directions selected together.	
	PUMP SWITCHES LOCKED – SELECTED BEFORE FOOTSWITCH	A platform boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before key switch or footswitch closure.	
	PUMP SWITCHES LOCKED – SELECTED BEFORE AUX POWER	A ground boom function (lower lift, telescope, basket level, basket rotate, jib) was selected before aux power.	
	LIFT / SWING WITH NO QPROX	This fault only occurs with inductive joysticks. It occurs if the joystick is moved out of the neutral position with no Qprox sensors active.	
	l/s joy. qprox bad	These faults only occur with inductive joysticks. They indicate that the Q-Prox sensor is reading above 3.18 volts.	
	l/s joy. out of range low	Resistive joysticks: These faults do not occur. Inductive joysticks: The trigger points for these faults are dependent on the centertap voltage reading. These faults will be triggered when the voltage is less than the centertap voltage minus half the center tap voltage minus 0.3 volts. If the centertap is at the high end of the range, these faults will be triggered below 1.05 volts. If the centertap is at the low end of the range, these faults will be triggered below 0.79 volts.	
	l/s joy. out of range high	Resistive joysticks: These faults do not occur if the Vref voltage is below 8.1 volts. If Vref is above 7.7 volts, Vref is operating out of tolerance or a short to battery has occurred. Inductive joysticks: The trigger points for these faults are dependent on the centertap voltage reading. These faults will be triggered when the voltage is more than the centertap volt-age plus half the centertap voltage plus 0.3 volts. If the centertap is at the high end of the range, these faults will be triggered above 4.35 volts. If the centertap is at the low end of the range, these faults will be triggered above 3.8 volts.	
	l/s joy. center tap bad	Resistive joysticks: These faults occur when the center tap voltage is not between 3.08 volts and 3.83 volts. Due to resistor tolerances there is a +/-.1 volt range around these values where the fault may be indicated. Inductive joysticks: These faults occur when the center tap voltage is not between 2.18 volts and 2.70 volts. Due to resistor tolerances there is a +/-.1 volt range around these values where the fault may be indicated.	
	PUMP SWITCHES LOCKED – SELECTED BEFORE START SWTICH	This fault occurs when a hydraulic function switch is closed before the start switch is closed.	
	FOOTSWITCH SELECTED BEFORE START	The user attempted to start the machine with the footswitch engaged.	
2/4	**Flash code 2/4 indicates that steering digital inputs are faulty.** **NOT REQUIRED**		
2/5	**Flash code 2/5 indicates that a function is prevented due to a cutout.**		**4**
	BOOM PREVENTED – DRIVE SELECTED	A boom function is selected while a drive function is selected and drive cutout is configured to prevent simul-taneous drive & boom operation.	
	DRIVE PREVENTED – ABOVE ELEVATION	Drive is selected while above elevation and drive cutout is configured to prevent drive.	
	DRIVE PREVENTED – BOOM SELECTED	Drive is selected while a boom function is selected and drive cutout is configured to prevent simultaneous drive & boom operation.	
	DRIVE PREVENTED – TILTED & ABOVE ELEVA-TION	Drive is selected while tilted and above elevation and tilt is configured to cutout drive.	
	MODEL CHANGED – HYDRAULICS SUSPENDED – CYCLE EMS	User changed the model number using the analyzer. User must cycle power before the hydraulics system will be active again.	11
	UMS SENSOR BACKWARD LIMIT REACHED	The UMS to turntable angle is a value greater than 2.5°	5
	UMS SENSOR FORWARD LIMIT REACHED	The UMS to turntable angle is a value less than –4.0°	
	AUTO DETECTION INPUT LOW	UMS detects a valid ground module software version but digital input 2 is not tied high	

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/7	**Flash code 2/7 indicates that the accelerator input is faulty.** **NOT REQUIRED**		
2/8	**Flash code 2/8 indicates a problem with a hydraulic filter. Not reported during 2 second power-up.**		5
	RETURN FILTER BYPASSED	Hydraulic return filter clogged	
	charge pump filter bypassed	Charge pump filter clogged	
3/1	**Flash code 3/1 indicates that a contactor did not close when energized.** **NOT REQUIRED**		
3/2	**Flash code 3/2 indicates that a contactor did not open when energized.** **NOT REQUIRED**		
3/3	**Flash code 3/3 indicates a driver problem. All driver faults are detected in a similar manner. Open circuit faults are detected when the analog feedback reads too high and the output is commanded off. Short to ground is detected when the analog feedback reads low and the output is commanded on. Short to battery is detected when the analog feedback reads Vbat and the output is commanded off. Not reported during 2 second power-up.**		6
	ALTERNATOR/ECM POWER SHORT TO GROUND		
	HOUR METER SHORT TO GROUND		
	HOUR METER SHORT TO BATTERY		
	HORN SHORT TO GROUND		
	HORN OPEN CIRCUIT		
	HORN SHORT TO BATTERY		
	AUX POWER SHORT TO GROUND		
	AUX POWER OPEN CIRCUIT		
	AUX POWER SHORT TO BATTERY		
	GLOW PLUG SHORT TO GROUND		
	GLOW PLUG OPEN CIRCUIT		
	GLOW PLUG SHORT TO BATTERY		
	LP LOCK SHORT TO GROUND		
	LP LOCK OPEN CIRCUIT		
	LP LOCK SHORT TO BATTERY		
	LP START ASSIST SHORT TO GROUND		
	LP START ASSIST OPEN CIRCUIT		
	LP START ASSIST SHORT TO BATTERY		
	MAIN DUMP SHORT TO GROUND		
	MAIN DUMP OPEN CIRCUIT		
	MAIN DUMP SHORT TO BATTERY		
	PARKING BRAKE SHORT TO GROUND		
	PARKING BRAKE OPEN CIRCUIT		
	PARKING BRAKE SHORT TO BATTERY		
	START SOLENOID SHORT TO GROUND		

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	START SOLENOID OPEN CIRCUIT		
	START SOLENOID SHORT TO BATTERY		
	STEER DUMP SHORT TO GROUND		
	STEER DUMP OPEN CIRCUIT		
	STEER DUMP SHORT TO BATTERY		
	TWO SPEED SHORT TO GROUND		
	TWO SPEED OPEN CIRCUIT		
	TWO SPEED SHORT TO BATTERY		
	GROUND ALARM SHORT TO GROUND		
	GROUND ALARM OPEN CIRCUIT		
	GROUND ALARM SHORT TO BATTERY		
	GENERATOR SHORT TO GROUND		
	GENERATOR OPEN CIRCUIT		
	GENERATOR SHORT TO BATTERY		
	WELDER SHORT TO GROUND		
	WELDER OPEN CIRCUIT		
	WELDER SHORT TO BATTERY		
	HEAD TAIL LIGHT SHORT TO GROUND		
	HEAD TAIL LIGHT OPEN CIRCUIT		
	HEAD TAIL LIGHT SHORT TO BATTERY		
	BASKET UP OVERRIDE SHORT TO GROUND	Only occurs on machines with electronic leveling systems.	
	BASKET UP OVERRIDE OPEN CIRCUIT	Only occurs on machines with electronic leveling systems.	
	BASKET UP OVERRIDE SHORT TO BATTERY	Only occurs on machines with electronic leveling systems.	
	BASKET UP SHORT TO GROUND		
	BASKET UP OPEN CIRCUIT		
	BASKET UP SHORT TO BATTERY		
	BASKET DOWN SHORT TO GROUND		

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	BASKET DOWN OPEN CIRCUIT		
	BASKET DOWN SHORT TO BATTERY		
	BASKET DOWN OVERRIDE SHORT TO GROUND	Only occurs on machines with electronic leveling systems.	
	BASKET DOWN OVERRIDE OPEN CIRCUIT	Only occurs on machines with electronic leveling systems.	
	BASKET DOWN OVERRIDE SHORT TO BATTERY	Only occurs on machines with electronic leveling systems.	
	BASKET LEFT OPEN CIRCUIT		
	BASKET LEFT SHORT TO BATTERY		
	BASKET LEFT SHORT TO GROUND		
	BASKET RIGHT SHORT TO GROUND		
	BASKET RIGHT OPEN CIRCUIT		
	BASKET RIGHT SHORT TO BATTERY		
	JIB UP SHORT TO GROUND		
	JIB UP OPEN CIRCUIT		
	JIB UP SHORT TO BATTERY		
	JIB DOWN SHORT TO GROUND		
	JIB DOWN OPEN CIRCUIT		
	JIB DOWN SHORT TO BATTERY		
	JIB LEFT SHORT TO GROUND		
	JIB LEFT OPEN CIRCUIT		
	JIB LEFT SHORT TO BATTERY		
	JIB RIGHT SHORT TO GROUND		
	JIB RIGHT OPEN CIRCUIT		
	JIB RIGHT SHORT TO BATTERY		
	TOWER UP SHORT TO GROUND		
	TOWER UP OPEN CIRCUIT		
	TOWER UP SHORT TO BATTERY		
	TOWER DOWN SHORT TO GROUND		

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	TOWER DOWN OPEN CIRCUIT		
	TOWER DOWN SHORT TO BATTERY		
	TOWER IN SHORT TO GROUND		
	TOWER IN OPEN CIRCUIT		
	TOWER IN SHORT TO BATTERY		
	TOWER OUT SHORT TO GROUND		
	TOWER OUT OPEN CIRCUIT		
	TOWER OUT SHORT TO BATTERY		
	UPPER IN SHORT TO GROUND		
	UPPER IN OPEN CIRCUIT		
	UPPER IN SHORT TO BATTERY		
	UPPER OUT SHORT TO GROUND		
	UPPER OUT OPEN CIRCUIT		
	UPPER OUT SHORT TO BATTERY		
	LIFT UP DUMP SHORT TO GROUND		
	LIFT UP DUMP OPEN CIRCUIT		
	LIFT UP DUMP SHORT TO BATTERY		
	LIFT DOWN HOLDING SHORT TO GROUND		
	LIFT DOWN HOLDING OPEN CIRCUIT		
	LIFT DOWN SHORT TO BATTERY		
	HOUR METER OPEN CIRCUIT	This fault cannot be detected during normal operation. It may be reported during self test.	
	FORD ECM POWER OPEN CIRCUIT	This fault cannot be detected during normal operation. It may be reported during self test.	
	FORD ECM POWER SHORT TO BATTERY	This fault cannot be detected during normal operation. It may be reported during self test.	
3/4	**Flash code 3/4 indicates a driver problem on a platform valve block valve driver. All driver faults are detected in a similar manner. Open circuit faults are detected when the analog feedback reads too high and the output is commanded off. Short to ground is detected when the analog feedback reads low and the output is commanded on. Short to battery is detected when the analog feedback reads Vbat and the output is commanded off. Not reported during 2 second power-up.**		6
	BASKET UP SHORT TO BATTERY		
	BASKET UP SHORT TO GROUND		
	BASKET UP OPEN CIRCUIT		
	BASKET UP SHORT TO BATTERY OR OPEN CIRCUIT	Only occurs on machines with electronic basket leveling.	
	BASKET DOWN SHORT TO BATTERY		
	BASKET DOWN SHORT TO GROUND		
	BASKET DOWN OPEN CIRCUIT		

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	BASKET DOWN SHORT TO BATTERY OR OPEN CIRCUIT	Only occurs on machines with electronic basket leveling.	
	BASKET LEFT SHORT TO BATTERY		
	BASKER LEFT SHORT TO GROUND		
	BASKET LEFT OPEN CIRCUIT		
	BASKET RIGHT SHORT TO BATTERY		
	BASKET RIGHT SHORT TO GROUND		
	BASKET RIGHT OPEN CIRCUIT		
	JIB UP SHORT TO BATTERY		
	JIB UP SHORT TO GROUND		
	JIB UP OPEN CIRCUIT		
	JIB DOWN SHORT TO BATTERY		
	JIB DOWN SHORT TO GROUND		
	JIB DOWN OPEN CIRCUIT		
	JIB LEFT SHORT TO BATTERY		
	JIB LEFT SHORT TO GROUND		
	JIB LEFT OPEN CIRCUIT		
	JIB RIGHT SHORT TO BATTERY		
	JIB RIGHT SHORT TO GROUND		
	JIB RIGHT OPEN CIRCUIT		
	PLATFORM CONTROL VALVE SHORT TO BATTERY	Only occurs on machines with electronic basket leveling	
	PLATFORM CONTROL VALVE SHORT TO GROUND	Only occurs on machines with electronic basket leveling	
	PLATFORM CONTROL VALVE OPEN CIRCUIT	Only occurs on machines with electronic basket leveling	
3/5	**Flash code 3/5 indicates a brake pressure problem. NOT REQUIRED**		
4/2	**Flash code 4/2 indicates that the engine is over temperature. NOT REQUIRED**		
4/3	**Flash code 4/3 indicates problems with the engine. Except where noted, these faults are not reported during 2 second power-up sequence.**		**9**
	HIGH ENGINE TEMP	Occurs when the engine temperature is above 117 degrees Celsius for the Ford engines, and above 130 degrees Celsius for the Deutz engines.	
	AIR FILTER BYPASSED	Air filter clogged	
	NO ALTERNATOR OUTPUT	The engine has been running for 15 seconds or more and the battery voltage is still below 12.5 volts.	
	LOW OIL PRESSURE	If a Deutz engine is installed, the oil pressure is below 8 PSI and the engine has been running for at least 10 seconds. If a Ford engine is installed, the Ford ECM has reported a low oil pressure fault.	
	OIL PRESSURE SHORT TO BATTERY	If a Deutz engine is installed, this indicates that the oil pressure sensor is reading above 6.6 volts.	
	OIL PRESSURE SHORT TO GROUND	If a Deutz engine is installed, this indicates that the oil pressure sensor is reading below 0.1 volts for more than 5 seconds. This fault is not detected during crank.	

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	COOLANT TEMPERATURE SHORT TO GROUND	If a Deutz engine is installed, this indicates that the coolant temperature is reading below 0.1 volts.	
	FORD FAULT CODE ##	All Ford fault codes except 63 are simply passed through from the FORD ECM. They only occur if a Ford engine is selected in the machine configuration digits. Can be reported during power-up sequence.	
	FORD FAULT CODE UNKNOWN	An unrecognized Ford ECM fault code has been received. Can be reported during power-up sequence.	
	485 COMMUNICATIONS LOST	This fault only occurs with a Ford engine. It occurs when no responses are received from the ECM for 2.5 seconds. Can be reported during power-up sequence.	
	FUEL SENSOR SHORT TO BATTERY	Indicates that the fuel sensor is reading above 4.3 volts.	
	FUEL SENSOR SHORT TO GROUND	Indicates that the fuel sensor is reading below 0.2 volts.	
4/4	**Flash code 4/4 indicates problems with the battery supply. Not reported during 2 second power-up.**		**7**
	BATTERY LOW	Battery voltage is below 11V for more than 5 seconds. This fault is not detected during crank. This is a warning – the controller does not shut down.	
	BATTERY TOO HIGH – SYSTEM SHUT DOWN	Battery voltage is above 16V. EMS recycle required.	
	BATTERY TOO LOW – SYSTEM SHUT DOWN	Battery voltage is below 9V.	
5/5	**Flash code 5/5 indicates problems with vehicle engine RPM or the encoder. Not reported during 2 second power-up.**		**8**
	SPEED SENSOR READING INVALID SPEED	This fault is detected with diesel engines only. The RPM pickup is indicating a speed that greater than 4000 RPM or approximately 8875 Hz.	
	SPEED INPUT LOST	This fault is detected with diesel engines only. It occurs if there is no RPM detected and the oil pressure input is reading above 8 PSI for more than three seconds. This is probably due to wiring problems at the ground module or a faulty speed sensor.	
6/6	**Flash code 6/6 indicates problems with the CAN bus.**		**10**
	CAN BUS FAILURE:	The ground module or platform module is not receiving CAN messages. This is probably due to wiring problems between the platform and ground modules.	
	UMS SENSOR COMMUNICATIONS LOST	The Ground module is not receiving CANbus information from the UMS module.	10
7/7	**Flash code 7/7 indicates problems with a motor.** **NOT REQUIRED**		
8/1	**Flash code 8/1 indicates UMS sensor issues.**		**11**
	UMS SENSOR OUT OF USABLE RANGE	Both the Chassis tilt sensor and the UMS sensor read greater then 10°	
	UMS SENSOR NOT CALIBRATED	The Ground module detects that the UMS angle sensor has not been calibrated	
	UMS SENSOR FAULTED	The Ground module detects the UMS sensor is reading a frequency outside the 100Hz +/- 5Hz range or the duty cycle is outside 50% +/- 21% range	

Table 6-11. Help Fault Codes, Displayed Faults, and Descriptions - (S/N 0300066931 to S/N 0300183033)

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
9/9	**Flash code 9/9 indicates problems with the controller.**		**11**
	PLATFORM MODULE SOFTWARE UPDATE REQUIRED	Platform module code is too old to support the EIM or BPE load sensor and the machine is configured to use one of these two sensors. The PM code must be updated to a newer version.	
	HIGH RESOLUTION A2D FAILURE –INTERRUPT LOST	The ADS1213 chip in the platform module has stopped asserting its interrupt (DRDY) line for some reason. An EMS cycle is required.	
	HIGH RESOLUTION A2D FAILURE-REINIT LIMIT	The ADS1213 has needed to be reset 3 or more times.	
	PLATFORM MODULE FAILURE: hwfs CODE 1	Platform module Flow) FET has failed	
	GROUND MODULE FAILURE: hwfs CODE 1	Ground module V(Low) FET has failed	
	GROUND SENSOR REF VOLTAGE OUT OF RANGE	These faults occur when the seven volt reference voltage used for the joysticks, sensors, etc goes out of range. Not reported during 2 second power-up.	
	PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	These faults occur when the seven volt reference voltage used for the joysticks, sensors, etc goes out of range. Not reported during 2 second power-up.	
	EEPROM FAILURE – CHECK ALL SETTINGS	A critical failure occurred with the EEPROM. Personalities, machine configuration digits, etc may be reset to default values and should be checked.	
	CHASSIS TILT SENSOR NOT GAIN CALIBRATED	Indicates that the chassis tilt sensor calibration information has been lost. Machine will indicate that it is tilted at all times. This calibration data is programmed into the unit at the factory.	
	CHASSIS TILT SENSOR GAIN OUT OF RANGE	Indicates that the chassis tilt sensor calibration has become corrupted.	
	INCOMPATIBLE SOFTWARE DETECTED	The UMS module detects that the Ground module software is incompatible with the UMS module	**12**

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
HELP COMMENT	000	00	0		
EVERYTHING OK	001	00	1	Y	N
GROUND MODE OK	002	00	2	Y	N
RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION	0010	00	10	Y	N
FSW OPEN	0011	00	11	Y	N
RUNNING AT CREEP - CREEP SWITCH OPEN	0012	00	12	Y	N
RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	0013	00	13	Y	N
CHASSIS TILT SENSOR OUT OF RANGE	0014	00	14	Y	N
LOAD SENSOR READING UNDER WEIGHT	0015	00	15	Y	N
APU ACTIVE	0035	00	35	Y	N
RUNNING AT CREEP-CREEP SWITCH CLOSED	0040	00	40	Y	N
POWER-UP	210	21	0	Y	N
POWER CYCLE	211	21	1	Y	N
KEYSWITCH FAULTY	212	21	2	N	N
FSW FAULTY	213	21	3	N	N
PLATFORM INPUTS	220	22	0		N
STEER SWITCHES FAULTY	227	22	7	N	N
FSW INTERLOCK TRIPPED	2211	22	11	Y	N
DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	2212	22	12	Y	N
STEER LOCKED - SELECTED BEFORE FOOTSWITCH	2213	22	13	Y	N
DRIVE/STEER LOCKED - JOYSTICK MOVED BEFORE ENABLE	2214	22	14	Y	N
D/S JOY. OUT OF RANGE LOW	2215	22	15	N	N
D/S JOY. OUT OF RANGE HIGH	2216	22	16	N	N
D/S JOY. CENTER TAP BAD	2217	22	17	N	N
L/S JOY. OUT OF RANGE LOW	2218	22	18	N	N
L/S JOY. OUT OF RANGE HIGH	2219	22	19	N	N
L/S JOY. CENTER TAP BAD	2220	22	20	N	N
LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	2221	22	21	Y	N
WAITING FOR FSW TO BE OPEN	2222	22	22	Y	N
FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE	2223	22	23	Y	N
FOOTSWITCH SELECTED BEFORE START	2224	22	24	Y	N
FUNCTION PROBLEM-HIGH SPEED AND CREEP ACTIVE TOGETHER	2269	22	69	N	N
GROUND INPUTS	230	23	0		
FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	234	23	4	Y	N
FUNCTION SWITCHES LOCKED - SELECTED BEFORE AUX POWER	235	23	5	Y	N
FUNCTION SWITCHES LOCKED - SELECTED BEFORE START SWITCH	236	23	6	Y	N
START SWITCH LOCKED - SELECTED BEFORE KEYSWITCH	237	23	7	Y	N
FUNCTION PREVENTED	250	25	0		
MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS	259	25	9	Y	N
GENERATOR MOTION CUTOUT ACTIVE	2513	25	13	Y	N
BOOM PREVENTED - DRIVE SELECTED	2514	25	14	Y	N
DRIVE PREVENTED - ABOVE ELEVATION	2516	25	16	Y	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
DRIVE PREVENTED - TILTED & ABOVE ELEVATION	2517	25	17	Y	N
DRIVE PREVENTED - BOOM SELECTED	2518	25	18	Y	N
DRIVE PREVENTED - TILTED & EXTENDED OR HIGH ANGLE	2519	25	19	Y	N
FUNCTIONS LOCKED OUT - CONSTANT DATA VERSION IMPROPER	2520	25	20	N	N
UMS SENSOR FORWARD LIMIT REACHED	2530	25	30	N	N
UMS SENSOR OUT OF USABLE RANGE	2531	25	31	N	N
UMS SENSOR BACKWARD LIMIT REACHED	2532	25	32	N	N
GROUND OUTPUT DRIVER	330	33	0		
BRAKE - SHORT TO BATTERY	331	33	1	N	N
BRAKE - OPEN CIRCUIT	332	33	2	N	N
GROUND ALARM - SHORT TO BATTERY	3311	33	11	N	N
RIGHT FORWARD DRIVE PUMP - SHORT TO GROUND	3316	33	16	N	N
RIGHT FORWARD DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3319	33	19	N	N
RIGHT REVERSE DRIVE PUMP - SHORT TO GROUND	3320	33	20	N	N
RIGHT REVERSE DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3323	33	23	N	N
LEFT FORWARD DRIVE PUMP - SHORT TO GROUND	3324	33	24	N	N
LEFT FORWARD DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3327	33	27	N	N
LEFT REVERSE DRIVE PUMP - SHORT TO GROUND	3328	33	28	N	N
LEFT REVERSE DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3331	33	31	N	N
FORWARD DRIVE PUMP - SHORT TO GROUND	3332	33	32	N	N
FORWARD DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3333	33	33	N	N
REVERSE DRIVE PUMP - SHORT TO GROUND	3334	33	34	N	N
REVERSE DRIVE PUMP - SHORT TO BATTERY OR OPEN CIRCUIT	3335	33	35	N	N
ALTERNATOR POWER - SHORT TO GROUND	3336	33	36	N	N
AUX POWER - SHORT TO GROUND	3340	33	40	N	N
AUX POWER - OPEN CIRCUIT	3341	33	41	N	N
AUX POWER - SHORT TO BATTERY	3342	33	42	N	N
ELECTRIC FAN - SHORT TO GROUND	3346	33	46	N	N
ELECTRIC FAN - OPEN CIRCUIT	3347	33	47	N	N
ELECTRIC FAN - SHORT TO BATTERY	3348	33	48	N	N
ELECTRIC PUMP - SHORT TO GROUND	3349	33	49	N	N
ELECTRIC PUMP - OPEN CIRCUIT	3350	33	50	N	N
ELECTRIC PUMP - SHORT TO BATTERY	3351	33	51	N	N
LP LOCK - SHORT TO GROUND	3352	33	52	N	N
LP LOCK - OPEN CIRCUIT	3353	33	53	N	N
LP LOCK - SHORT TO BATTERY	3354	33	54	N	N
LP START ASSIST - SHORT TO GROUND	3355	33	55	N	N
LP START ASSIST - OPEN CIRCUIT	3356	33	56	N	N
LP START ASSIST - SHORT TO BATTERY	3357	33	57	N	N
MAIN DUMP VALVE - SHORT TO GROUND	3358	33	58	N	N
MAIN DUMP VALVE - OPEN CIRCUIT	3359	33	59	N	N
MAIN DUMP VALVE - SHORT TO BATTERY	3360	33	60	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
BRAKE - SHORT TO GROUND	3361	33	61	N	N
START SOLENOID - SHORT TO GROUND	3362	33	62	N	N
START SOLENOID - OPEN CIRCUIT	3363	33	63	N	N
START SOLENOID - SHORT TO BATTERY	3364	33	64	N	N
STEER DUMP VALVE - SHORT TO GROUND	3365	33	65	N	N
STEER DUMP VALVE - OPEN CIRCUIT	3366	33	66	N	N
STEER DUMP VALVE - SHORT TO BATTERY	3367	33	67	N	N
TWO SPEED VALVE - SHORT TO GROUND	3368	33	68	N	N
TWO SPEED VALVE - OPEN CIRCUIT	3369	33	69	N	N
TWO SPEED VALVE - SHORT TO BATTERY	3370	33	70	N	N
GROUND ALARM - SHORT TO GROUND	3371	33	71	N	N
GROUND ALARM - OPEN CIRCUIT	3372	33	72	N	N
GEN SET/WELDER - SHORT TO GROUND	3373	33	73	N	N
GEN SET/WELDER - OPEN CIRCUIT	3374	33	74	N	N
GEN SET/WELDER - SHORT TO BATTERY	3375	33	75	N	N
HEAD TAIL LIGHT - SHORT TO GROUND	3376	33	76	N	N
HEAD TAIL LIGHT - OPEN CIRCUIT	3377	33	77	N	N
HEAD TAIL LIGHT - SHORT TO BATTERY	3378	33	78	N	N
HOUR METER - SHORT TO GROUND	3379	33	79	N	N
PLATFORM LEVEL UP VALVE - SHORT TO GROUND	3382	33	82	N	N
PLATFORM LEVEL UP VALVE - OPEN CIRCUIT	3383	33	83	N	N
PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	3384	33	84	N	N
PLATFORM LEVEL UP OVERRIDE VALVE - SHORT TO GROUND	3385	33	85	N	N
PLATFORM LEVEL UP OVERRIDE VALVE - OPEN CIRCUIT	3386	33	86	N	N
PLATFORM LEVEL UP OVERRIDE VALVE - SHORT TO BATTERY	3387	33	87	N	N
PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	3388	33	88	N	N
PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT	3389	33	89	N	N
PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	3390	33	90	N	N
PLATFORM LEVEL DOWN OVERRIDE VALVE - SHORT TO GROUND	3391	33	91	N	N
PLATFORM LEVEL DOWN OVERRIDE VALVE - OPEN CIRCUIT	3392	33	92	N	N
PLATFORM LEVEL DOWN OVERRIDE VALVE - SHORT TO BATTERY	3393	33	93	N	N
PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	3394	33	94	N	N
PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT	3395	33	95	N	N
PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	3396	33	96	N	N
PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	3397	33	97	N	N
PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT	3398	33	98	N	N
PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	3399	33	99	N	N
JIB LIFT UP VALVE - SHORT TO GROUND	33100	33	100	N	N
JIB LIFT UP VALVE - OPEN CIRCUIT	33101	33	101	N	N
JIB LIFT UP VALVE - SHORT TO BATTERY	33102	33	102	N	N
JIB LIFT DOWN VALVE - SHORT TO GROUND	33103	33	103	N	N
JIB LIFT DOWN VALVE - OPEN CIRCUIT	33104	33	104	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
JIB LIFT DOWN VALVE - SHORT TO BATTERY	33105	33	105	N	N
TOWER LIFT UP VALVE - SHORT TO GROUND	33106	33	106	N	N
TOWER LIFT UP VALVE - OPEN CIRCUIT	33107	33	107	N	N
TOWER LIFT UP VALVE - SHORT TO BATTERY	33108	33	108	N	N
TOWER LIFT DOWN VALVE - SHORT TO GROUND	33109	33	109	N	N
TOWER LIFT DOWN VALVE - OPEN CIRCUIT	33110	33	110	N	N
TOWER LIFT DOWN VALVE - SHORT TO BATTERY	33111	33	111	N	N
TOWER TELESCOPE IN VALVE - SHORT TO GROUND	33112	33	112	N	N
TOWER TELESCOPE IN VALVE - OPEN CIRCUIT	33113	33	113	N	N
TOWER TELESCOPE IN VALVE - SHORT TO BATTERY	33114	33	114	N	N
TOWER TELESCOPE OUT VALVE - SHORT TO GROUND	33115	33	115	N	N
TOWER TELESCOPE OUT VALVE - OPEN CIRCUIT	33116	33	116	N	N
TOWER TELESCOPE OUT VALVE - SHORT TO BATTERY	33117	33	117	N	N
SWING RIGHT VALVE - SHORT TO GROUND	33118	33	118	N	N
SWING RIGHT VALVE - OPEN CIRCUIT	33119	33	119	N	N
TELESCOPE IN VALVE - SHORT TO BATTERY	33120	33	120	N	N
SWING RIGHT VALVE - SHORT TO BATTERY	33121	33	121	N	N
SWING LEFT VALVE - SHORT TO GROUND	33122	33	122	N	N
TELESCOPE OUT VALVE - SHORT TO BATTERY	33123	33	123	N	N
LIFT UP DUMP VALVE - SHORT TO GROUND	33124	33	124	N	N
LIFT UP DUMP VALVE - OPEN CIRCUIT	33125	33	125	N	N
LIFT UP DUMP VALVE - SHORT TO BATTERY	33126	33	126	N	N
LIFT DOWN HOLDING VALVE - SHORT TO GROUND	33127	33	127	N	N
LIFT DOWN HOLDING VALVE - OPEN CIRCUIT	33128	33	128	N	N
LIFT DOWN HOLDING VALVE - SHORT TO BATTERY	33129	33	129	N	N
THROTTLE ACTUATOR - SHORT TO GROUND	33130	33	130	N	N
THROTTLE ACTUATOR - OPEN CIRCUIT	33131	33	131	N	N
THROTTLE ACTUATOR - SHORT TO BATTERY	33132	33	132	N	N
PLATFORM CONTROL VALVE - SHORT TO GROUND	33133	33	133	N	N
PLATFORM CONTROL VALVE - OPEN CIRCUIT	33134	33	134	N	N
PLATFORM CONTROL VALVE - SHORT TO BATTERY	33135	33	135	N	N
LIFT DOWN VALVE - OPEN CIRCUIT	33170	33	170	N	N
LIFT DOWN VALVE - SHORT TO BATTERY	33171	33	171	N	N
LIFT DOWN VALVE - SHORT TO GROUND	33172	33	172	N	N
JIB ROTATE LEFT VALVE - OPEN CIRCUIT	33175	33	175	N	N
JIB ROTATE LEFT VALVE - SHORT TO BATTERY	33176	33	176	N	N
JIB ROTATE LEFT VALVE - SHORT TO GROUND	33177	33	177	N	N
JIB ROTATE RIGHT VALVE - OPEN CIRCUIT	33178	33	178	N	N
JIB ROTATE RIGHT VALVE - SHORT TO BATTERY	33179	33	179	N	N
JIB ROTATE RIGHT VALVE - SHORT TO GROUND	33180	33	180	N	N
TELESCOPE OUT VALVE - OPEN CIRCUIT	33186	33	186	N	N
TELESCOPE OUT VALVE - SHORT TO GROUND	33188	33	188	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
TELESCOPE IN VALVE - OPEN CIRCUIT	33189	33	189	N	N
TELESCOPE IN VALVE - SHORT TO GROUND	33190	33	190	N	N
HORN - OPEN CIRCUIT	33207	33	207	N	N
HORN - SHORT TO BATTERY	33208	33	208	N	N
HORN - SHORT TO GROUND	33209	33	209	N	N
GLOWPLUG - OPEN CIRCUIT	33279	33	279	N	N
GLOWPLUG - SHORT TO BATTERY	33280	33	280	N	N
GLOWPLUG - SHORT TO GROUND	33281	33	281	N	N
SWING LEFT VALVE - OPEN CIRCUIT	33295	33	295	N	N
SWING LEFT VALVE - SHORT TO BATTERY	33306	33	306	N	N
FLOW CONTROL VALVE - OPEN CIRCUIT	33314	33	314	N	N
FLOW CONTROL VALVE - SHORT TO BATTERY	33315	33	315	N	N
FLOW CONTROL VALVE - SHORT TO GROUND	33316	33	316	N	N
DRIVE FORWARD VALVE - OPEN CIRCUIT	33317	33	317	N	N
DRIVE FORWARD VALVE - SHORT TO BATTERY	33318	33	318	N	N
DRIVE FORWARD VALVE - SHORT TO GROUND	33319	33	319	N	N
DRIVE REVERSE VALVE - OPEN CIRCUIT	33320	33	320	N	N
DRIVE REVERSE VALVE - SHORT TO BATTERY	33321	33	321	N	N
DRIVE REVERSE VALVE - SHORT TO GROUND	33322	33	322	N	N
LIFT UP VALVE - OPEN CIRCUIT	33323	33	323	N	N
LIFT UP VALVE - SHORT TO BATTERY	33324	33	324	N	N
LIFT UP VALVE - SHORT TO GROUND	33325	33	325	N	N
DRIVE - CURRENT FEEDBACK READING TOO LOW	33331	33	331	N	N
LEFT TRACK - CURRENT FEEDBACK READING TOO LOW	33332	33	332	N	N
RIGHT TRACK - CURRENT FEEDBACK READING TOO LOW	33333	33	333	N	N
LEFT TRACK - CURRENT FEEDBACK READING LOST	33408	33	408	N	N
RIGHT TRACK - CURRENT FEEDBACK READING LOST	33409	33	409	N	N
DRIVE - CURRENT FEEDBACK READING LOST	33410	33	410	N	N
PLATFORM OUTPUT DRIVER	340	34	0		
PLATFORM LEVEL UP VALVE - OPEN CIRCUIT	341	34	1	N	N
PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	342	34	2	N	N
PLATFORM LEVEL UP VALVE - SHORT TO GROUND	343	34	3	N	N
PLATFORM LEVEL UP VALVE - SHORT TO BATTERY OR OPEN CIRCUIT	344	34	4	N	N
PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT	345	34	5	N	N
PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	346	34	6	N	N
PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	347	34	7	N	N
PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY OR OPEN CIRCUIT	348	34	8	N	N
PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT	349	34	9	N	N
PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	3410	34	10	N	N
PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	3411	34	11	N	N
PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT	3412	34	12	N	N
PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	3413	34	13	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	3414	34	14	N	N
JIB LIFT UP VALVE - OPEN CIRCUIT	3415	34	15	N	N
JIB LIFT UP VALVE - SHORT TO BATTERY	3416	34	16	N	N
JIB LIFT UP VALVE - SHORT TO GROUND	3417	34	17	N	N
JIB LIFT DOWN VALVE - OPEN CIRCUIT	3418	34	18	N	N
JIB LIFT DOWN VALVE - SHORT TO BATTERY	3419	34	19	N	N
JIB LIFT DOWN VALVE - SHORT TO GROUND	3420	34	20	N	N
JIB ROTATE LEFT VALVE - OPEN CIRCUIT	3421	34	21	N	N
JIB ROTATE LEFT VALVE - SHORT TO BATTERY	3422	34	22	N	N
JIB ROTATE LEFT VALVE - SHORT TO GROUND	3423	34	23	N	N
JIB ROTATE RIGHT VALVE - OPEN CIRCUIT	3424	34	24	N	N
JIB ROTATE RIGHT VALVE - SHORT TO BATTERY	3425	34	25	N	N
JIB ROTATE RIGHT VALVE - SHORT TO GROUND	3426	34	26	N	N
ENGINE	430	43	0		
FUEL SENSOR - SHORT TO BATTERY	431	43	1	N	Y
FUEL SENSOR - SHORT TO GROUND	432	43	2	N	Y
OIL PRESSURE - SHORT TO BATTERY	433	43	3	N	Y
OIL PRESSURE - SHORT TO GROUND	434	43	4	N	Y
COOLANT TEMPERATURE - SHORT TO GROUND	435	43	5	N	Y
FORD FAULT CODE ##	436	43	6	N	Y
ENGINE TROUBLE CODE	437	43	7	N	N
HIGH ENGINE TEMP	438	43	8	N	Y
AIR FILTER BYPASSED	439	43	9	N	Y
NO ALTERNATOR OUTPUT	4310	43	10	N	Y
LOW OIL PRESSURE	4311	43	11	N	Y
485 COMMUNICATIONS LOST	4312	43	12	N	Y
THROTTLE ACTUATOR FAILURE	4313	43	13	N	Y
WRONG ENGINE SELECTED - ECM DETECTED	4314	43	14	N	Y
LOSS OF ENGINE SPEED SENSOR	4322	43	22	N	Y
SPEED SENSOR READING INVALID SPEED	4323	43	23	N	Y
BATTERY / GENSET	440	44	0		
BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN	441	44	1	N	Y
BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN	442	44	2	N	Y
BATTERY VOLTAGE LOW	445	44	5	N	Y
COMMUNICATION	660	66	0		
CANBUS FAILURE - PLATFORM MODULE	662	66	2	N	N
CANBUS FAILURE - ACCESSORY MODULE	664	66	4	N	N
CANBUS FAILURE - PROPULSION MODULE	665	66	5	N	N
CANBUS FAILURE - ENGINE CONTROLLER	666	66	6	N	N
CANBUS FAILURE - UMS SENSOR	6620	66	20	N	N
ACCESSORY	670	67	0		
ACCESSORY FAULT	671	67	1	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
TILT SENSOR	810	81	0		
CHASSIS TILT SENSOR NOT CALIBRATED	813	81	3	N	N
CHASSIS TILT SENSOR DISAGREEMENT	815	81	5	N	N
UMS SENSOR NOT CALIBRATED	816	81	6	N	N
UMS SENSOR FAULT	817	81	7	N	N
PLATFORM LOAD SENSE	820	82	0		
LSS HAS NOT BEEN CALIBRATED	825	82	5	N	N
RUNNING AT CREEP - PLATFORM OVERLOADED	826	82	6	N	N
DRIVE & BOOM PREVENTED - PLATFORM OVERLOADED	827	82	7	N	N
LIFT UP & TELE OUT PREVENTED - PLATFORM OVERLOADED	828	82	8	N	N
PLATFORM / JIB	830	83	0		
PLATFORM LEVELING OVERRIDE ON	831	83	1	N	N
PLATFORM LEVELING OVERRIDE OFF	832	83	2	N	N
PLATFORM LEVEL UP CRACKPOINT - NOT CALIBRATED	833	83	3	N	N
PLATFORM LEVEL DOWN CRACKPOINT - NOT CALIBRATED	834	83	4	N	N
PLATFORM LEVEL SENSOR #1 - NOT ZERO CALIBRATED	835	83	5	N	N
PLATFORM LEVEL SENSOR #1 - ZERO OUT OF RANGE	836	83	6	N	N
PLATFORM LEVEL SENSOR #1 - SHORT TO BATTERY	837	83	7	N	N
PLATFORM LEVEL SENSOR #1 - SHORT TO GROUND OR OPEN CIRCUIT	838	83	8	N	N
PLATFORM LEVEL SENSOR #2 - NOT ZERO CALIBRATED	839	83	9	N	N
PLATFORM LEVEL SENSOR #2 - ZERO OUT OF RANGE	8310	83	10	N	N
PLATFORM LEVEL SENSOR #2 - SHORT TO BATTERY	8311	83	11	N	N
PLATFORM LEVEL SENSOR #2 - SHORT TO GROUND OR OPEN CIRCUIT	8312	83	12	N	N
PLATFORM LEVEL SENSOR #1 - REFERENCE VOLTAGE OUT OF RANGE	8313	83	13	N	N
PLATFORM LEVEL SENSOR #2 - REFERENCE VOLTAGE OUT OF RANGE	8314	83	14	N	N
PLATFORM LEVELING SENSOR - DISAGREEMENT	8315	83	15	N	N
PLATFORM LEVEL SENSOR #1 - COMMUNICATIONS LOST	8316	83	16	N	N
PLATFORM LEVEL SENSOR #2 - COMMUNICATIONS LOST	8317	83	17	N	N
PLATFORM LEVELING SYSTEM TIMEOUT	8318	83	18	N	N
STEERING / AXLE	860	86	0		
FRONT LEFT STEER VALVE - OPEN CIRCUIT	8639	86	39	N	N
FRONT LEFT STEER VALVE - SHORT TO BATTERY	8640	86	40	N	N
FRONT LEFT STEER VALVE - SHORT TO GROUND	8641	86	41	N	N
FRONT RIGHT STEER VALVE - OPEN CIRCUIT	8642	86	42	N	N
FRONT RIGHT STEER VALVE - SHORT TO BATTERY	8643	86	43	N	N
FRONT RIGHT STEER VALVE - SHORT TO GROUND	8644	86	44	N	N
REAR LEFT STEER VALVE - OPEN CIRCUIT	8645	86	45	N	N
REAR LEFT STEER VALVE - SHORT TO BATTERY	8646	86	46	N	N
REAR LEFT STEER VALVE - SHORT TO GROUND	8647	86	47	N	N
REAR RIGHT STEER VALVE - OPEN CIRCUIT	8648	86	48	N	N
REAR RIGHT STEER VALVE - SHORT TO BATTERY	8649	86	49	N	N
REAR RIGHT STEER VALVE - SHORT TO GROUND	8650	86	50	N	N

Table 6-12. Analyzer Fault Code Listing

Analyzer Text	DTC	Flash Code	Sequence	Operational Fault	Clear Sky Default Information
RIGHT TRACK FORWARD VALVE - OPEN CIRCUIT	8652	86	52	N	N
RIGHT TRACK FORWARD VALVE - SHORT TO BATTERY	8653	86	53	N	N
RIGHT TRACK FORWARD VALVE - SHORT TO GROUND	8654	86	54	N	N
RIGHT TRACK REVERSE VALVE - OPEN CIRCUIT	8655	86	55	N	N
RIGHT TRACK REVERSE VALVE - SHORT TO BATTERY	8656	86	56	N	N
RIGHT TRACK REVERSE VALVE - SHORT TO GROUND	8657	86	57	N	N
LEFT TRACK FORWARD VALVE - OPEN CIRCUIT	8658	86	58	N	N
LEFT TRACK FORWARD VALVE - SHORT TO BATTERY	8659	86	59	N	N
LEFT TRACK FORWARD VALVE - SHORT TO GROUND	8660	86	60	N	N
LEFT TRACK REVERSE VALVE - OPEN CIRCUIT	8661	86	61	N	N
LEFT TRACK REVERSE VALVE - SHORT TO BATTERY	8662	86	62	N	N
LEFT TRACK REVERSE VALVE - SHORT TO GROUND	8663	86	63	N	N
SERVICE REQUIRED	870	87	0		
RETURN FILTER BYPASSED	871	87	1	N	N
CHARGE PUMP FILTER BYPASSED	872	87	2	N	N
HARDWARE	990	99	0		
EEPROM FAILURE - CHECK ALL SETTINGS	998	99	8	N	N
FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER	9910	99	10	N	N
FUNCTIONS LOCKED OUT - PROPULSION MODULE SOFTWARE VERSION IMPROPER	9913	99	13	N	N
PLATFORM MODULE SOFTWARE UPDATE REQUIRED	9914	99	14	N	N
CHASSIS TILT SENSOR NOT GAIN CALIBRATED	9915	99	15	N	N
CHASSIS TILT SENSOR GAIN OUT OF RANGE	9916	99	16	N	N
HIGH RESOLUTION A2D FAILURE - INTERRUPT LOST	9917	99	17	N	N
HIGH RESOLUTION A2D FAILURE - REINIT LIMIT	9918	99	18	N	N
GROUND SENSOR REF VOLTAGE OUT OF RANGE	9919	99	19	N	N
PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	9920	99	20	N	N
GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY	9921	99	21	N	N
PLATFORM MODULE FAILURE - HWFS CODE 1	9922	99	22	N	N
GROUND MODULE FAILURE - HWFS CODE 1	9923	99	23	N	N
FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED	9924	99	24	N	N
CURRENT FEEDBACK GAINS OUT OF RANGE	9944	99	44	N	N
CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT	9945	99	45	N	N

Analyzer Diagnostics Menu Structure

In the following structure descriptions, an intended item is selected by pressing ENTER; pressing ESC steps back to the next outer level. The LEFT/RIGHT arrow keys move between items in the same level. The UP or DOWN arrow keys alter a value if allowed

Table 6-13. ADJUSTMENTS - Personality Descriptions

DRIVE	
ACCEL	Displays/adjusts drive acceleration
DECEL	Displays/adjusts drive deceleration
MIN FORWARD	Displays/adjusts minimum forward drive speed
MAX FORWARD	Displays/adjusts maximum forward drive speed
MIN REVERSE	Displays/adjusts minimum reverse drive speed
MAX REVERSE	Displays/adjusts maximum reverse drive speed
ELEVATED MAX	Displays/adjusts maximum drive speed NOTE: used when elevation cutout switches are limiting maximum speed
CREEP MAX	Displays/adjusts maximum drive speed NOTE: used when creep switch on pump pot is active
STEER MAX	Displays/adjusts the maximum steer speed
LIFT	
ACCEL	Displays/adjusts upper lift acceleration
DECEL	Displays/adjusts upper lift deceleration
MIN UP	Displays/adjusts minimum upper lift up speed
MAX UP	Displays/adjusts maximum upper lift up speed
CREEP UP	Displays/adjusts maximum upper lift up speed NOTE: used when creep switch on pump pot is active
MIN DOWN	Displays/adjusts minimum upper lift down speed
MAX DOWN	Displays/adjusts maximum upper lift down speed
CREEP DOWN	Displays/adjusts maximum upper lift down speed NOTE: used when creep switch on pump pot is active
SWING	
ACCEL	Displays/adjusts swing acceleration
DECEL	Displays/adjusts swing deceleration
MIN LEFT	Displays/adjusts minimum swing left speed
MAX LEFT	Displays/adjusts maximum swing left speed

Table 6-13. ADJUSTMENTS - Personality Descriptions

CREEP LEFT	Displays/adjusts maximum swing left speed NOTE: used when creep switch on pump pot is active
MIN RIGHT	Displays/adjusts minimum swing right speed
MAX RIGHT	Displays/adjusts maximum swing right speed
CREEP RIGHT	Displays/adjusts maximum swing right speed NOTE: used when creep switch on pump pot is active
UPPER TELESCOPE	
ACCEL	Displays/adjusts telescope acceleration
DECEL	Displays/adjusts telescope deceleration
MIN IN	Displays/adjusts minimum telescope in speed
MAX IN	Displays/adjusts maximum telescope in speed
MIN OUT	Displays/adjusts minimum telescope out speed
MAX OUT	Displays/adjusts maximum telescope out speed
BASKET LEVEL	
ACCEL	Displays/adjusts basket level acceleration
DECEL	Displays/adjusts basket level deceleration
MIN UP	Displays/adjusts minimum basket level up speed
MAX UP	Displays/adjusts maximum basket level up speed
MIN DOWN	Displays/adjusts minimum basket level down speed
MAX DOWN	Displays/adjusts maximum basket level down speed
BASKET ROTATE	
ACCEL	Displays/adjusts basket rotate acceleration
DECEL	Displays/adjusts basket rotate deceleration
MIN LEFT	Displays/adjusts minimum basket rotate left speed
MAX LEFT	Displays/adjusts maximum basket rotate left speed
MIN RIGHT	Displays/adjusts minimum basket rotate right speed
MAX RIGHT	Displays/adjusts maximum basket rotate right speed
JIB LIFT	Not displayed if JIB = NO
ACCEL	Displays/adjusts jib acceleration
DECEL	Displays/adjusts jib deceleration
MIN UP	Displays/adjusts minimum jib up speed
MAX UP	Displays/adjusts maximum jib up speed
MIN DOWN	Displays/adjusts minimum jib down speed

Table 6-13. ADJUSTMENTS - Personality Descriptions

MAX DOWN	Displays/adjusts maximum jib down speed
MIN LEFT	Displays/adjusts minimum jib left speed
MAX LEFT	Displays/adjusts maximum jib left speed
MIN RIGHT	Displays/adjusts minimum jib right speed
MAX RIGHT	Displays/adjusts maximum jib right speed
STEER	
MAX SPEED	Displays/adjusts maximum steer speed, which applies when vehicle speed is at minimum
GROUND MODE	
LIFT UP	Displays/adjusts fixed lift up speed
LIFT DOWN	Displays/adjusts fixed lift down speed
SWING	Displays/adjusts fixed swing speed
TELE	Displays/adjusts fixed telescope speed
BASKETLEVEL	Displays/adjusts fixed basket level speed
BASKETROTATE	Displays/adjusts fixed basket rotate speed
JIB (U/D)	Displays/adjusts jib lift speed Not displayed if JIB = NO
JIB (L/R)	Displays/adjusts jib swing speed Not displayed if JIB = NO

Table 6-14. Diagnostic Menu Descriptions

DRIVE	
DRIVE FOR	Displays drive joystick direction & demand
STEER	Displays steer switch direction & demand NOTE: steer demand is inversely proportional to vehicle speed
BRAKES	Displays brake control system status
CREEP	Displays pump pot creep switch status
TWO SPEED	Displays two speed switch status
2 SPEED MODE	Displays status of two speed valve
HIGH ENGINE	Displays high engine switch status
BOOM	
U LIFT UP	Displays lift joystick direction & demand
SWING LEFT	Displays swing joystick direction & demand
LEVEL UP	Displays basket level switch direction & demand NOTE: demand is controlled by the pump pot
ROT. LEFT	Displays basket rotate switch direction & demand NOTE: demand is controlled by the pump pot
U TELE IN	Displays telescope switch direction & demand NOTE: demand is controlled by the pump pot
JIB UP	Displays jib lift switch direction & demand NOTE: demand is controlled by the pump pot Not displayed if JIB = NO
JIB LEFT	Displays jib swing switch direction & demand NOTE: demand is controlled by the pump pot Not displayed if JIB = NO
PUMP POT	Displays pump pot demand
ENGINE	
START	Displays start switch status
AIR FILTER	Displays air filter status
BATTERY	Displays measured battery voltage
COOLANT	Displays coolant temperature
OIL PRS	Displays oil pressure status
FUEL SELECT	Displays selected fuel (Dual Fuel only)
FUEL LEVEL	Displays fuel level status
RPM	Displays Engine RPM
GM BATTERY	Displays battery voltage at ground module

Table 6-14. Diagnostic Menu Descriptions

PM BATTERY	Displays battery voltage at platform module
TEMP	Displays ground module temperature
ELEV. CUTOUT	Displays elevation cutout switch status
FUNC. CUTOUT	Displays function cutout switch status
CREEP	Displays creep switch status
TILT	Displays measured vehicle tilt
AUX POWER	Displays status of auxiliary power switch
HORN	Displays status of horn switch
R FILTER	Displays status of return filter switch
C FILTER	Displays status of charge pump filter
LOAD LENGTH	Displays length switch status
ANGLE	Displays angle switch status
LOAD	Displays load sensor value NOTE: Not displayed if load = 0.
DATALOG	
ON	Displays total controller on (EMS) time
ENGINE	Displays engine run time
DRIVE	Displays total controller drive operation time
LIFT	Displays total controller lift operation time
SWING	Displays total controller swing operation time
TELE	Displays total controller tele operation time
MAX.TEMP	Displays maximum measured heatsink temp.
MIN.TEMP	Displays minimum measured heatsink temp.
MAX.VOLTS	Displays maximum measured battery voltage
RENTAL	Displays total controller operation time NOTE: can be reset
ERASE RENTAL	Not available at password level 2
YES:ENTER, NO:ESC	ENTER resets rental datalog time to zero
VERSIONS	
GROUND	Displays ground module software version
PLATFORM	Displays platform module software version
ANALYSER	Displays Analyzer software version

SECTION 7. ELECTRICAL INFORMATION & SCHEMATICS

7.1 GENERAL

This section contains basic electrical information and schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

NOTE: *Some of the procedures/connectors shown in this section may not be applicable to all models.*

7.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the Voltage source.

Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the Voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

Polarity

Getting a negative Voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the Ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

μ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kW = 1200 W
Example: 50 mA = 0.05 A

Voltage Measurement

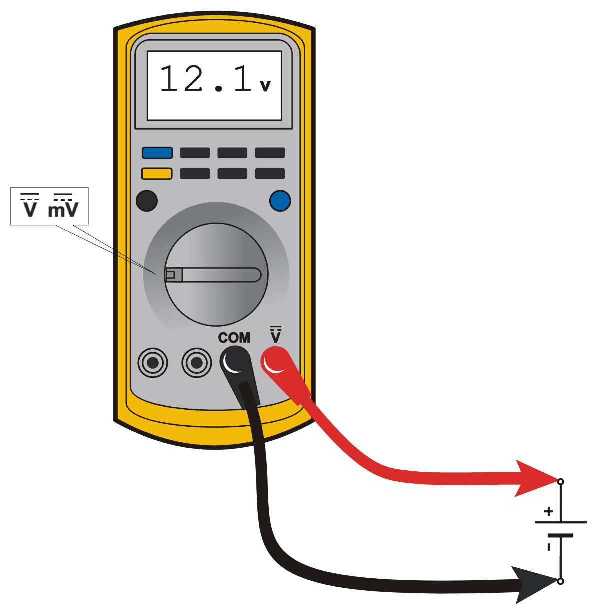


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range. (See multimeter's operation manual).
- Use firm contact with meter leads.

Resistance Measurement

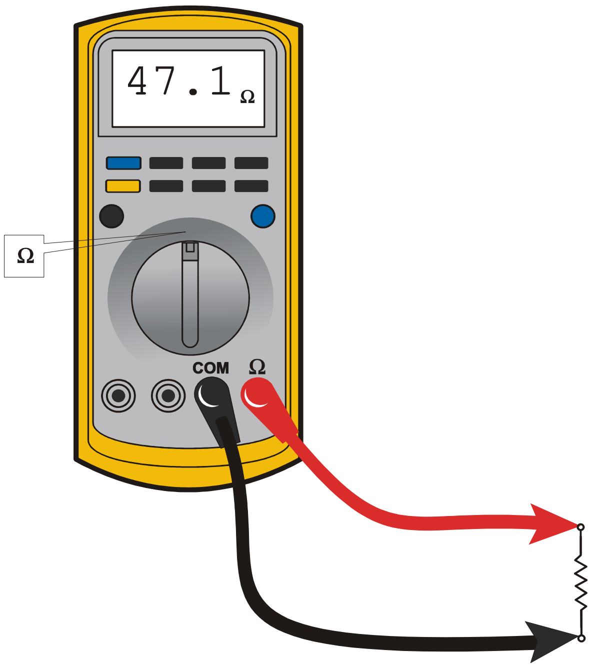


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit. (very low resistance).
- Circuit power must be turned OFF before testing resistance.
- Disconnect component from circuit before testing.
- If meter is not auto ranging, set it to the correct range. (See multimeter's operation manual).
- Use firm contact with meter leads.

Continuity Measurement

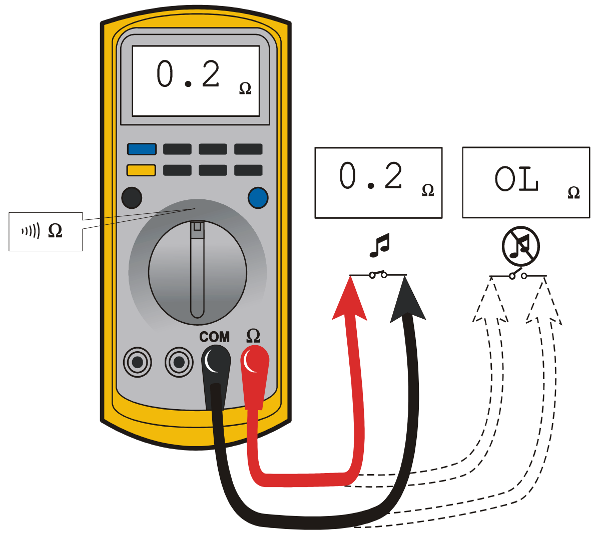


Figure 7-3. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing.
- Circuit power must be turned OFF before testing continuity.
- Disconnect component from circuit before testing.
- Use firm contact with meter leads.
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity.

Current Measurement

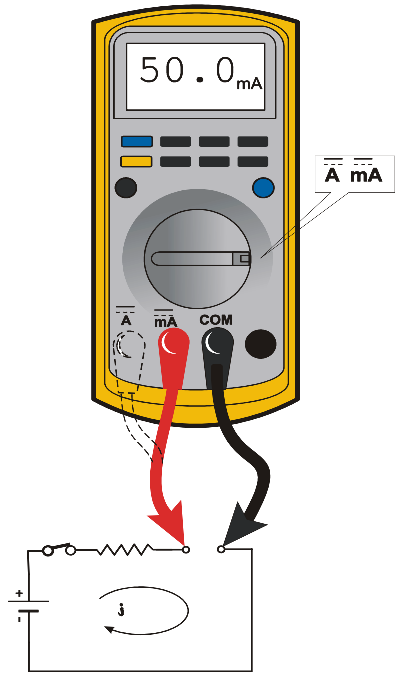


Figure 7-4. Current Measurement (DC)

- Set up the meter for the expected current range.
- Be sure to connect the meter leads to the correct jacks for the current range you have selected.
- If meter is not auto ranging, set it to the correct range. (See multi meter's operation manual).
- Use firm contact with meter leads.

7.3 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

NOTE: *This section is not applicable for battery terminals.*

NOTICE

JLG P/N 0100048 DIELECTRIC GREASE (NOVAGARD G661) IS THE ONLY MATERIAL APPROVED FOR USE AS A DIELECTRIC GREASE.

NOTE: *Do NOT apply dielectric grease to the following connections:*

- Main Boom Rotary sensor connections (on Celesco Sensor),
- LSS Modules connections,
- Deutz EMR 2 ECM connection.

Silicone Dielectric Compound must be used on all electrical connections except for those mentioned above for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. This procedure applies to all plug connections not enclosed in a box. Silicone grease should not be applied to connectors with external seals.

1. To prevent oxidation, silicone grease must be packed completely around male and female pins on the inside of the connector prior to assembly. This is most easily achieved by using a syringe.

NOTE: *Over a period of time, oxidation increases electrical resistance at the connection, eventually causing circuit failure.*

2. To prevent shorting, silicone grease must be packed around each wire where they enter the outside of the connector housing. Also, silicone grease must be applied at the joint where the male and female connectors come together. Any other joints (around strain reliefs, etc.) where water could enter the connector should also be sealed.

NOTE: *This condition is especially common when machines are pressure washed since the washing solution is much more conductive than water.*

3. Anderson connectors for the battery boxes and battery chargers should have silicone grease applied to the contacts only.

NOTE: *Curing-type sealants might also be used to prevent shorting and would be less messy, but would make future pin removal more difficult.*

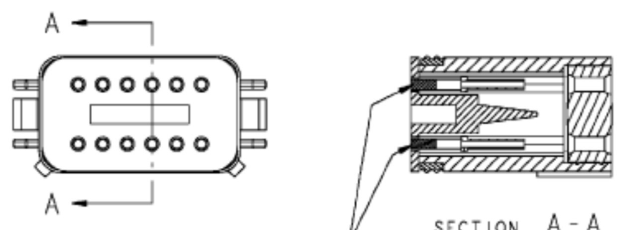
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease shall be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

Installation of Dielectric Grease

Before following these instructions, refer to excluded connector types (See Exclusions below).

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to the female contact (fill it approximately ½ full; see example below)
3. Leave a thin layer of dielectric grease on the face of the connector
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination
5. Pierce one of the unused wire seals prior to assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.



Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environment interconnect. Follow the installation instructions.

AWP Seal

The AMP Seal connector system is used on the Control ADE Platform and Ground Modules.

Apply dielectric grease to the female contact. If trapped air prevents the connector from latching, pierce one of the unused wire seals. After assembly, install a seal plug (JLG #4460905) in that location to prevent moisture ingress.

Note that seal plugs may be installed by the wire harness manufacturer if an unused wire seal becomes compromised (wire inserted in the wrong cavity during assembly and then corrected).

Figure 7-5. Application to Female Contacts

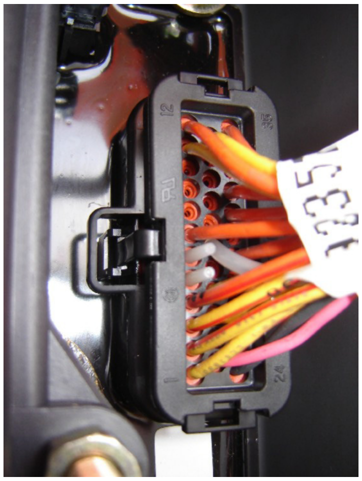
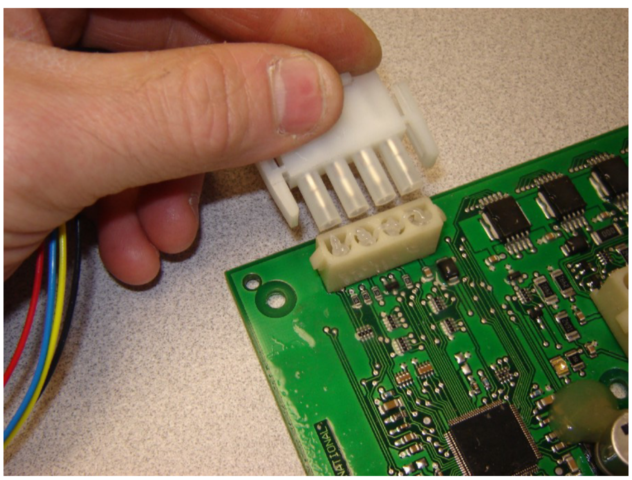


Figure 7-6. Use of Seal Plugs

AMP Mate-N-Lok

Follow the installation instructions.



DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.

Exclusions

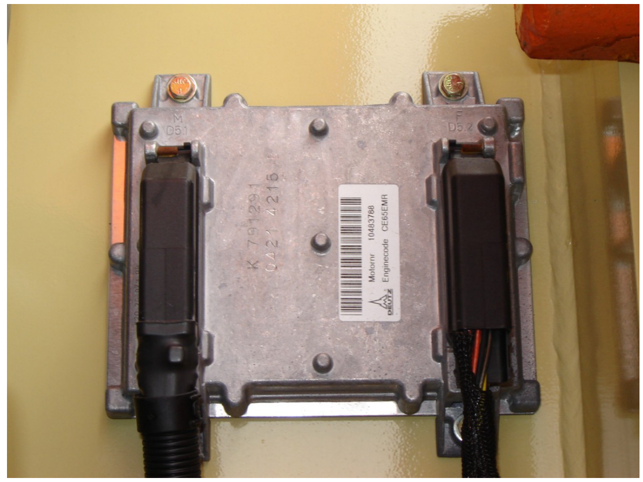
A limited number of connectors do not benefit from dielectric grease, or may be permanently damaged by application. Dielectric grease may not be required in properly sealed enclosures.

BRAD HARRISON / PHOENIX CONTACT M12

The connector uses gold contact material to resist corrosion and an o-ring seal for moisture integrity. If dielectric grease is mistakenly applied to this connector system, the low-force contacts cannot displace the grease to achieve electrical contact. Once contaminated, there is no practical way to remove the dielectric grease (replacement of female contacts required). The JLG Load Sensing System and 1250AJP Rotary Angle Sensors are examples of components with the M12 connector system.

AMP JUNIOR TIMER

This type of connector uses back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR2 engine control module from Deutz employs this connector system (for example).



7.4 AMP CONNECTOR

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position. (See Figure 7-7.). Proceed as follows

:

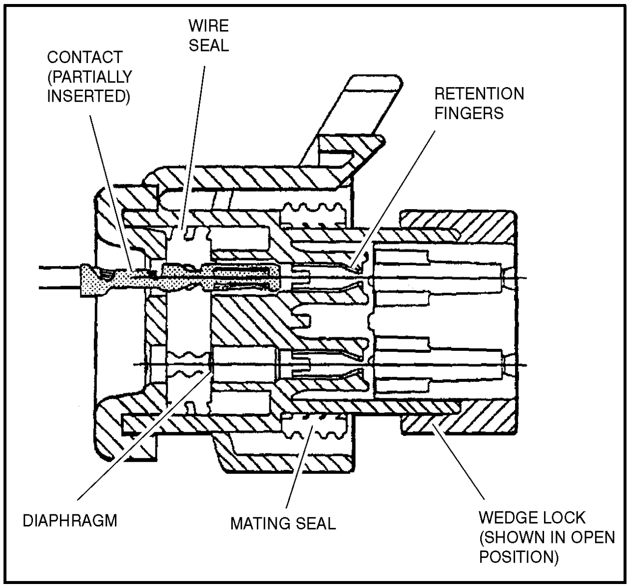


Figure 7-7. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go. (See Figure 7-9.).
2. Pull back on the contact wire with a force of 1 or 2 lbs. to be sure the retention fingers are holding the contact. (See Figure 7-9.).

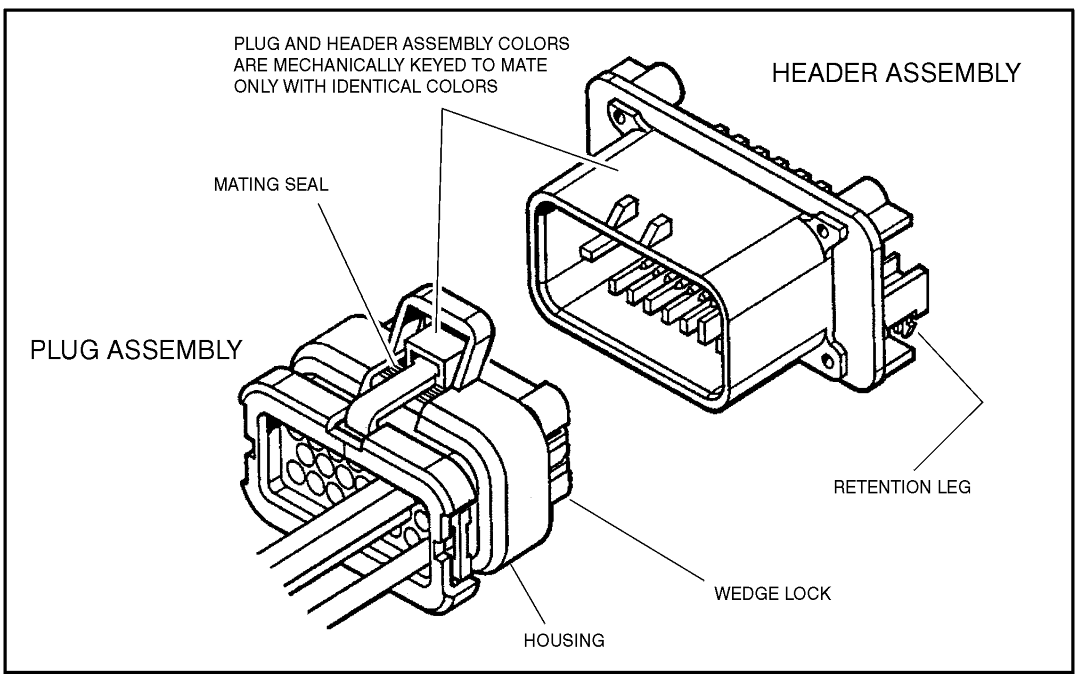


Figure 7-8. AMP Connector

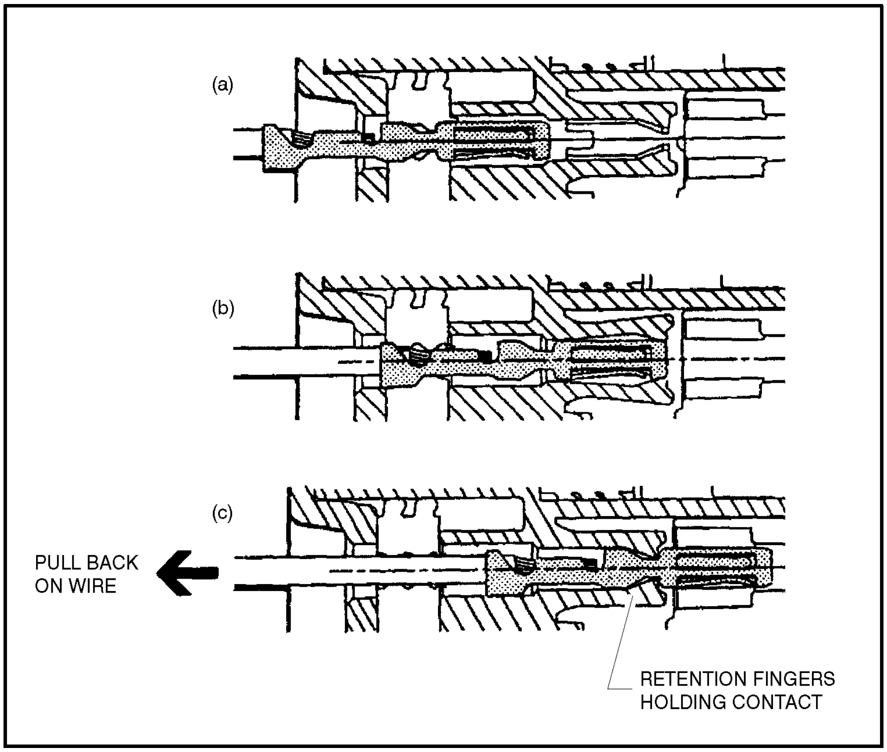


Figure 7-9. Connector Assembly Figure 2

3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward. (See Figure 7-10.).

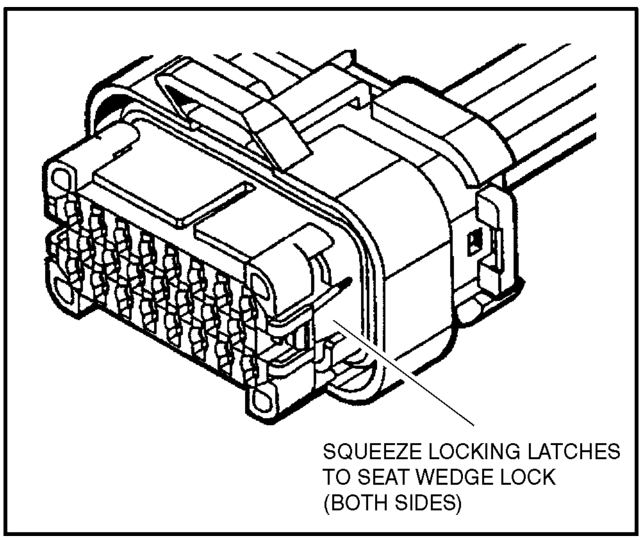


Figure 7-10. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing. (See Figure 7-11.).

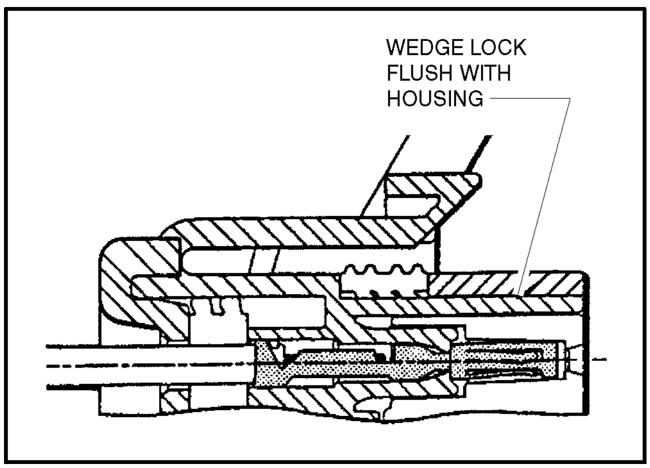


Figure 7-11. Connector Assembly Figure 4

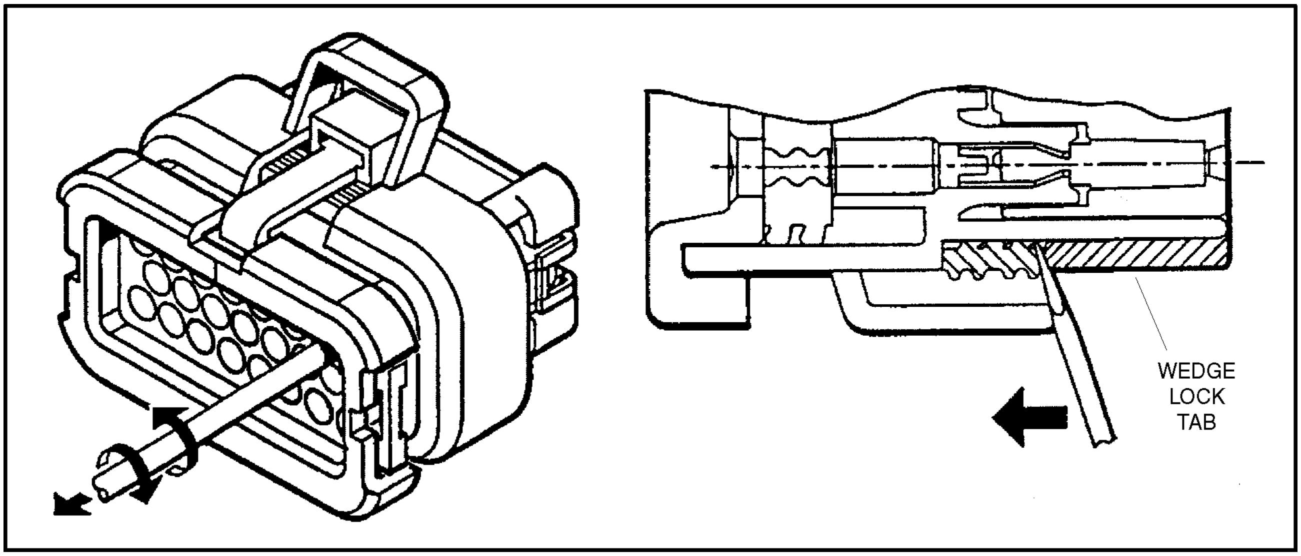


Figure 7-12. Connector Disassembly

Disassembly

1. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
2. Pry open the wedge lock to the open position.
3. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

NOTE: *The wedge lock should never be removed from the housing for insertion or removal of the contacts.*

Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

Service - Voltage Reading

NOTICE

DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMP-SEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

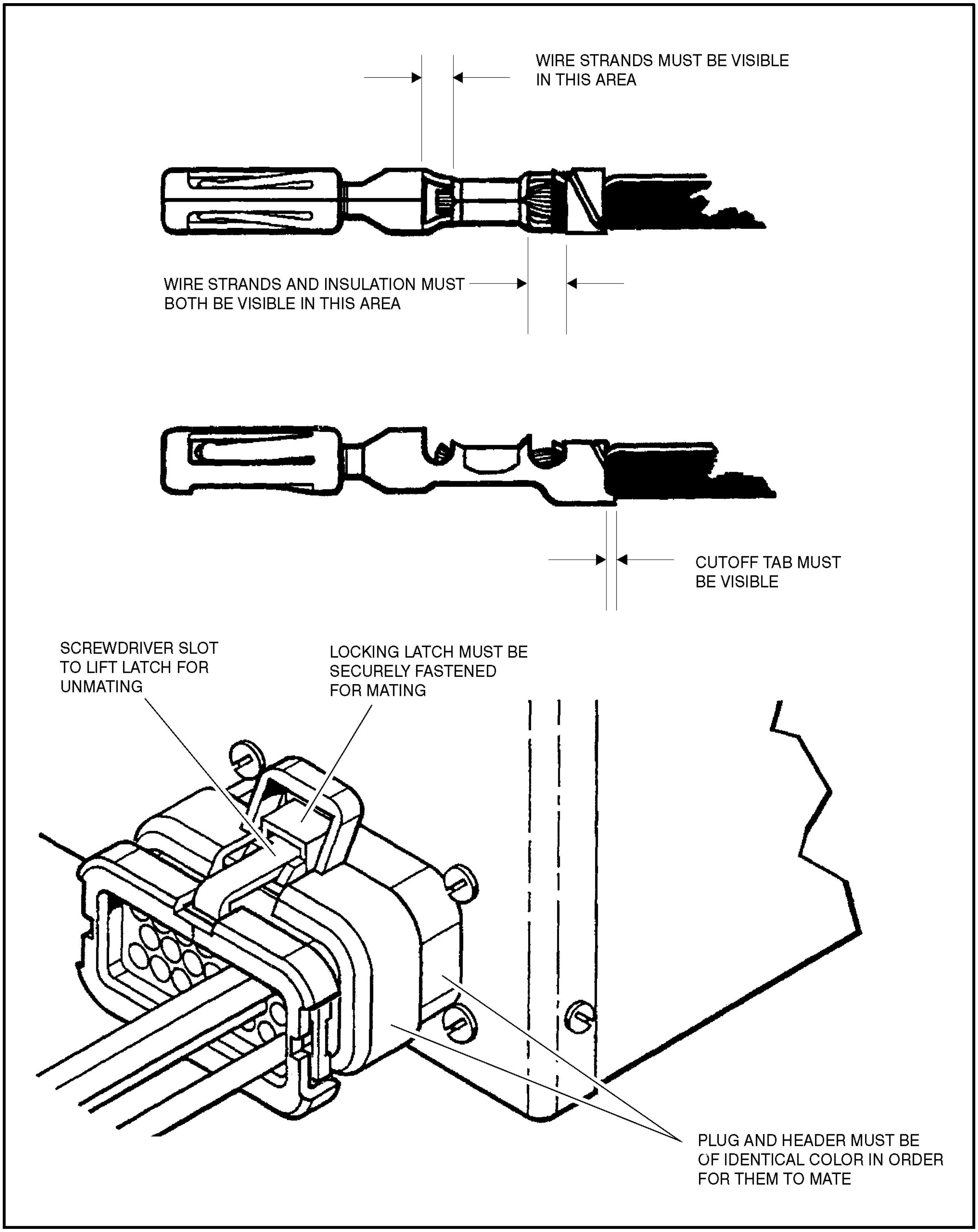
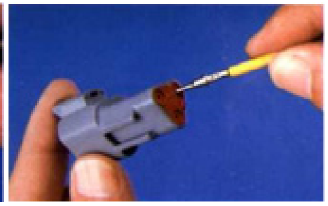


Figure 7-13. Connector Installation

7.5 DEUTSCH CONNECTORS

DT/DTP Series Assembly


A


B


C

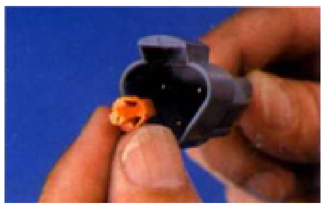

D

Figure 7-14. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. Thy may go in either way.

NOTE: *The receptacle is shown - use the same procedure for plug.*

DT/DTP Series Disassembly


A


B


C

Figure 7-15. DT/DTP Contact Removal

1. Remove wedgelock using needle nose pliers or a hook shaped wire to pull wedge straight out.
2. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.
3. Hold the rear seal in place, as removing the contact may displace the seal.

HD30/HDP20 Series Assembly

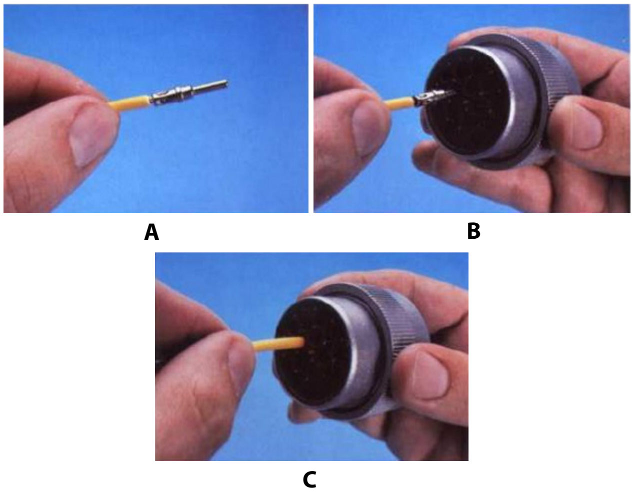


Figure 7-16. HD/HDP Contact Installation

1. Grasp contact about 25mm behind the contact crimp barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

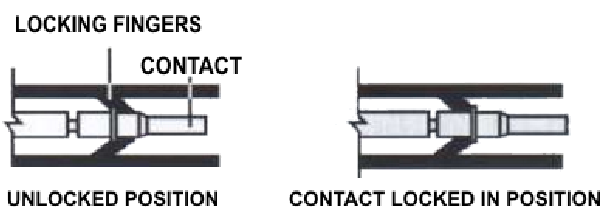


Figure 7-17. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing.*

HD30/HDP20 Series Disassembly

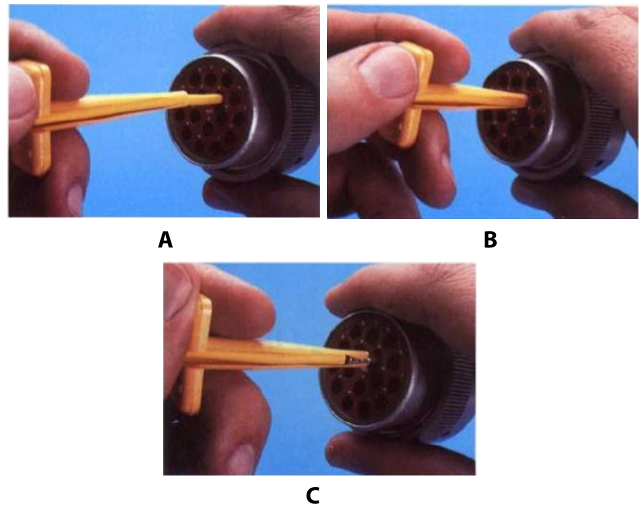


Figure 7-18. HD/HDP Contact Removal

1. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.
2. Slide tool along into the insert cavity until it engages contact and resistance is felt.
3. Pull contact-wire assembly out of connector.

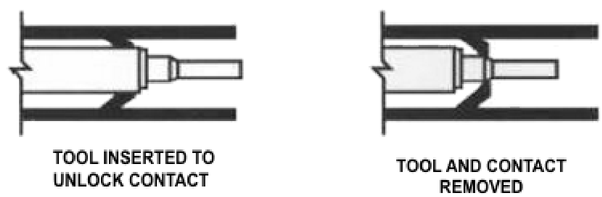


Figure 7-19. HD/HDP Unlocking Contacts

NOTE: *Do Not twist or insert tool at an angle.*

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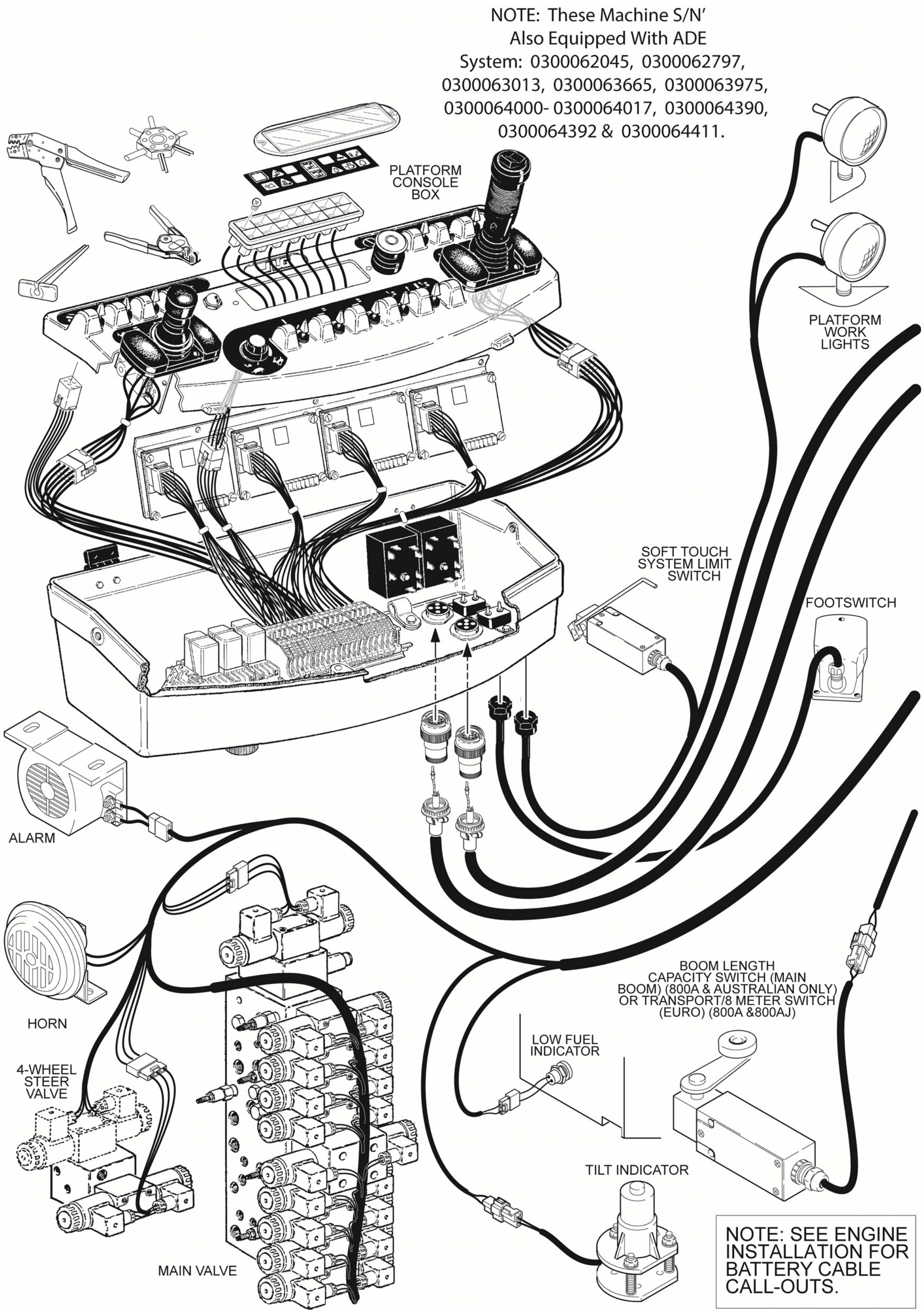


Figure 7-20. Electrical Components Installation (Prior to S/N 0300064432) - Sheet 1 of 2

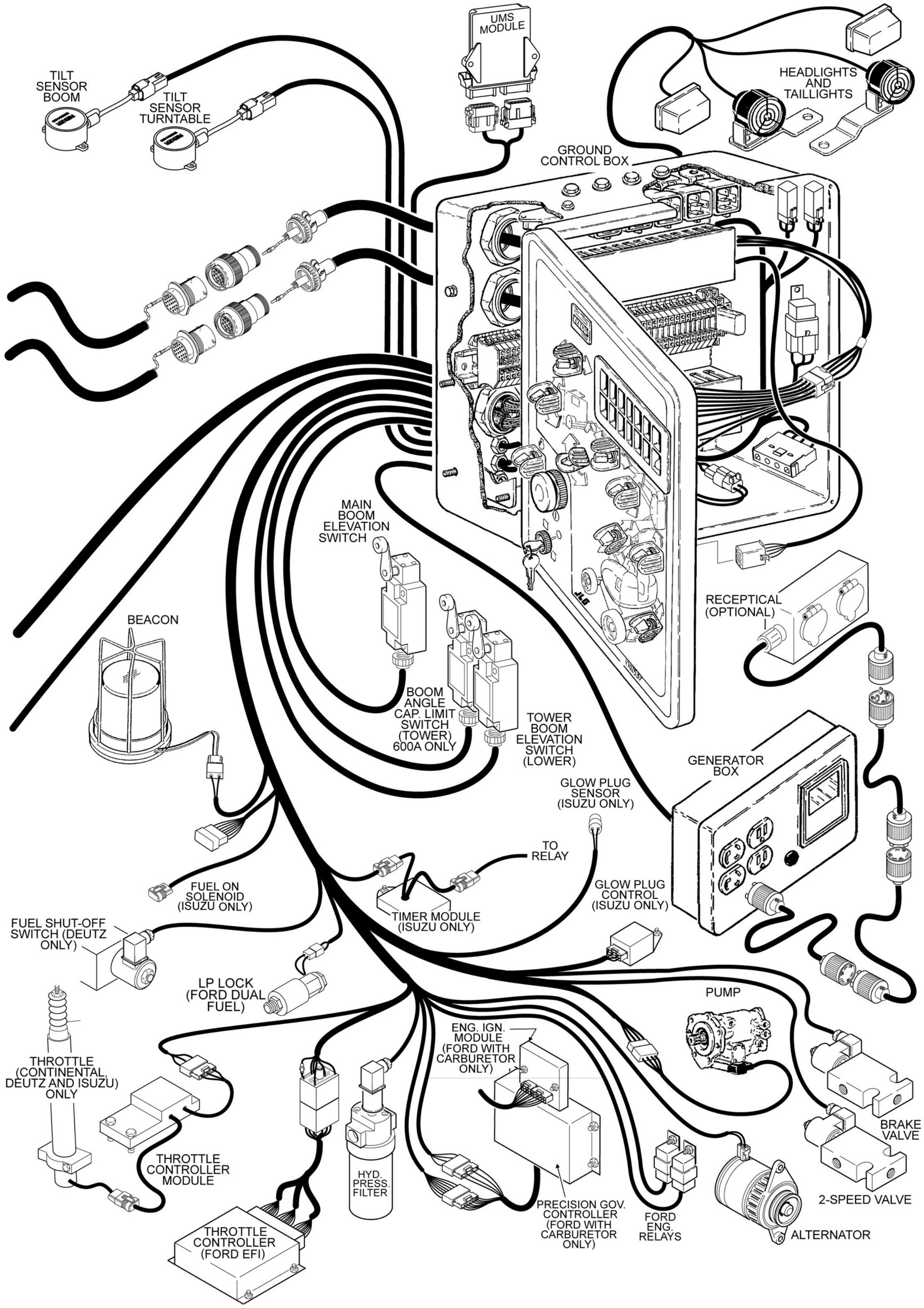


Figure 7-21. Electrical Components Installation (Prior to S/N 0300064432) - Sheet 2 of 2

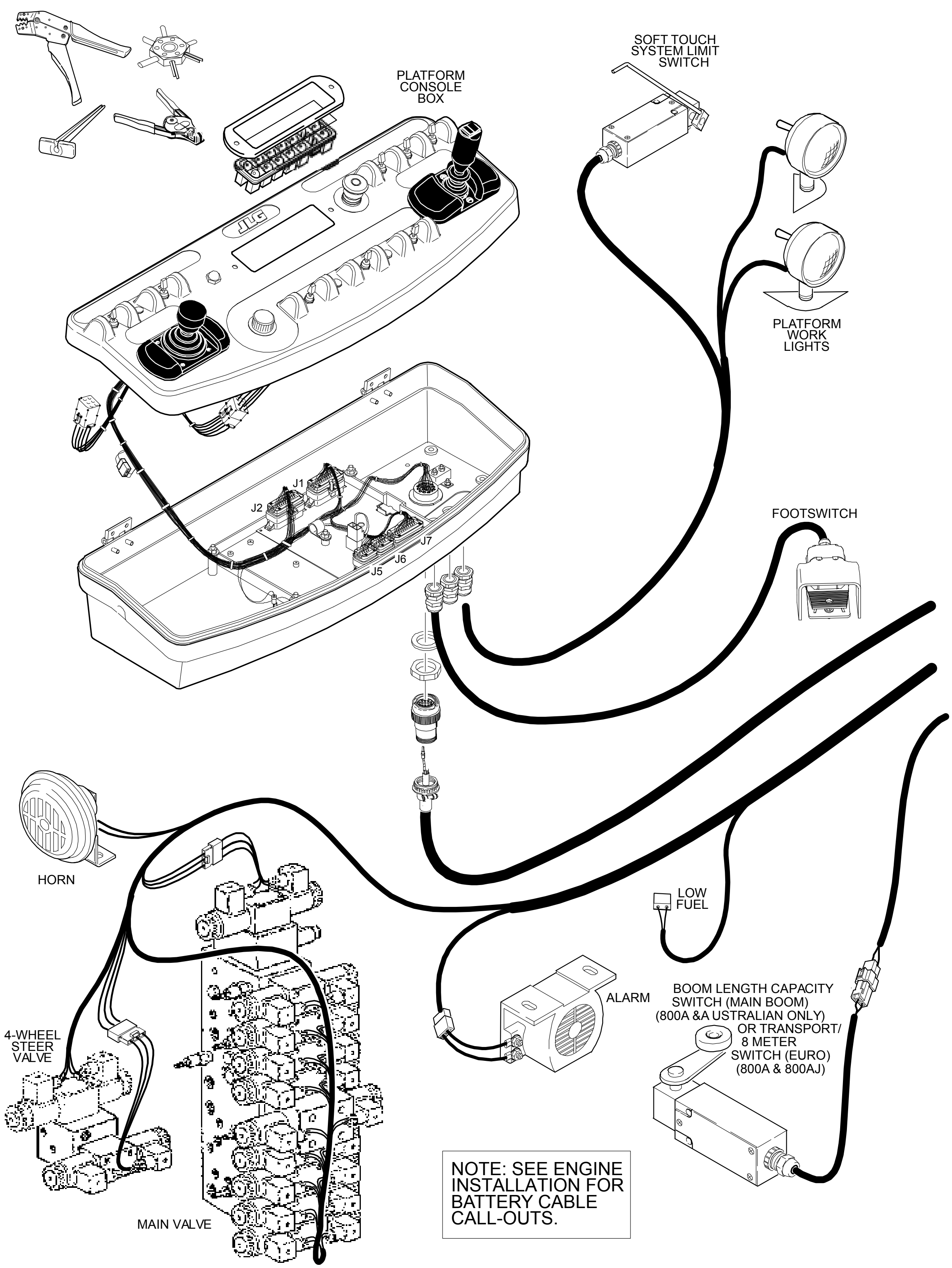


Figure 7-22. Electrical Components Installation (S/N 0300064432 to S/N 0300069000) - Sheet 1 of 2

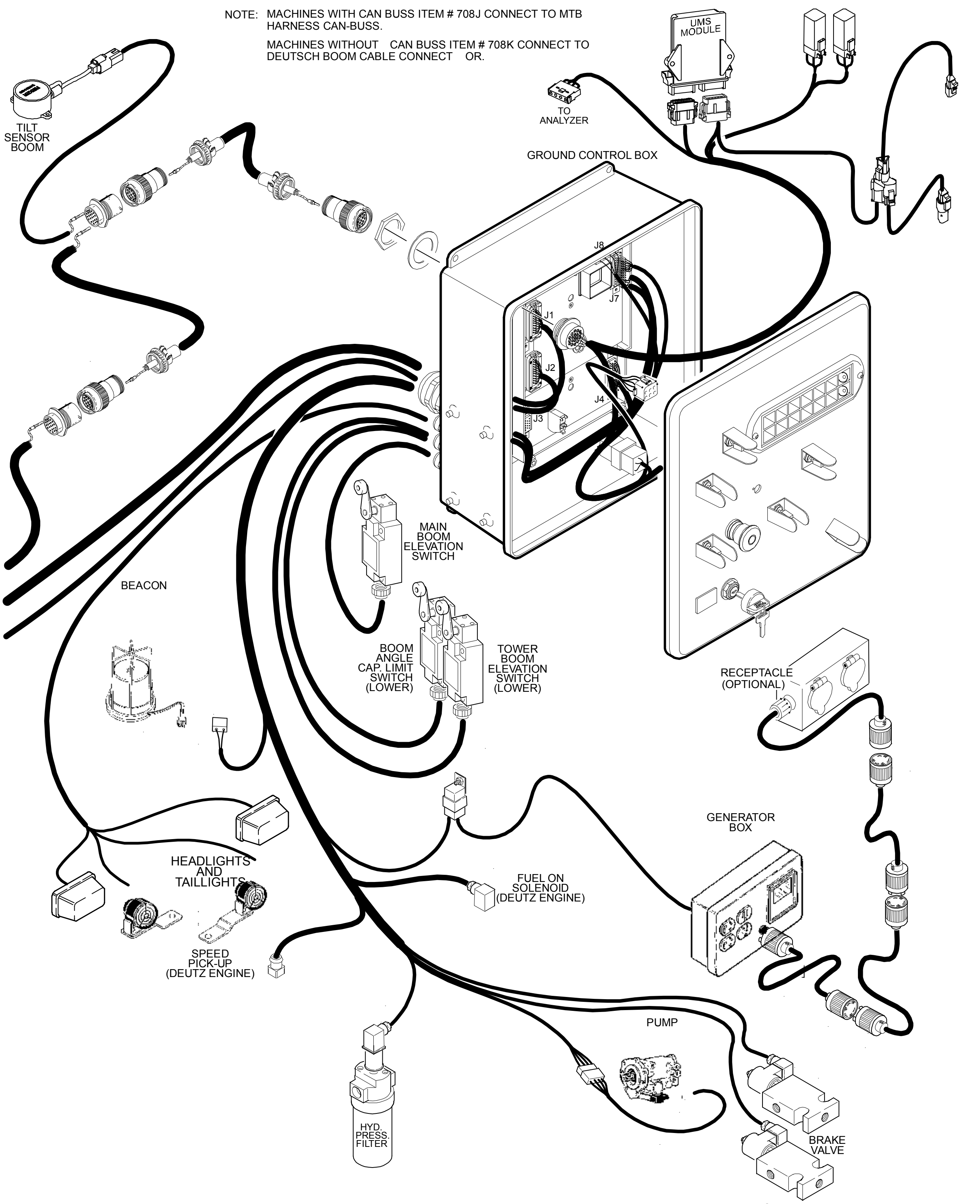


Figure 7-23. Electrical Components Installation (S/N 00300064432 to S/N 0300069000) - Sheet 2 of 2

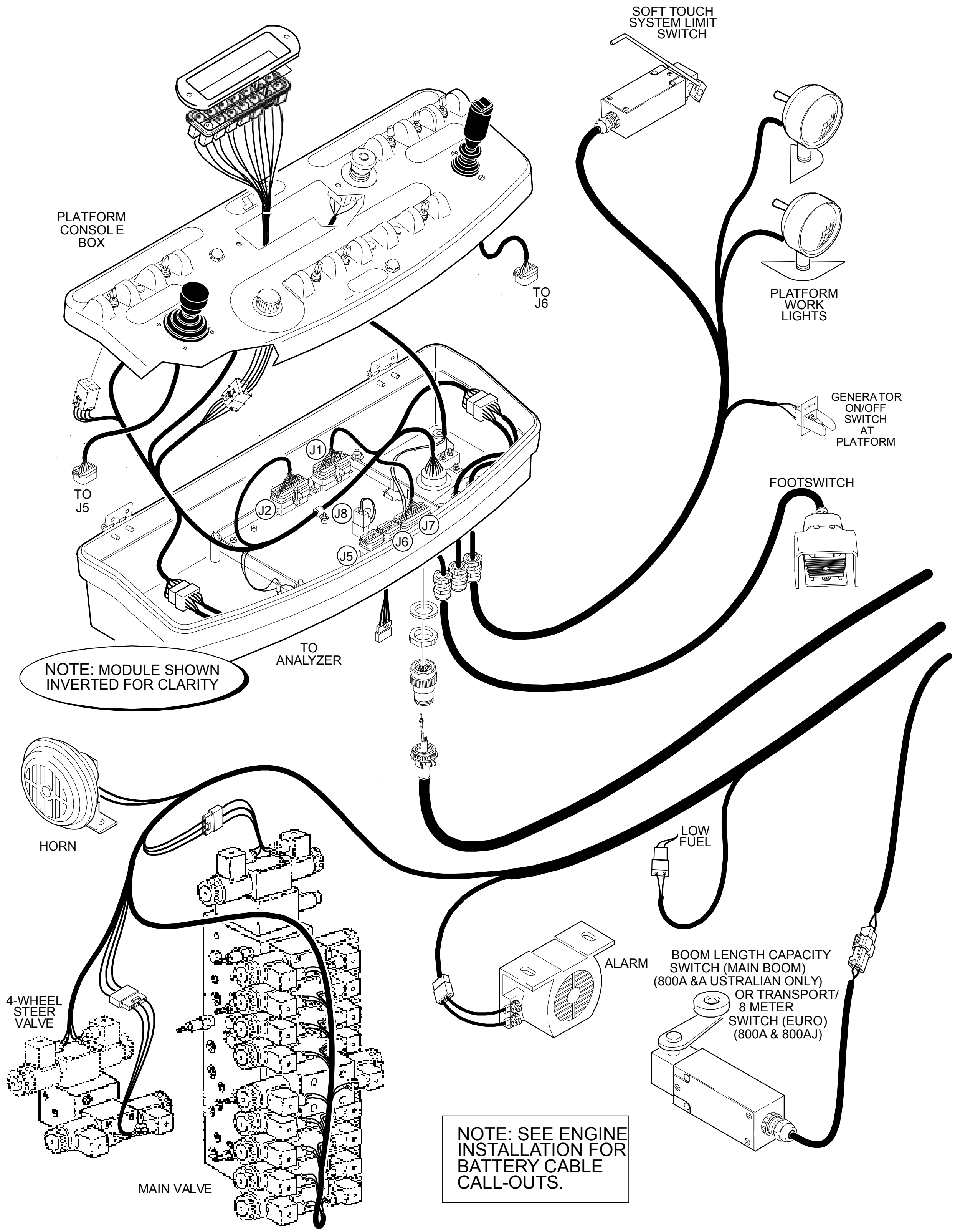


Figure 7-24. Electrical Components Installation w/ADE (S/N 0300064432 to S/N 0300069000) - Sheet 1 of 2

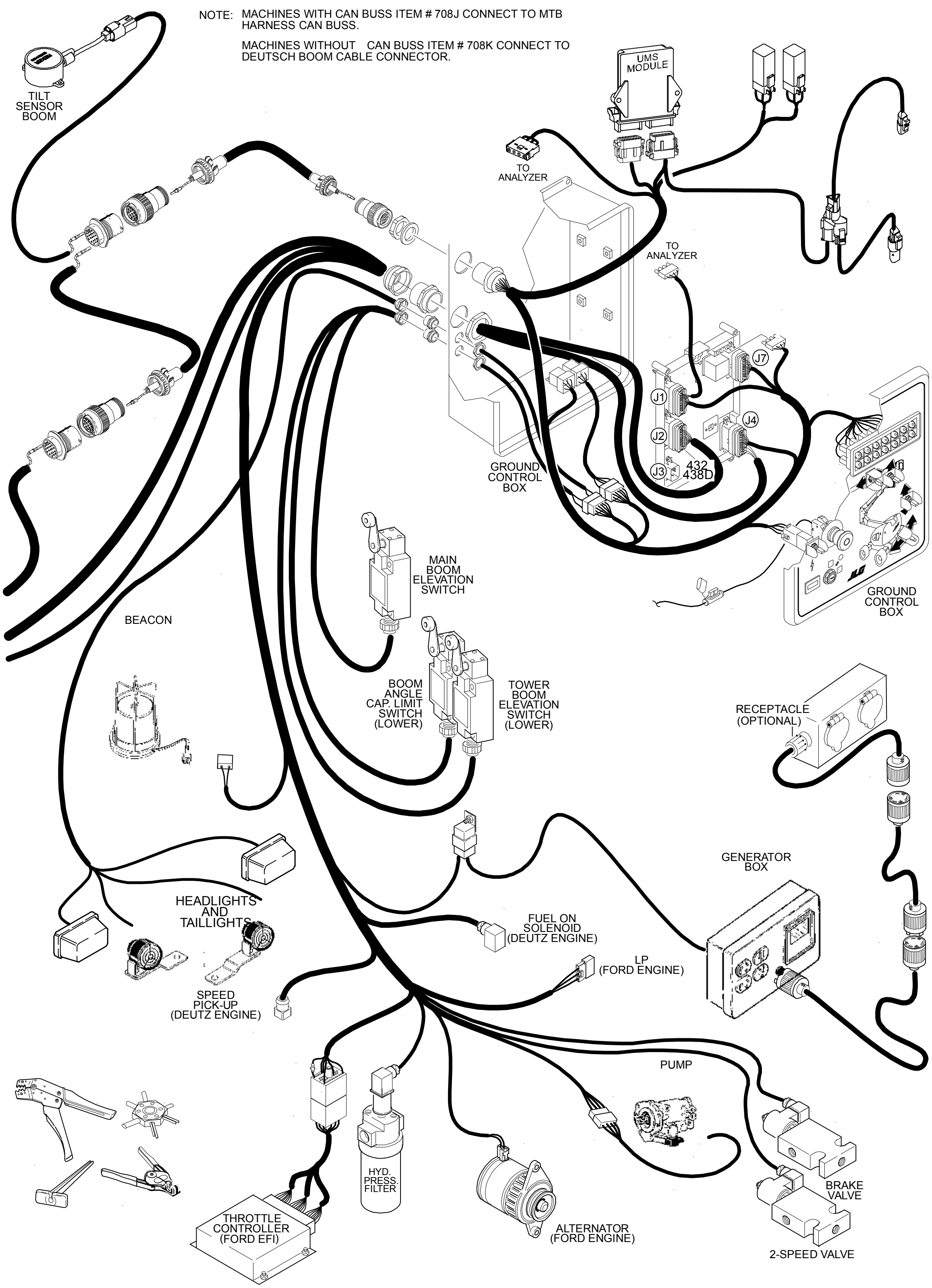


Figure 7-25. Electrical Components Installation w/ADE (S/N 0300064432 to S/N 0300069000) - Sheet 2 of 2

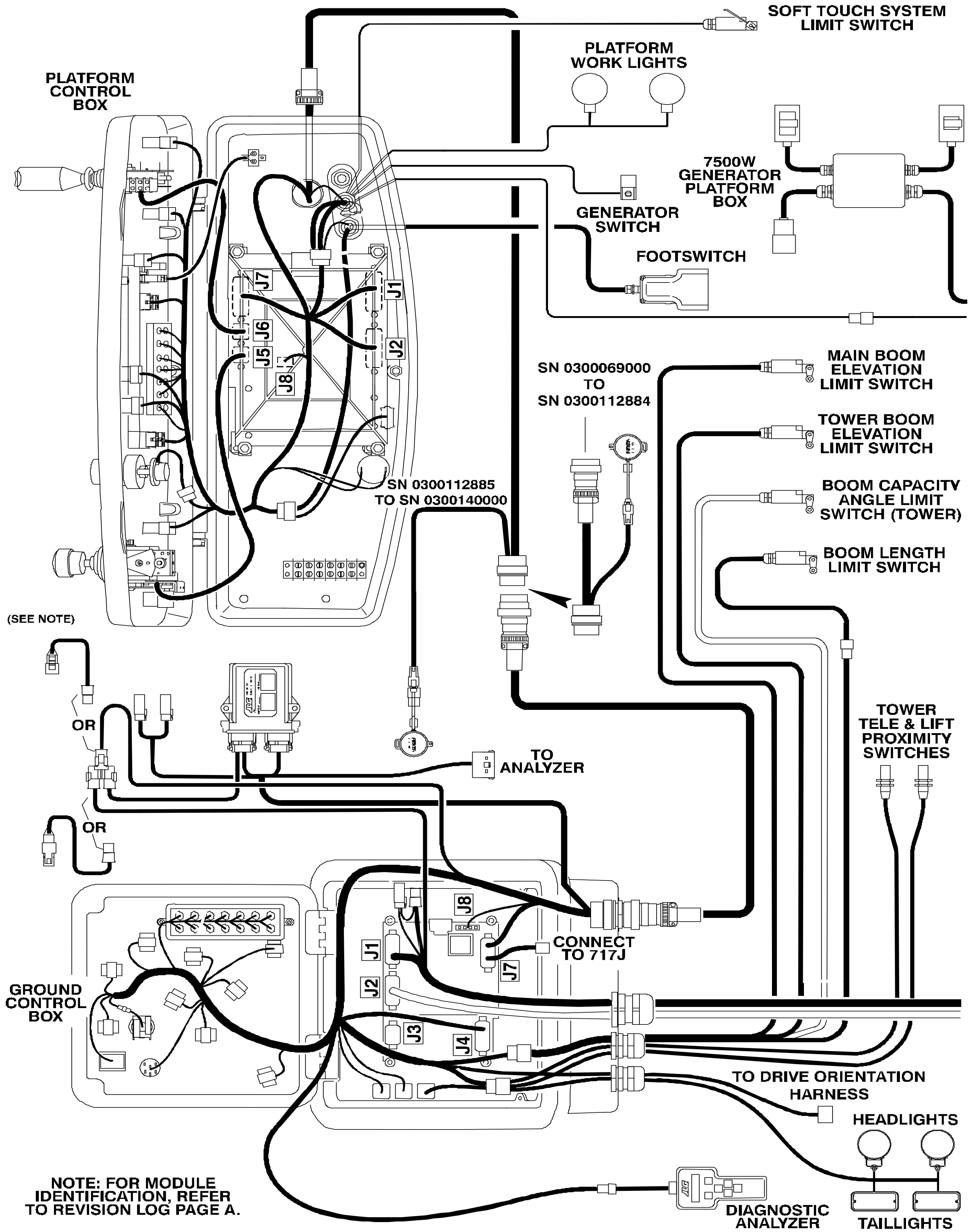


Figure 7-26. Electrical Components Installation w/ADE (S/N 0300069000 to S/N 0300140000) - Sheet 1 of 2

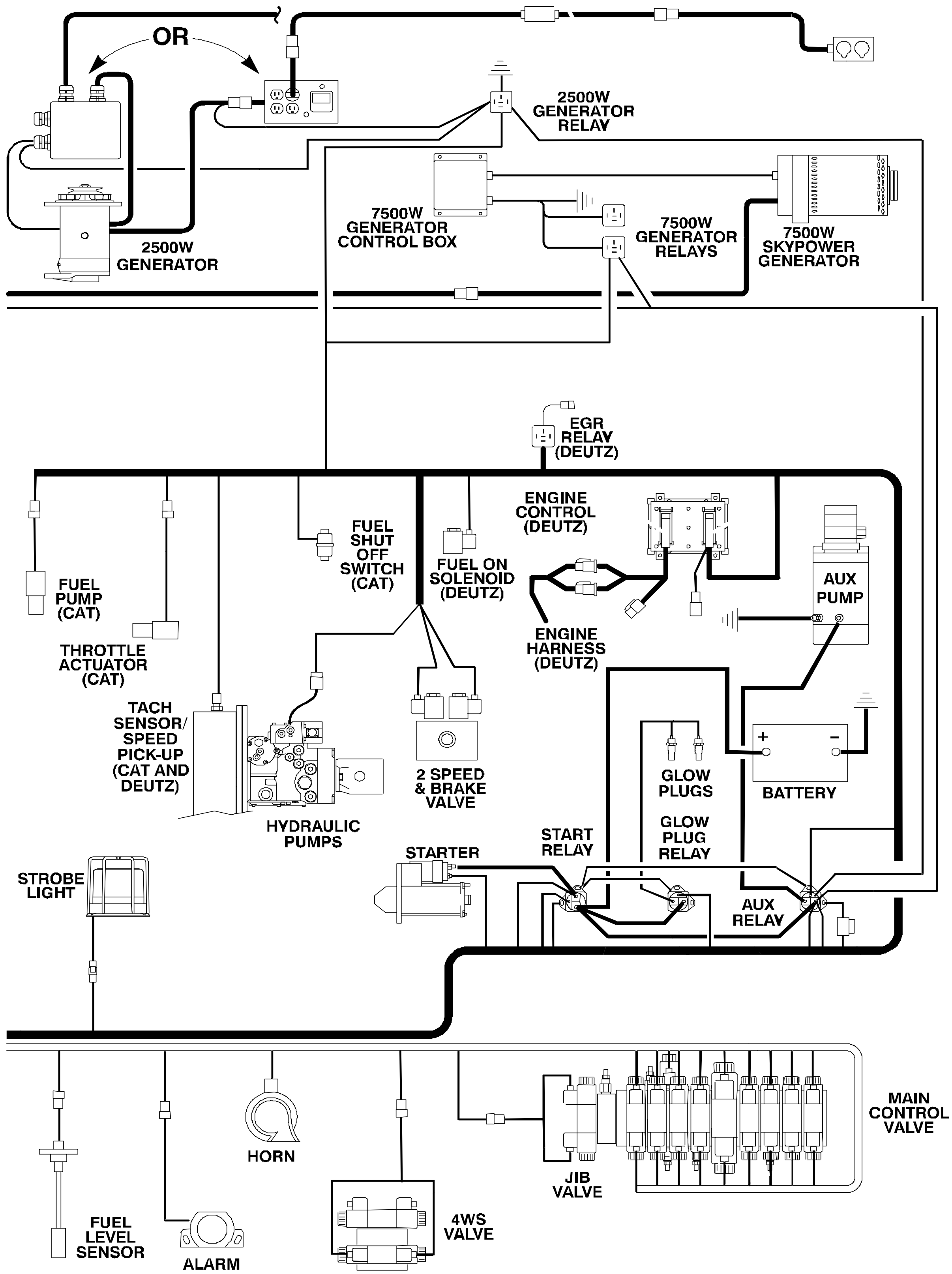


Figure 7-27. Electrical Components Installation w/ADE (S/N 0300069000 to S/N 0300140000) - Sheet 2 of 2

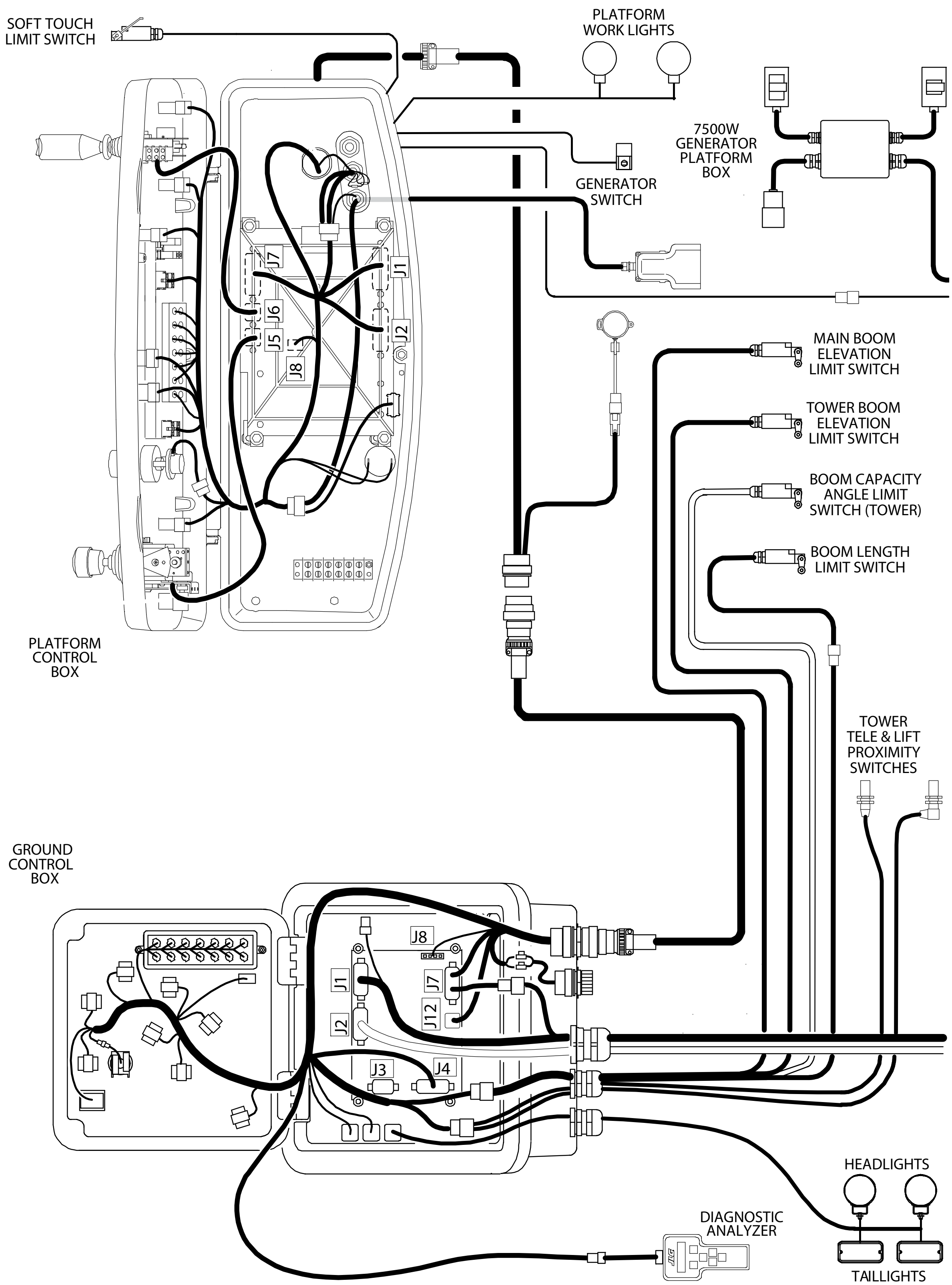


Figure 7-28. Electrical Components Installation w/ADE (S/N 0300140000 to S/N 0300183033) - Sheet 1 of 2

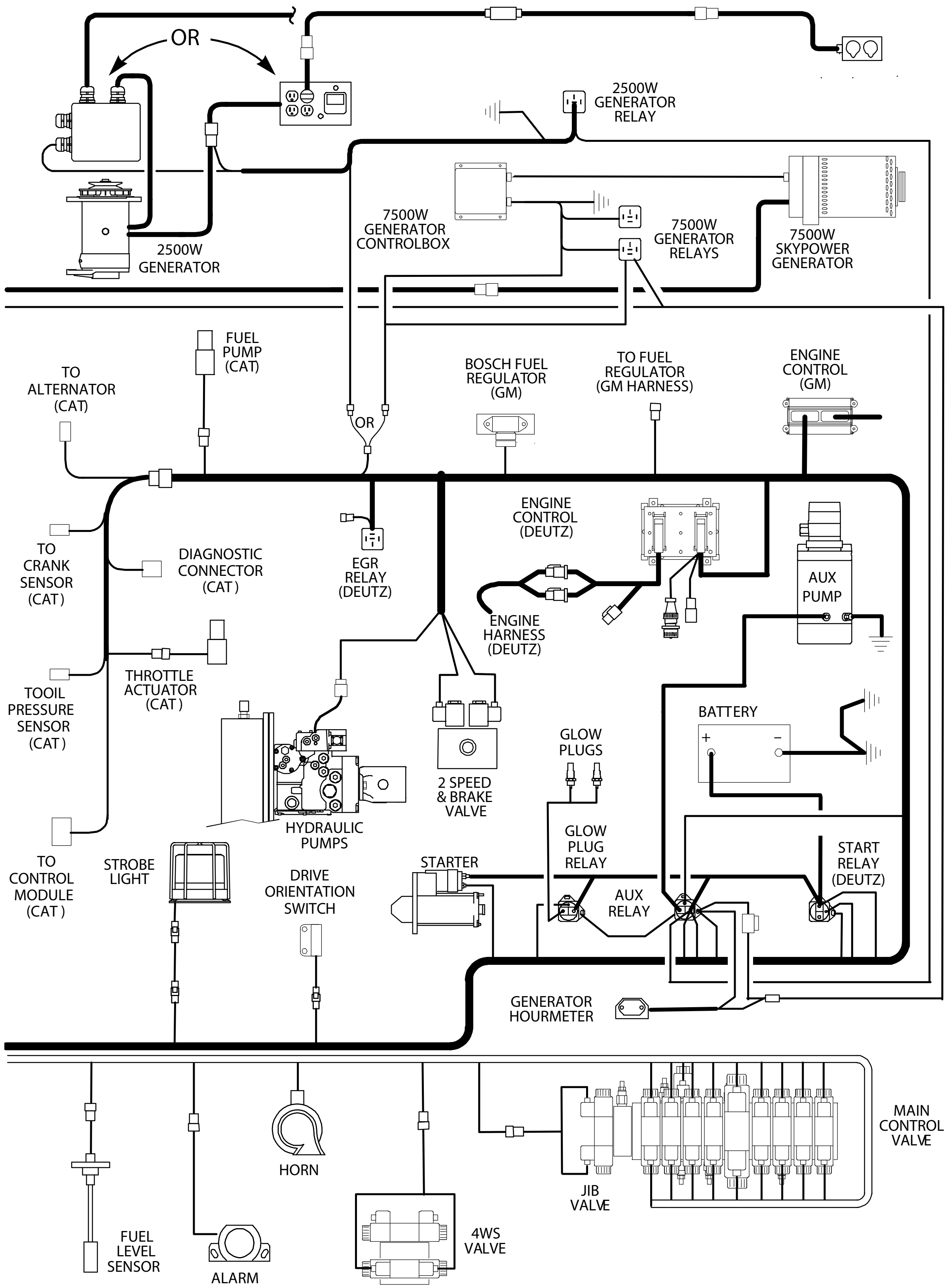


Figure 7-29. Electrical Components Installation w/ADE (S/N 0300140000 to S/N 0300183033) - Sheet 2 of 2

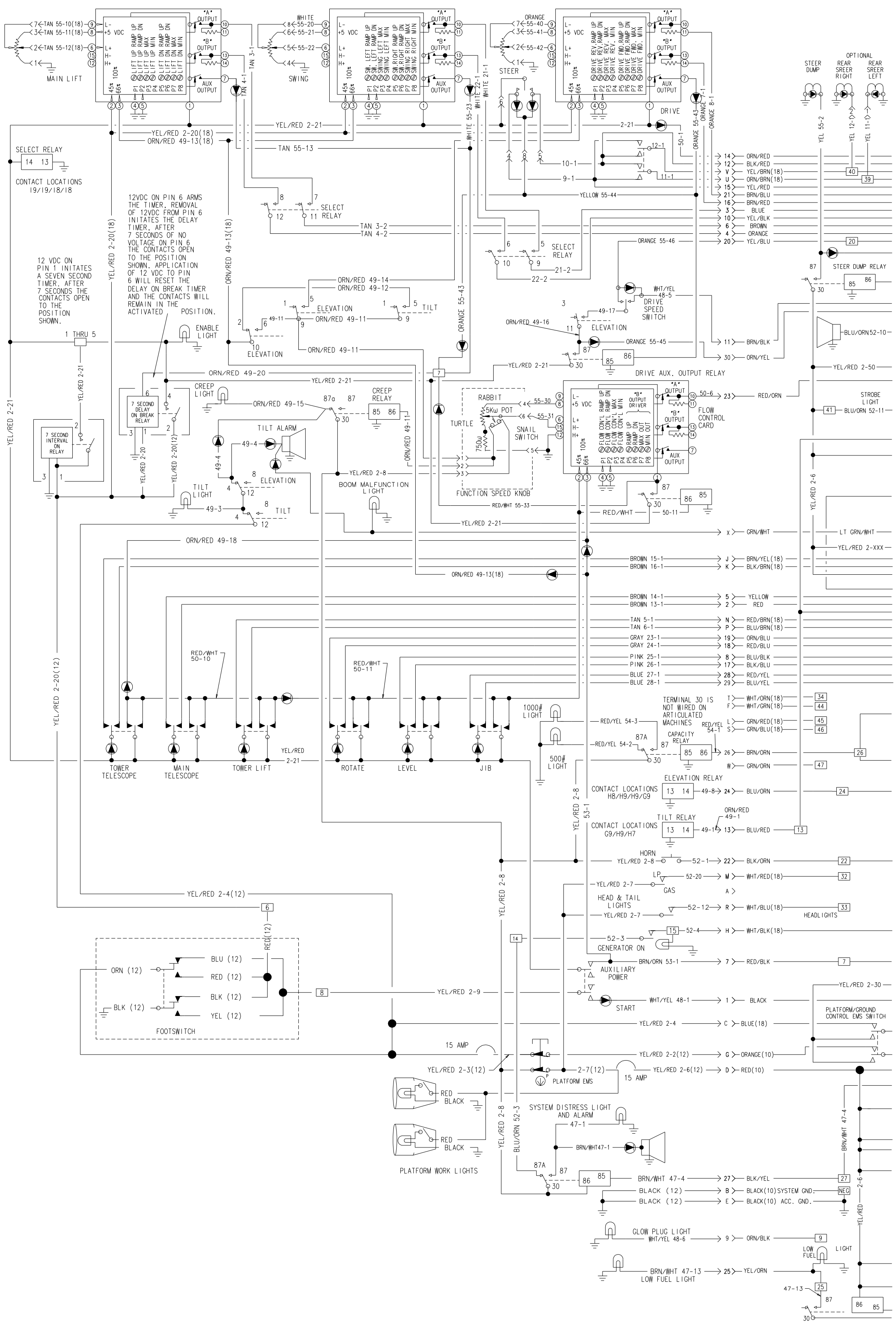
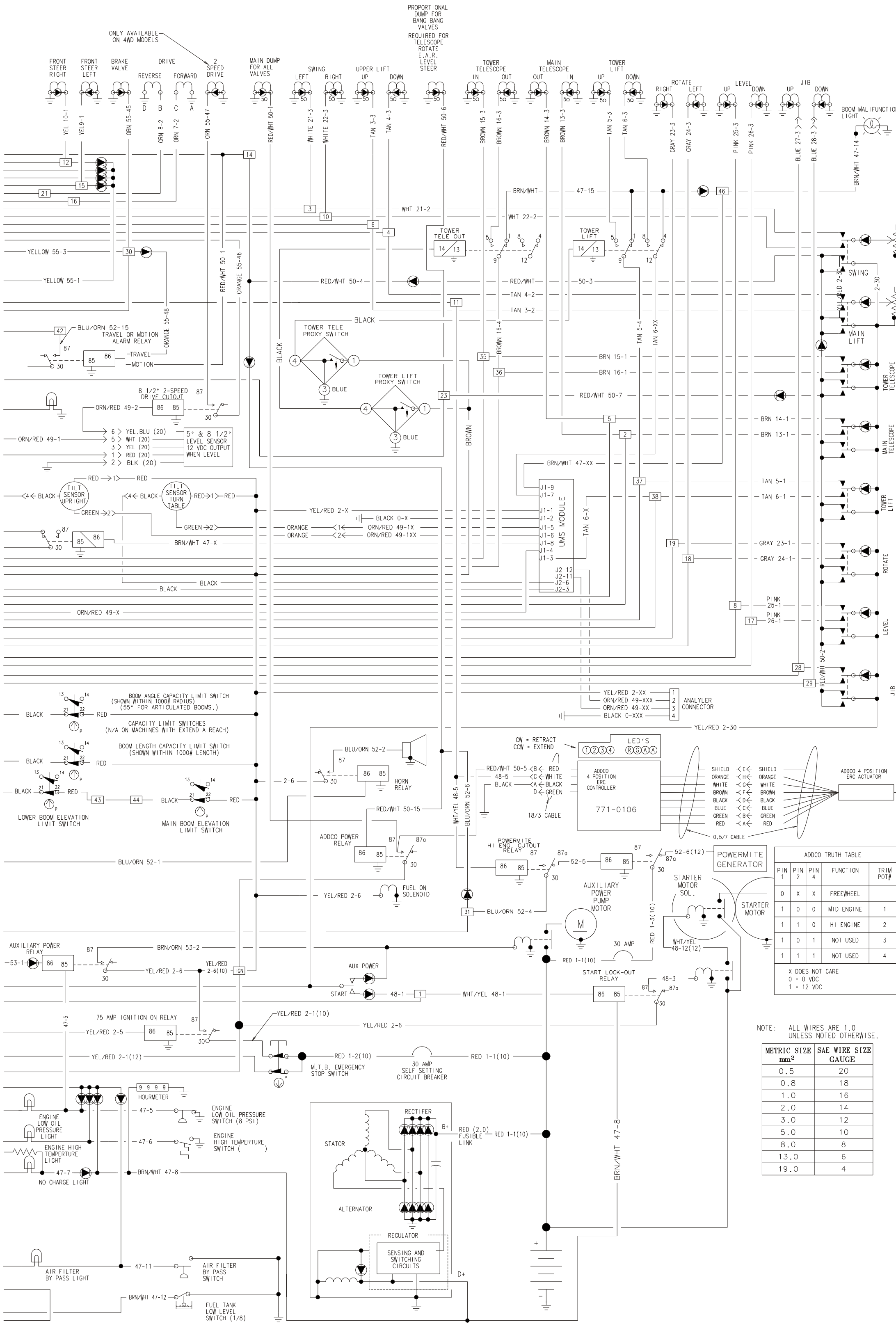


Figure 7-30. Electrical Schematic - Deutz Engine (Prior to S/N 0300065634) - Sheet 1 of 2



ADDCO TRUTH TABLE				
PIN 1	PIN 2	PIN 4	FUNCTION	TRIM POT#
0	X	X	FREEWHEEL	
1	0	0	MID ENGINE	1
1	1	0	HI ENGINE	2
1	0	1	NOT USED	3
1	1	1	NOT USED	4

X DOES NOT CARE
0 = 0 VDC
1 = 12 VDC

NOTE: ALL WIRES ARE 1.0 UNLESS NOTED OTHERWISE.

METRIC SIZE mm^2	SAE WIRE SIZE GAUGE
0.5	20
0.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4

1870063 I

Figure 7-31. Electrical Schematic - Deutz Engine (Prior to S/N 0300065634) - Sheet 2 of 2

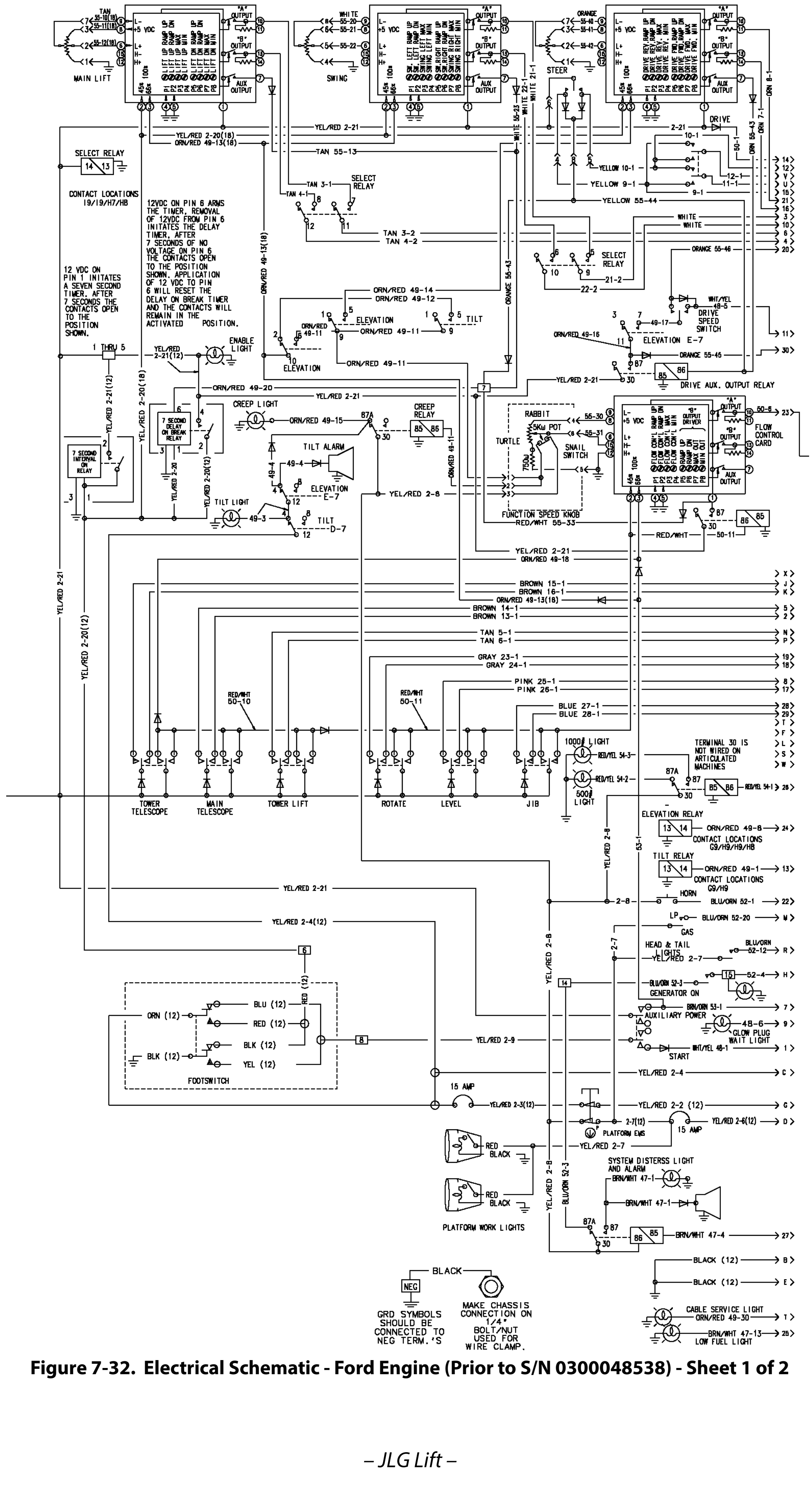


Figure 7-32. Electrical Schematic - Ford Engine (Prior to S/N 0300048538) - Sheet 1 of 2

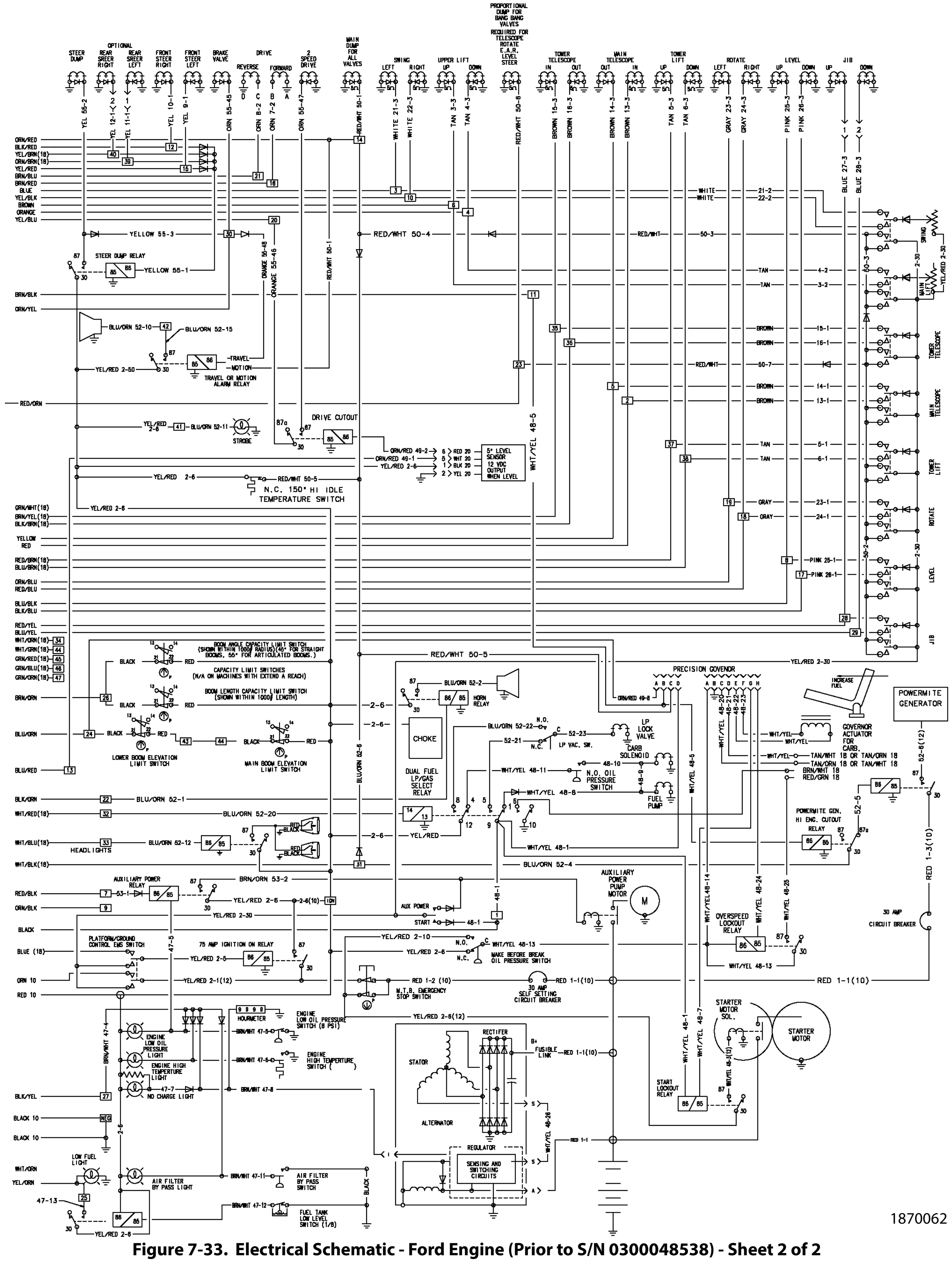


Figure 7-33. Electrical Schematic - Ford Engine (Prior to S/N 0300048538) - Sheet 2 of 2

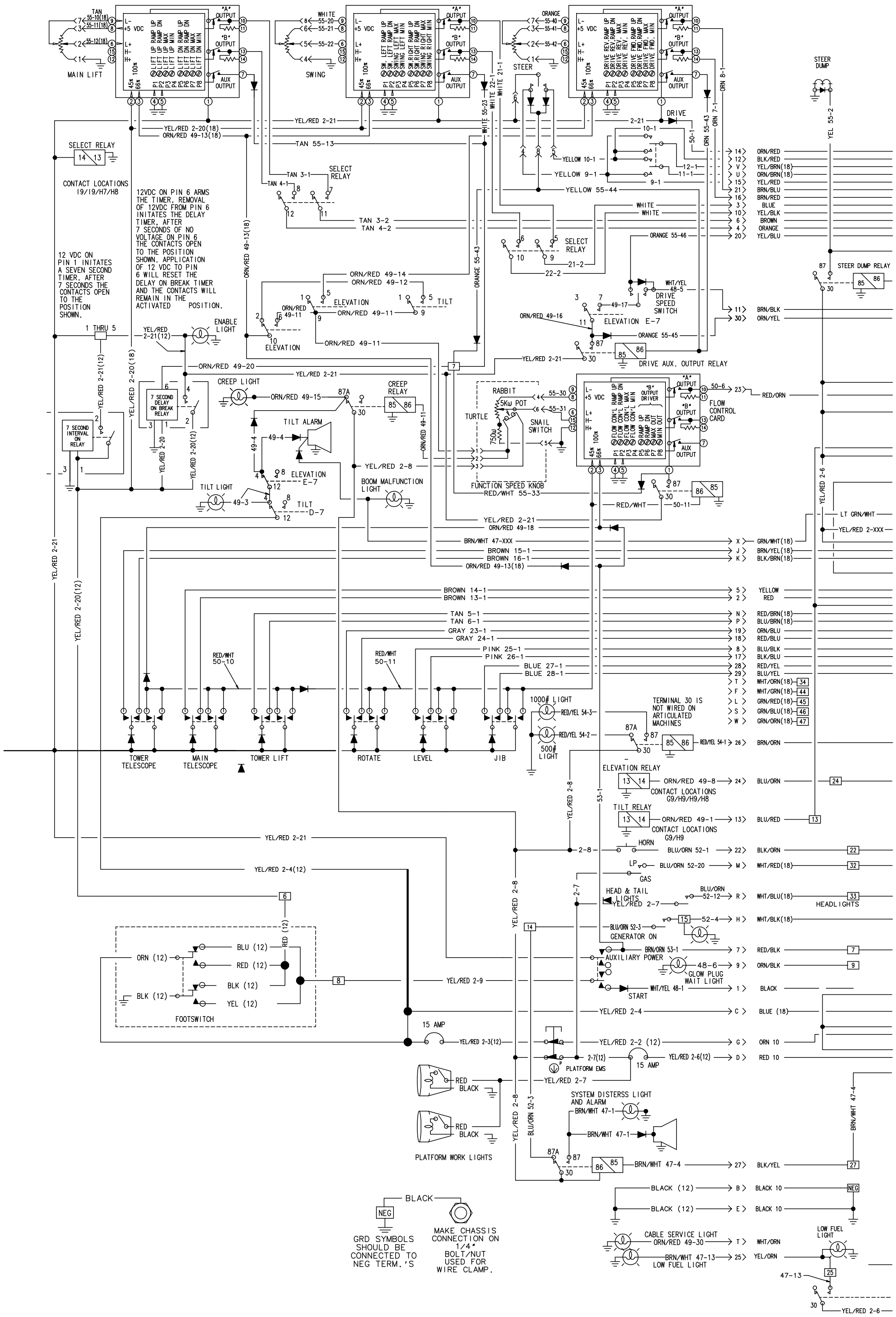
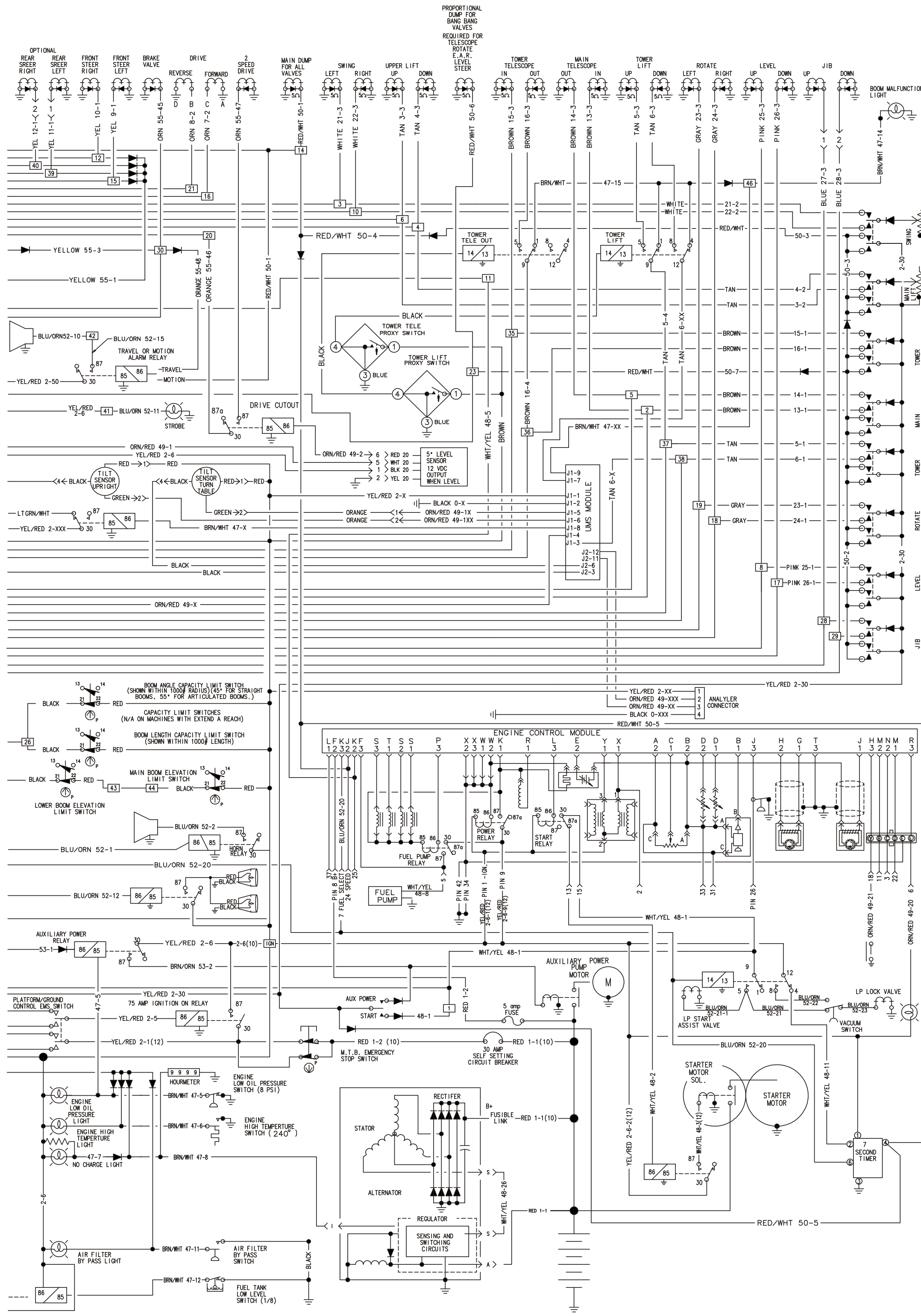


Figure 7-34. Electrical Schematic - Ford EFI Engine (S/N 0300048538 to S/N 0300065634) - Sheet 1 of 2



1870100 G

Figure 7-35. Electrical Schematic - Ford EFI Engine (S/N 0300048538 to S/N 0300065634) - Sheet 2 of 2

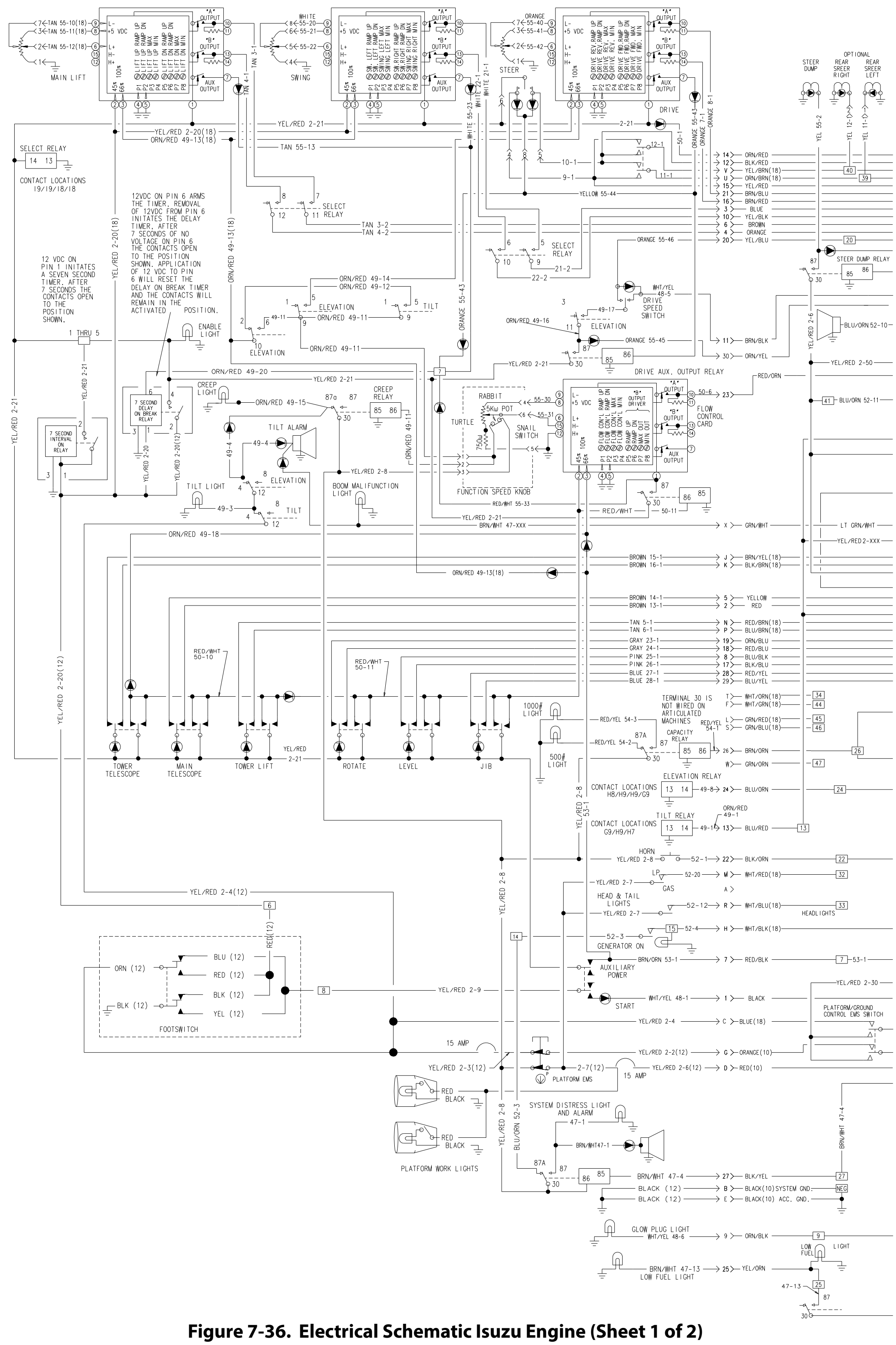


Figure 7-36. Electrical Schematic Isuzu Engine (Sheet 1 of 2)

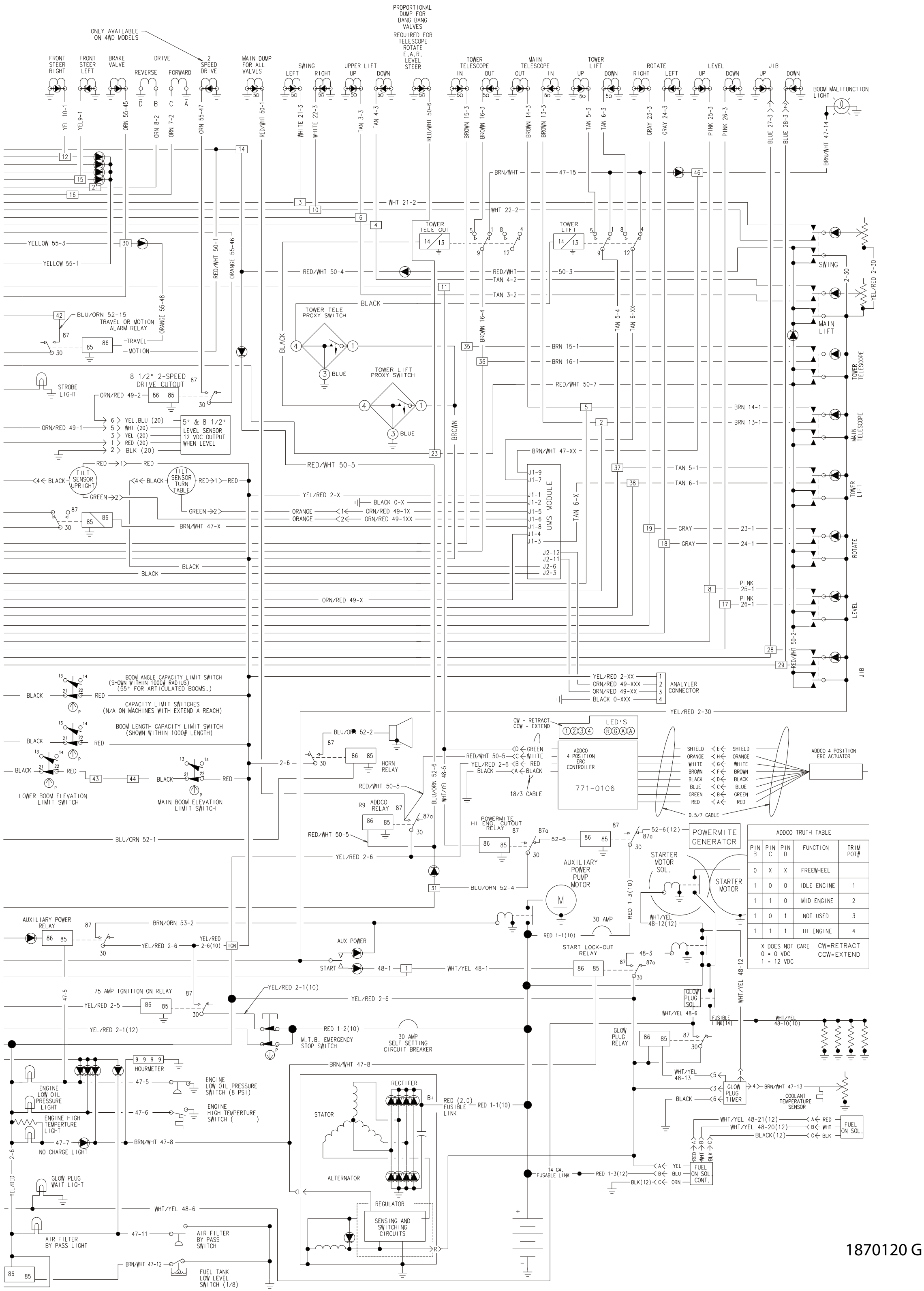


Figure 7-37. Electrical Schematic Isuzu Engine (Sheet 2 of 2)

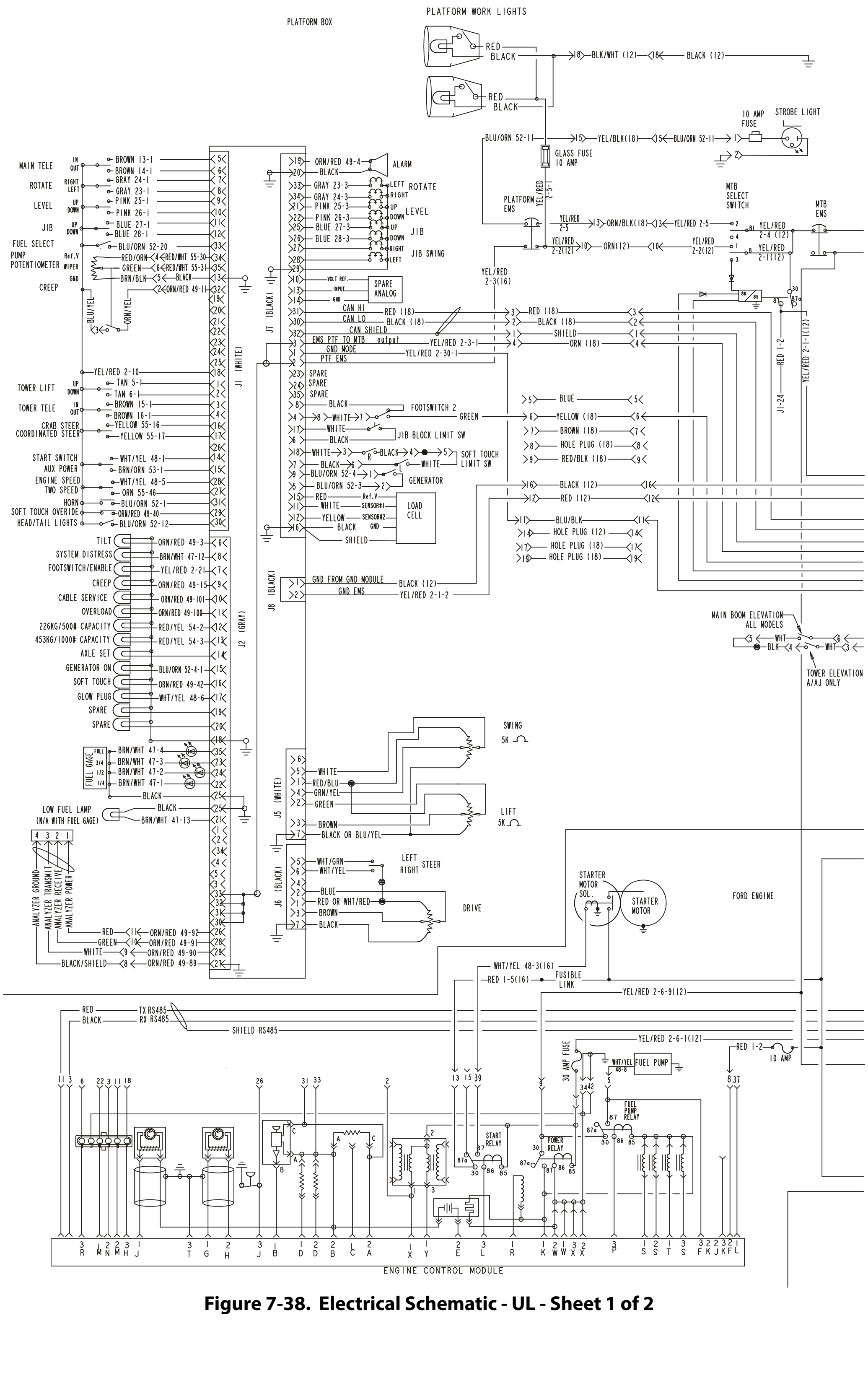
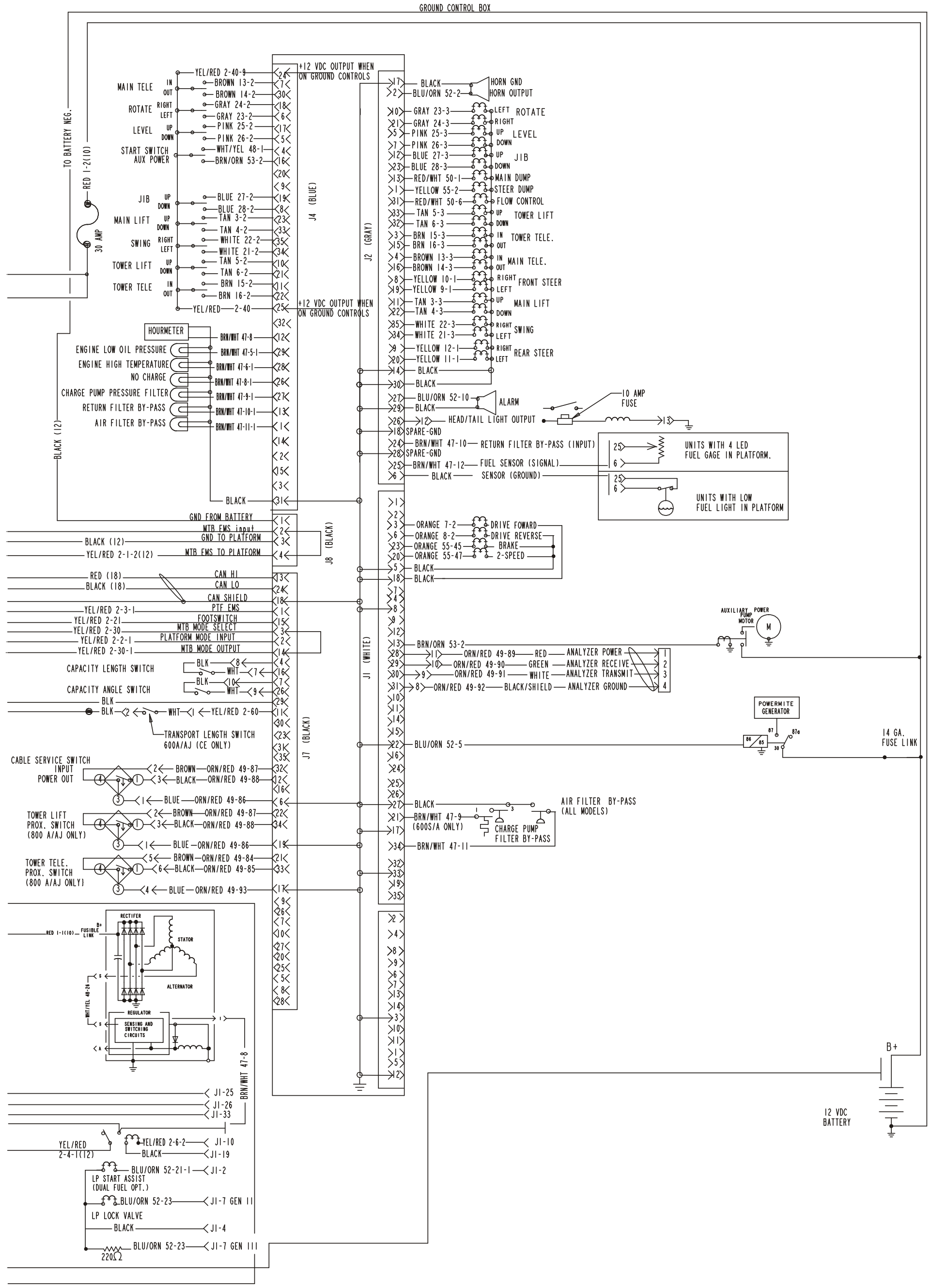


Figure 7-38. Electrical Schematic - UL - Sheet 1 of 2



NOTE: SEE SCHEMATIC 1001110310 FOR PLATFORM AND MAIN TERMINAL BOX WIRING. THIS SCHEMATIC CAN BE USED FOR ENGINE WIRING.

1870160 C

Figure 7-39. Electrical Schematic - UL - Sheet 2 of 2

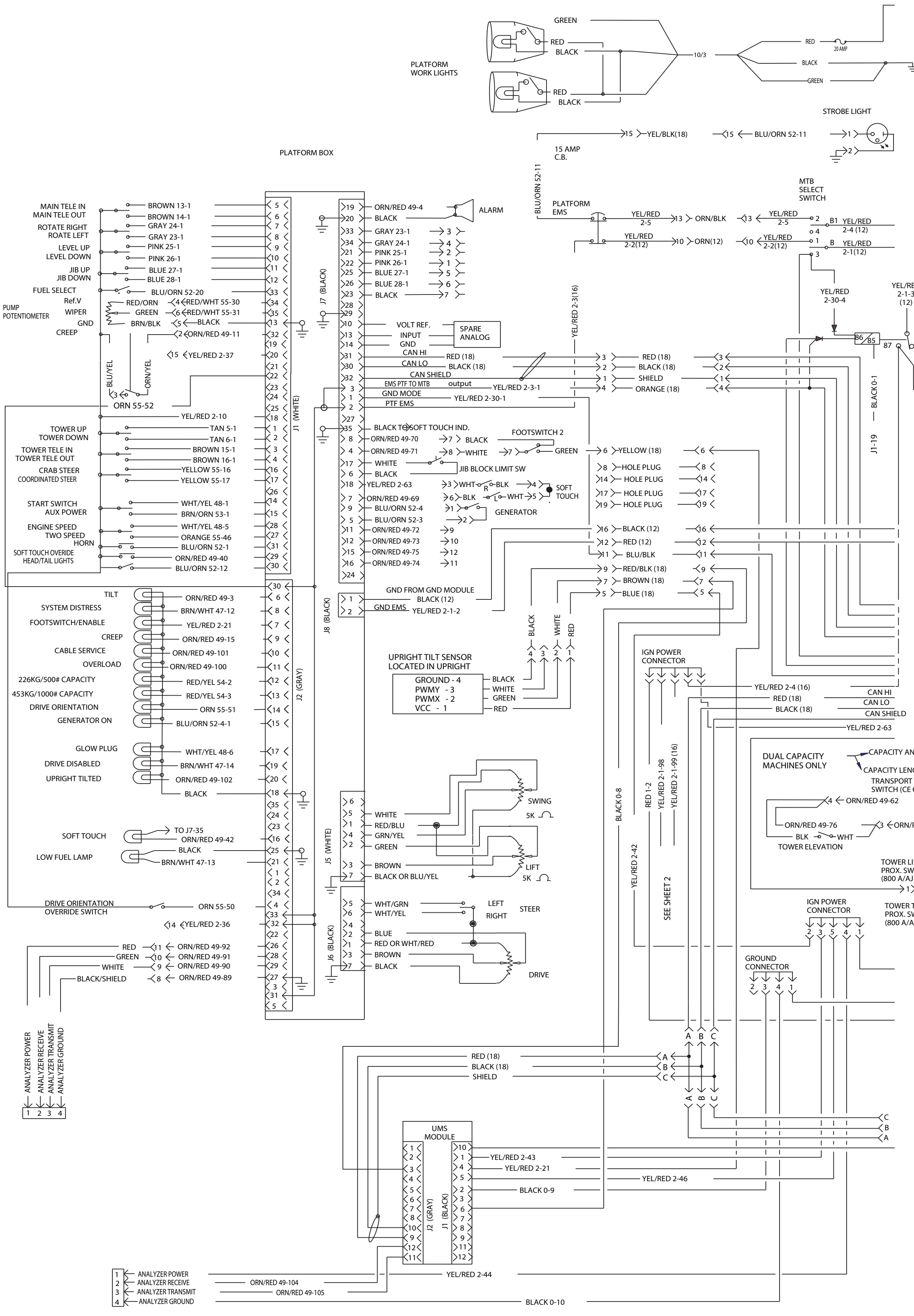
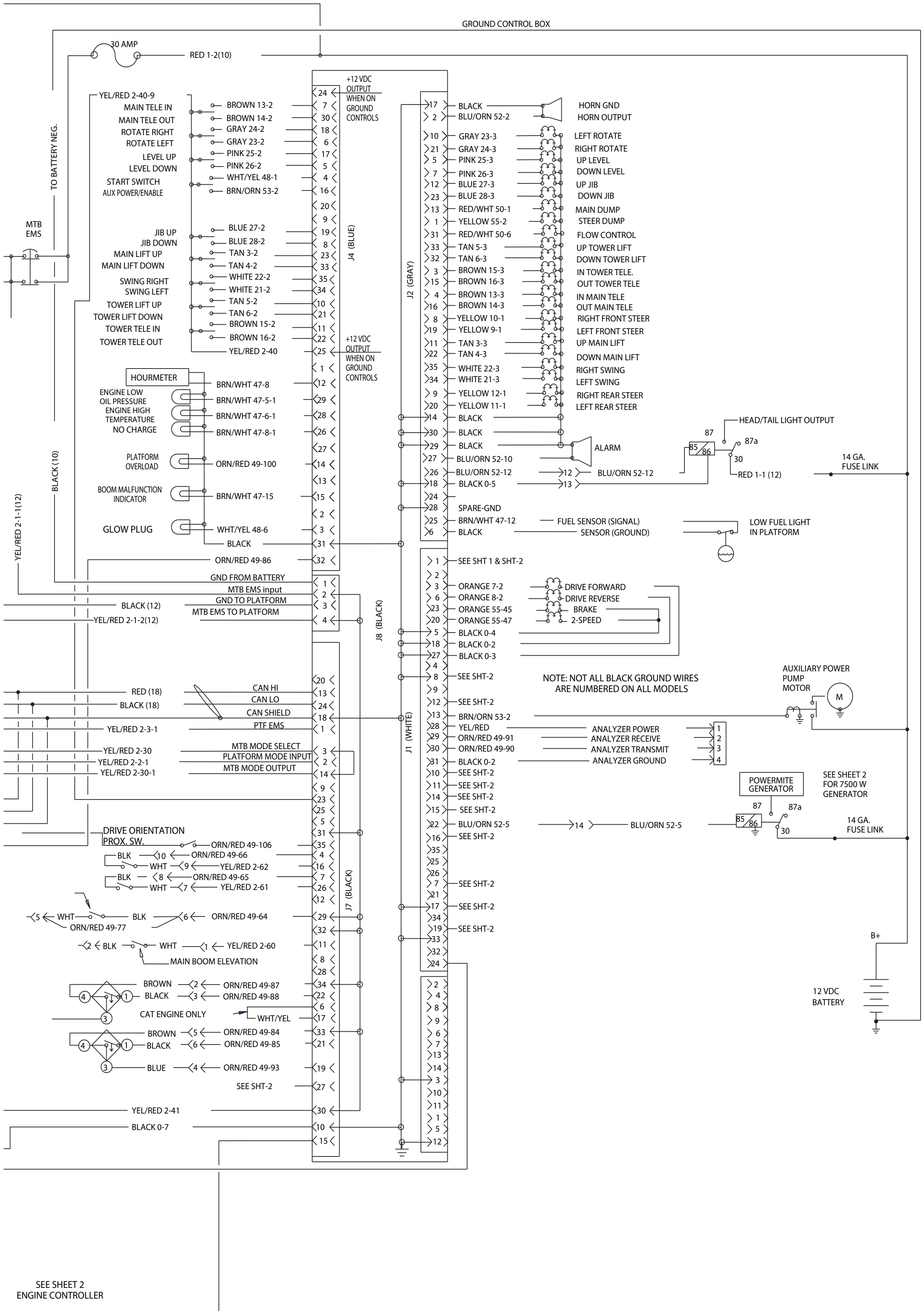


Figure 7-40. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 1 of 6



1001096461 F

Figure 7-41. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 2 of 6

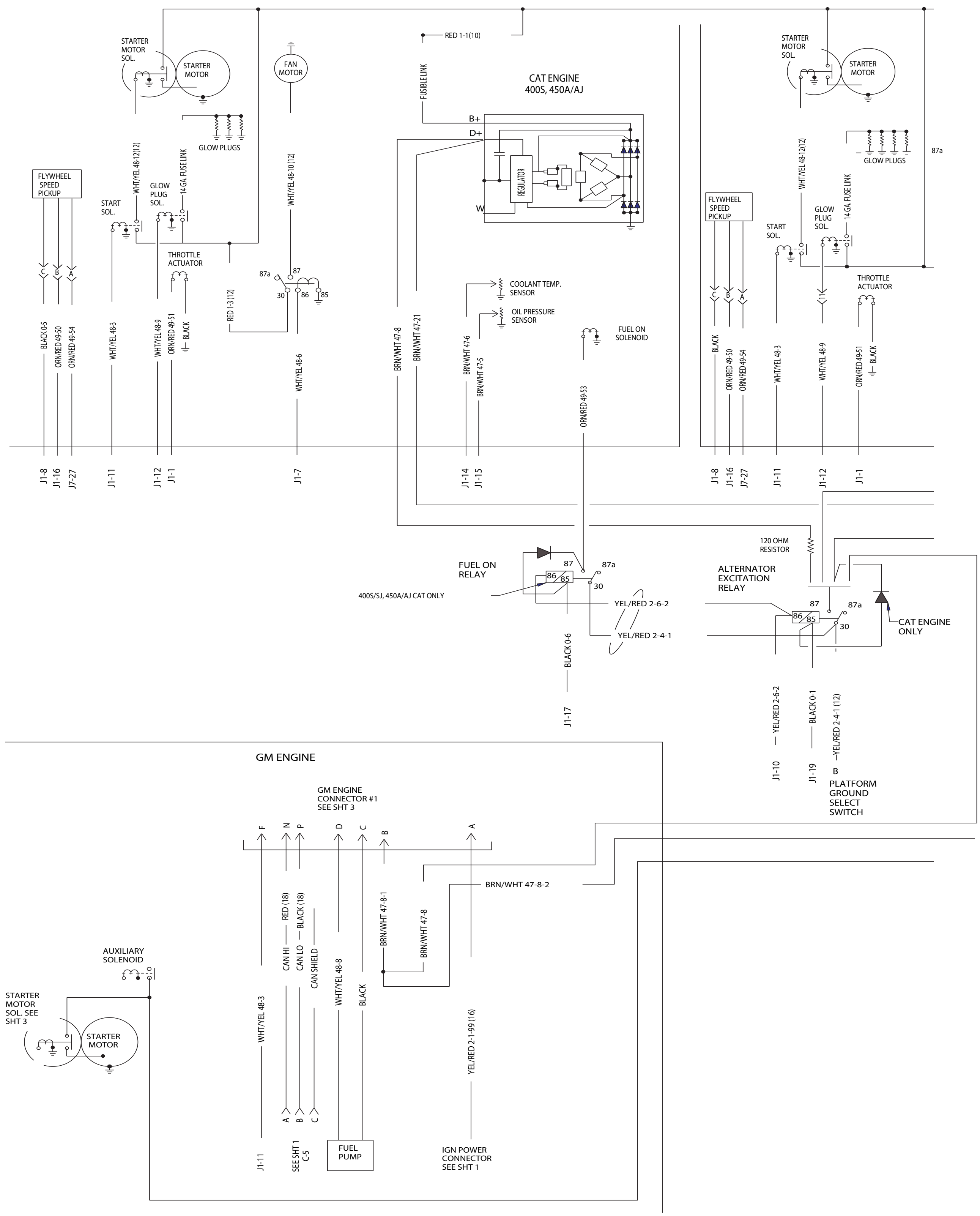


Figure 7-42. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 3 of 6

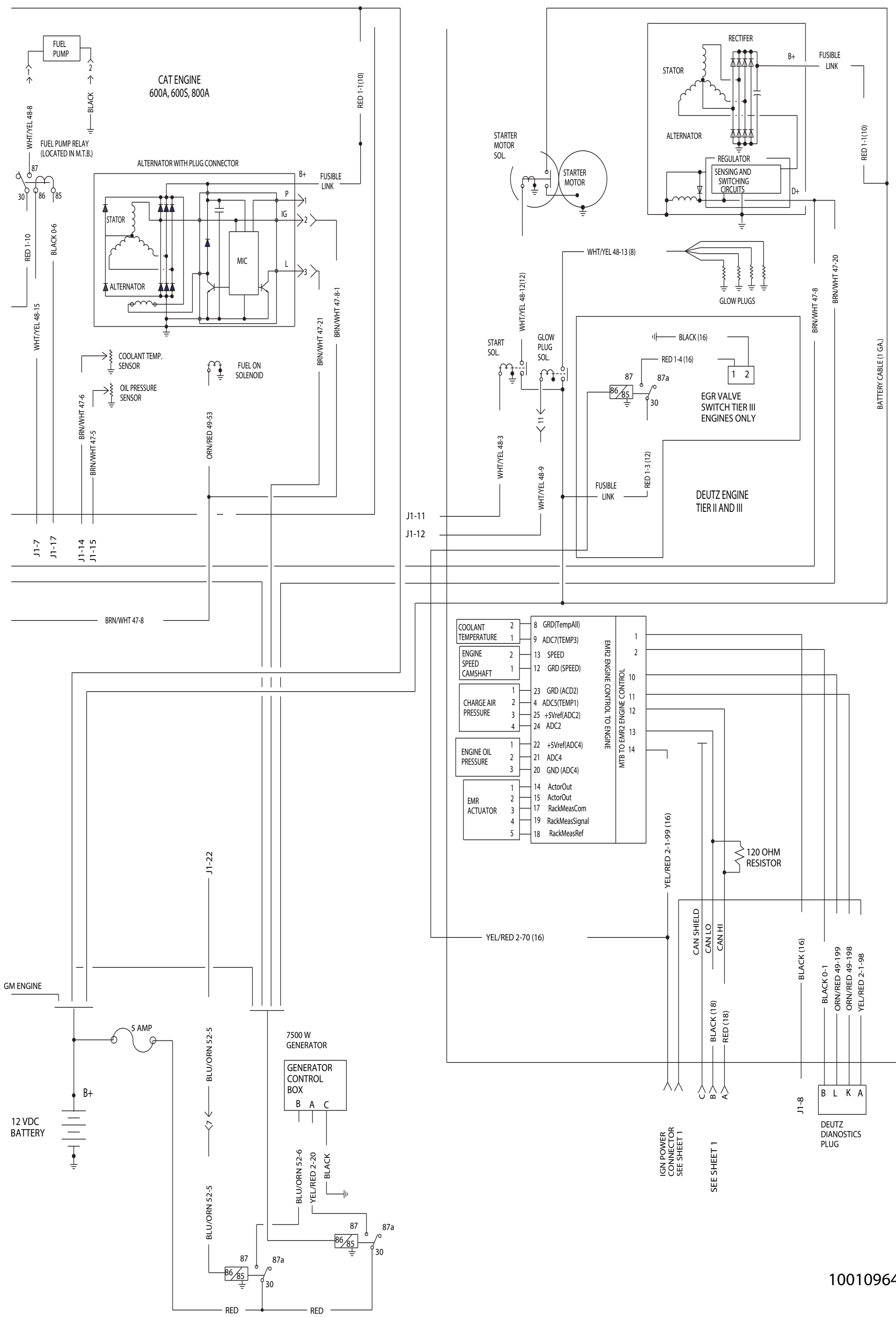


Figure 7-43. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 4 of 6

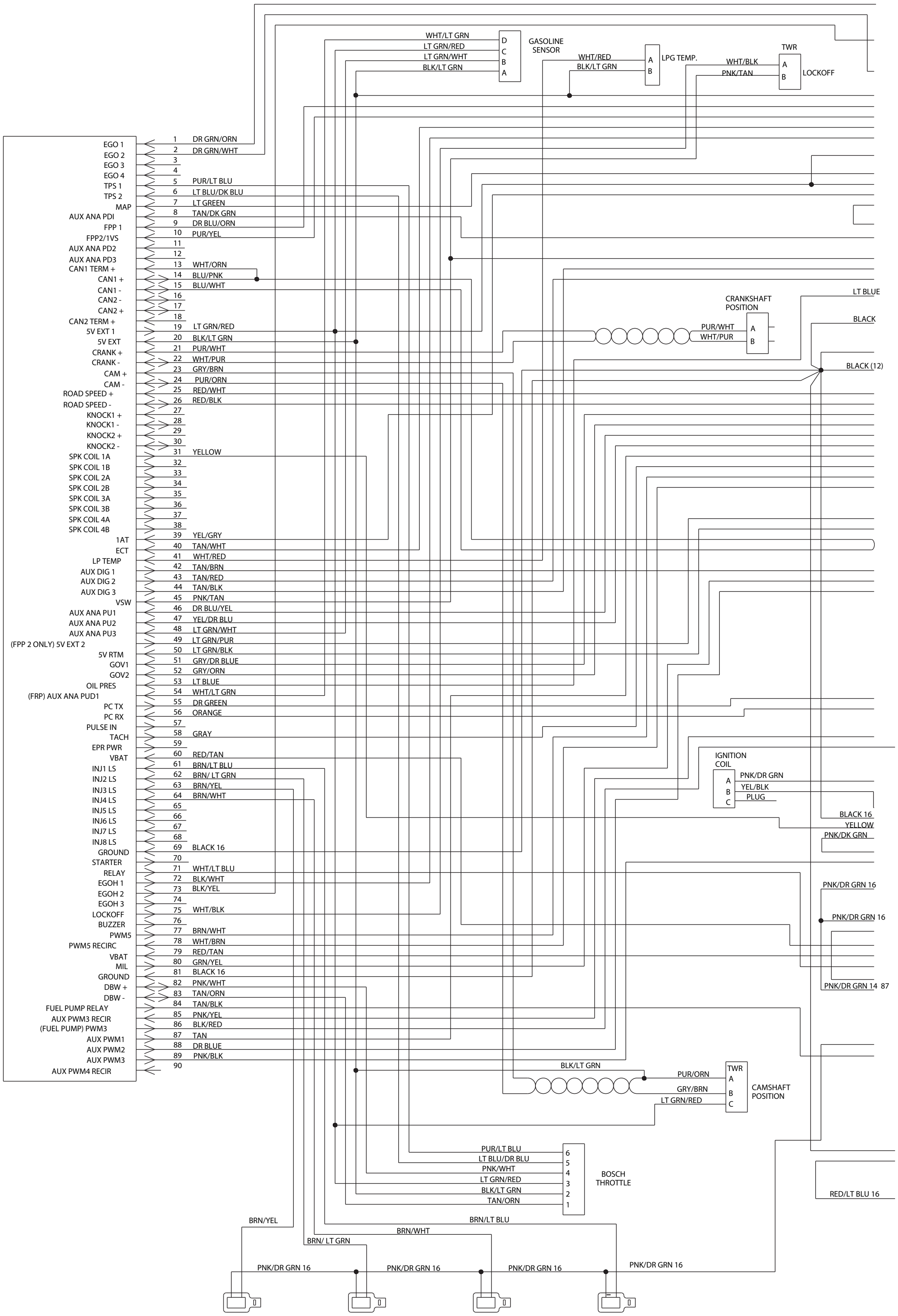


Figure 7-44. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 5 of 6

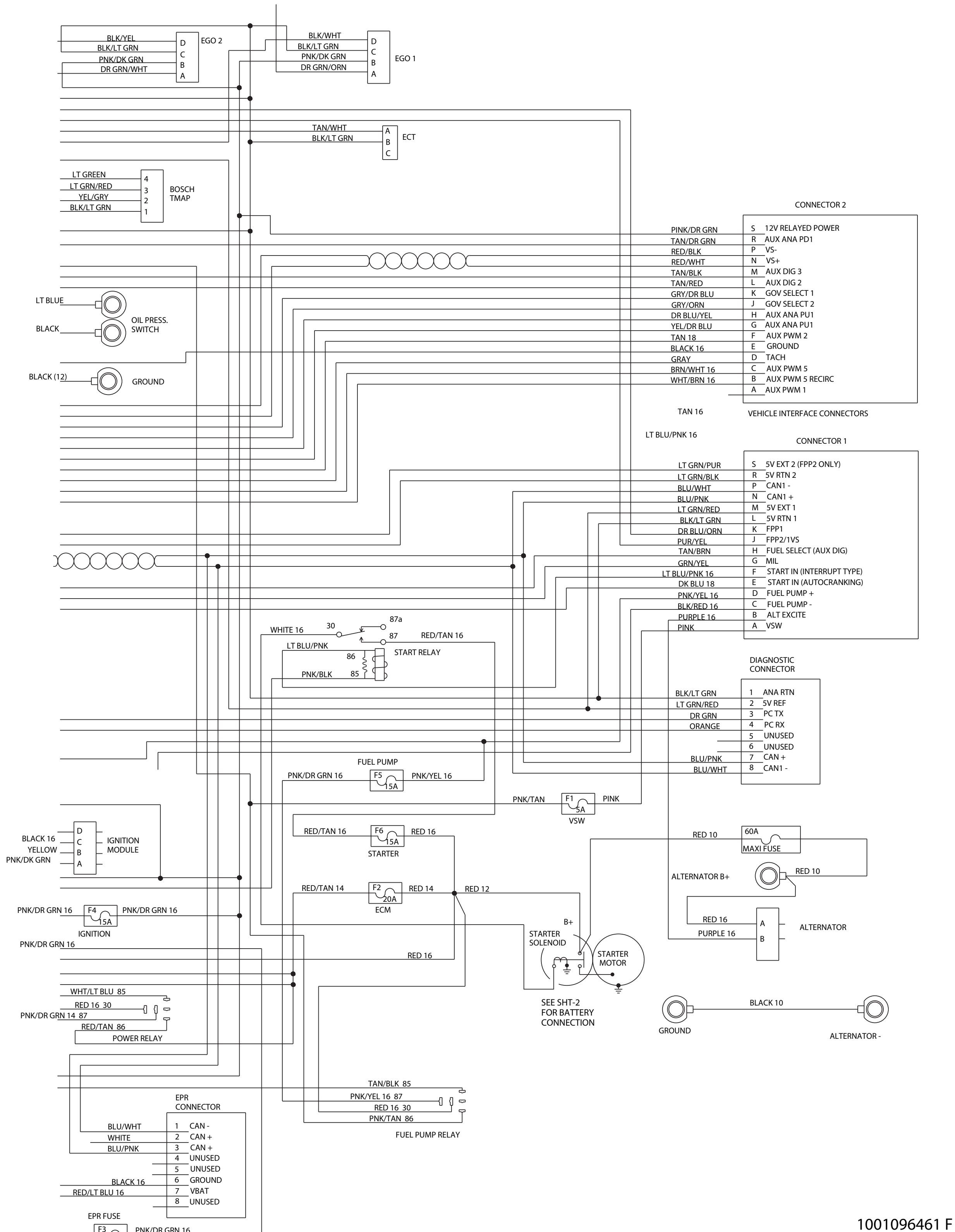


Figure 7-45. Electrical Schematic - Caterpillar, Deutz, & GM - with UGM - Sheet 6 of 6

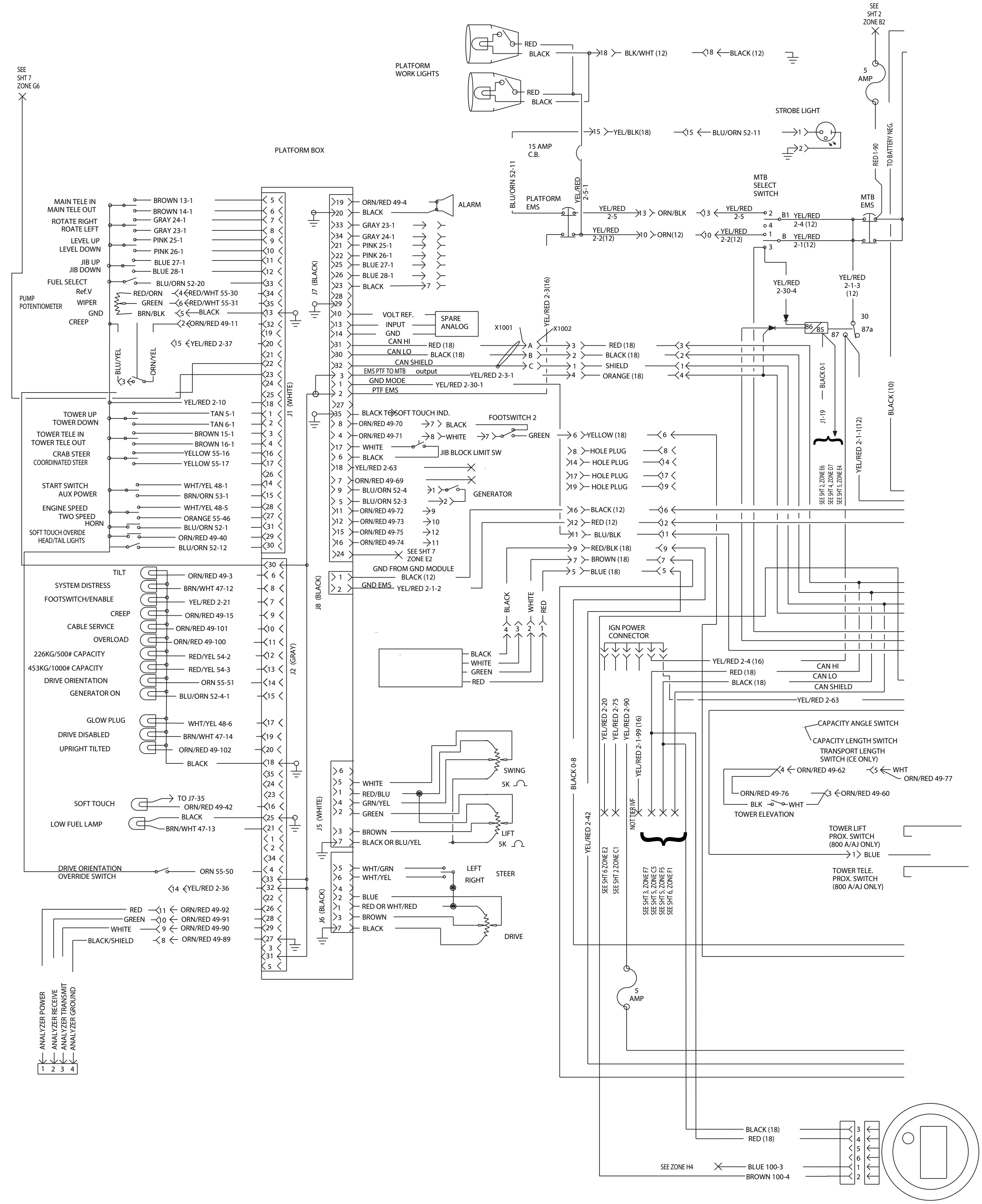


Figure 7-46. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 1 of 10

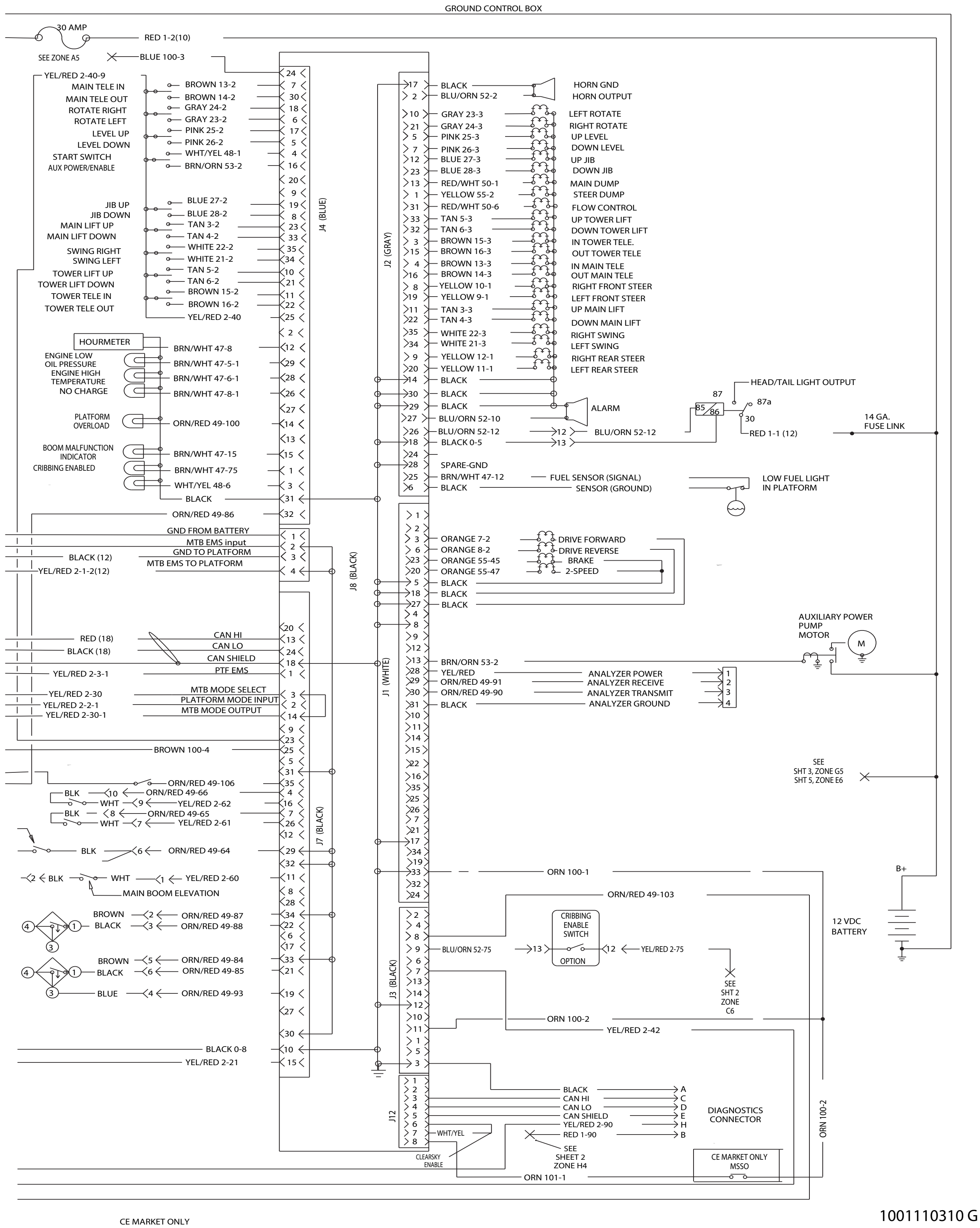


Figure 7-47. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 2 of 10

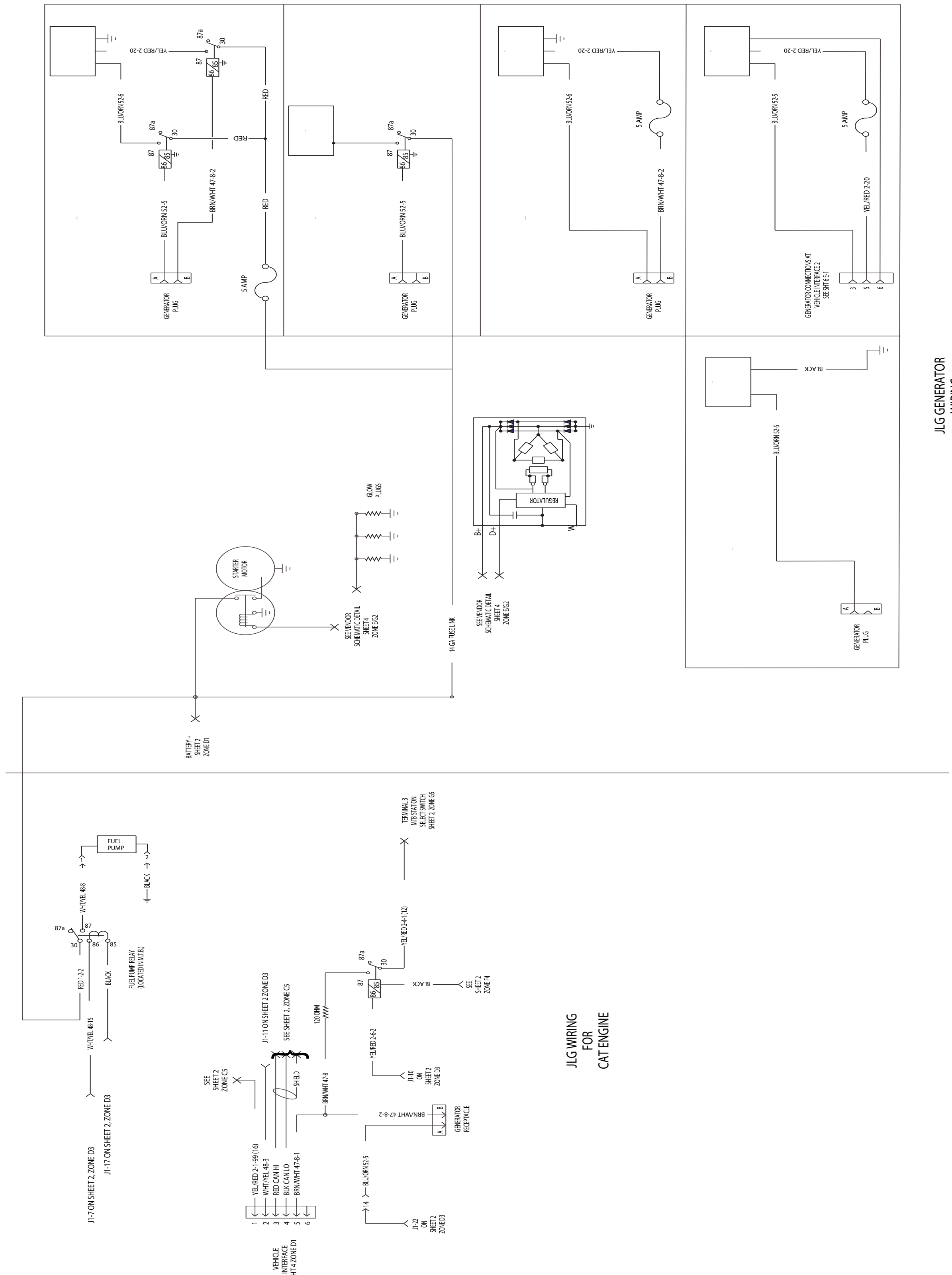


Figure 7-48. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 3 of 10

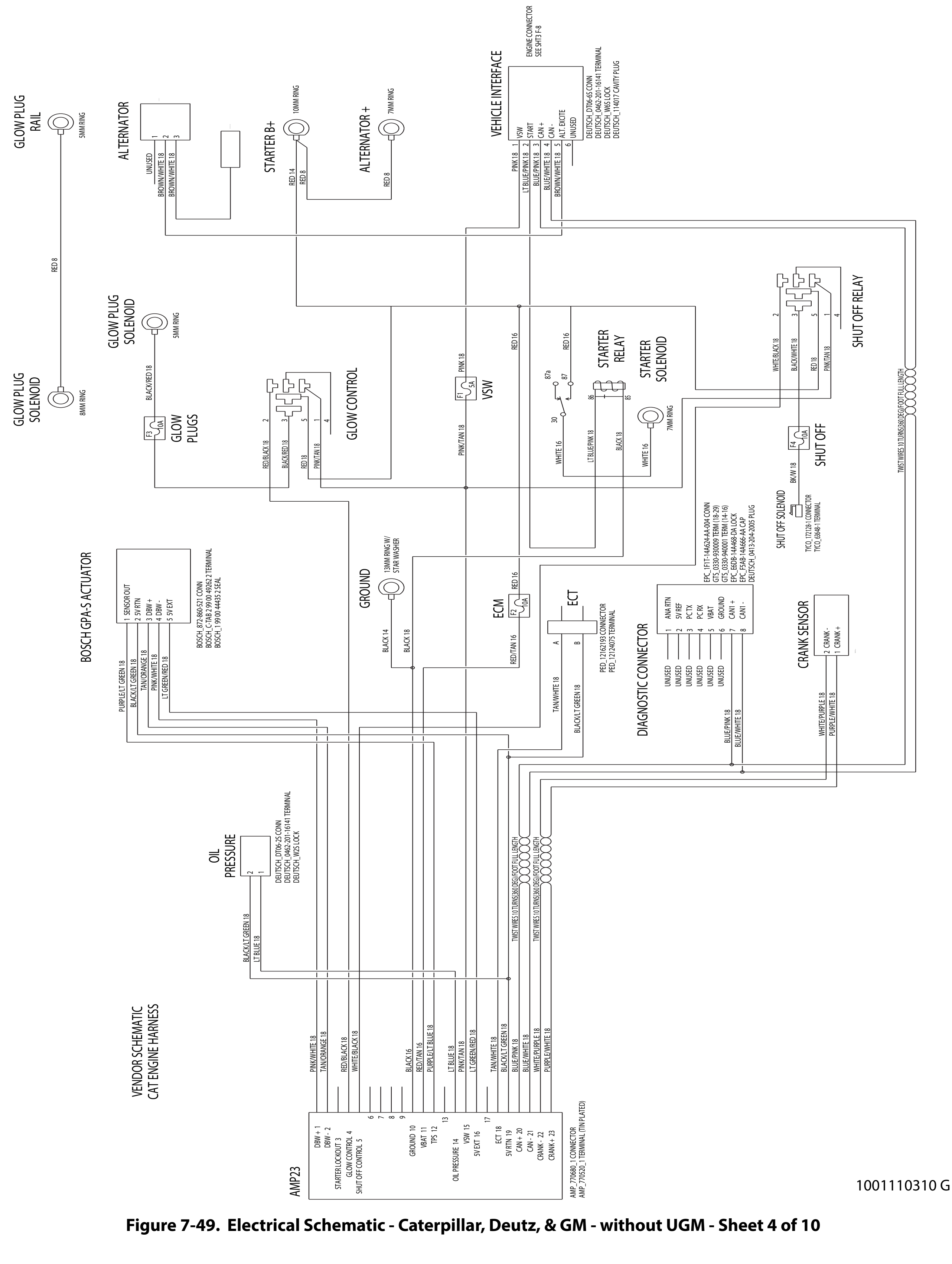


Figure 7-49. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 4 of 10

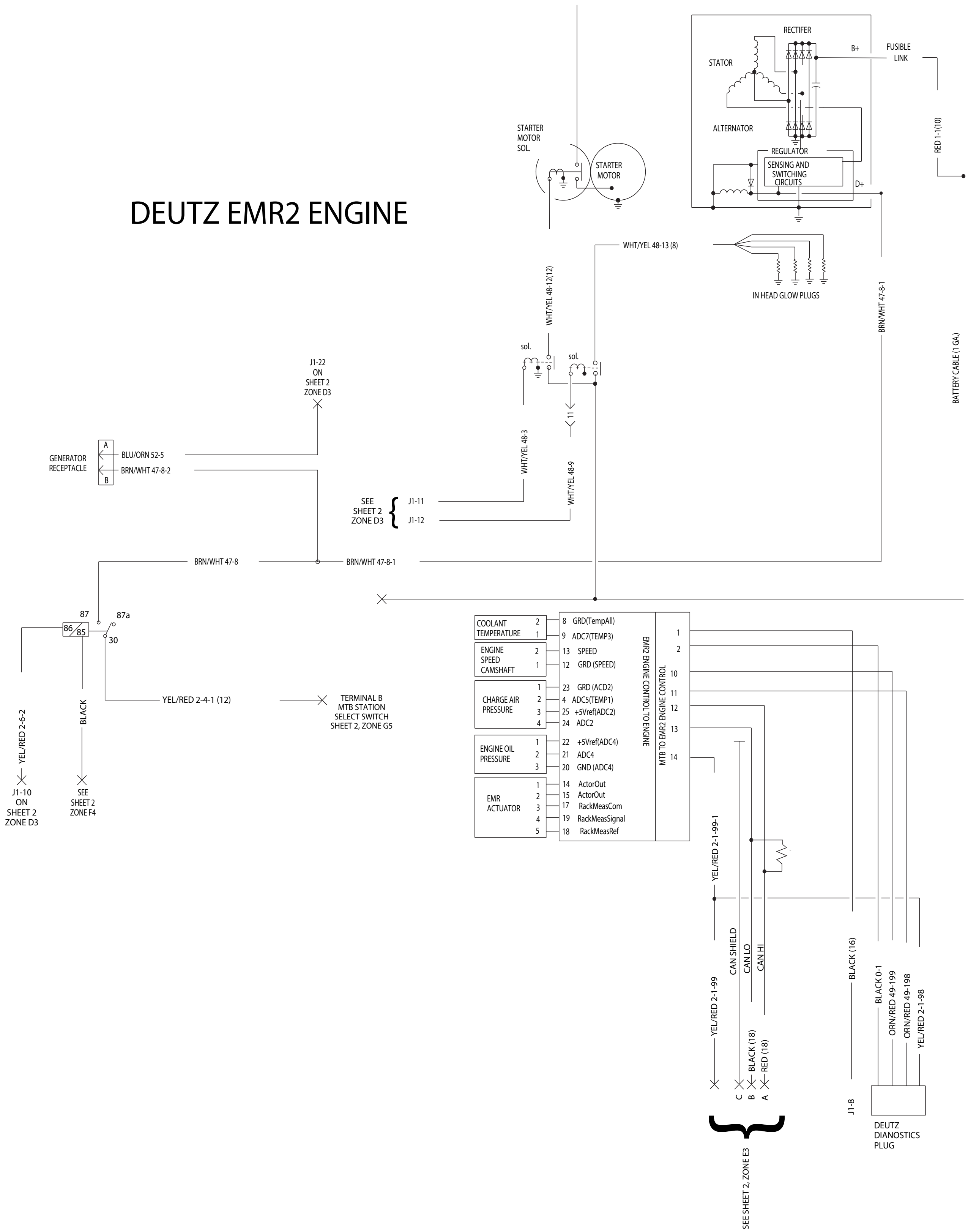


Figure 7-50. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 5 of 10

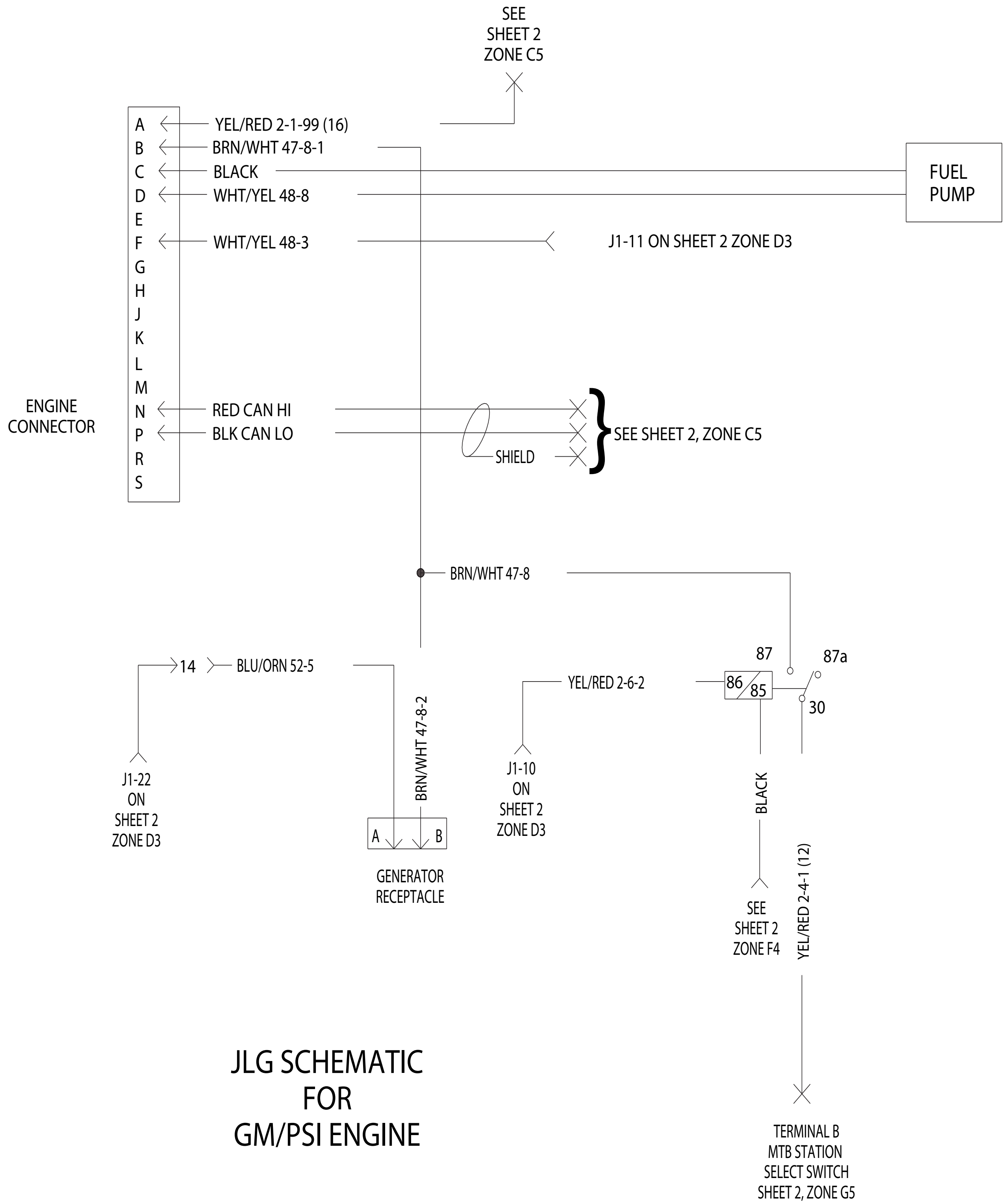


Figure 7-51. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 6 of 10

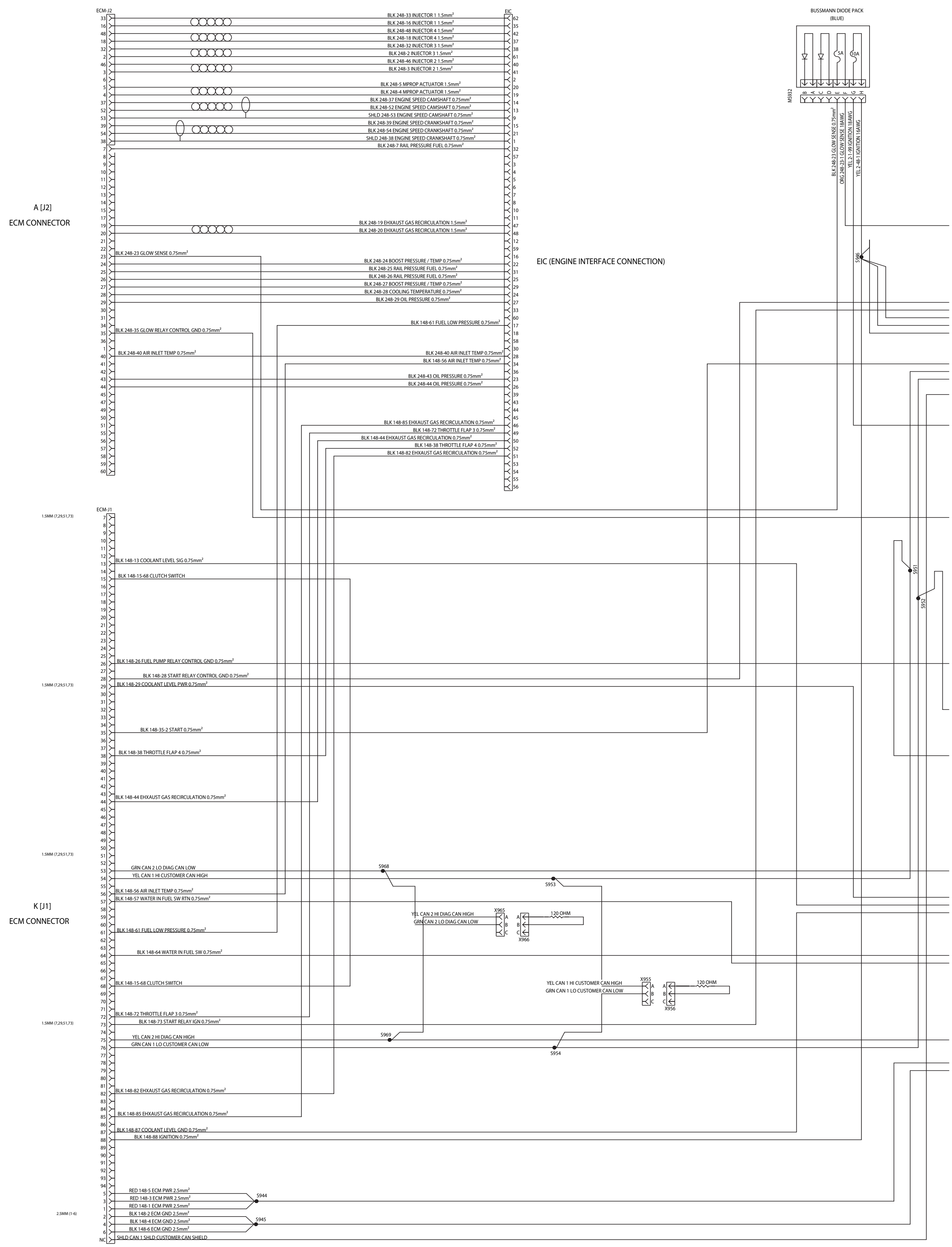


Figure 7-52. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 7 of 10

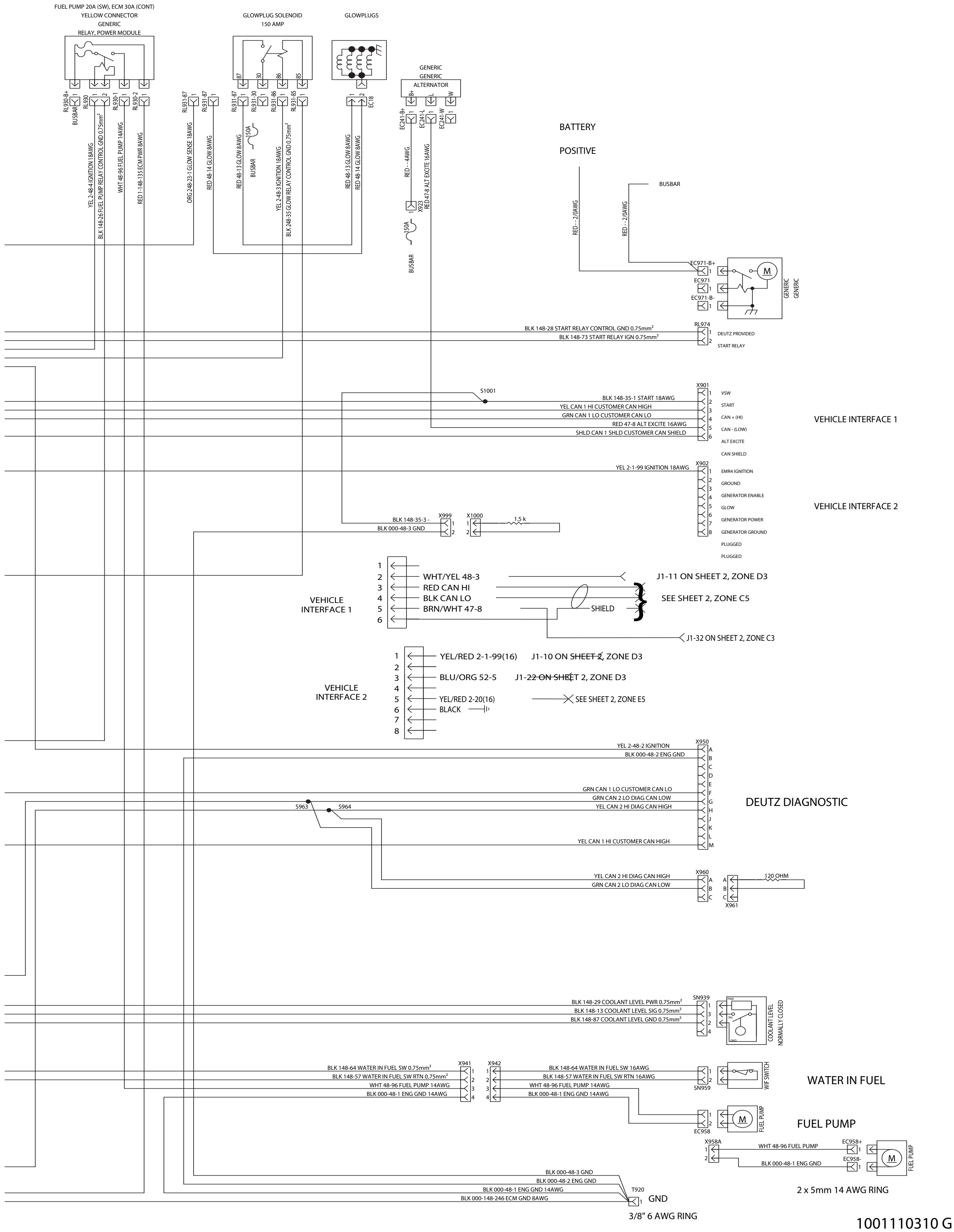


Figure 7-53. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 8 of 10

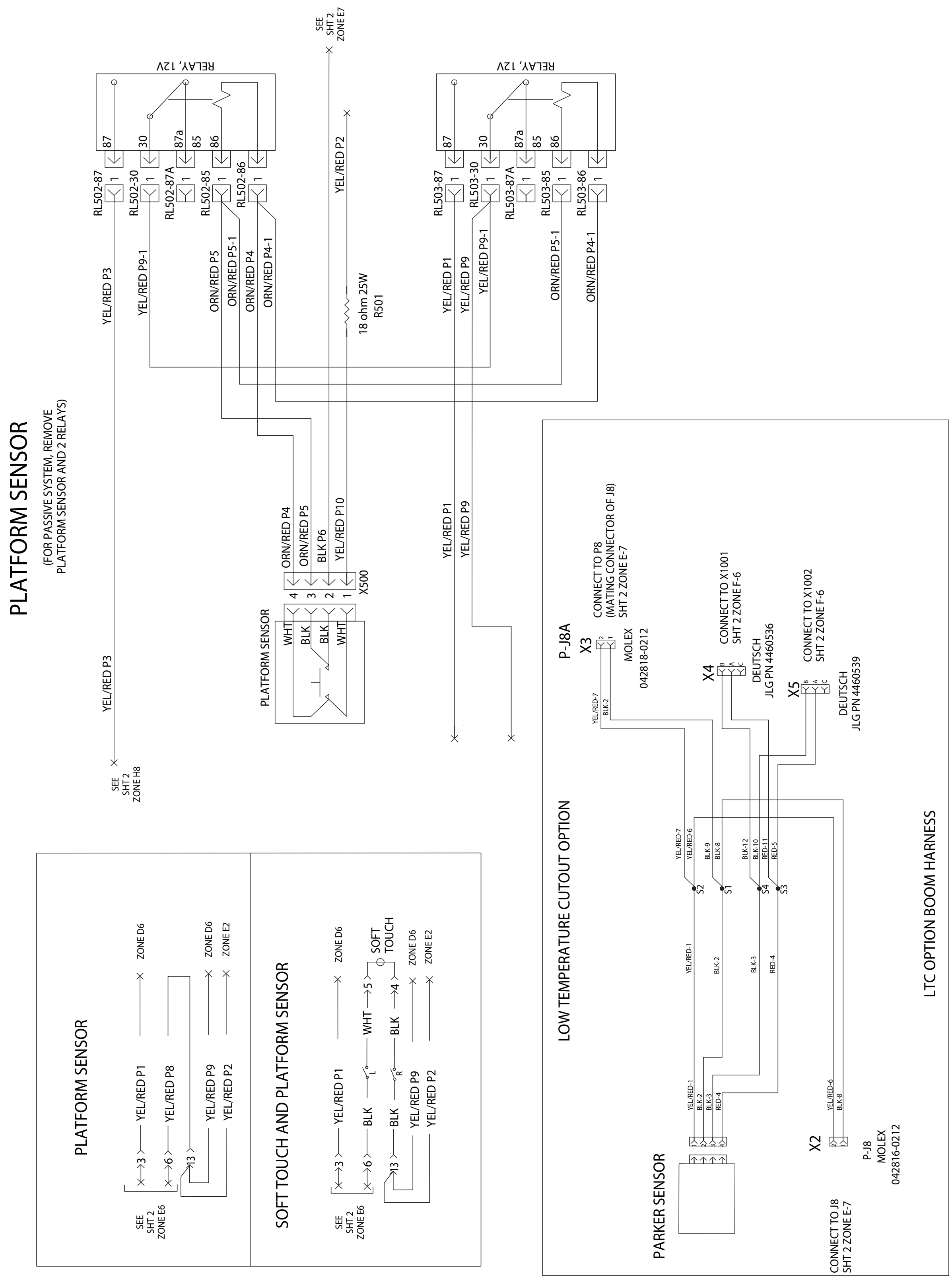


Figure 7-54. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 9 of 10

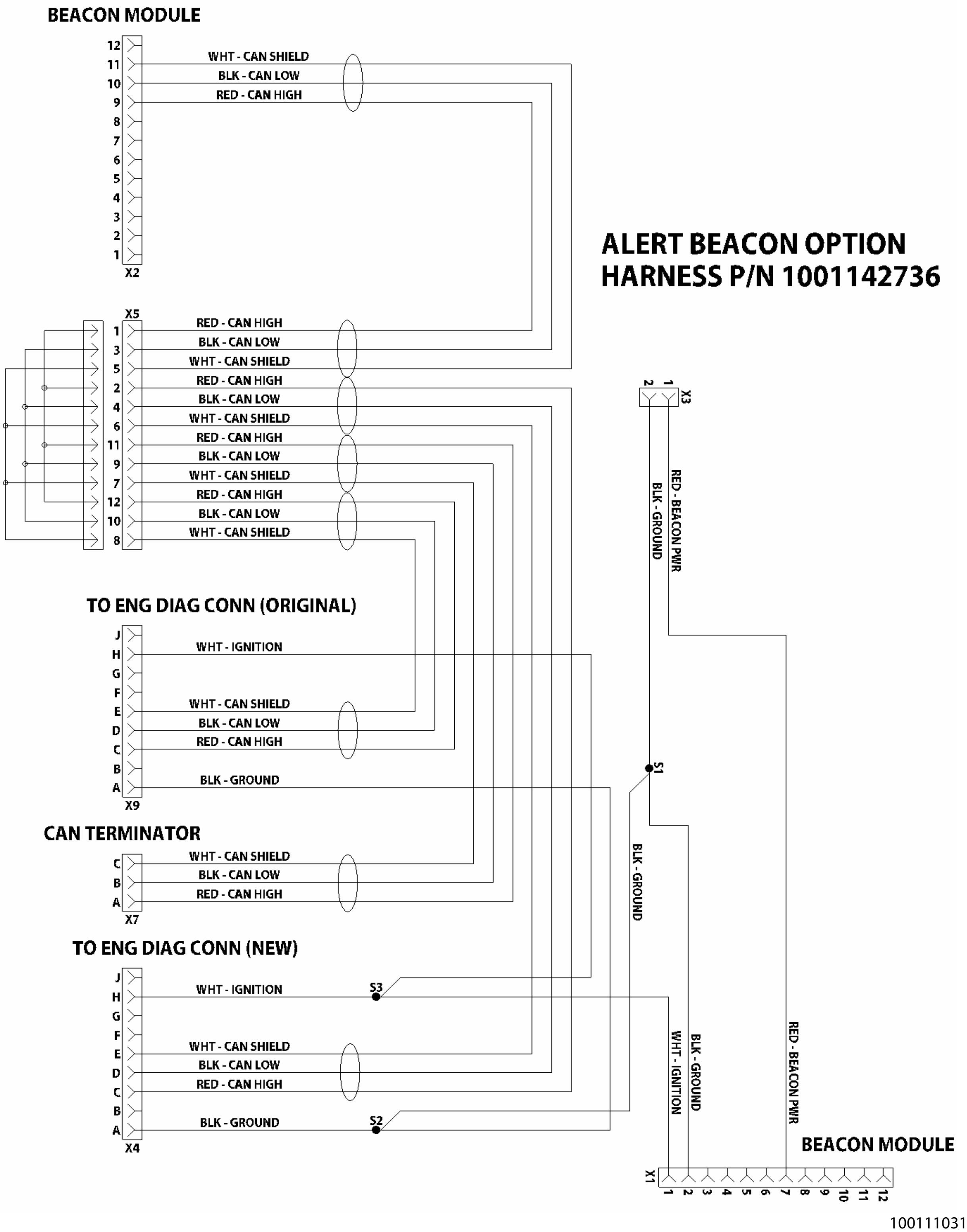


Figure 7-55. Electrical Schematic - Caterpillar, Deutz, & GM - without UGM - Sheet 10 of 10

NOTES:

PROPOSITION 65 WARNING

- Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.
- Batteries also contain other chemicals known to the State of California to cause cancer.
- Wash hands after handling.

WARNING:

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

1702961

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