Service and Maintenance Manual

Models
600S/SJ
660SJ
600A/AJ

Prior to
S/N 0300080000

P/N - 3120840

November 22, 2016

ADE Identification

All 600S, 600SJ, and 660SJ machines from S/N 61927 incorporate ADE (JLG Control System). The following machine serial numbers prior to S/N 61927 also utilize EPBCS: 58993, 58998, 59222, 59223, 59275, 59281, 59315, 59319, 59352, 59358, 59631, 59769, 60253, 60254, 60286, 60642, 60645, 61120, 61257, 61402, 61440, 61491, 61833, 61840, 61875, and 61878.

All 600A and 600AJ machines from S/N 64249 incorporate ADE (JLG Control System). The following machine serial numbers prior to S/N 64249 also utilize EPBCS: 63908, 63912, 63932, 63936, 63938, 63954, 63959, and 63963.

A Machine that incorporates ADE (JLG Control System) can be outwardly identified by the analyzer connection at the base of the platform control box as shown by the arrow.

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

MODIFICATION OF THE MACHINE WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE MACHINE IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED, IS A SAFETY VIOLATION.

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.

Relieve system pressure by cycling the applicable control several times with the engine stopped and ignition on, to direct any line pressure back into the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION MAY 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 DISCONNECTED-DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

REVISON LOG

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Fuel Tank

148 Liters (S Models)

114 Liters (A Models)

Hydraulic Oil Tank

Gasoline/Diesel Power - 117 Liters with 10% air space (S Models) - 116 Liters) with 10% air space (A Models).

Hydraulic System (Including Tank)

Gasoline/Diesel Power - 141 Liters (S Models) 139 Liters (A Models).

Torque Hub, Drive

0.5 Liters.

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

Engine Crankcase

Deutz F4M1011F Diesel w/Filter - 10.5 Liters.

Continental TMD27 Diesel w/Filter - 6.7 Liters.

1.2 COMPONENT DATA

Engine - Diesel (Liquid-Cooled)

Manufacturer/Model- Deutz F4M1011F.

Oil Capacity.

4.5 Liters Cooling System.

11 Quarts (10.5 l) w/Filter.

16 Quarts (15 l) Total Capacity.

Idle RPM - 1000

Low RPM - 1800.

High RPM - 2800.

Alternator - 60 Amp, belt drive.

Battery - 1000 Cold Cranking Amps, 210 Minutes Reserve Capacity, 12 VDC.

Fuel Consumption.

Low RPM - 7.19 lph.

High RPM - 9.46 lph.

Horsepower - 65 @ 3000 RPM, full load.

Engine - Diesel (Water-Cooled)

Manufacturer/Model - Continental - TMD27.

Oil Capacity.

6.7 Liters w/Filter.

5.7 Liters w/o Filter.

Low RPM - 1800.

High RPM - 2800.

Alternator - 63 Amps, Belt Drive.

Battery - 85 Amphour, 550 Cold Cranking Amps, 12 VDC.

Fuel Consumption.

Low RPM - 6.81 lph.

High RPM - 8.71 lph.

Horsepower - 66.5 @ 3000 RPM.

Coolant - 3.6 Liters.

Drive System (S Models)

Tires - 15 x 19.5, G 14 ply rating, directional tread, pneumatic, tire pressure -5 Bar.

Drive Motor Displacement.

Standard - 2.8 cu. in. max. 1.1 cu. in. min.

(46 cm3] max. 18 cm3] min.).

Drive Hub Ratio.

Standard - 53.58:1 (2WD).

Standard - 43:1 (4WD).

Drive Brake - Automatic spring applied, hydraulically released disc brakes.

Drive System (A Models)

Tires - 14 x 17.5 NHS, G 14 ply rating, directional tread, pneumatic, tire pressure - 6 Bar.

Tires - 14 x 17.5, Super Heavy Duty (Airboss), non directional tread. (n Models)

Drive Motor Displacement.

Standard - 46 cm^3 max. 18 cm^3 min.

Drive Hub Ratio.

Standard - 39.96:1.

Drive Brake - Automatic spring applied, hydraulically released disc brakes.

Tire Pressure - 14 x 17.5 NHS, 6 Bar.

Steer System (S Models)

Tires - 15 x 19.5, G 14 ply rating, directional tread, pneumatic, tire pressure -5 Bar.

Tires - 15 x 19.5, G 14 ply rating, directional tread, foam filled.

Toe-in, adjust for 6.35 mm overall.

Steer System (A Models)

Tires - 14 x 17.5 NHS, G 14 ply rating, directional tread, pneumatic.

Tires - 14 x 17.5 NHS, G 14 ply rating, directional tread, foam filled.

Tires - 14 x 17.5, Super Heavy Duty (Airboss).

NOTE: *Tie rods are non-adjustable on A Models.*

Swing System

Swing Motor Displacement - 75 cm^3.

Swing Brake - Automatic spring applied hydraulically released disc brakes.

Swing Hub Ratio - 50:1.

Hydraulic Gear Pump. (at 1800 RPM) 29.9 lpm.

Pump Displacement - 16 cm^3.

Clockwise Rotation.

Auxiliary Power Pump.

9.8 lpm @ 82.7 Bar.

Pump Displacement - 14 cm^3.

DC Motor.

Clockwise Rotation.

Hydraulic Filter - In-line.

Return - Bypass Type.

10 Microns Absolute.

Charge.

10 Microns Absolute.

Hydraulic Strainers (In Tank).

30 Microns.

1.3 PERFORMANCE DATA

Travel Speed 600S.

2WD - 7.25 Km/hr.

4WD - 6.44 Km/hr.

Travel Speed 600A.

2WD - 5.8 Km/hr.

4WD - 6.4 Km/hr.

Gradeability.

(2WD) 30%.

(4WD) 45%.

Turning Radius (Outside) (S Models)

2WS/2WD - 5.4 m.

2WS/4WD - 6.2 m.

4WS/2WD - 3.5 m.

4WS/4WD - 3.4 m.

Turning Radius (Outside) (A Models)

2WS/2WD - 5.4 m.

2WS/4WD - 6.2 m.

2WD/4WS - 3.6 m.

4WS/4WD - 3.5 m.

Turning Radius (Inside) (S Models)

2WS/2WD - 3.7 m.

2WS/4WD - 5.25 m.

4WS/2WD - 1.65 m.

4WS/4WD - 1.2 m.

Turning Radius (Inside) (A Models)

2WS/2WD - 3.3 m.

2WS/4WD - 3.6 m.

2WD/4WS - 1.6 m.

4WS/4WD - 1.6 m.

Boom Elevation (S Models)

600S - +18.36 m

-1.87 m.

600SJ - +18.43 m

-2.98 m.

660SJ - +20.31 m

3.49 m.

Boom Elevation (A Models)

600A - +18.42 m

-0.28 m.

600AJ - +18.46 m

-0.83 m.

Machine Weight approximately

(600S) - 2WD - 9,979.2 kg.

(600SJ) - 2WD - 10,660 kg.

(660SJ) - 2WD - 11,567 kg.

(600A) - 2WD - 9,390 kg.

(600AJ) - 2WD - 10,025 kg.

(600S) - 4WD - 10,211 kg.

(600SJ) - 4WD - 10,877 kg.

(660SJ) - 4WD - 11,753 kg.

(600A) - 4WD - 9594 kg.

(600AJ) - 4WD - 10,113 kg.

Machine Height (Stowed) (S Models)

2.56 m.

Machine Height (Stowed) (A Models)

2.53 m.

Machine Length (Stowed) (S Models)

600S/600SJ/660SJ Models

Over Drive Axle - 8.5 m.

Over Drive Axle - 10.05 m.

Over Drive Axle - 11.4 m.

Machine Length (Stowed) (A Models)

600A/600AJ Models

Over Drive Axle - 8.05 m.

Over Drive Axle - 8.8 m.

Machine Width (S Models)

600S/600SJ/660SJ Models

2WS/2WD - 2.42 m.

2WS/4WD - 2.42 m.

4WS/2WD - 2.42 m.

4WS/4WD - 2.42 m.

Machine Width (A Models)

600A/600AJ Models

2WS/2WD - 2.44 m.

2WS/4WD - 2.44 m.

2WD/4WS - 2.44 m.

4WS/4WD - 2.44 m.

Wheel base (S Models)

2.48 m.

Wheel base (A Models)

2.44 m.

1.4 FUNCTION SPEEDS

Machine Orientation When Doing Speed Tests

Lift: Telescope Retracted. Lift Up, Record Time, Lift Down, Record Time.

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. The boom should be raised above horizontal. Results should be recorded for a 50 ft. (15.24 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. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
3. The platform speed knob control must be at full speed (turned clockwise completely).
4. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).
5. Some flow control functions may not work with the speed knob clicked into the creep position.

Table 1-1. Function Speeds (In Seconds)

Function	600S	600A
Lift Up	46-60	26-32
Lift Down	33-43	26-32
Swing Right & Left*	79-101	79-101
Telescope Out	50-67	35-50
Telescope In	25-33	22-30
Platform Rotate Right & Left**	16-25	16-25
Jib Up	22-34	22-34
Jib Down	16-26	16-26
Lower Lift Up	N.A.	37-50
Lower Lift Down	N.A.	28-38
Lower Telescope Out	N.A.	15-23
Lower Telescope In	N.A.	09-15
Drive Forward & Reverse (2WD)	28-33	35-42
Drive Forward & Reverse (4WD)	31-37	31-37
Drive Above Horizontal - Forward & Reverse (2WD & 4WD)	43-136	43-136
Drive Horizontal - Forward & Reverse	N.A.	84-70
*Max 10% Difference Between Left & Right **Max 15% Difference Between Left & Right		

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1.5 TORQUE REQUIREMENTS

Table 1-2. Torque Requirements

Description	Torque Value (Dry)	Interval Hours
Bearing To Chassis	See Note	50/600*
Bearing To Turntable	See Note	50/600*
Wire Rope	15 ft. lbs (20 Nm)	150
Wheel Lugs (S Models)	see Figure 1-1.	150
Wheel Lugs (A Models)	170 ft. lbs. (231 Nm)	150
Engine Mounting Bolts	165 ft. lbs. (231 Nm)	A/R
Engine Manifold Mounting Bolts	30 ft. lbs. (42 Nm)	A/R
*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.*		

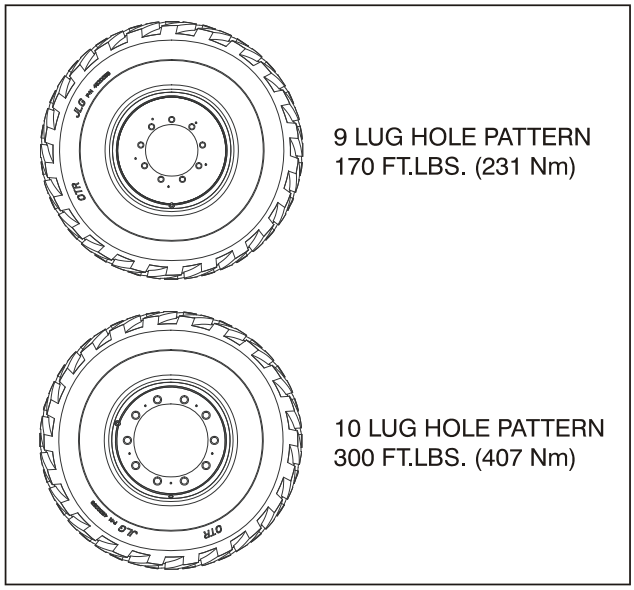

Figure 1-1. 600S Lug Torques

1.6 LUBRICATION

Deutz F4M1011F Engine

Single Viscosity Oil (CD-SE, CD-SF).

When Outside Temperature is Consistently	Use SAE Viscosity Number
-20°F. to +25°F. (-29°C. to +4°C.)	*10W
+5°F. to +50°F. (+15°C. to +10°C.)	20W-20
+40°F. to +85°F. (+4°C. to +30°C.)	30
Above 75°F. (24°C.)	40

Multi Viscosity Oil (CD-SE, CD-SF)

*This viscosity can be used at colder temperatures with engine oil preheating.

When Outside Temperature is Consistently	Use SAE Viscosity Number
-40°F. to +75°F. (-40°C. to +24°C.)	*5W-30 (Synthetic)
-15°F. to +70°F. (-26°C. to +21°C.)	10W-30
-15°F. to +85°F. (-26°C. to +30°C.)	10W-40
Above -5°F. (-21°C.)	15W-40
-5°F. to +75°F. (-21°C. to +24°C.)	15W-30

*This viscosity can be used at colder temperatures with engine oil preheating.

NOTE: *Crankcase oil should be MIL-L2104B/MIL-L2104C or have properties of API classification CC/CD grades.*

Continental TMD27 Engine

Single Viscosity Oils (CC-CD).

When Outside Temperature is Consistently	Use SAE Viscosity Number
+32°F. to +77°F. (+0°C. to +25°C.)	20
Above +77°F. (+25°C.)	30
Below +32°F. (+0°C.)	10W

Multi Viscosity Oil (CC-CD)

*Not recommended for severe service, including high RPM operation

When Outside Temperature is Consistently	Use SAE Viscosity Number
Below +32°F. (+0°C.)	10W-30

Hydraulic Oil

Table 1-3. Hydraulic Oil

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
-18° C to +83° C	10W
-18° C to +99° C	10W-20, 10W-30
+10° C to +210° 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 below 20° F (-7 degrees C), JLG Industries recommends the use of Mobil DTE 13M.*

Table 1-4. 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

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.

Lubrication Specifications

Table 1-5. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F. 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.

NOTE: *Refer to Lubrication Chart, for specific lubrication procedures.*

1.7 PRESSURE SETTINGS

Rexroth Valve (S Models)

Main Relief - 207 Bar.

Upper Boom Lift Down - 103 Bar.

Swing - 117 Bar.

Steer - 124 Bar.

Steer Reliefs - 4WS Front & Rear - 172 Bar.

Platform Level Forward - 193 Bar.

Backward - 124 Bar.

Articulating Jib Boom Up - 103 Bar.

Down - 83 Bar.

Rexroth Valve (A Models)

Main Relief - 207 Bar.

Upper Boom Lift Down - 83 Bar.

Swing - 117 Bar.

Platform Level Forward - 193 Bar.

Backward - 124 Bar.

Steer - 124 Bar.

Steer Reliefs - 4WS Front & Rear - 172 Bar.

Articulating Jib Boom Up - 103 Bar.

Down - 83 Bar.

1.8 CYLINDER SPECIFICATIONS

Table 1-6. Cylinder Specifications (S Models)

DESRIPTON	BORE			STROKE			ROD DIA.		
	600SJ	660SJ	600S	600SJ	660SJ	600S	600SJ	660SJ	600S
Lift	6.00 (152.4)	6.00 (152.4)	6.00 (152.4)	44.6875 (1135.1)	44.6875 (1135.1)	44.6875 (1135.1)	3 (76.2)	3 (76.2)	3 (76.2)
Telescope	3.5 (88.9)	3.5 (88.9)	3.5 (88.9)	143.1875 (3637)	168.4375 (4278.3)	177.75 (4514.9)	2.5 (63.5)	2.5 (63.5)	2.5 (63.5)
Steer	2.5 (63.5)	2.5 (63.5)	2.5 (63.5)	10.75 (273.1)	10.75 (273.1)	10.75 (273.1)	1.25 (31.8)	1.25 (31.8)	1.25 (31.8)
Lockout (2wd)	4 (101.6)	4 (101.6)	4 (101.6)	3.875 (98.4)	3.875 (98.4)	3.875 (98.4)	1.5 (38.1)	1.5 (38.1)	1.5 (38.1)
Master	3.5 (88.9)	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)	1.5 (38.1)
Slave Level	3.5 (88.9)	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)	1.5 (38.1)
Lift (Articulating Jib Boom)	3 (76.2)	3 (76.2)	N/A	25.5 (647.7)	25.5 (647.7)	N/A	1.5 (38.1)	1.5 (38.1)	N/A

Table 1-7. Cylinder Specifications (A Models)

DESRIPTON	BORE		STROKE		ROD DIA.	
	600AJ	600A	600AJ	600A	600AJ	600A
Lower Lift	6.5 (165.1)	6.5 (165.1)	34.0625 (865.2)	34.0625 (865.2)	2.5 (63.5)	2.5 (63.5)
Tower Telescope	3 (76.2)	3 (76.2)	63.75 (1619.3)	63.75 (1619.3)	2 (50.8)	2 (50.8)
Upright Level	6 (152.4)	6 (152.4)	34.625 (879.5)	34.625 (879.5)	3 (76.2)	3 (76.2)
Upper Lift	4 (101.6)	4 (101.6)	36.625 (930.3)	36.625 (930.3)	2.5 (63.5)	2.5 (63.5)
Upper Telescope	3 (76.2)	3 (76.2)	134.375 (3413.1)	177.75 (4514.9)	2 (50.8)	2 (50.8)
Steer (2WD/2WSl	2.5 (63.5)	2.5 (63.5)	8.812 (204.7)	8.812 (204.7)	1.25 (31.8)	1.25 (31.8)
Steer (4WD/2WS)	2.5 (63.5)	2.5 (63.5)	10.75 (273.1)	10.75 (273.1)	1.25 (31.8)	1.25 (31.8)
Lockout (2WD)	3.5 (88.9)	3.5 (88.9)	3.875 (98.4)	3.875 (98.4)	2.5 (63.5)	2.5 (63.5)
Lockout (4WD	3.5 (88.9)	3.5 (88.9)	3.875 (98.4)	3.875 (98.4)	2.5 (63.5)	2.5 (63.5)
Master	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)
Slave	3.5 (88.9)	3 (76.2)	13.0625 (331.8)	8.5 (215.9)	1.5 (38.1)	1.5 (38.1)
Lift (Articulating Jib Boom)	3 (76.2)	N/A	25.5 (647.7)	N/A	1.5 (38.1)	N/A

1.9 MAJOR COMPONENT WEIGHTS

Table 1-8. Major Component Weights (S Models)

	600SJ		660SJ		600S	
	LB.	KG.	LB.	KG.	LB.	KG.
Platform Control Console	250	113	250	113	250	113
Platform Level Cylinder	60	27	60	27	46	21
Main Boom (Includes Lift Cyl., Rotator, and Support)	3483	1580	3783	1716	3527	1600
Turntable Complete (including engine)	7915	3590	9065	4112	7315	3318
Chassis Complete (w/pneumatic tires)	11300	5126	11775	5341	10400	4718
Chassis Complete (w/foam-filled tires)	12580	5707	13055	5922	11680	5300
Machine Complete (GVW) - 2WD w/pneumatic tires	23500	10660	25500	11567	22000	9979
Machine Complete (GVW) - 4WD w/pneumatic tires	23980	10877	25910	11753	22510	10211

Table 1-9. Major Component Weights (A Models)

	600AJ		600A	
	LB.	KG.	LB.	KG.
Platform Control Console	250	113	250	113
Platform Level Cylinder	60	27	46	21
Main Boom (Includes Lift Cyl., Rotator, and Support)	1685	764	1832	831
Upright including Master Cylinder	547	248	547	248
Upright Level Cylinder	316	143	316	143
Tower Boom Complete	1218	553	1218	553
Turntable Complete (including engine)	9740	4418	9240	4191
Chassis Complete (w/pneumatic tires)	6834	3100	6834	3100
Chassis Complete (w/foam-filled tires)	7918	3592	7918	3592
Machine Complete (GVW) - 2WD w/pneumatic tires	22100	10025	20700	9390
Machine Complete (GVW) - 4WD w/pneumatic tires	22295	10113	21150	9594

1.10 CRITICAL STABILITY WEIGHTS

⚠ WARNING

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

Table 1-10. Critical Stability Weights (S Models)

		600SJ		660SJ		600S	
		LB.	KG.	LB.	KG.	LB.	KG.
Tire and Wheel (Ballasted Only)	Size (15 - 19.5)	253	115	253	115	253	115
Engine	Deutz	534	242	534	242	534	242
	Continental	558	253	558	253	558	253
Counterweight	Weight	3500	1588	4650	2109	2900	1315
Platform	6 ft. (1.83 M)	205	93	205	93	205	93
	8 ft. (2.44 M)	230	105	230	105	230	105

Table 1-11. Critical Stability Weights (A Models)

		600AJ		600A	
		LB.	KG.	LB.	KG.
Tire and Wheel (Ballasted Only)	Size (14-17.5)	165	75	165	75
Engine	Deutz	534	242	534	242
	Continental	558	253	558	253
Counterweight	Weight	6200	2812	5700	2586
Platform	6 ft. (1.83 M)	205	93	205	93
	8 ft. (2.44 M)	230	105	230	105

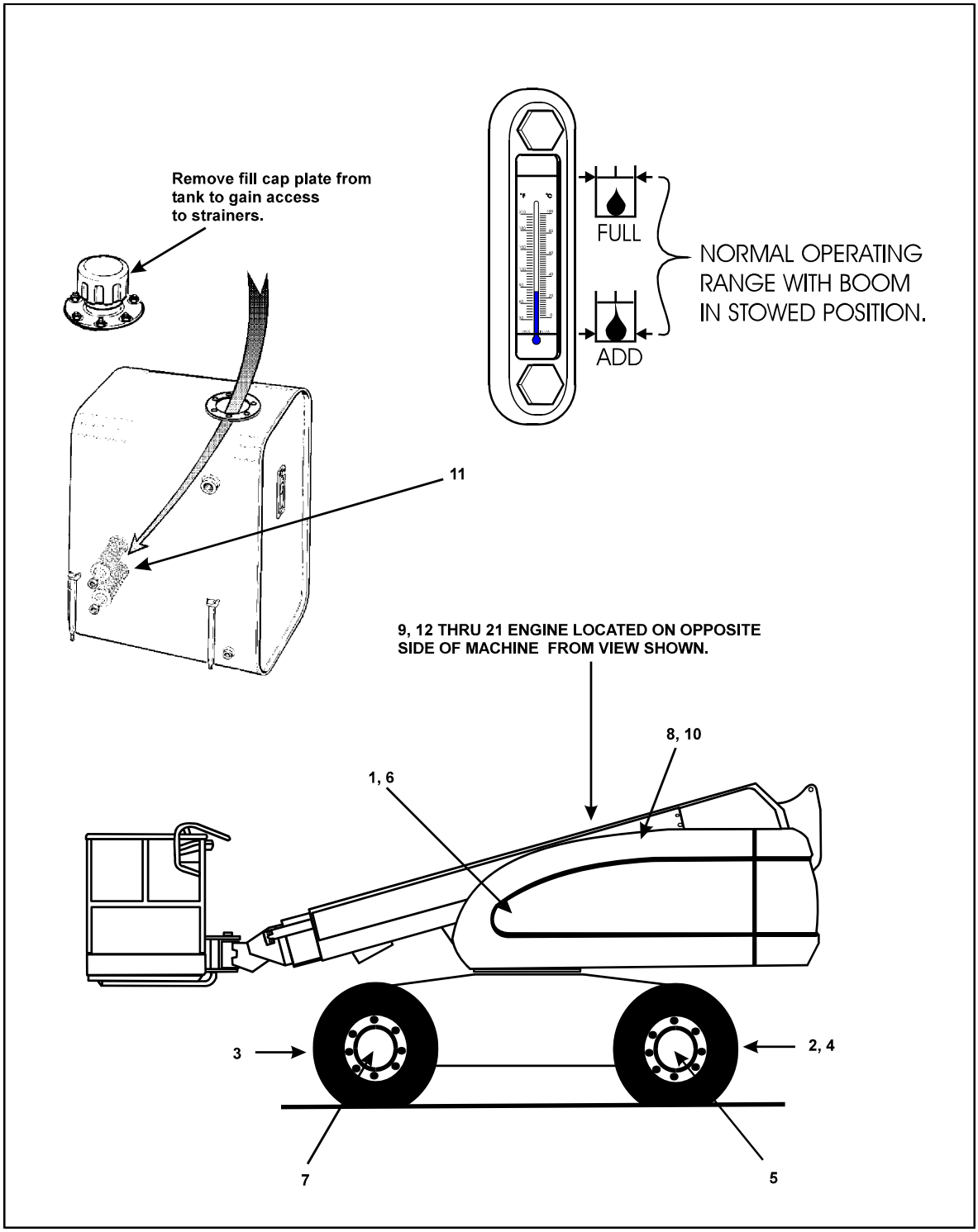

Figure 1-2. Lubrication Point Location - S Models

Table 1-12. Lubrication Chart - S Models

	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
Lubrication									
1	Swing Bearing	2 Grease Fittings	A/R	MPG	X				Remote Access
2	Steer Spindles (2WS)*	8 Grease Fittings	A/R	MPG	X				
3	Steer Spindles (4WS)*	2 Grease Fittings	A/R	MPG	X				
4	Steer Spindles (4WD)*	4 Grease Fittings	A/R	MPG	X				
5	Wheel Bearings	Repack	A/R	MPG				X	
6	Swing Drive Hub	Level/Fill Plug	0.5 liters (1/2 Full)	EPGL				X	Check level every 150 hrs/change 1200 hours
7	Wheel Drive Hub	Level/Fill Plug	0.5 liters (1/2 Full)	EPGL				X	Check level every 150 hrs/change 1200 hours
8	Hydraulic Return Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
9	Hydraulic Charge Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
10	Hydraulic Oil	Fill Cap	116 liters Tank 139 liters System	HO				X	Check level daily/change 1200 hours
11	Suction Strainers (in tank)	2	N/A	N/A				X	Remove and clean at time of hydraulic oil change.
Engines									
12	Oil Change w/Filter - Deutz	Fill Cap/Spin-on Element	10.5 liters Crankcase **4.5 liters Cooler	EO			X		Check level daily/Change in accordance with engine manual.
13	Fuel Filter - Deutz	Replaceable Element	N/A	N/A			X		
14	Air Filter - Deutz	Replaceable Element	N/A	N/A		X			Or as indicated by Condition Indicator.

NOTES:

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.

* Machines after S/N 38047 will have composite bushings and no grease fittings.

** When changing oil in the Deutz oil cooled engine, drain both the crankcase and the cooler. When refilling it is acceptable to overfill the crankcase (16 liters, capacity of both crankcase and cooler combined). Start engine, allow the engine to run until the thermostat opens (approximately 105 degrees C) cooler will fill up within minutes; shut down and wait for approximately two minutes. Check oil level, fill oil to max marking on the dipstick.

KEY TO LUBRICANTS

EO	Engine Oil
EPGL	Extreme Pressure Gear Lube
HO	Hydraulic Fluid (Mobil #424 or equivalent)
MPG	Multi-Purpose Grease

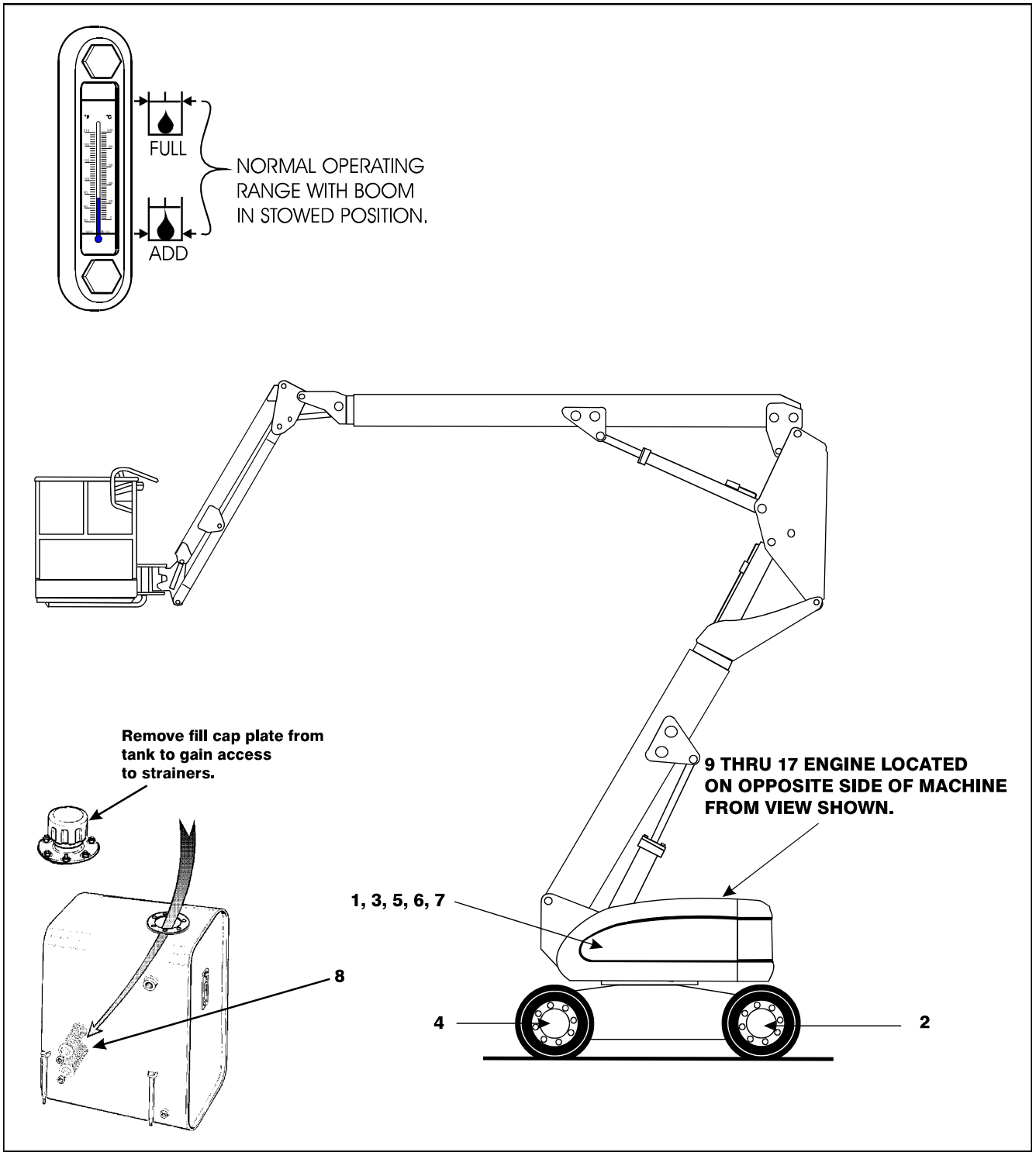

Figure 1-3. Lubrication Point Location - A Models

Table 1-13. Lubrication Chart - A Models

	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
Lubrication									
1	Swing Bearing	2 Grease Fittings	A/R	MPG	X				Remote Access
2	Wheel Bearings	Repack	A/R	MPG				X	
3	Swing Drive Hub	Level/Fill Plug	0.5 liters (1/2 Ful)l	EPGL				X	Check level every 150 hrs/change 1200 hours
4	Wheel Drive Hub	Level/Fill Plug	0.5 liters (1/2 Full)	EPGL				X	Check level every 150 hrs/change 1200 hours
5	Hydraulic Return Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
6	Hydraulic Charge Filter	N/A	N/A	N/A		X			Change after first 50 hrs. and every 300 hrs. thereafter or as indicated by Condition Indicator.
7	Hydraulic Oil	Fill Cap	116 liters Tank 139 liters System	HO				X	Check level daily/change 1200 hours
8	Suction Strainers (in tank)	2	N/A	N/A				X	Remove and clean at time of hydraulic oil change.
Engines									
9	Oil Change w/Filter	Fill Cap/Spin-on Element	10.5 liters Crankcase *4.5 liters Cooler	EO			X		Check level daily/Change in accordance with engine manual.
10	Fuel Filter - Deutz	Replaceable Element	N/A	N/A			X		
11	Air Filter - Deutz	Replaceable Element	N/A	N/A		X			Or as indicated by Condition Indicator.

NOTES:		KEY TO LUBRICANTS	
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.	* When changing oil in the Deutz oil cooled engine, drain both the crankcase and the cooler. When refilling it is acceptable to overfill the crankcase (16 liters, capacity of both crankcase and cooler combined). Start engine, allow the engine to run until the thermostat opens (approximately 105 degrees C) cooler will fill up within minutes; shut down and wait for approximately two minutes. Check oil level, fill oil to max marking on the dipstick.	EO EPGL HO MPG	Engine Oil Extreme Pressure Gear Lube Hydraulic Fluid (Mobil #424 or equivalent) Multi-Purpose Grease

1.11 SERIAL NUMBER LOCATIONS

A serial number plate is affixed to the left rear side of the frame. If the serial number plate is damaged or missing, the machine serial number is stamped on the left side of the frame.

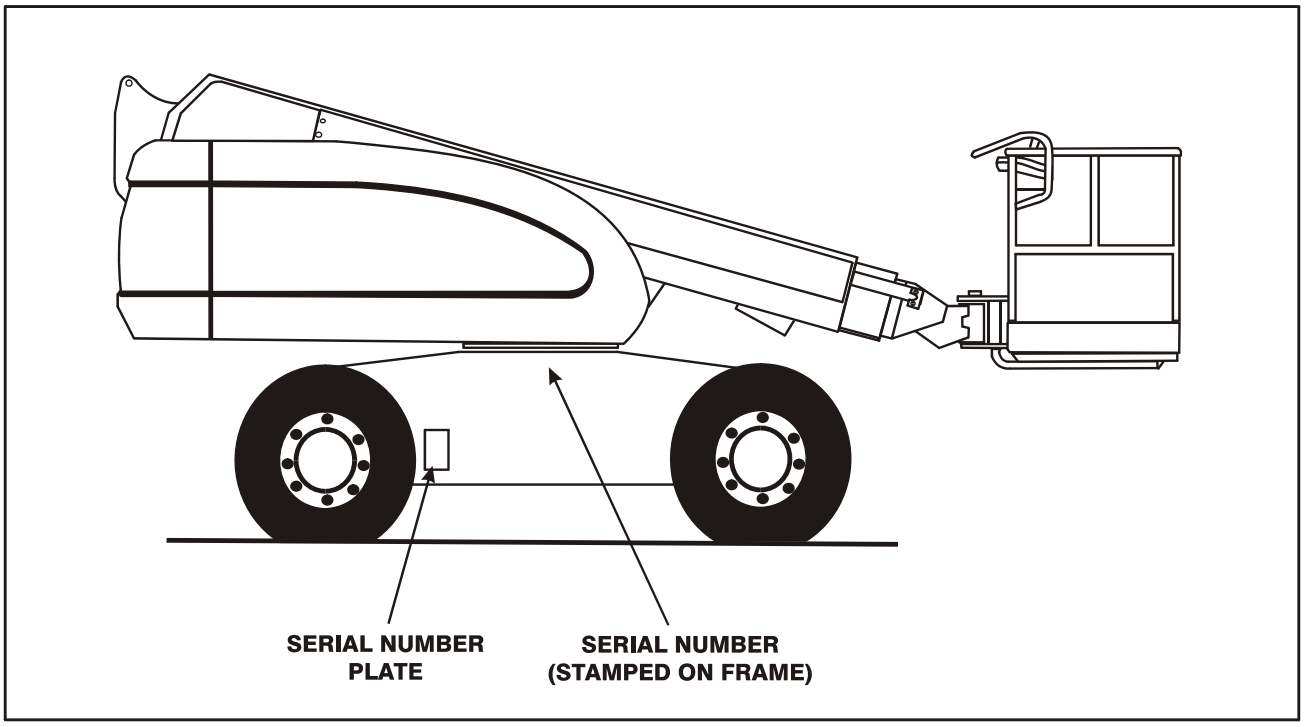

Figure 1-4. Serial Number Locations

				VALUES FOR ZINC PLATED BOLTS ONLY										UNPLATED CAP SCREWS	
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS					UNBRAKO 1960 SERIES SOCKET HEAD CAP SCREW WITH LOC-WEL PATCH	
SIZE	THD	BOLT DIA. (CM)	THREAD STRESS AREA (SQ. CM)	CLAMP LOAD (KG)	TORQUE (DRY OR LOC. 263)	TORQUE (LUB.)	TORQUE (LOCTITE 262)	TORQUE (LOCTITE 242 OR 271)	CLAMP LOAD (KG)	TORQUE (DRY OR LOC. 263)	TORQUE (LUB.)	TORQUE (LOCTITE 262)	TORQUE (LOCTITE 242 OR 271)	CLAMP LOAD (KG)	TORQUE (as received)
					NM	NM	NM	NM		NM	NM	NM	NM		NM
4	40	0.2845	0.0153	172	1	1	—	—	245	2	1	—	—	—	—
	48		0.0168	191	1	1	—	—	272	2	1	—	—	—	—
6	32	0.3505	0.0232	263	2	2	—	—	372	3	2	—	—	—	—
	40		0.0258	277	2	2	—	—	417	3	2	—	—	—	—
8	32	0.4166	0.0356	408	4	3	—	—	572	5	4	—	—	—	—
	36		0.0374	426	4	3	—	—	599	5	4	—	—	—	—
10	24	0.4826	0.0445	508	5	4	—	—	717	7	5	—	—	—	—
	32		0.0508	583	6	4	—	—	817	8	6	—	—	—	—
1/4	20	0.6350	0.0808	916	11	9	—	12	1297	16	12	—	18	1442	18
	28		0.0925	1052	14	10	—	16	1488	19	14	—	21	1651	19
5/16	18	0.7938	0.1331	1515	23	18	22	26	2141	34	25	30	41	2377	34
	24		0.1473	1678	26	19	23	29	2821	34	27	34	41	2631	37
3/8	16	0.9525	0.1969	2241	41	31	38	48	3175	61	48	54	68	3493	61
	24		0.2230	2540	48	34	43	54	3583	68	48	61	75	3983	68
7/16	14	1.1112	0.2700	3085	68	48	61	75	4332	95	75	85	109	4822	95
	20		0.3015	3425	75	68	68	81	4854	109	81	95	122	5384	102
1/2	13	1.2700	0.3604	4105	102	75	92	115	5783	149	109	130	163	6437	149
	20		0.4061	4854	122	88	108	136	6532	163	122	146	183	7253	156
9/16	12	1.4288	0.4623	5262	149	109	133	163	7539	204	149	188	224	8256	210
	18		0.5156	5874	163	122	148	183	8278	231	176	209	258	9208	224
5/8	11	1.5875	0.5740	6532	204	149	183	224	9231	298	231	244	326	10251	285
	18		0.6502	7394	231	176	207	258	10433	326	244	277	359	11612	298
3/4	10	1.9050	0.8484	9662	353	271	325	387	13653	515	380	408	570	15150	495
	16		0.9474	10796	407	298	363	448	15241	570	434	456	631	16919	542
7/8	9	2.2225	1.1735	13336	583	434	523	644	18870	814	624	658	895	20956	793
	14		1.2929	14697	637	475	576	705	20775	895	678	724	983	23088	861
1	8	2.5400	1.5392	17509	868	651	785	915	23360	1220	922	931	1342	27488	1173
	12		1.6840	19142	949	719	858	997	27080	1356	1003	1079	1492	30074	1241
1-1/8	7	2.8575	1.9380	19187	1085	814	968	1139	31162	1736	1302	1396	1898	34610	1681
	12		2.1742	21546	1193	895	1087	1254	34927	1953	1464	1566	2136	38828	1871
1-1/4	7	3.1750	2.4613	24404	1519	1139	1368	1593	38554	2468	1844	1970	2712	43954	2373
	12		2.7254	27035	1681	1247	1516	1762	43818	2712	2034	2183	2983	48671	2549
1-1/2	6	3.4925	2.9337	29076	1980	1492	1792	2068	47174	3227	2413	2586	3559	52391	3145
	12		3.3401	33113	2278	1708	2042	2373	53570	3688	2766	2935	4068	59648	3308
1-1/2	6	3.8100	3.5687	35381	2630	1980	2379	2746	57380	4284	3200	3430	4712	63731	4122
	12		4.0132	39781	2983	2224	2676	3118	142200	4827	3607	3856	5322	71669	4433

Note: These torque values do not apply to cadium plated fasteners.

SAE GRADE 5

SAE GRADE 8

Figure 1-5. Torque Chart

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.

2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.

3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.

4. It is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

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

Hydraulic Oil

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

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

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

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

Changing Hydraulic Oil

1. Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, 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. JLG Industries recommends changing the hydraulic oil annually.

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, upper 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.
   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.

⚠ CAUTION

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

2.7 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

Silicone Dielectric Compound must be used on all electrical connections 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.*

2.8 AMP CONNECTOR

Applying Silicone Dielectric Compound to AMP Connectors

Silicone Dielectric Compound must be used on the AMP connections 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.

1. To prevent oxidation and low level conductivity, silicone dielectric grease must be packed completely around male and female pins on the inside of the connector after the mating of the housing to the header. This is easily achieved by using a syringe to fill the header with silicone dielectric compound, to a point just above the top of the male pins inside the header. When assembling the housing to the header, it is possible that the housing will become air locked, thus preventing the housing latch from engaging.
2. Pierce one of the unused wire seals to allow the trapped air inside the housing to escape.
3. Install a hole plug into this and/or any unused wire seal that has silicone dielectric compound escaping from it.

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 2-1.). Proceed as follows:

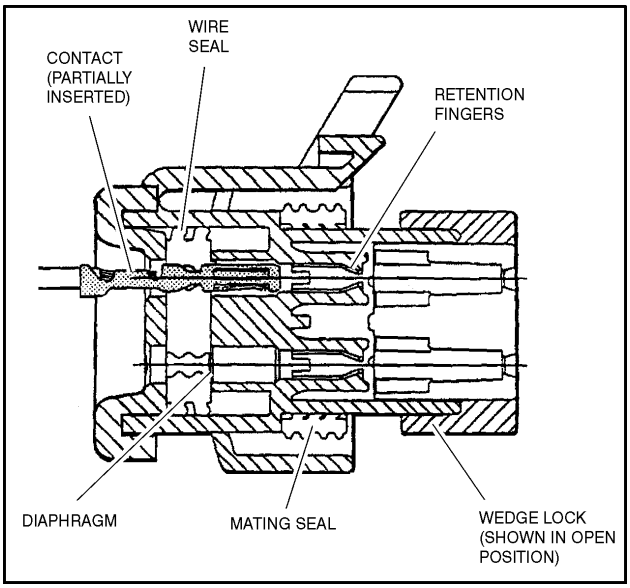


Figure 2-1. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 2-3.).
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 2-3.).

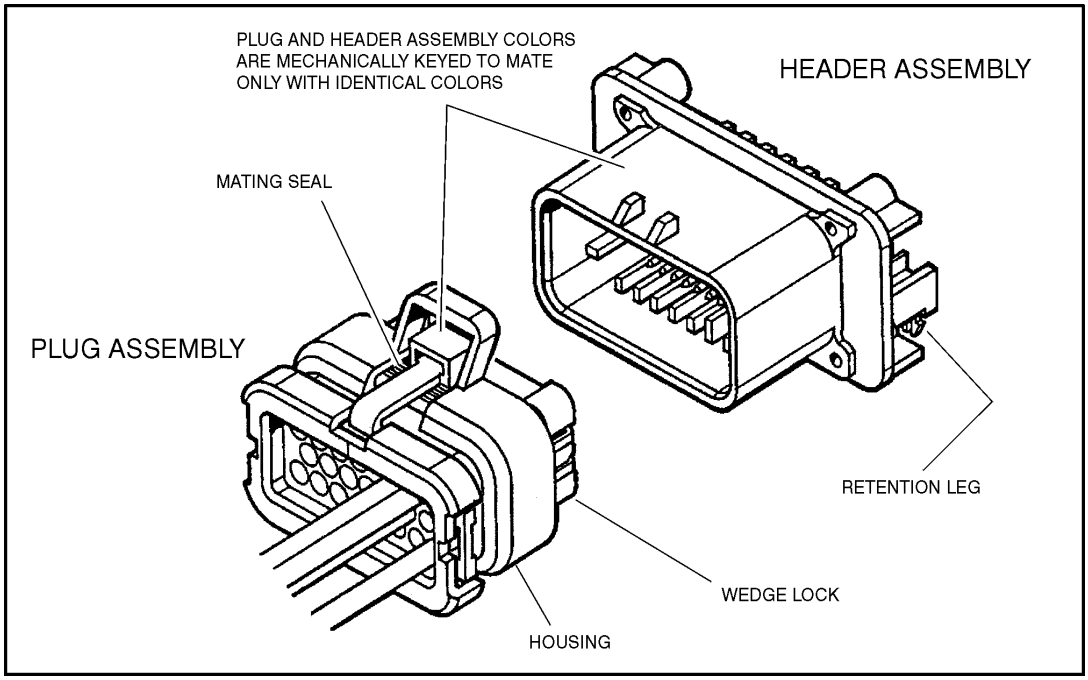


Figure 2-2. AMP Connector

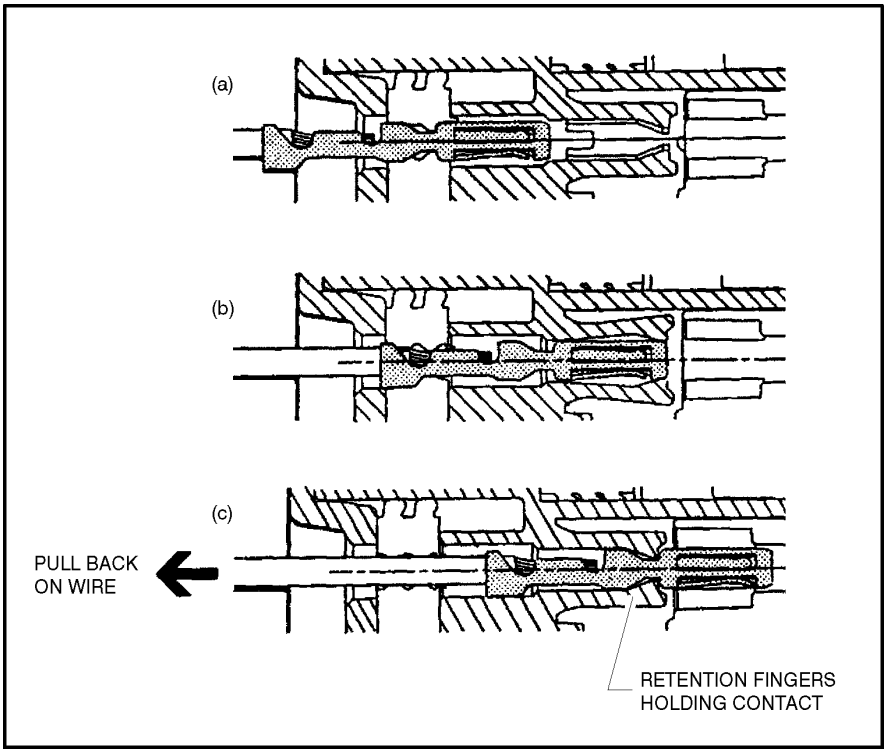


Figure 2-3. Connector Assembly Figure 2

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 2-4.).

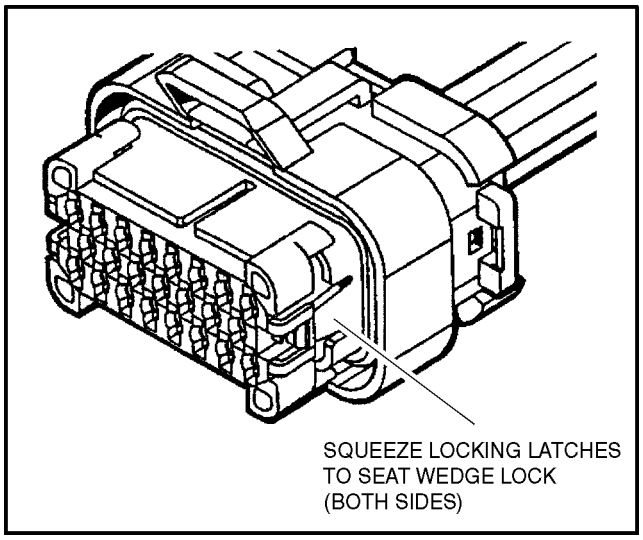


Figure 2-4. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 2-5.).

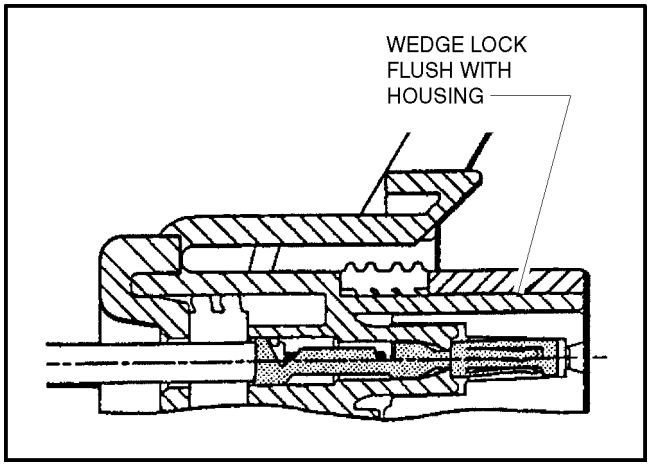


Figure 2-5. Connector Assembly Figure 4

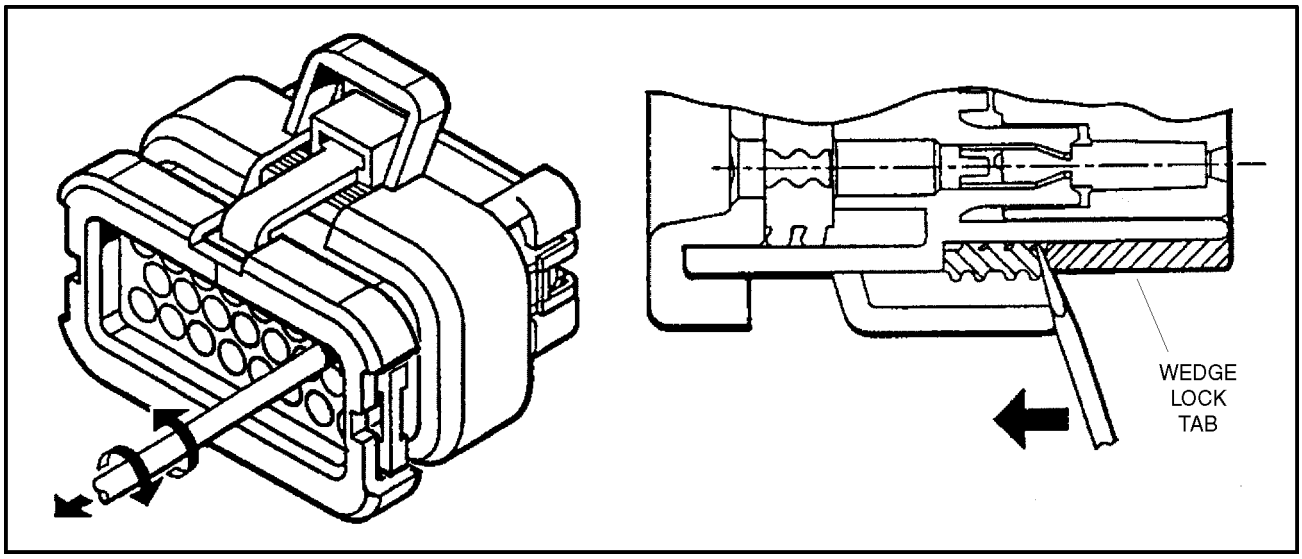


Figure 2-6. Connector Disassembly

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

⚠ CAUTION

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 AMPSEAL 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.

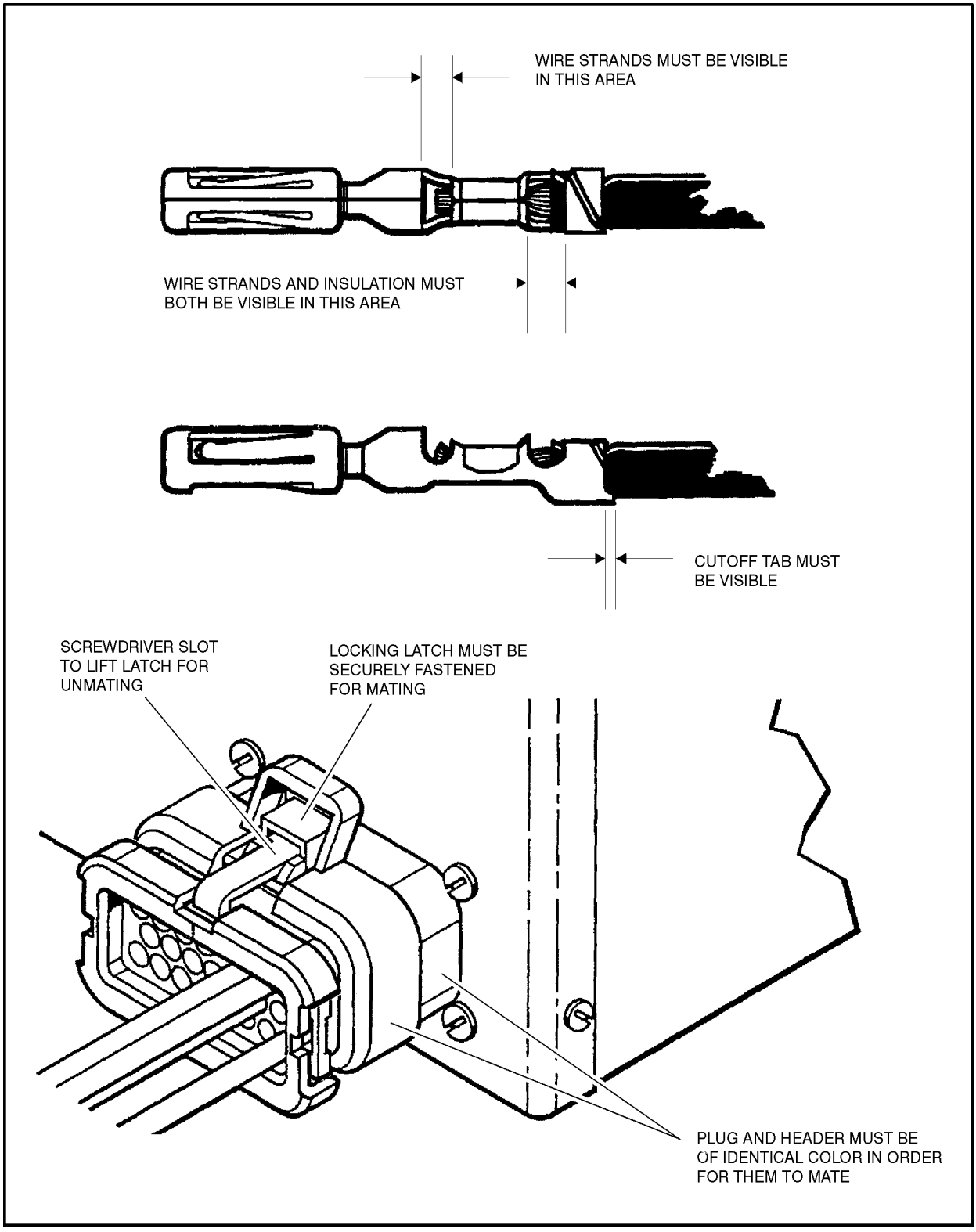


Figure 2-7. Connector Installation

2.9 DEUTSCH CONNECTORS

DT/DTP Series Assembly

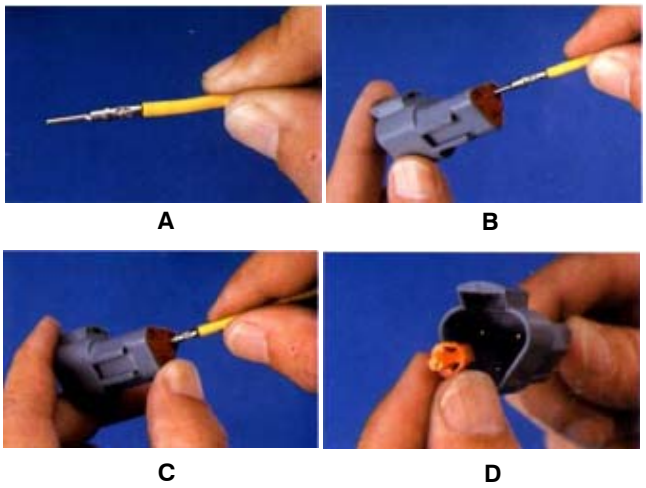


Figure 2-8. DT/DTP Contact Installation

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

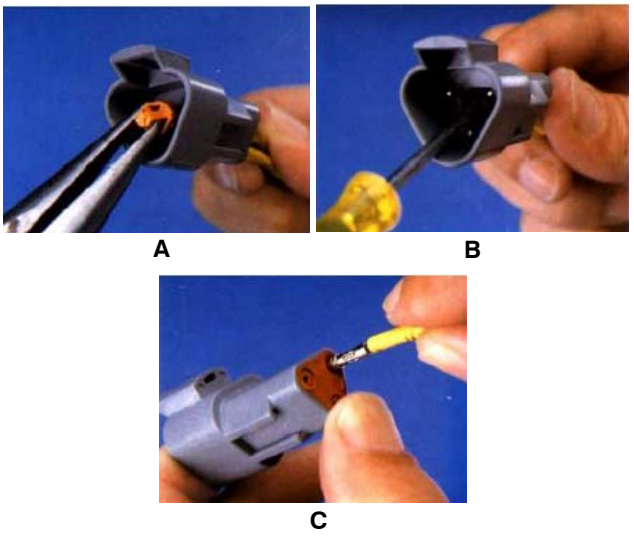


Figure 2-9. DT/DTP Contact Removal

1. Remove wedgelock using needlenose 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

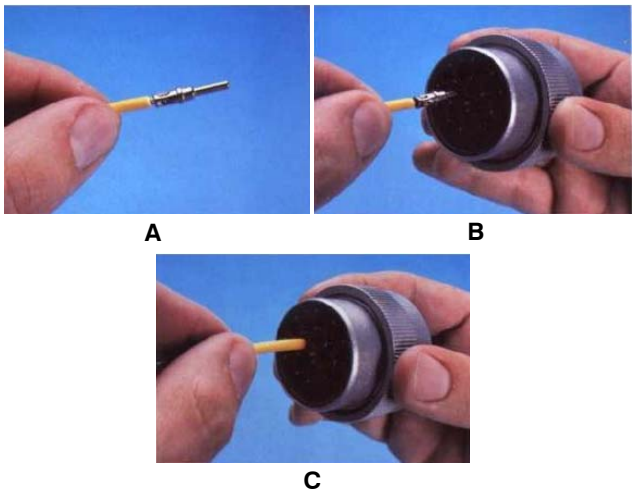


Figure 2-10. HD/HDP Contact Installation

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.

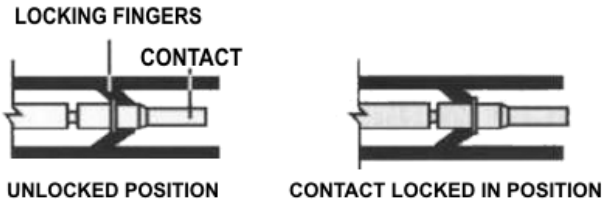


Figure 2-11. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing*

HD30/HDP20 Series Disassembly

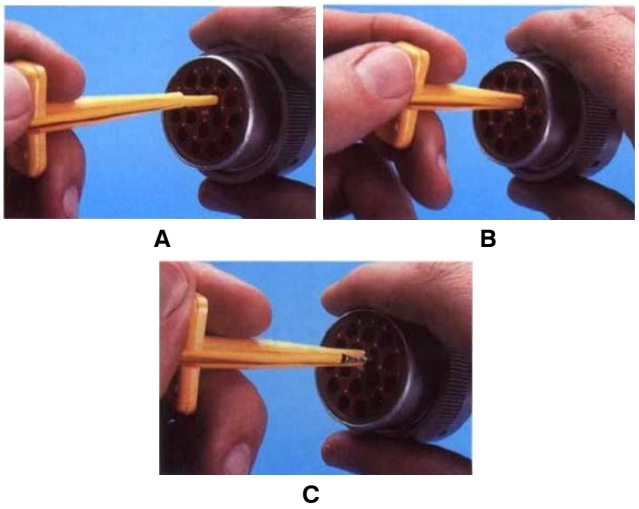


Figure 2-12. HD/HDP Contact Removal

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.

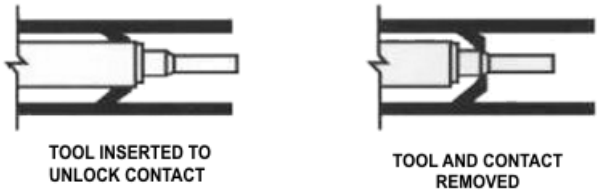


Figure 2-13. HD/HDP Unlocking Contacts

NOTE: *Do not twist or insert tool at an angle.*

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				1,2,3	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				
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						
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						
Torque Hubs				11	11	
Functions/Controls	9					
Platform Controls	5	5		6	6	

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
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	
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	
General						
Operators and Safety Manuals in Storage Box	21			21	21	
ANSI and EMI Manuals/Handbooks Installed					21	
Capacity Decals Installed, Secure, Legible	21			21	21	
All Decals/Placards Installed, Secure, Legible	21			21	21	
Walk-Around Inspection Performed	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
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

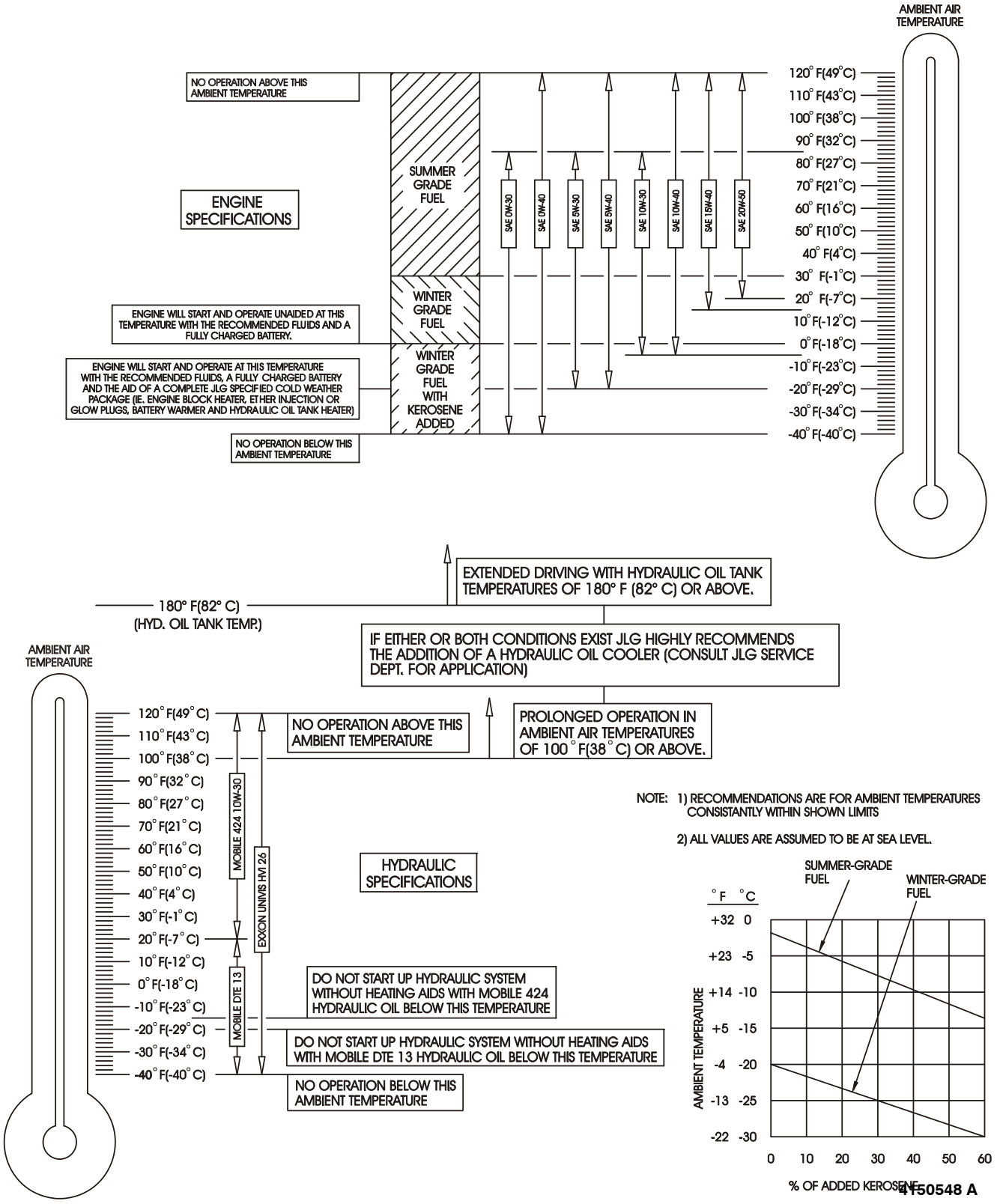


Figure 2-14. Engine Operating Temperature Specifications - Deutz

SECTION 3. CHASSIS & TURNTABLE

3.1 DRIVE TORQUE HUB, PRIOR TO S/N 75606

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 eight bolts (41) and four shoulder bolts (42) 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 counter bore 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.

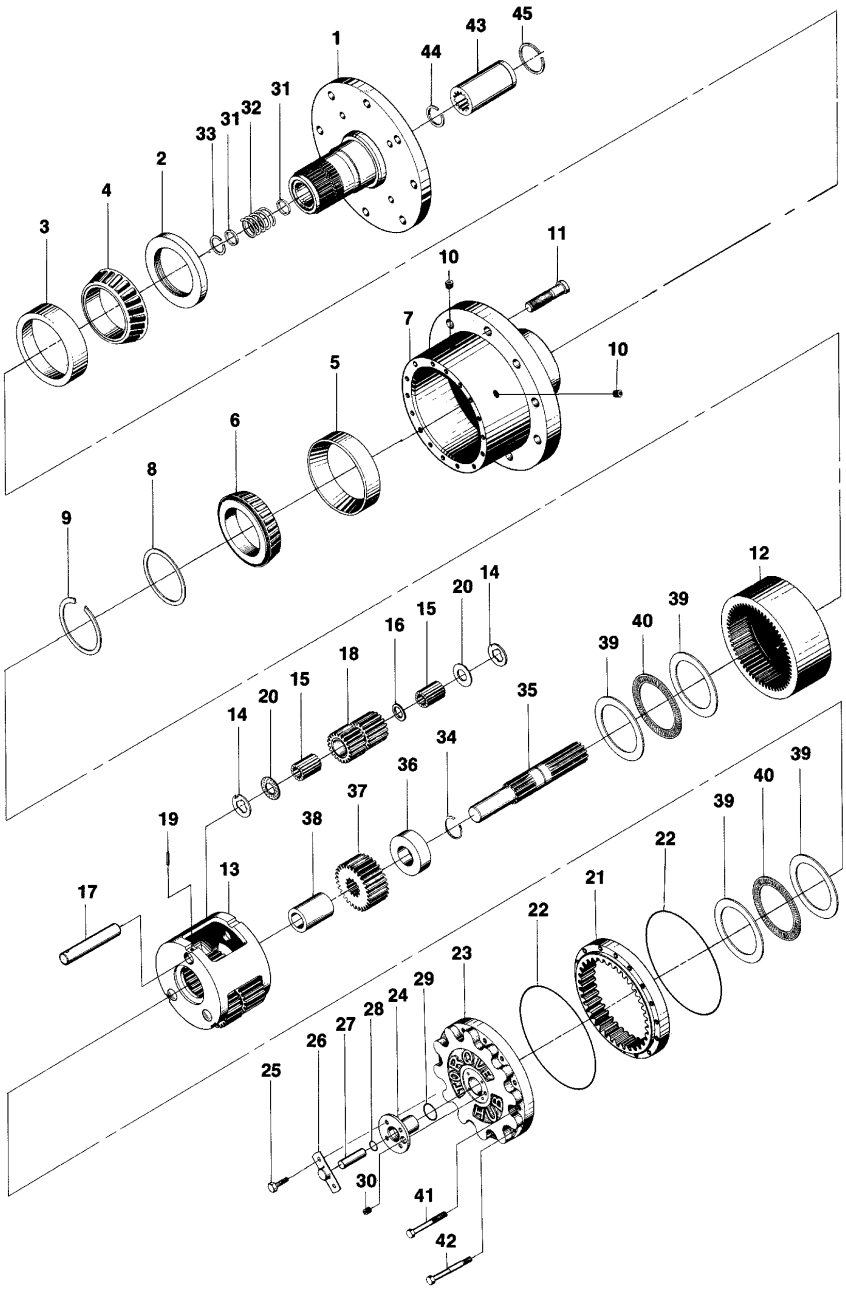
8. Remove inside bearing cone (6) and bearing shim (8).
9. If necessary, pry seal (2) out of hub using screwdriver or pry bar. With seal removed, outside bearing cone (4) can be removed.
10. If necessary, remove inner and outer bearing cones (3, 5) using a suitable slide hammer puller.

⚠ IMPORTANT

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.



1. Spindle
2. Seal
3. Bearing Cup
4. Bearing Cone
5. Bearing Cup
6. Bearing Cone
7. Hub
8. Spacer
9. Retaining Ring
10. Pipe Plug
11. Bolt
12. Internal Gear
13. Carrier
14. Thrustwasher
15. Needle Roller
16. Spacer
17. Pinion Shaft
18. Cluster Gear
19. Roll Pin
20. Thrustwasher
21. Ring 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. Thrust Spacer
39. Thrustwasher
40. Thrust Bearing
41. Bolt
42. Shoulder Bolt
43. Coupling
44. Retaining Ring
45. Retaining Ring

Figure 3-1. Torque Hub, Drive (Fairfield)

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 7.9-9.0 Nm.

   j. Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 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.

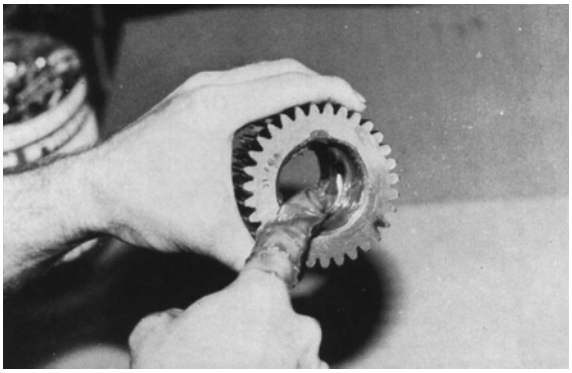
   d. Remove sixteen needle rollers (15) from cluster gear bore.

   e. Remove spacer (16) from cluster gear bore and remove second set of sixteen needle rollers (15).

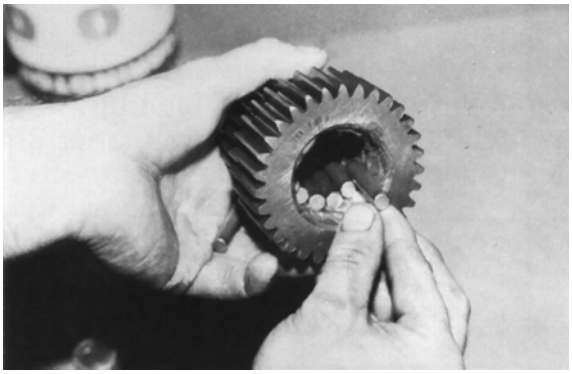
   f. Repeat steps (a) through (e) for remaining two cluster gears.

   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.

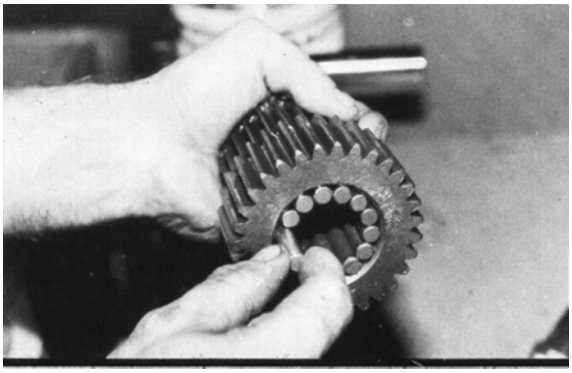


   i. Place sixteen needle rollers into cluster gear bore.

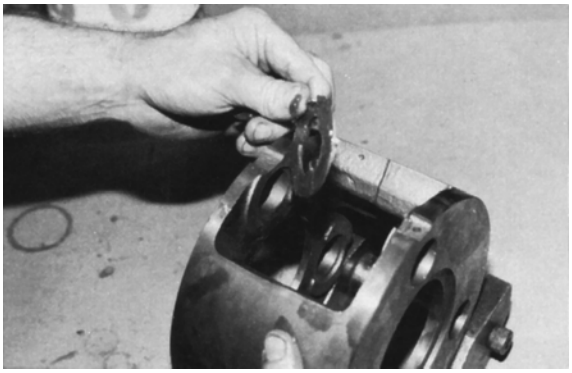


   j. Place spacer into opposite side of cluster gear and against needle rollers.

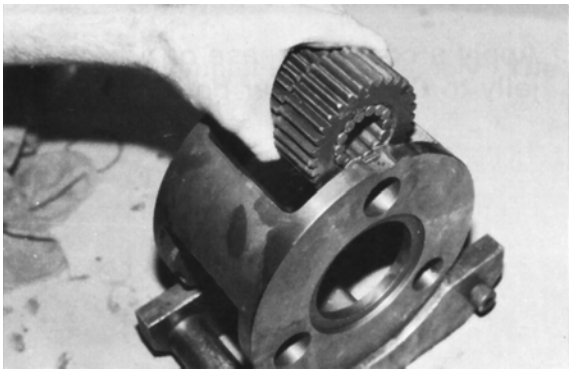
k. Place second set of sixteen needle rollers into cluster gear.



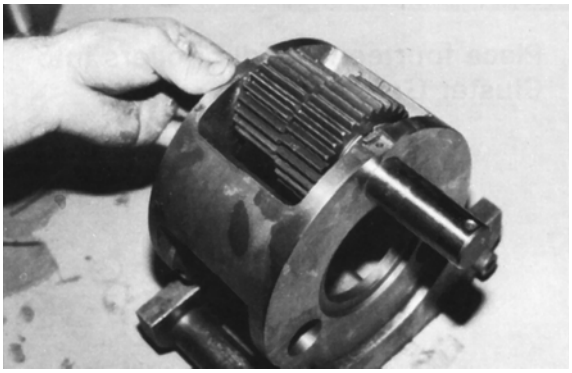
l. Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.



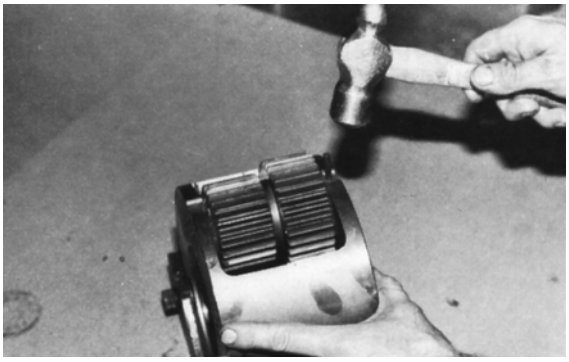
m. While keeping thrust washers in place, slide cluster gear into carrier with larger gear on side with small pin hole.



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

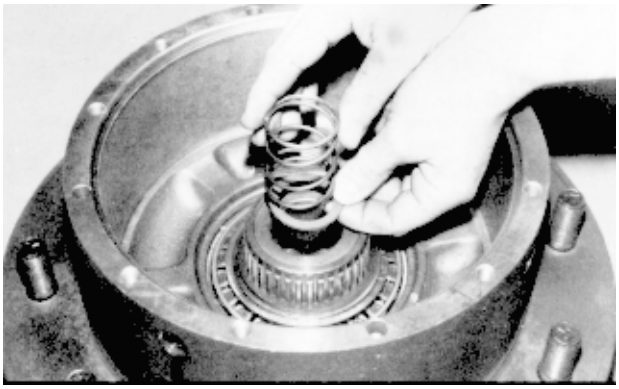
EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL AND INSTALLATION.

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

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

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

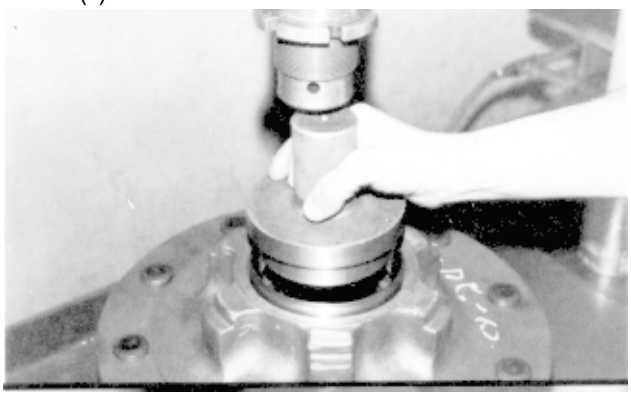
d. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.



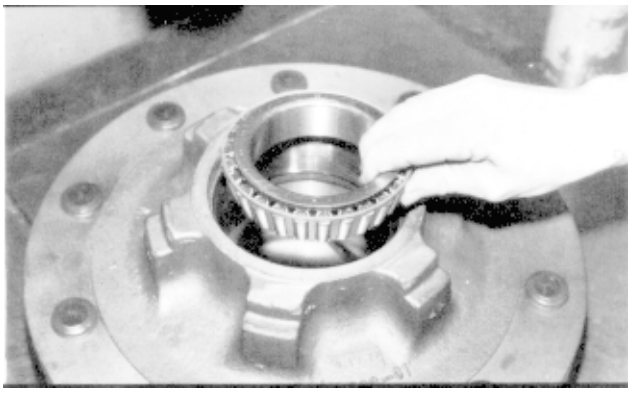
e. Install retaining ring into input shaft groove to secure spacers and spring to shaft.

Assembly

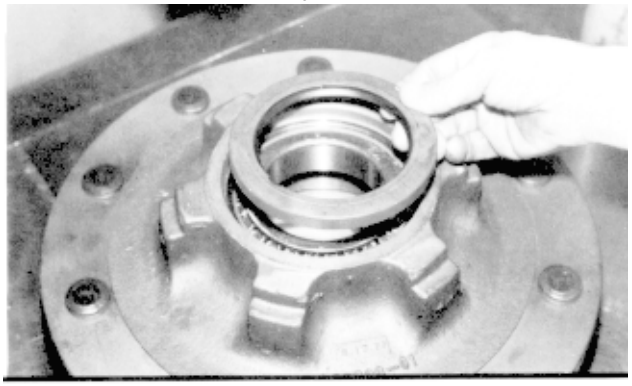
1. Using a suitable press, press new bearing cups (3, 5), with large inside diameters facing out, into hub (7) counter bores.



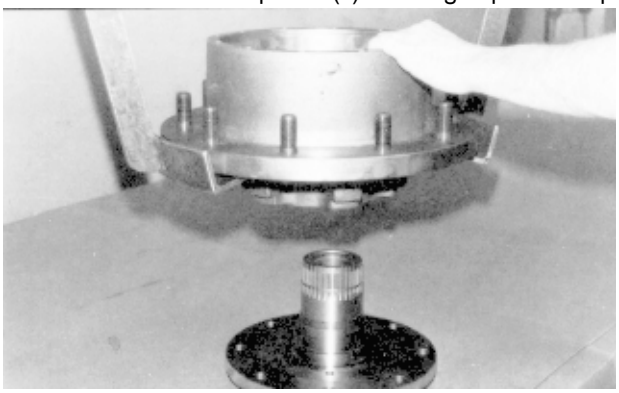
2. Place bearing cone (4) into bearing cup (3) in small end of hub.



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

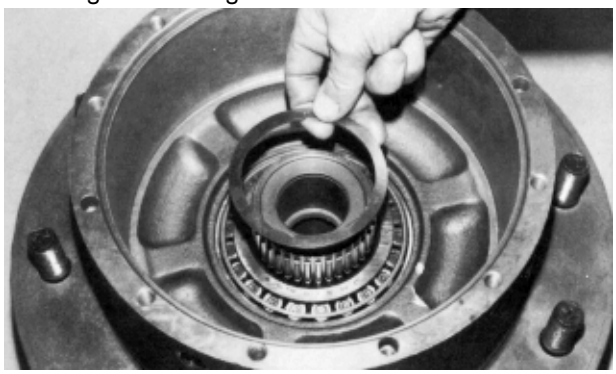


4. Lower hub onto spindle (1) with large open end up.



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

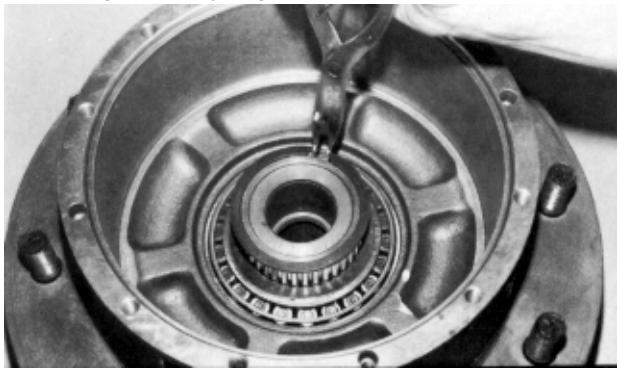
6. Place bearing shim (8) over end of spindle and against bearing cone.



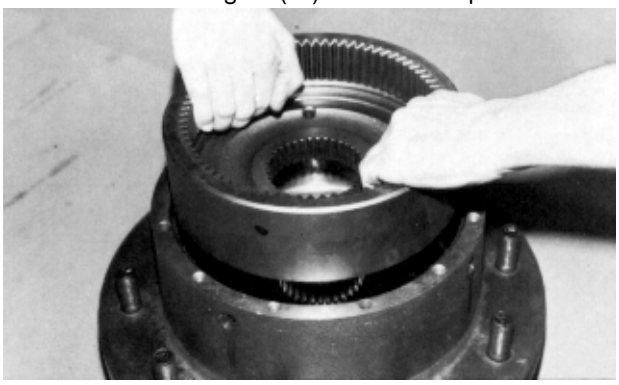
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

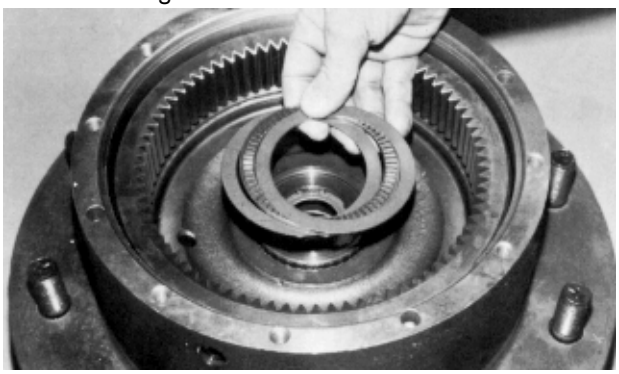
7. Install new retaining ring (9) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.



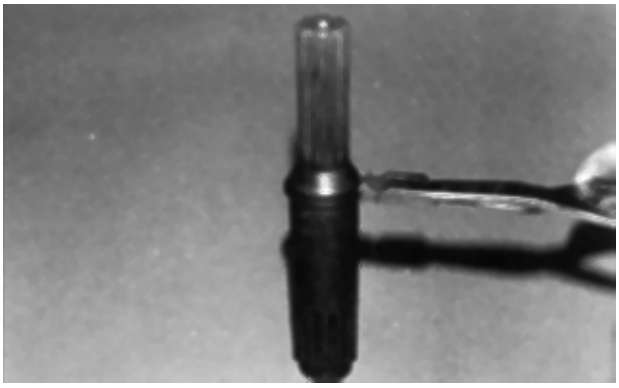
8. Place internal gear (12) onto end of spindle.



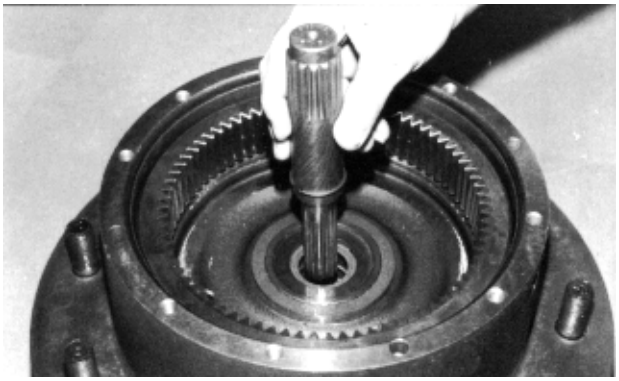
9. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.



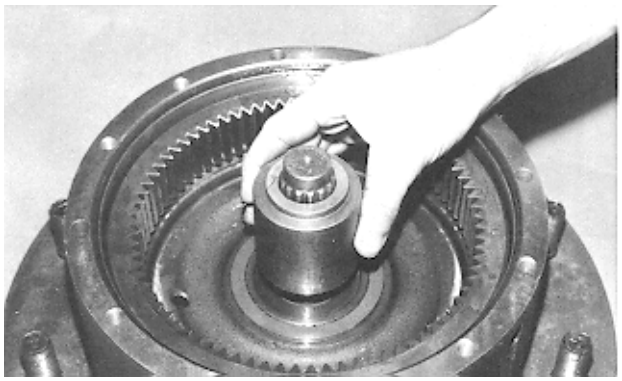
10. Install retaining ring (34) into input shaft retaining ring groove.



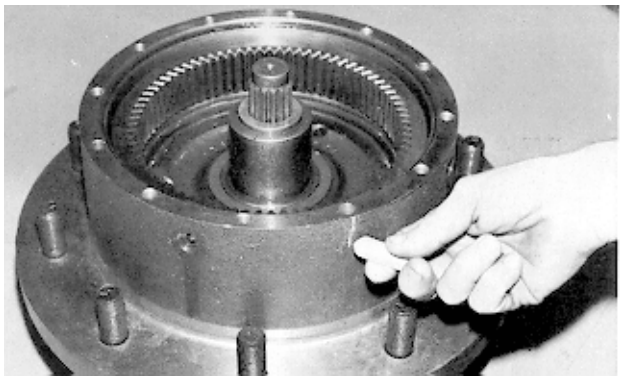
11. Place input shaft assembly (35) into spindle bore with unsplined end facing out.



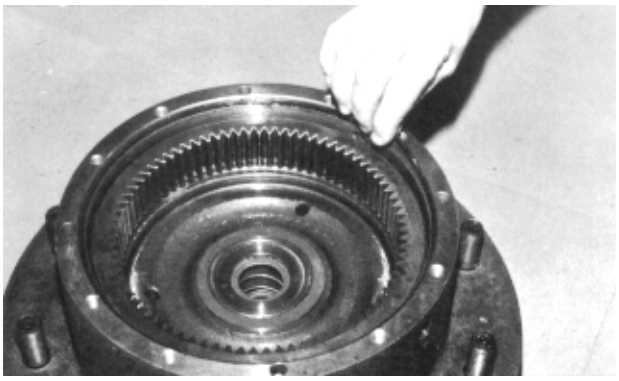
12. Place thrust spacer (36) over input shaft (35) with counter bore side facing spindle.



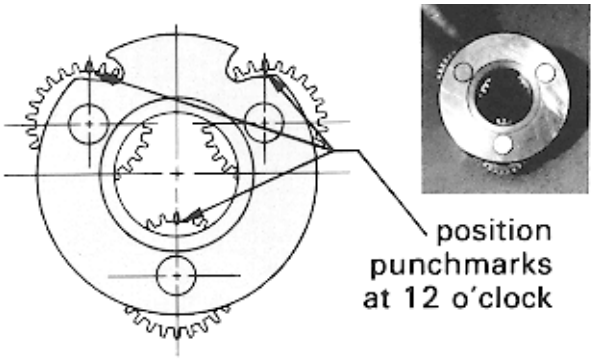
13. Locate the four counter reamed holes in the face of the hub, mark them for later identification.



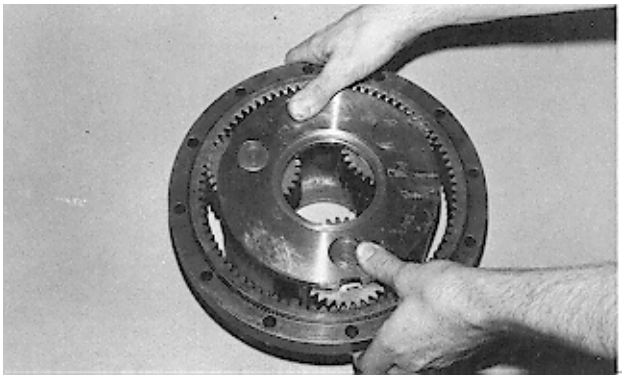
14. Place o-ring (22) into hub counter bore. Use petroleum or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.



15. 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.

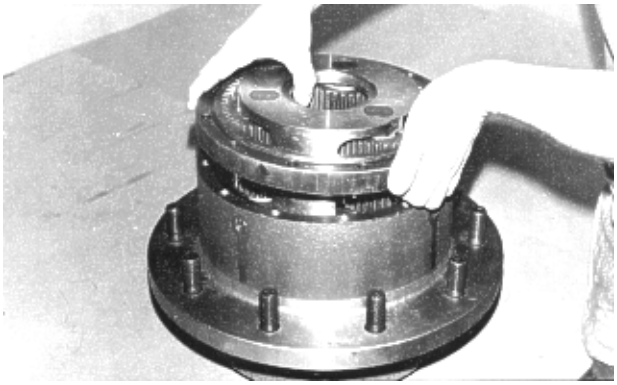


16. With shoulder side of ring gear (21) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation.



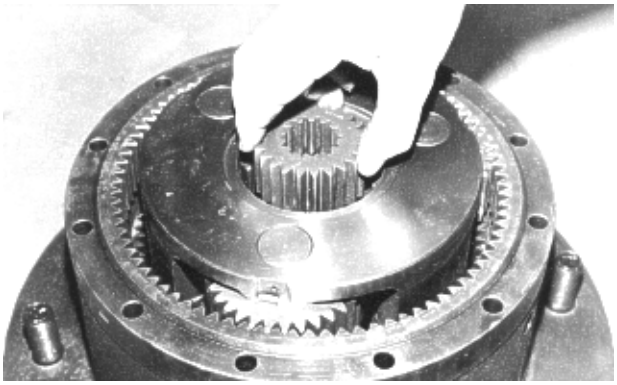
17. While holding ring gear, input gear, and cluster gears in mesh, place small side of cluster gears into

mesh with internal gear. On ring gear, locate hole marked 'X' over one of counter bored holes in hub.

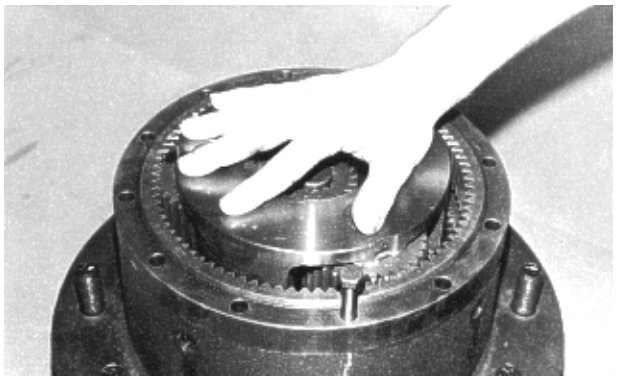


NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster gear timing.*

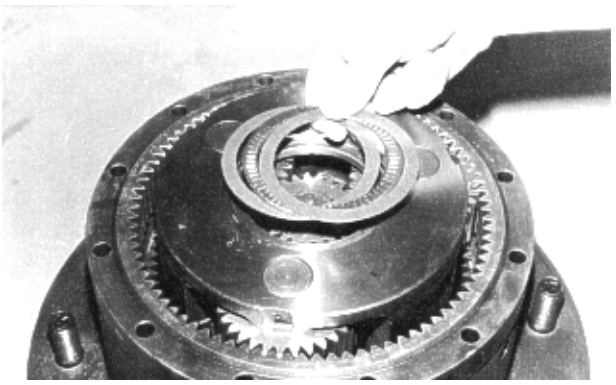
18. Install input gear (37) into carrier, meshing with large diameter cluster gears (18). Counter bore in bore of input gear must be to outside of carrier assembly.



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



20. Install thrust washers and thrust bearing (39, 40) into carrier counter bore.

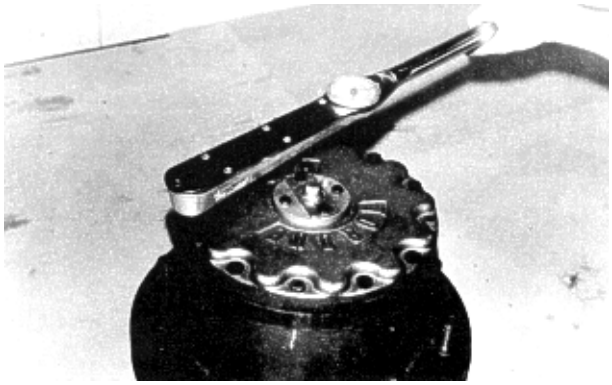


21. Place o-ring (22) into cover assembly counter bore. Use petroleum jelly or grease to hold o-ring in place.

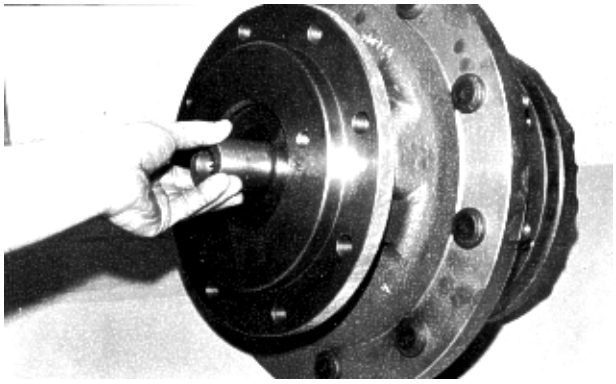
22. Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.

23. Locate four shoulder bolts (42), 90 degrees apart into counter bored holes in hub marked in step (13). Torque shoulder bolts to 64 Nm.

24. Install bolts (41) in remaining holes. Torque bolts to 64 Nm.



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



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

3.2 TORQUE HUB, DRIVE (AUBURN GEAR)

Disassembly

1. Position hub over suitable container and remove drain plugs (27) from unit. Allow oil to completely drain, then replace drain plugs.
2. Remove twelve bolts (25) and flat washers (26) and the cover from the hub (9). The thrust washer (21) and the disengage plunger (22) usually remain with cover (24) when it is removed. Remove thrust washer (21), disengage plunger (22) and o-ring (23) from the cover (24), discard o-ring seal (23).
3. Remove primary sun gear (20) from input shaft (2).
4. Remove the primary carrier assembly (19).
5. Remove the secondary carrier assembly (18). It may be necessary to remove the ring gear (17) first, if difficulty is encountered removing the carrier.
6. Remove the input shaft (2) from spindle (3). Remove the retaining rings (14), washers (15), and spring (16) from input shaft (2) only if replacement is required.

NOTE: *The retaining rings (14), washers (15) and disengage spring (16) are not included in unit equipped with a cast iron disengage cover (29).*

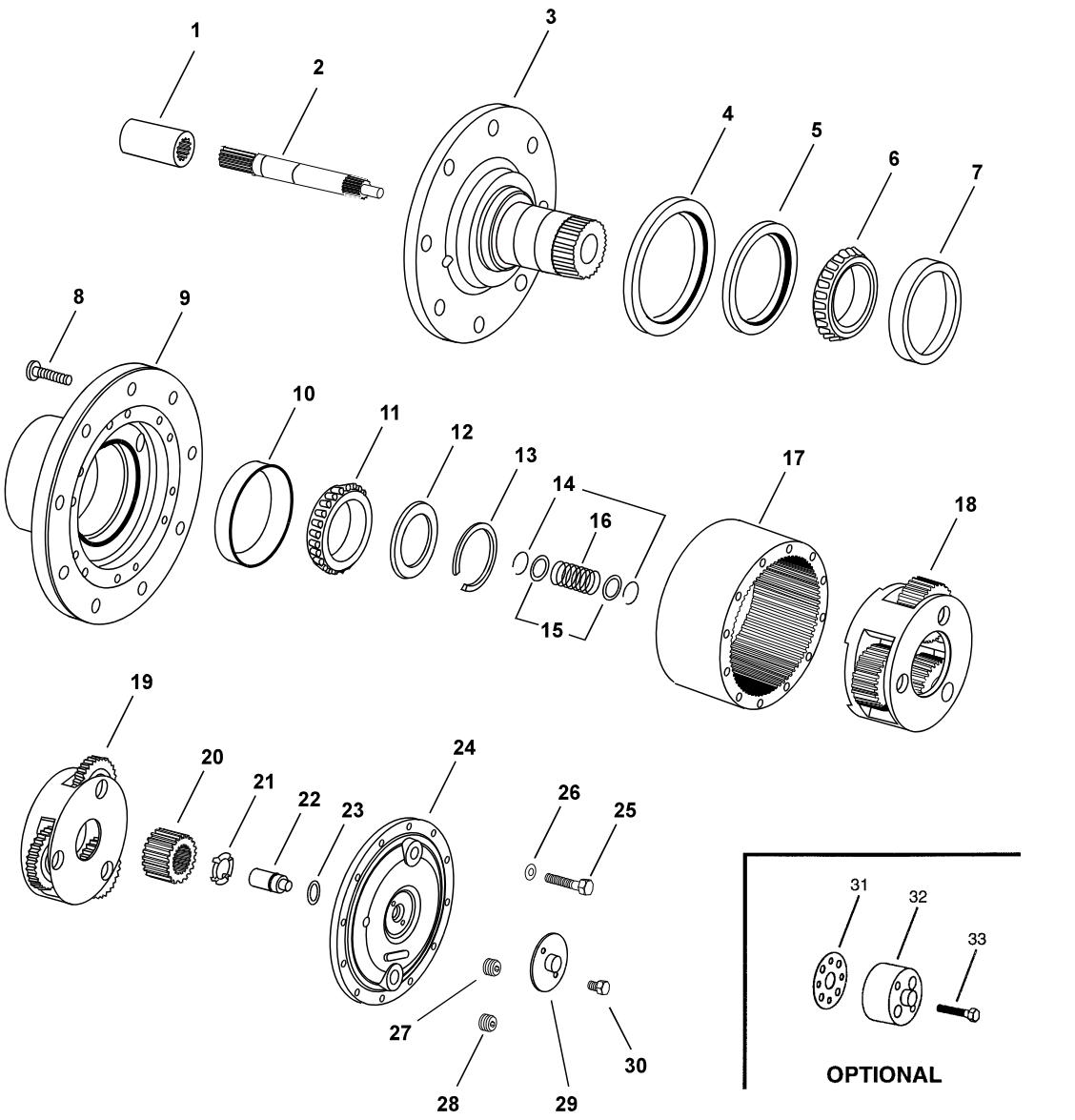
7. If not previously removed (see step 5), remove ring gear (17) from hub (9). It may be necessary to strike ring gear (17) with a rubber mallet to loosen from hub (9).
8. Remove the retaining ring (13) from groove in spindle (3).

NOTE: *Use a retaining ring expander tool to remove retaining ring (13).*

9. Lift hub (9) from spindle (3). If bearings are not a loose fit, it may be necessary to press spindle (3) from hub (9).
10. Remove oil seals (4) and (5) and bearing cones (6 & 11) from the hub (9). Inspect bearing cups (7 & 10) in position and remove only if replacement is required.

Assembly

1. If necessary press new bearing cups (7 & 10) in each end of the hub (9). It is recommended that bearing cups (7 & 10) and cones (6 & 11) be replaced in sets.



1. Coupling
2. Input Shaft
3. Spindle
4. Boot Seal
5. Oil Seal
6. Bearing Cone
7. Bearing Cup
8. Wheel Bolt
9. Hub
10. Bearing Cup
11. Bearing Cone
12. Thrust Washer
13. Retaining Ring
14. Retaining Ring
15. Washer
16. Spring
17. Ring Gear
18. Secondary Carrier
19. Primary Carrier
20. Primary Sun Gear
21. Thrust Washer
22. Plunger
23. O-ring
24. Cover
25. Bolt
26. Washer
27. Plug
28. Pipe Plug
29. Cover
30. Bolt
31. Gasket
32. Disconnect Assembly
33. Bolt

Figure 3-2. Torque Hub, Drive (Auburn Gear)

2. Assemble bearing cone (6) into cup (7) at seal end of hub (9) and press a new seal (5) into hub. Install boot seal (4) on the hub (9) if hub is so equipped.
3. Position spindle (3) upright on bench. Lubricate lips of seals (4) and (5) and lower hub onto spindle (3). Hub should be centered as it is lowered over spindle (3) to prevent seal damage.
4. Assemble bearing cone (11) over spindle (3) and into bearing cup (10). Replace thrust washer (12) over spindle end splines and on bearing cone (11).
5. Select the thickest ring (13) that can be assembled into the ring groove of the splined end of spindle (3) above bearing. Bearing should have from 0.00 - 0.15 mm of end play when proper retaining ring (13) is installed.
6. For hubs equipped with the standard spring disconnect or optional quick disconnect, assemble a washer (15), spring (16), a second washer (15), and retaining ring (14) in the middle grooves of the input shaft (2). Install second retaining ring (14) in groove near small end of input shaft.
7. Assemble the splined end of the input shaft (2) down into spindle (3).
8. Assemble the secondary carrier assembly (18) to spindle (3) at splines.
9. Clean mating surfaces and apply a bead of silicone sealant to face of hub (9) that mates with ring gear (17). Assemble ring gear (17) to hub (9), being careful to align bolt holes.
10. Assemble the primary carrier assembly (19) into the ring gear (17). It will be necessary to rotate carrier to align secondary sun gear (part of primary carrier assembly (19)) with planet gear teeth in secondary carrier assembly (18). Assemble primary sun gear (20) over input shaft (2). Rotate primary sun gear (20) to align input shaft (2) to gear splines and gear teeth in primary carrier assembly (19).
11. Lubricate o-ring (23) and assemble in groove inside cover hole, then push disengage plunger (22) into cover with pointed end facing inside of hub.

NOTE: *These parts (22 & 23) are not included in hubs produced with a cast iron disengage cover (29).*

12. For hubs with the standard spring disengage, assemble the thrust washer (21) with tangs engaged with cover (24). Note: A small amount of grease applied to the back side of thrust washer (21) will hold washer in place.
13. Assemble cover (24), aligning holes of cover and ring gear. Assemble the twelve bolts (25) and flat washer (26). Torque bolts to 61 - 67 Nm.

3.3 DRIVE TORQUE HUB, S/N 75606 TO PRESENT

Roll, Leak and Brake Testing

Torque-Hub units should always be roll and leak tested before disassembly and after assembly to make sure that the unit's gears, bearings and seals are working properly. The following information briefly outlines what to look for when performing these tests.

NOTE: *The brake must be released before performing the roll test. This can be accomplished by either pressurizing the brake using the Brake Leak Test procedure below or by tightening the bolts into the piston through the end plate (See Brake Disassembly Procedure)*

NOTE: *Bolts must be removed while performing brake release test*

THE ROLL TEST

The purpose of the roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for improper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency.

THE LEAK TEST (MAIN UNIT)

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your leak checking fitting starts to fall after the unit has been pressurized and allowed to equalize. Leaks will most likely occur at the pipe plugs, the main seal or wherever o-rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where the o-rings or gaskets meet on the exterior of the unit, then checking for air bubbles. If a leak is detected in a seal, o-ring or gasket, the part must be replaced, and the unit rechecked. Leak test at 10 psi for 20 minutes.

THE BRAKE TEST

Reference: Sample Model 7HBE01F0B30057. The underlined letter is the brake option. Options are A, B, C, D, E, or X.

A Input Brake	2,200 in-lb (248 Nm) Static, 280 psi (19.3 bar) Full Release 3000 psi (207 bar) maximum o-ring check.
B Input Brake	1,900 in-lb (215 Nm) Static, 240 psi (16.5 bar) Full Release 3000 psi (207 bar) maximum o-ring check.
C Input Brake	1,600 in-lb (181 Nm) Static, 200 psi (13.8 bar) Full Release 3000 psi (207 bar) maximum o-ring check.
D Input Brake	1,400 in-lb (158 Nm) Static, 180 psi (12.4 bar) Full Release 3000 psi (207 bar) maximum o-ring check.
E Input Brake	1,250 in-lb (141 Nm) Static, 160 psi (11.0 bar) Full Release 3000 psi (207 bar) maximum o-ring check.
X – No Brake	

If brake does not release at these pressure values, brake has to be inspected, repaired or replaced.

NOTE: *Failure to perform this test may result in damaged or ineffective brake parts.*

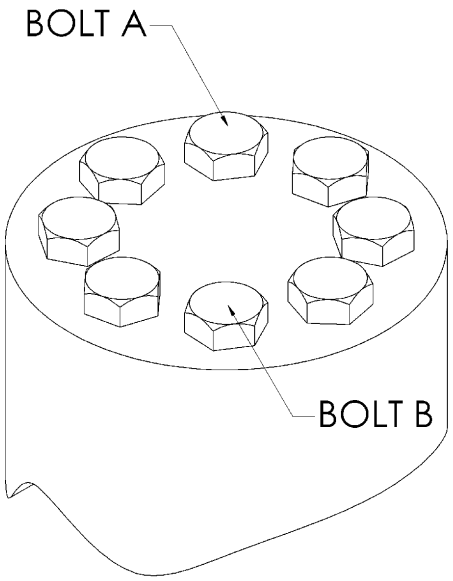
Tightening and Torquing Bolts

If an air impact wrench is used to tighten bolts, extreme care should be taken to ensure that the bolts are not tightened beyond their specified torque.

The following steps describe how to tighten and torque bolts or socket head cap screws in a bolt circle.

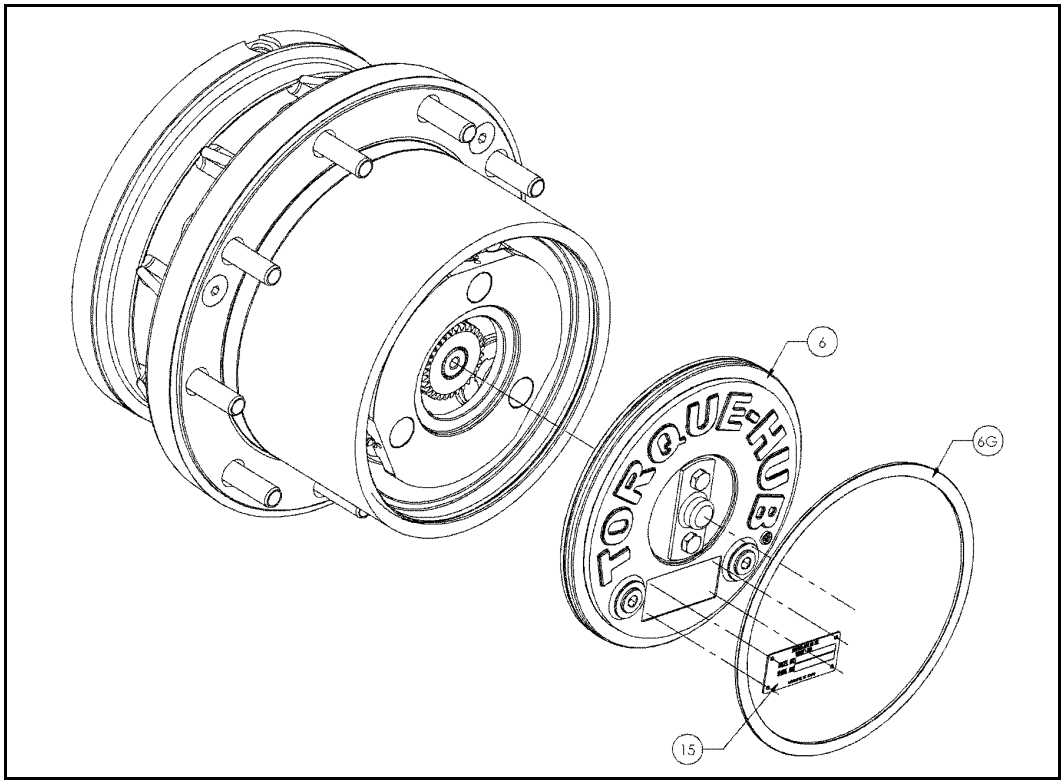
1. Tighten (but do not torque) bolt "A" until snug.
2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.
3. Crisscross around the bolt circle and tighten remaining bolts.
4. Now use a torque wrench to apply the specified torque to bolt "A".

5. Using the same sequence, crisscross around the bolt circle and apply an equal torque to the remaining bolts.



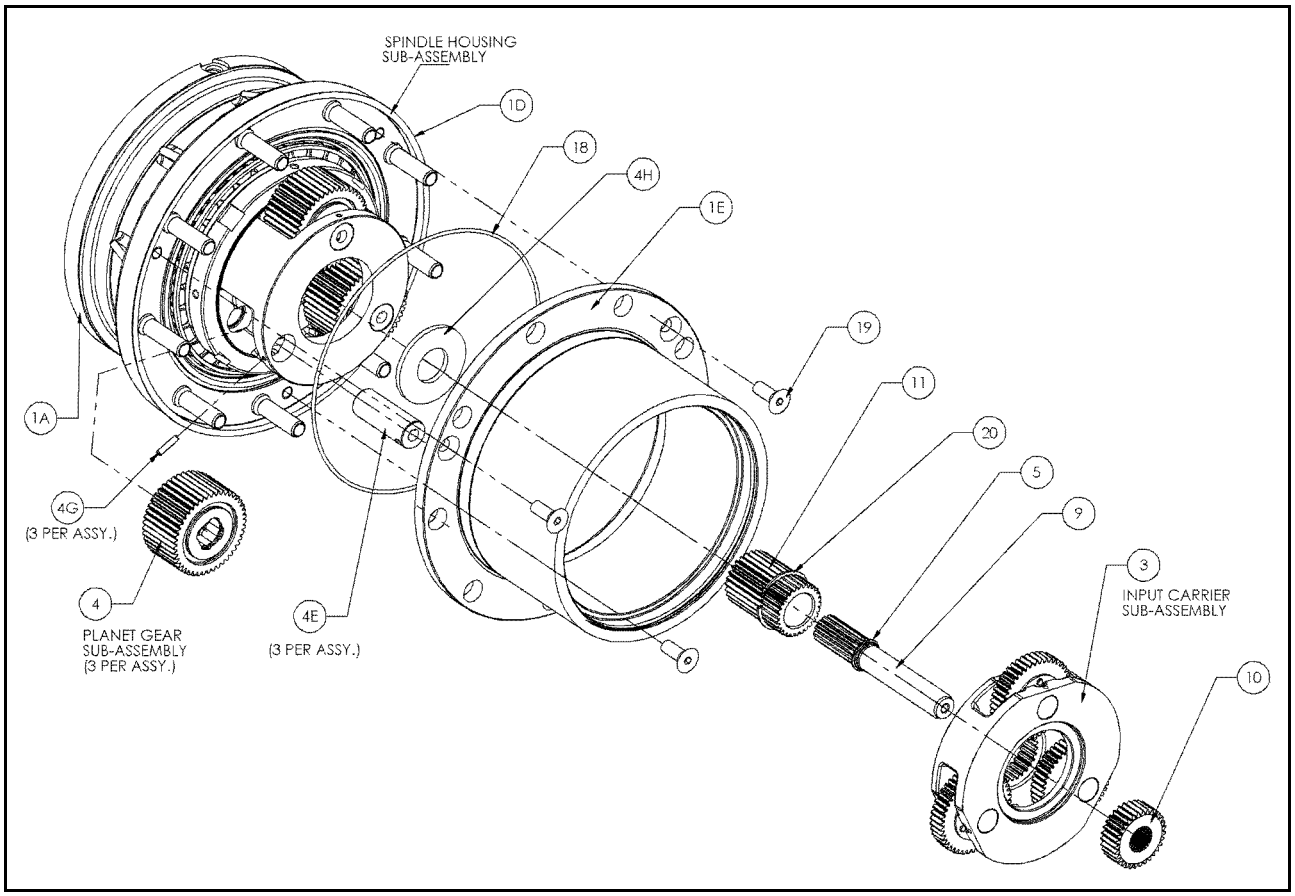
Main Disassembly

1. Perform Roll Check, Leak Check and Brake Check if applicable prior to disassembling the unit.
2. Drain oil from unit. Note the condition and volume of the oil.
3. Remove Retaining Ring (6G) by prying the open end of Retaining Ring out of the groove in the Ring Gear (1E) with a screwdriver, then grasp the loose end with pliers and pull the Retaining Ring completely out of the groove.
4. Remove the Cover Subassembly (6) from the unit. The unit can be carefully pressurized with air to pop the cover out of the unit.



6. Cover
6G. Retaining Ring
15. ID Plate

Figure 3-3. Main Disassembly



1A. Spindle
1D. Housing
1E. Ring Gear
3. Input Carrier
4. Planet Gear
4E. Planet Shaft
4G. Roll Pin
4H. Thrust Washer
5. Retaining Ring
9. Input Shaft
10. First Stage Sun Gear
11. Second Stage Sun Gear
18. O-ring
19. Bolt
20. Retaining Ring

Figure 3-4. Input Carrier

5. Remove the First Stage Sun Gear (10) if applicable.

NOTE: *On units with ratios greater than 36:1 numerically, there will not be a separate First Stage Sun Gear (10), as the gear teeth will be integral to the Input Shaft (9).*

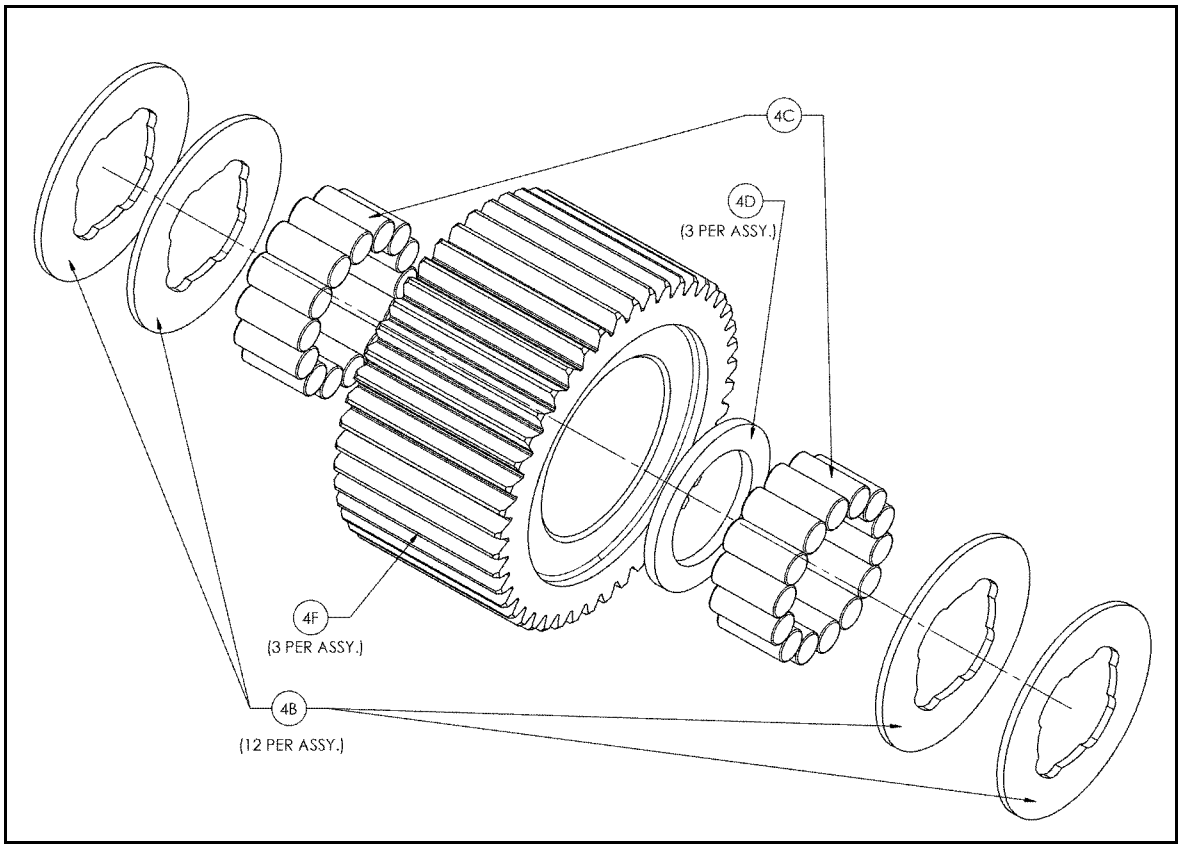
6. Remove the Input Carrier Subassembly (3).
7. Remove the Input Shaft (9).
8. Remove the Second Stage Sun Gear (11).

NOTE: *On units with a ratio 48:1, the Sun Gear (11) and the Input Shaft (9) will need to be removed together.*

9. Loosen and remove the three Flat Head Bolts (19) that retain the Ring Gear (1E) to the Housing (1G).
10. Lift the Ring Gear (1E) off of the Housing (1D).
11. Remove the O-ring (18) from between the Housing (1D) and the Ring Gear (1E).
12. Using a 1/8” diameter punch, drive the Roll Pin (4G) into the Planet Shaft (4E) until it bottoms against the Spindle (1A).
13. Grasp the Roll Pin (4G) using needle nosed pliers or some sort of hooked tool, and pull the Planet Shaft (4E) out of the Spindle (1A).
14. Using a 1/8” diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (4E).

NOTE: *The Roll Pins (4G) should not be reused when reassembling the unit.*

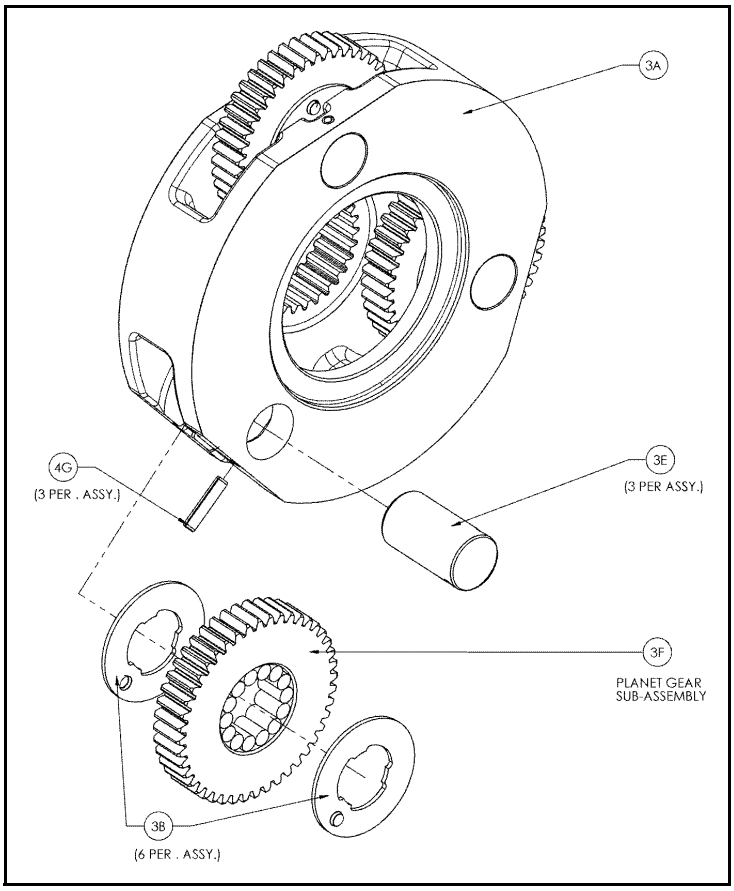
15. Slide the Planet Gear Subassembly (4) out of the Spindle (1A) being careful to not drop the Needle Bearings (4C) in the process.
16. Remove 4 Thrust Washers (4B), 28 Needle Rollers (4C) and the Thrust Spacer (4D) from the Second Stage Planet Gear (4F).
17. Repeat Steps 12 though 16 for the remaining two Planet Gears (4F).
18. Remove the Thrust Washer (4H) from the counterbore in the Spindle (1A).



4B. Thrust Washer
4C. Needle Roller
4D. Thrust Spacer
4F. Planet Gear

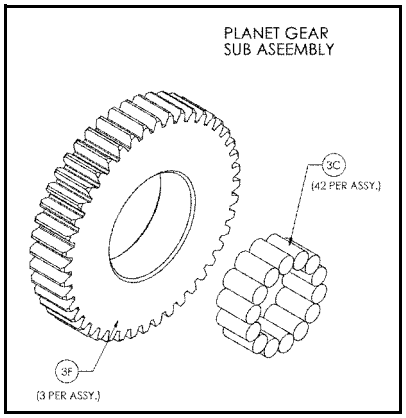
Figure 3-5. Planet Gear Sub Assembly

Input Carrier Disassembly



3A. Carrier
3B. Thrust Washer
3E. Planet Shaft
3F. Planet Gear
4G. Roll Pin

Figure 3-6. Input Carrier



3C. Needle Bearing
3F. Planet Gear

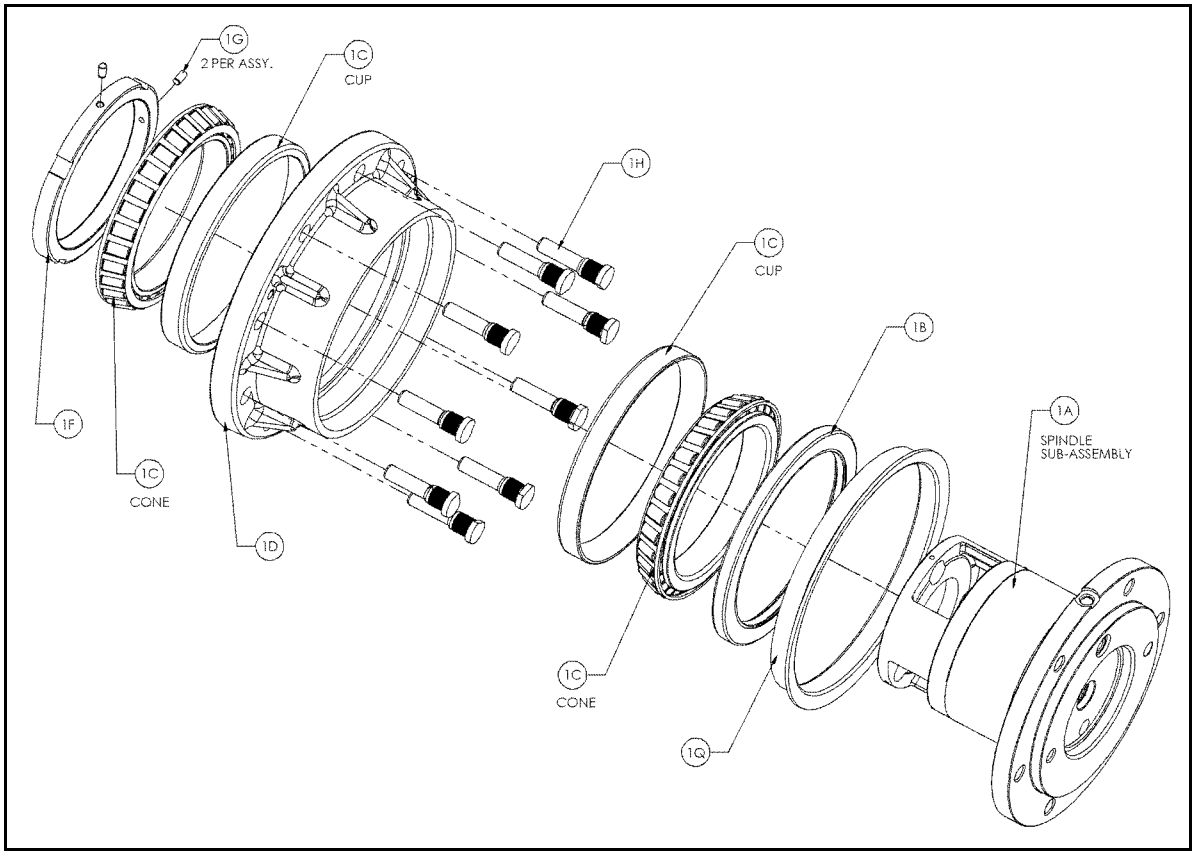
Figure 3-7. Planet Gear Subassembly

1. Using a 1/8” diameter punch, drive the Roll Pin (4G) into the Planet Shaft (3E) until it bottoms against the Carrier (3A).
2. Using a soft face hammer, tap the Planet Shaft (3E) out of the Carrier (3A).
3. Using a 1/8” diameter punch, drive the Roll Pin (4G) out of the Planet Shaft (3E).

NOTE: *The Roll Pins (4G) should not be reused when reassembling the unit.*

4. Slide the Planet Gear (3F) and the two Thrust Washers (3B) out of the Carrier (3A).
5. Remove the 14 needle Bearings (3C) from the bore of the Planet Gear (3F).
6. Repeat steps 1 through 5 for each of the two remaining planet gears.

Hub-Spindle Disassembly



1A. Barrel	1F. Bearing Nut
1B. Seal	1G. Setscrew
1C. Bearing Cone	1H. Stud
1D. Hub	1Q. Boot Seal

Figure 3-8. Hub Spindle

1. Place unit on bench with Spindle (1A) end down.
2. Remove 2 Set Screws (1G) and Bearing Nut (1F) using T-206569.

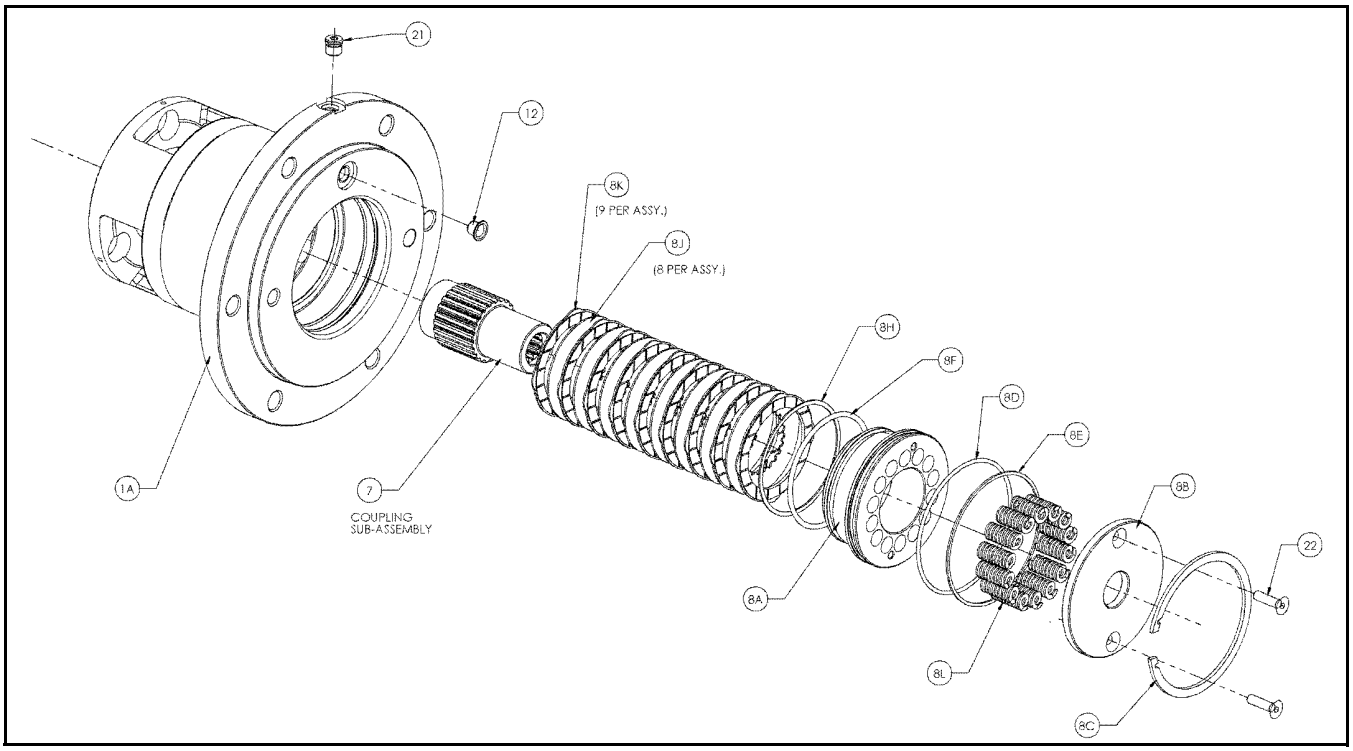
NOTE: *The holes in the Bearing Nut (1F) for the Set Screws (1G) were staked for retention of the Set Screws (1G). The holes will need to be cleaned up prior to removing the Set Screws.*

3. Remove “A” position Bearing Cone (1C) from Bearing Cup (1C) in Hub (1D).
4. While supporting the unit on Hub (1D) flange, press Spindle (1A) out of Hub (1D).
5. Lift Hub (1D) off of Spindle (1A). Remove Boot Seal (1Q) from Hub (1D) if applicable.
6. If necessary, press 9 Studs (1H) out of Hub (1D). Locate Hub (1D) on Seal (1B) end.
7. Remove Seal (1B) from Hub (1D).

NOTE: *The Seal (1B) should NOT be reused when reassembling the unit.*

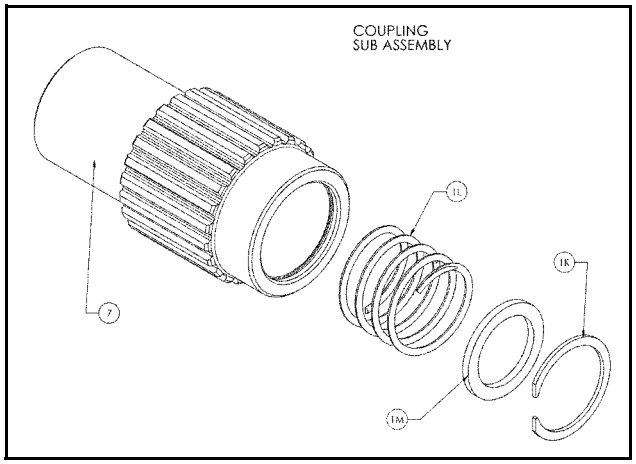
8. Remove “B” position Bearing Cone (1C) from Bearing Cup (1C) in Hub (1D).
9. Remove “B” position Bearing Cone (1C) from Hub (1D).
10. Using a soft steel rod, knock both Bearing Cups (1C) out of Hub (1D).

Spindle-Brake Disassembly



1A. Spindle
7. Coupling Subassembly
8A. Piston
8B. Pressure Plate
8C. Retaining Ring
8D. O-Ring
8E. Backup Ring
8F. O-Ring
8H. Backup Ring
8J. Rotor
8K. Stator
8L. Compression Spring
12. Plastic Plug
21. Pipe Plug
22. Flat Head Capscrew

Figure 3-9. Spindle Brake



1K. Retaining Ring
1L. Spring
1M. Spacer
7. Coupling

Figure 3-10. Coupling Subassembly

NOTE: *This procedure applies only to units with integral Input Brake (8).*

⚠ CAUTION

EYE PROTECTION MUST BE WORN WHILE PERFORMING THE STEPS 1-3 IN THIS PROCEDURE.

1. Compress the Compression Springs (8L) by installing two 1/4-20 x 5/8" Flat Head Cap Screws (22) through Pressure Plate (8B) and into Piston (8A) and tightening incrementally until spring force has been taken off of the Retaining Ring (8C).

NOTE: *Flat Head Cap Screws (22) are removed prior to shipping new units since they are for transit and service only. They are included in most brake repair kits.*

2. Using retaining ring pliers, remove Retaining Ring (8C) from the groove in the Spindle (1A).
3. Back Flat Head Cap Screws (22) incrementally out of Piston (8A) until spring force is relieved from the

Pressure Plate (8B). Then, remove Flat Head Cap Screws (22) and Pressure Plate (8B) from brake cavity in Spindle (1A).

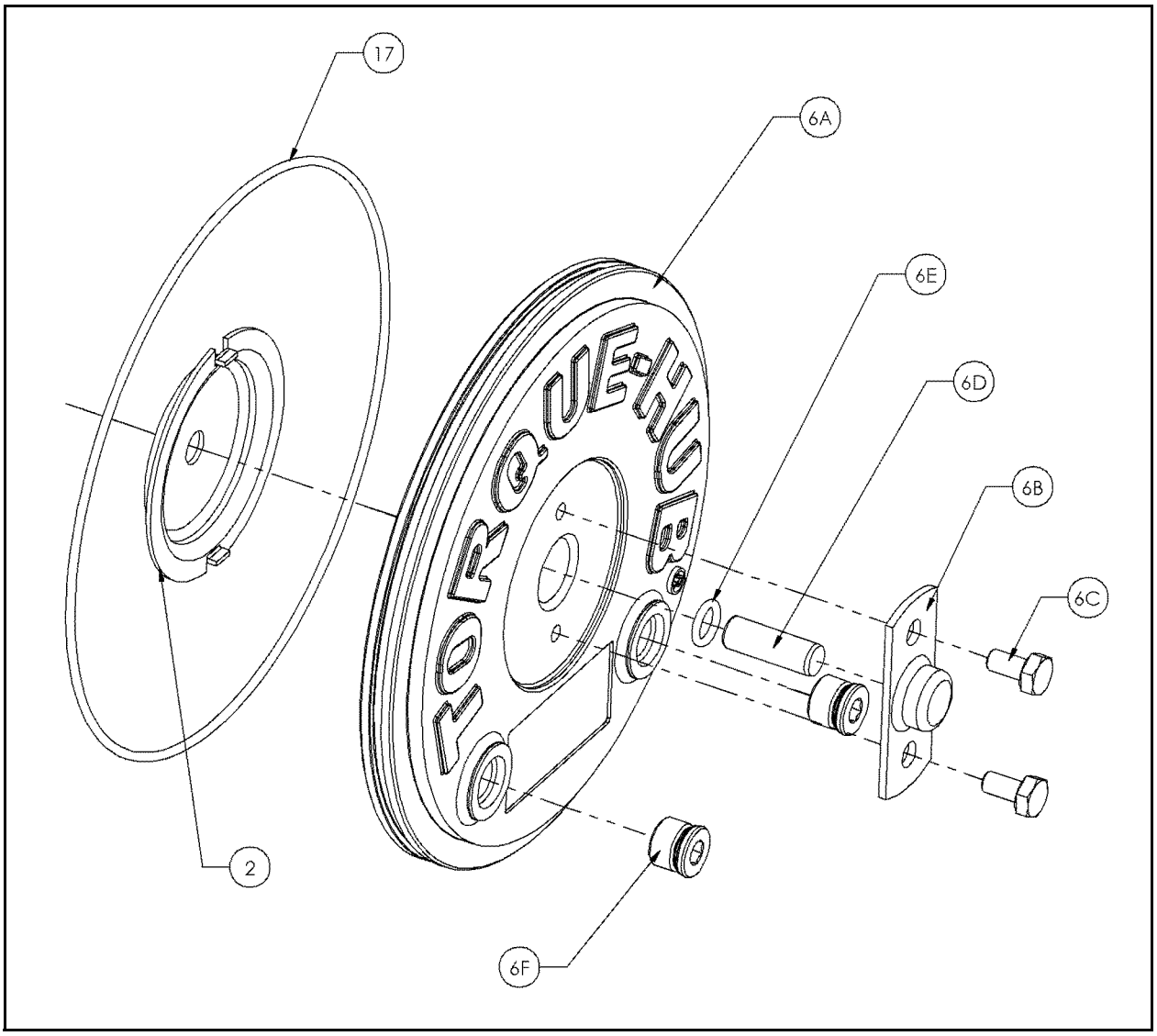
4. Remove Compression Springs (8L) from Piston (8A).

⚠ CAUTION

EYE PROTECTION MUST BE WORN WHILE PERFORMING THE NEXT STEP IN THIS PROCEDURE.

5. Using an air hose, slowly and carefully pressurize the brake port in the Spindle (1A) until the Piston (8A) comes out of piston bore of Spindle (1A), Then pull the Piston (8A) the rest of the way out of the Spindle (1A) by hand.
6. Remove Backup Rings (8E) & (8H) and O-rings (8D) & (8F) from grooves in Piston (8A).
7. Remove Rotors (8J) and Stators (8K) from brake cavity in Spindle (1A).
8. Remove Coupling Subassembly (7) from brake cavity in Spindle (1A).
9. Remove Retaining Ring (1K) out of the internal groove using appropriate tool.
10. Remove the Spacer (1M) & Spring (1L) out of the bore of Coupling (7).
11. Remove Plastic Plug (12) & Pipe Plug (21) from Spindle (1A) if applicable.

Cover Disassembly



2. Thrust Washer
6A. Cover
6B. Disengage Cap
6C. Bolt
6D. Disengage Rod
6E. O-Ring
6F. Pipe Plug
17. O-Ring

Figure 3-11. Cover

1. Remove O-Ring (17) from groove in Cover (6A).
2. Remove Thrust Washer (2) from Cover (6A) pockets.
3. Unscrew two Hex Head Bolts (6C) and remove Disengage Cap (6B) from Cover (6A).
4. Pull Disengage Rod (6D) out from Cover (6A).
5. Use appropriate tool to remove O-ring (6E) from internal groove in Cover (6A).
6. Remove two O-Ring Pipe Plugs (6F) from Cover (6A).

Input Carrier Sub-Assembly

1. Apply a liberal coat of grease to the bore of one Input Planet Gear (3F).
2. Line the inside of the Planet Gear (3F) with 14 Needle Rollers (3C).

NOTE: *The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers which form the space, and then slid, parallel to the other rollers, into place.*

3. Set Carrier (3A) in an upright position.
4. Insert a Planet Shaft (3E) into the planet shaft hole in the end of the Carrier (3A) opposite the splined end. The end of the planet shaft that does NOT have the roll pin hole should be inserted into the carrier FIRST.
5. Place one Thrust Washer (3B) onto the end of Planet Shaft (3E). Make sure the flat faces towards the inside of the carrier and make sure the button fits in the pocket on the inside of the Carrier (3A) towards the OD.
6. Following the thrust washer, place Planet Gear (3F) with needle rollers, onto Planet Shaft (3E).
7. Following the planet gear, place one more Thrust Washer (3B) onto Planet Shaft (3E). Align the Thrust Washer (3B) in the same manner described in Step 5.
8. Now insert Planet Shaft (3E) through the opposite planet shaft hole on Carrier (3A). Use an alignment punch or similar tool to align the roll pin holes on Carrier (3A) and Planet Shaft (3E).

NOTE: *Be sure not to hit the Planet Gears (3F) when driving in the Roll Pins (4G).*

9. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with the flat of carrier.
10. Repeat Steps 1-9 for the installation of the two remaining Planet Gears (3F).

NOTE: *Some grease may need to be applied to the Thrust Washers (3B) to hold them in place while installing the planet gears.*

Output Planet Gear Sub-Assembly

1. Apply a liberal coat of grease to the bore of one Output Planet Gear (4F).
2. Line the inside of the Planet Gear (4F) with 14 Needle Rollers (4C).

NOTE: *The last roller installed must be installed end wise. That is, the end of the last roller must be placed in between the ends of the two rollers which form the space, and then slid, parallel to the other rollers, into place.*

3. Place Spacer (4D) into the bore of the Output Planet (4F).
4. Repeat Step 2 to put in second roll of Needle Rollers (4C).
5. Apply grease to hold two Thrust Washers (4B) together and onto Output Planet Gear (4F) counterbore. Do the same to the other side.
6. Repeat Steps 1-5 to finish the assembly of the two remaining Output Planet Gears (4F).

Spindle - Brake Sub-Assembly

1. Place Spindle (1A) such that the flange side is up.
2. Place Stator (8K) into the Spindle (1A) scallop cuts.
3. Place Rotor (8J) on top of Stator (8K).
4. Repeat steps 2 & 3 until there are a total of 9 Stators (8K) and 8 Rotors (8J) installed.
5. Place Piston (8A) such that the smaller O.D. end is facing upward. Grease the two O-Rings and the two Backup Rings.
6. Install large Backup Ring (8E) in the large-diameter groove at the bottom of the Piston (8A).
7. Install large O-Ring (8D) in the large-diameter groove at the bottom of the Piston (8A), on top of the large Backup Ring (8E).
8. Install small O-Ring (8F) in the small-diameter groove near the top of the Piston (8A). Make sure the O-Ring is seated on the bottom of the groove.

9. Install small Backup Ring (8H) in the small-diameter groove near the top of the Piston (8A), on top of the small O-Ring (8F).
10. Insert Piston (8A) into Spindle (1A) until it contacts the Stator (8K).
11. Insert the appropriate number of Springs (8L), based on the assembly print, into Piston (8A)counterbore.
12. Place Spring (1L) into Coupling (7) counterbore. Place the Pressure plate (1M) on top of Spring (1L).
13. Use appropriate tool to install Retaining Ring (1K) into the retaining ring groove in the coupling (7) counterbore.
14. Insert Coupling sub-Assembly (7) through Rotors (8J).
15. Place Pressure Plate (8B) on top of Springs (8L).
16. Use two ¼ -20 x .625 flat head Cap Screws (22) by bolting the Pressure Plate (8B) and Piston (8A) together or some other appropriate tools to install Retaining Ring on top of Pressure Plate (8B) until Retaining Ring (8C) is seated.

NOTE: *Remove 2 Screws from units when done, otherwise brake will not function.*

17. Install Pipe Plug (21) if applicable

Hub-Spindle Sub-Assembly

NOTE: *Spray a light film of oil on all component parts during assembly. Spray a generous amount of oil on bearings during installation.*

1. Press Bearing Cup of part (1C), position "A", into Hub using T-158422 pressing tool.
2. Turn hub over and press Bearing Cup of part (1C), position "B", into hub using T-158422 pressing tool.(T).
3. Place Bearing Cone of part (1C), into Bearing Cup of part (1C), position "B".
4. Grease Seal (1B) lip and press seal into Hub (1D) using appropriate tool until seal is flush with end of hub.(T).
5. Place Hub (1D) into pressing base. Press nine Studs (1H) into Hub.

NOTE: *Use enough pressure to press in studs. Don t use excessively high pressure to press in studs or hub may crack.*

6. Set Spindle assembly (1A) on the bench with the flange down. Turn Hub (1D) over and lower onto Spindle (5). Install boot (21) if applicable.
7. Install Bearing Cone of part (1C) into Bearing Cup, position "A".
8. Apply Loctite 243 on Bearing Nut (1F) thread. Screw Nut (1F) on top of Bearing Cone of part (1C). Leave .003-.005 inches endplay to check the initial rolling torque with the unit tied down. Then torque Bearing Nut (1F) until rolling torque is 40 to 50 in-lbs greater than initial rolling torque. Using tool T-206569 for the Bearing Nut.

NOTE: *Final torque is initial rolling torque plus 40-50 in-lbs. E.g., if the initial rolling torque is 30 in-lbs, the final rolling torque is between 70-80 in-lbs. Be sure to rotate hub as the torque is applied to properly seat the bearing. Be sure the torque wrench is tangent to the Hub (1D) OD.*

9. Using appropriate tool, install two Set Screws (1G) into Bearing Nut (1F) threaded holes. Make sure Set Screw is driven into the spindle thread. Tighten the set screws to damage the thread and stake the edge of the nut around the Set Screws (1G) so the nut will not loosen.
10. Place Thrust Washer (4H) into counterbore of Spindle (1A).
11. Place Planet Gear Sub-assembly (4) into Spindle (1A) through gap between two Studs (1H). Align the planet gear bore with one of the planet shaft holes on the spindle (1A) assembly using T-209919.
12. Insert a Planet Shaft (4E) into the planet shaft hole described in Step (11) on Spindle (1A). The end of the planet shaft that does NOT have the roll pin hole should be inserted into the Spindle FIRST.
13. Now insert Planet Shaft (4E) through the first set of Thrust Washers (4B), Planet gear, then the second set of Washers (4B). Use an alignment punch or similar tool to align roll pin holes on Spindle (1A) and Planet Shaft (4E).

NOTE: *Be sure not to hit the Planet Gears (4F) when driving in Roll Pins (4G).*

14. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with OD of spindle.
15. Repeat Steps (11-14) for the installation of the two remaining Planet Gears (4F).

Cover Sub-Assembly

1. Grease O-Ring (6E) and insert into internal groove in Cover (6A).
2. Assemble Disengage Cap (6B) onto Cover (6A) using two Hex Head Bolts (6C). Torque bolts to 70-80 in-lbs.
3. Insert Disengage Rod (6D) into hole in Cover (6A) until it touches the inside of the Disengage Cap (6B).

NOTE: *The Disengage Rod can be inserted either end first.*

4. Grease Face of Thrust Washer (2) and place in Cover (6A) making sure that tangs on washer seat into pockets in cover.
5. Install O-Ring Pipe Plugs (6F) into Cover (6A). The plugs should be hand tight.

Main Assembly

NOTE: *All components should receive a generous amount of lubricant oil as they are being assembled.*

1. Place Hub-Spindle Sub-Assembly on the bench.
2. Grease O-Ring (18) and place it into groove of Hub (1D).
3. Place Ring Gear (1E) onto Hub (1D). Align the three shipping Cap Screw Holes on Hub (1D) and Ring Gear (1E).
4. Install three shipping Cap Screws (19) into ring gear and hub. Torque them to 15-20 ft-lbs.
5. Place External Retaining Ring (5) over 13T spline to the retaining groove on Input Shaft (9).

NOTE: *For ratio 48:1, assemble Output Sun Gear (11) over Input Shaft (9) first, then install External Retaining Ring (5).*

6. Using appropriate tool to install Retaining Ring (20) into groove on Output Sun (11).
7. Place Input Shaft (9) spline end into mesh with Internal Coupling (7) splines.
8. With the modified spline end facing up, place the Output Gear (11) into mesh with the planet gears from the Hub-Spindle Sub-Assembly.
9. Place Input Carrier Sub-Assembly (3A) onto Output Sun Gear (11) splines. Drop Input Sun (10) into mesh with planet gears for specific ratios, if required. (No timing required).
10. Grease O-Ring (17) and insert into groove in Cover Sub-Assembly (6).
11. Install Cover Sub-Assembly (6) into Ring Gear (1E) counterbore and install Retaining Ring (6G) into groove in Ring Gear (1E).
12. Attach ID Tag (15) onto unit using Drive Screws (16).
13. Check disconnect, roll and air check unit, leak check brake, and record release pressure.
14. Insert Plastic Plug (12) into place if applicable.

Integral Brake Check

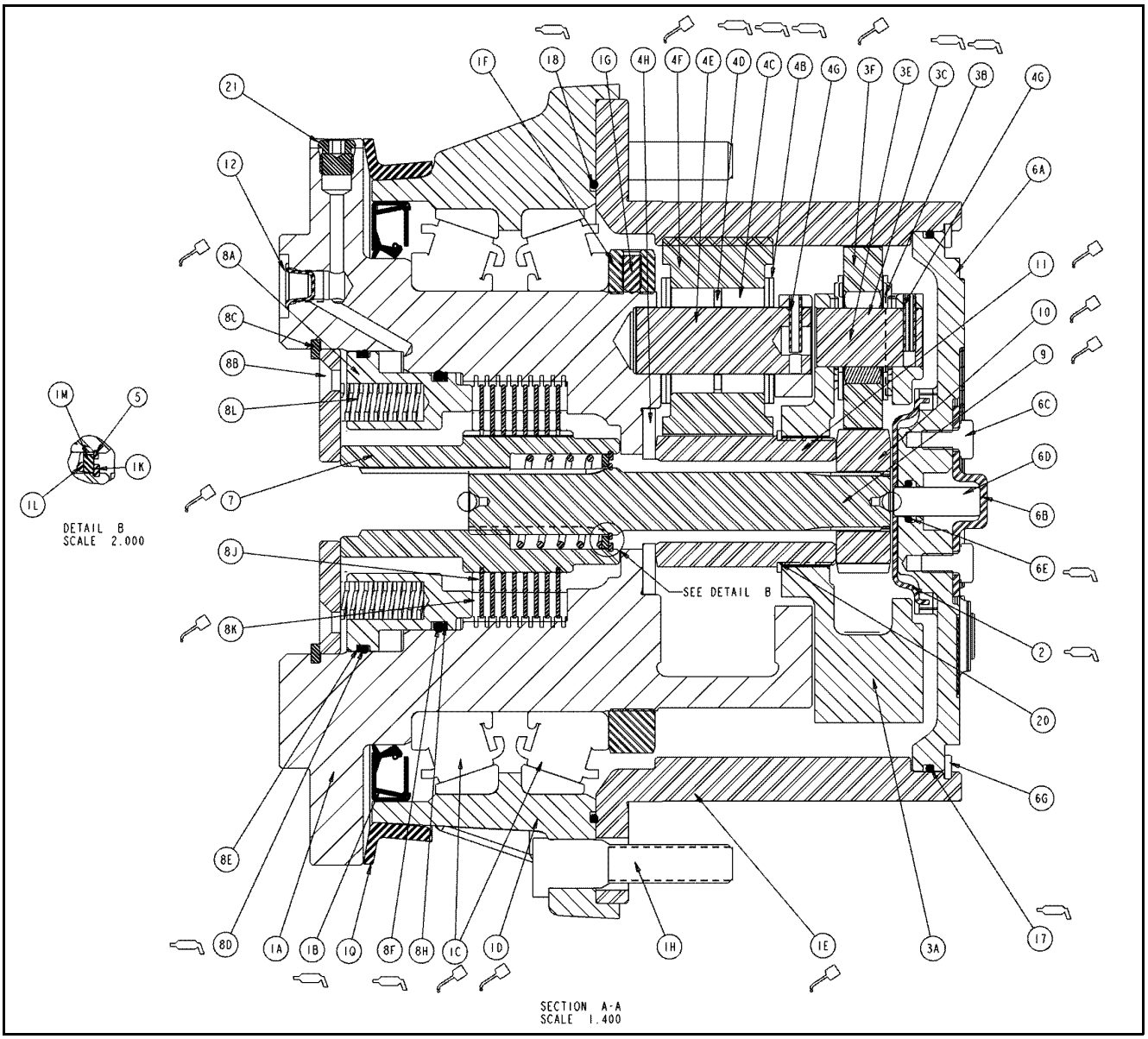
1. Using appropriate fittings, connect hydraulic line from hand pump to brake port.
2. Check to see that brake is set by trying to rotate Input Shaft (9). This can be accomplished by installing an appropriate tool (any tool that can locate on the splines of the Input Coupling (7), such as a mating splined shaft) into Input Coupling (7).
3. Bleed brake. Increase hydraulic pressure gradually while trying to rotate the input until brake just starts to release. Note this pressure. Make sure the pressure falls into the appropriate range below.

BRAKE CODE	JUST RELEASE PRESSURE RANGE	
	PSI	BAR
A	200-260	13.7-17.9
B	170-220	11.7-15.1
C	140-185	9.6-12.7
D	130-155	8.9-10.6
E	115-145	7.9-9.9

4. Increase pressure to 1,000 psi and hold for 30 seconds to check for leaks. Repair leaks if necessary.

NOTE: *Make sure that brake re-engages when pressure is released.*

NOTE: *When done, make sure Input Coupling (7) is centered in Spindle (1A) to make installation of motor possible without release of brake.*



1A. Spindle
1B. Lip Seal
1C. Tapered Bearing
1D. Housing
1E. Ring Gear
1F. Bearing Nut
1G. Setscrew
1H. Stud
1K. Retaining Ring
1L. Spring
1M. Thrust Washer
1Q. Seal Boot
2. Thrust Spacer
3A. Carrier
3B. Thrust Washer
3C. Needle Bearing
3E. Planet Shaft
3F. Planet Gear
4B. Thrust Washer
4C. Needle Bearing
4D. Thrust Spacer
4E. Planet Shaft
4F. Planet Gear
4G. Roll Pin
4H. Thrust Washer
5. Retaining Ring
6A. Cover
6B. Disengage Cap
6C. Bolt
6D. Dowel Pin
6E. O-Ring
6F. Pipe Plug
6G. Retaining Ring
7. Coupling
8A. Brake Piston
8B. Pressure Plate
8C. Retaining Ring
8D. O-Ring
8E. Backup Ring
8F. O-Ring
8H. Backup Ring
8J. Brake Rotor
8K. Brake Stator
8L. Spring
9. Input Shaft
10. Sun Gear
11. Sun Gear
12. Plastic Plug
15. ID Plate
16. Drive Screw
17. O-Ring
18. O-Ring
19. Bolt
20. Retaining Ring
21. O-Ring Plug

Figure 3-12. Hub Assembly

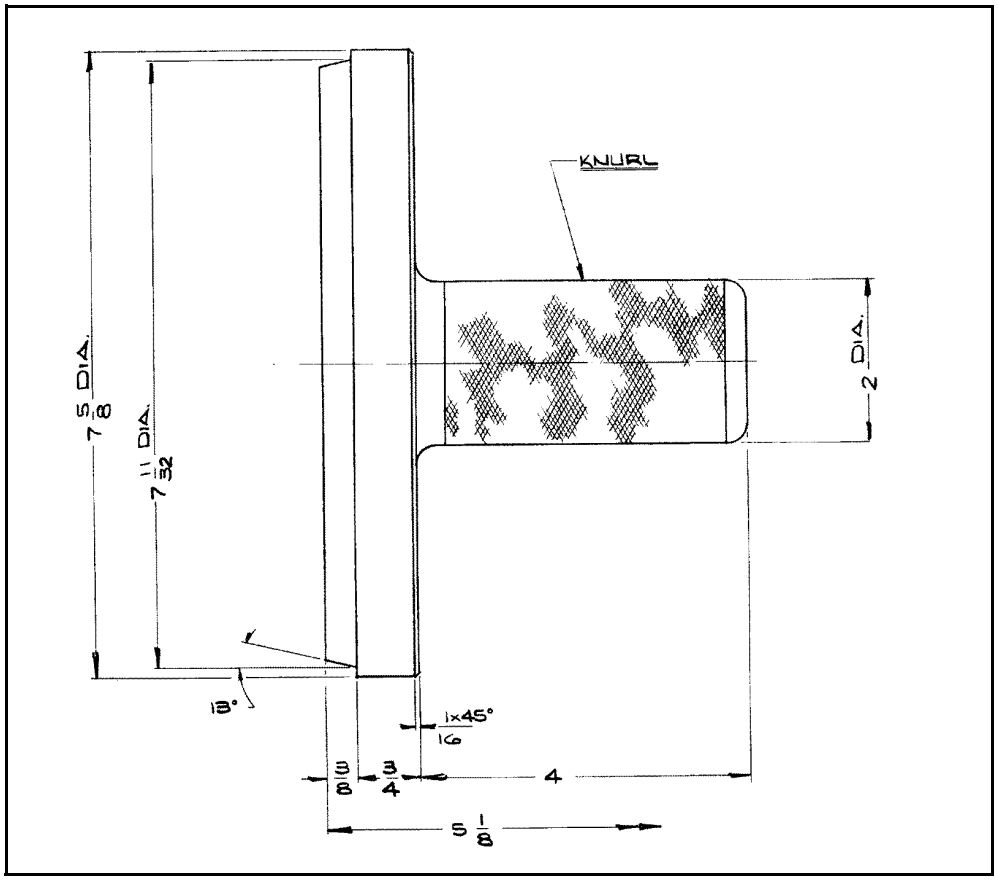


Figure 3-13. Bearing Cup Pressing Tool

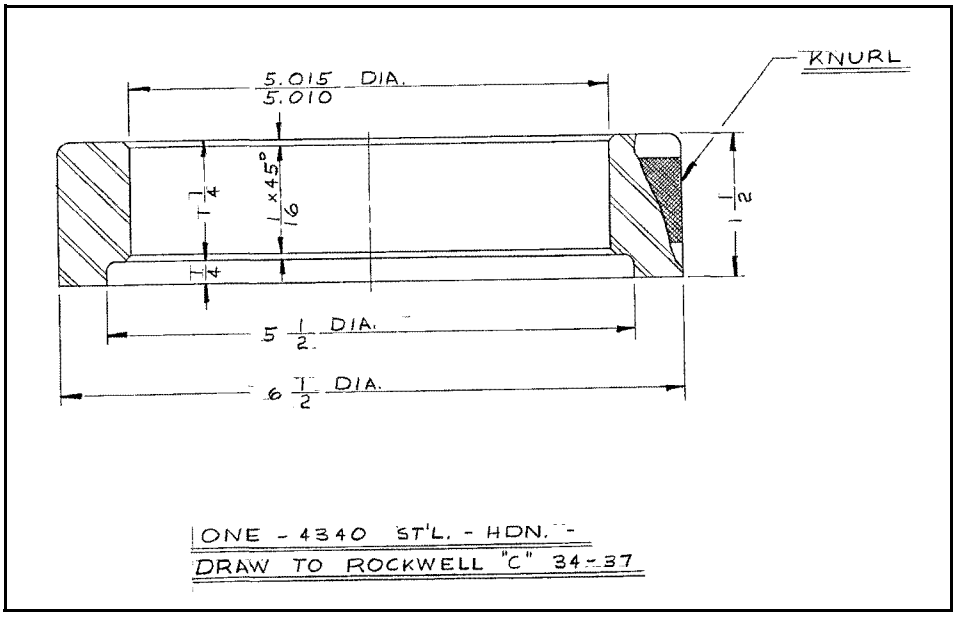


Figure 3-14. Seal Pressing Tool

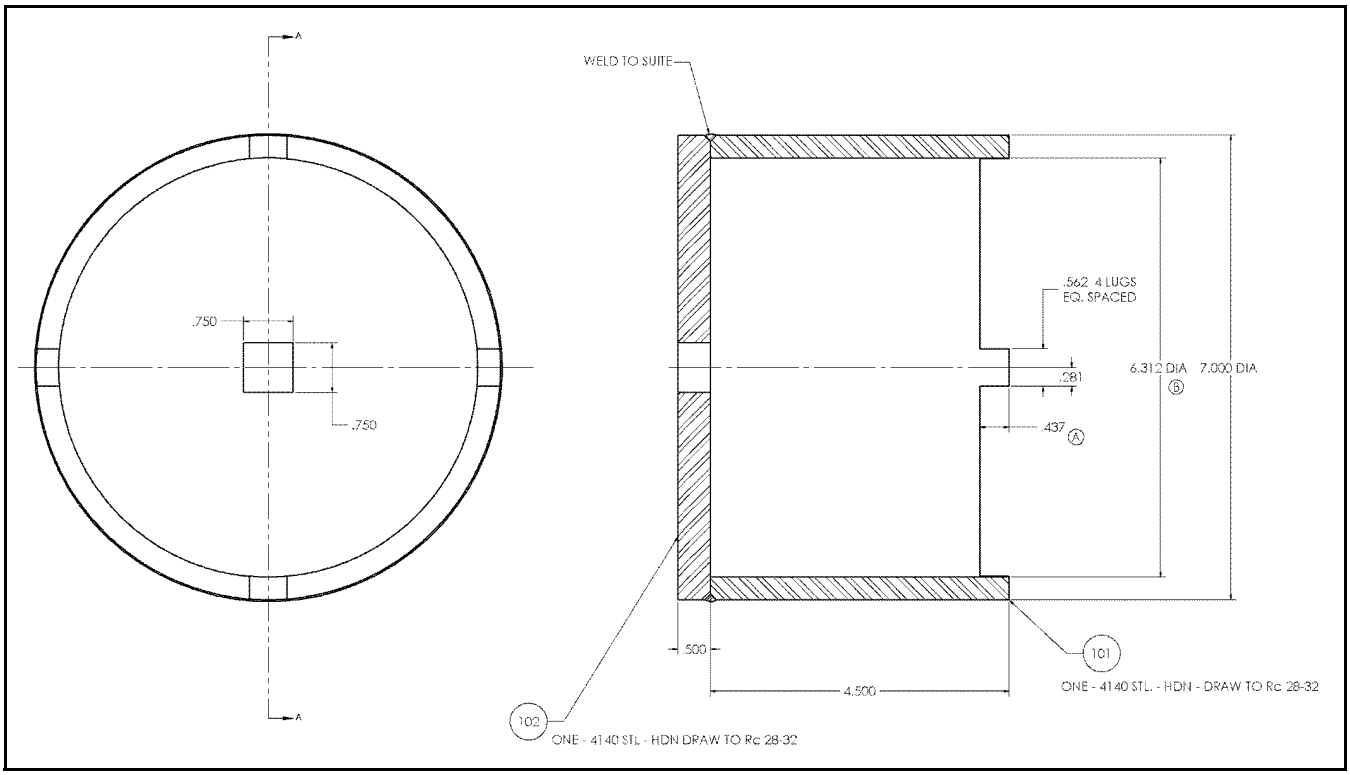


Figure 3-15. Bearing Cup Pressing Tool

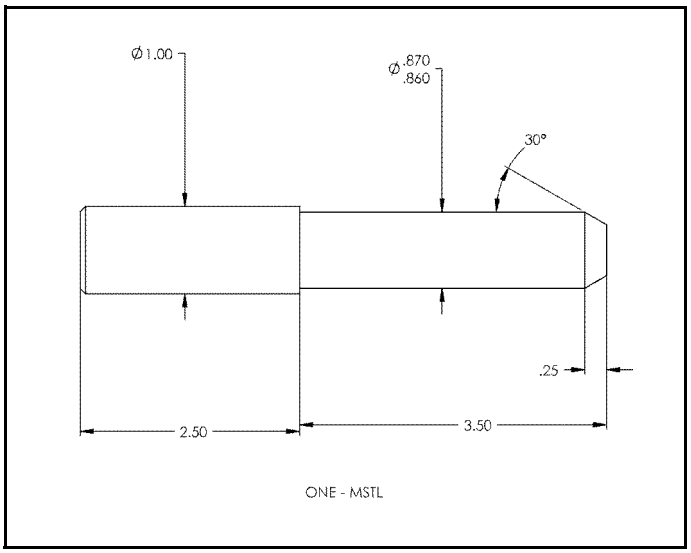


Figure 3-16. Drift Pin for Lining Up Thrust Washers with Output Planet Gear

3.4 DRIVE BRAKE - MICO

Disassembly

1. With shaft protrusion downward, remove end cover (13) by removing capscrews (12).

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 681 KG. THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (1362 KG MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Remove case seal (11) from housing (7) then remove bleeder screw (14) from end cover (13).
3. Remove piston (24) from end cover (13).
4. Remove o-ring (19), back-up ring (18), o-ring (21) and back-up ring (20) from piston (24).
5. Remove separators (10) from housing (7).
6. Remove stack assembly, consisting of discs (23), return plate (8) and friction discs (22) from housing (7).
7. Remove dowel pins (17), springs (5 & 6) from housing (7).
8. Remove retaining ring (3) from housing (7).
9. Remove shaft by pressing or using a soft mallet on male end of shaft (4).
10. Remove retaining ring (15) bearing (2) from shaft (4).
11. Press rotary seal (1) from housing (7).

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 inspection, they are found to be in good condition.*

Assembly

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

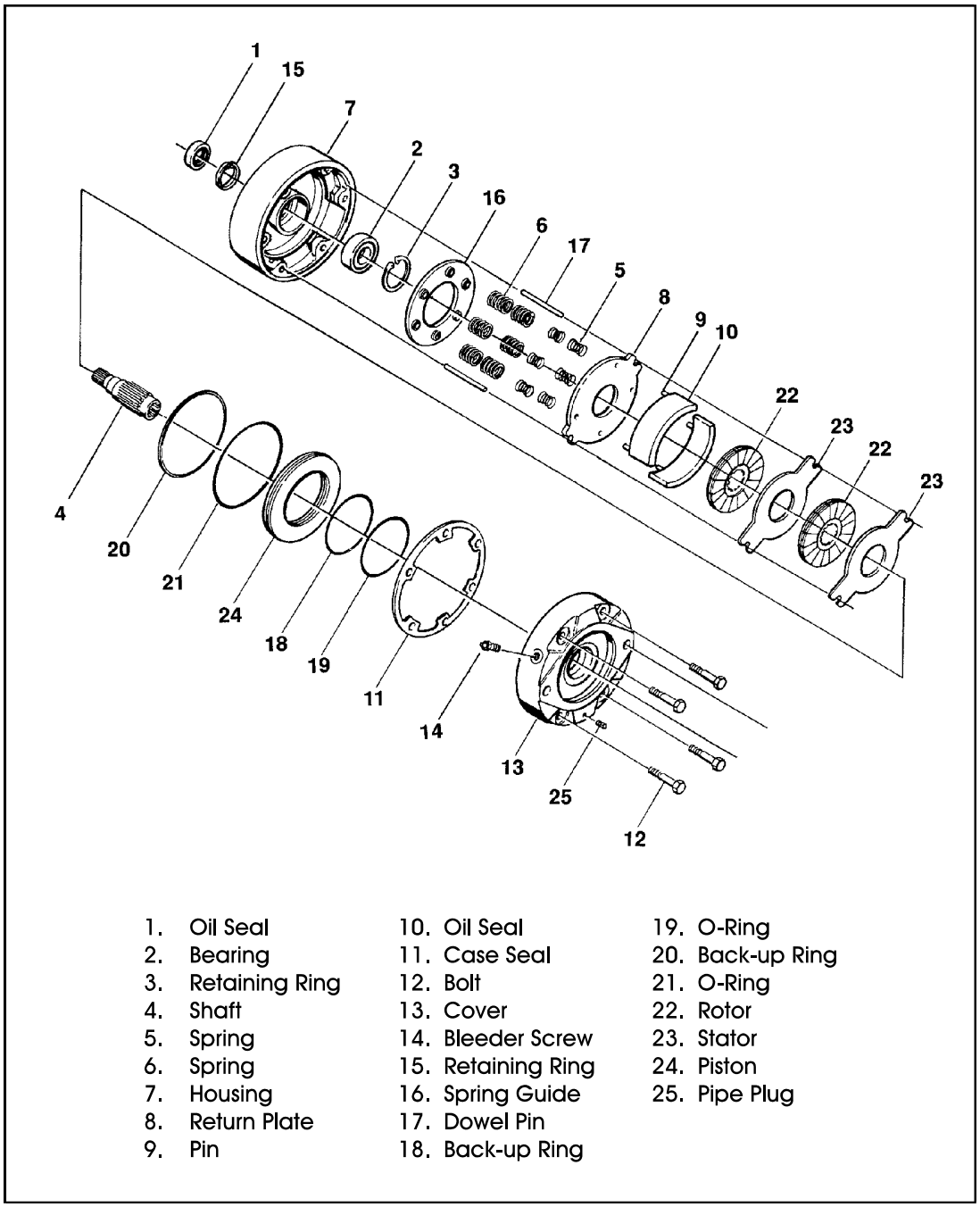
1. Press new rotary seal (1) into housing (7). Note the direction of seal.
2. Install new bearing (2) on shaft (4).
3. Install shaft assembly and retaining ring (3) into housing (7).
4. Install dowel pins (17), spring retainer (16), and springs (5 & 6) into housing (7).

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

5. Position new large diameter return plate (8) in housing with tabs guided by dowel pins (17) until disc rests on springs (5 & 6).

NOTE: *Discs (8 & 23) and friction discs (22) should remain dry during installation. No oil contaminate disc surfaces.*

6. Place new disc (22) on shaft (4) until it contacts return plate (8).
7. Add additional discs (23) as required to complete assembly.
8. Insert separators (10) in holes of return plate (8).
9. Install new o-ring (19), new back-up ring (18), new o-ring (20) and new back-up ring (21) on piston (24). Insert piston (24) into end cover (13) being careful not to shear o-rings or back-up rings.
10. Install new case seal (11) in housing (7) then install bleeder screw (14) in end cover.
11. Position end cover (13) on housing (7) aligning dowel pins (17) with holes in end cover.
12. Insert capscrews (12) and tighten evenly to draw end cover (13) to housing (7). Torque capscrews to 75 Nm.



1. Oil Seal
2. Bearing
3. Retaining Ring
4. Shaft
5. Spring
6. Spring
7. Housing
8. Return Plate
9. Pin
10. Oil Seal
11. Case Seal
12. Bolt
13. Cover
14. Bleeder Screw
15. Retaining Ring
16. Spring Guide
17. Dowel Pin
18. Back-up Ring
19. O-Ring
20. Back-up Ring
21. O-Ring
22. Rotor
23. Stator
24. Piston
25. Pipe Plug

Figure 3-17. Drive Brake Assembly (Mico)

3.5 FREE WHEELING OPTION

To Disengage Drive Motors and Brakes (Free Wheel) for Towing, etc.

1. Chock wheels securely if not on flat level surface.
2. Disconnect both drive hubs by inverting disconnect caps in center of hubs.

If equipped, move steer/tow selector valve to float (tow) position by pulling valve 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.

Remove chocks from wheels as required.

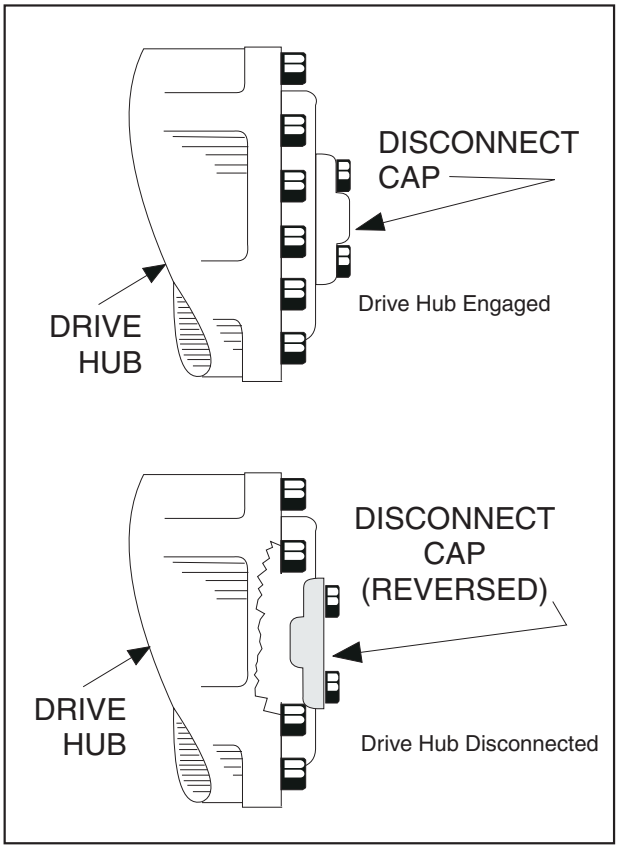
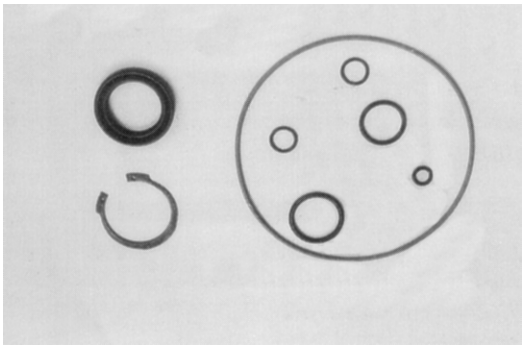


Figure 3-18. Disconnecting the Drive Hubs

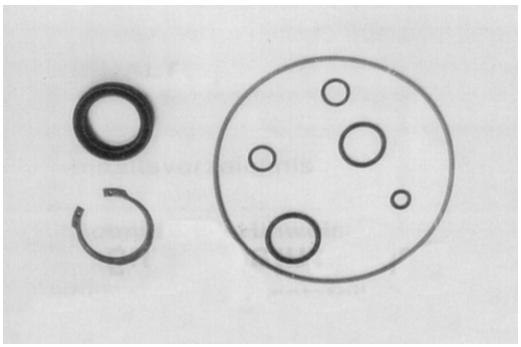
3.6 DRIVE MOTOR (600S, 600A 4WD)

Spare Parts Kits

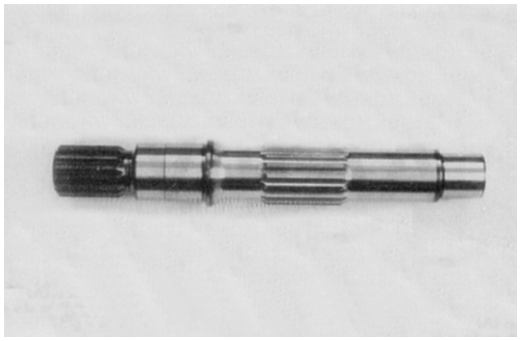
Sealing kit, existing spare parts: shaft sealing ring, 6 different O-rings and a circlip (sealing mat.: perbunan)

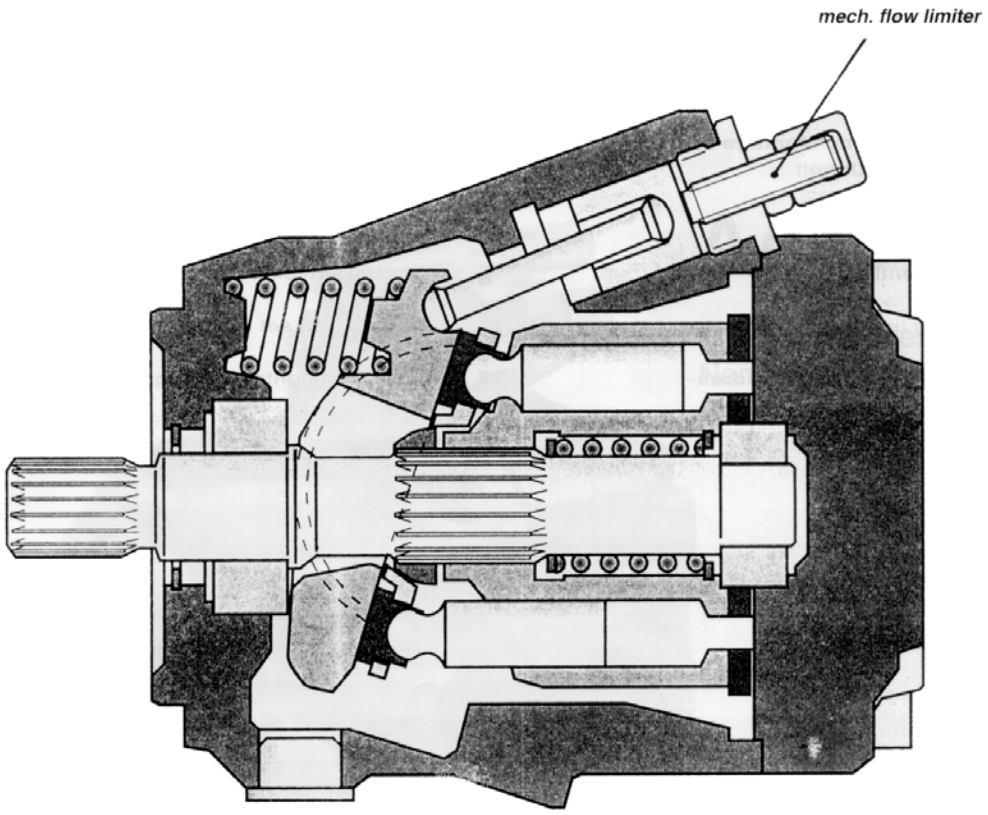


Same sealing kit like shown above only seal material changed to Viton

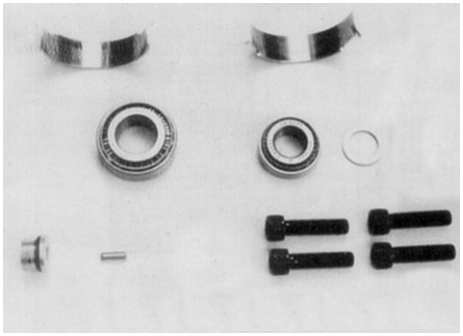


Drive shaft

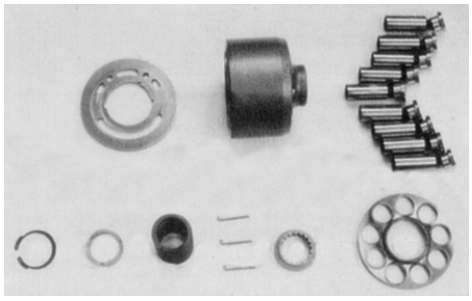




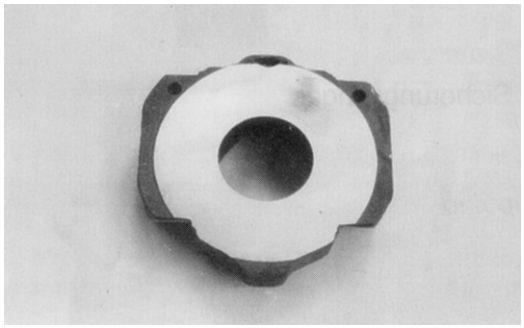
Bearing set/miscellaneous parts



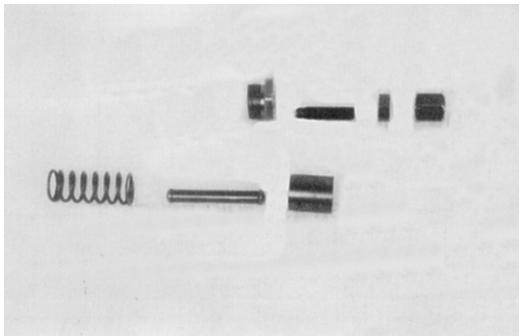
Rotary group complete 9 pistons, cylinder sub-assembly, valve plate (cw or ccw corresponding to the order) retaining plate and retaining ball.



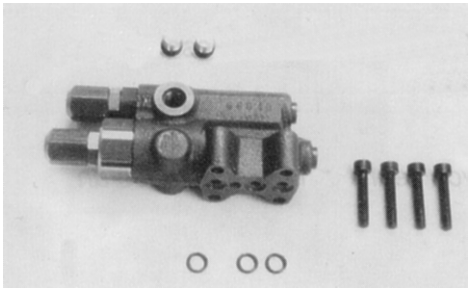
Swash Plate



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

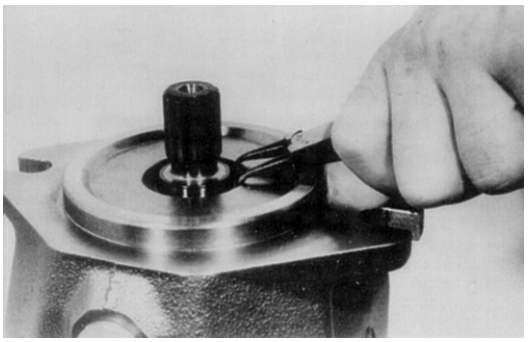


Spare parts kit DFR pilot valve

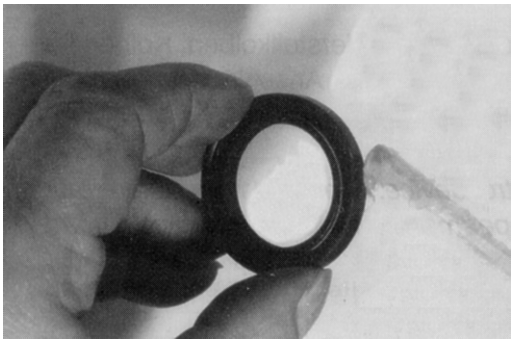


Replacing the Drive Shaft Seal

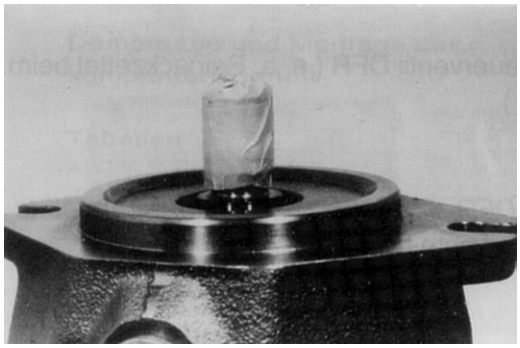
1. Remove the snap ring



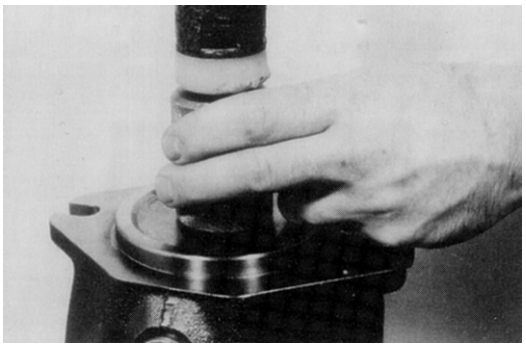
2. Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.



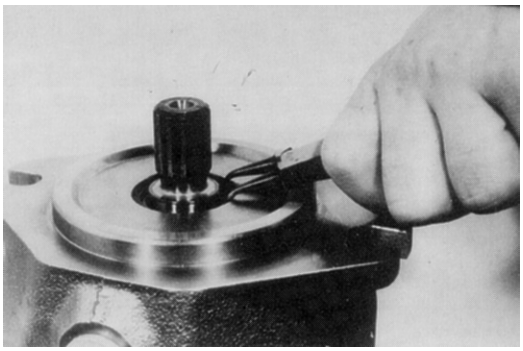
3. Be careful while you seal the drive shaft, use an adhesive tape to protect the splines.



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



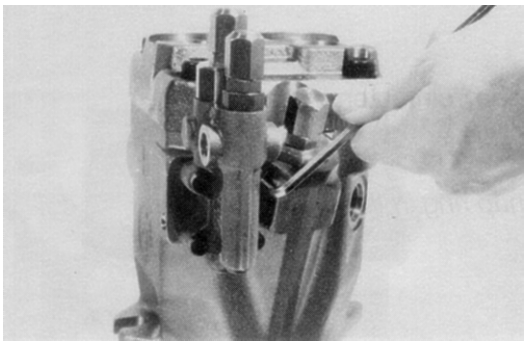
5. Assemble the snap ring.



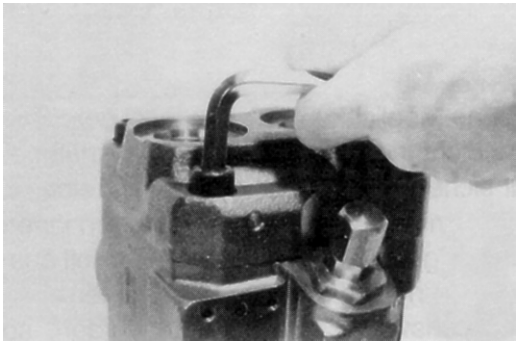
6. Assemble the snap ring in the correct position.

Disassembly and Assembly

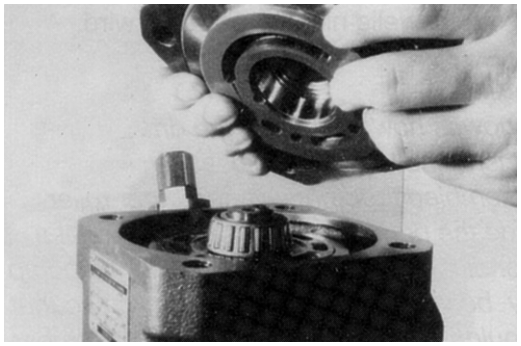
1. Disassemble the pilot valve.



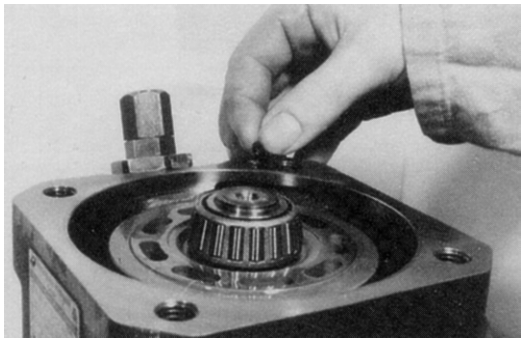
2. Mark the position of the port plate and remove the socket screw from the port plate.



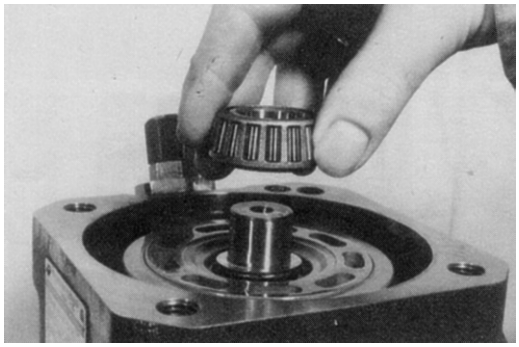
3. Remove the port plate together with the valve plate (hold the valve plate so that the plate can't fall down).



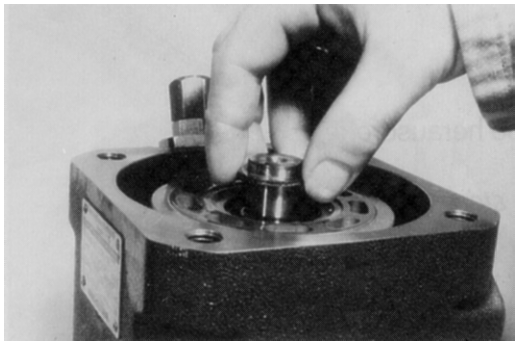
4. Remove the O-ring.



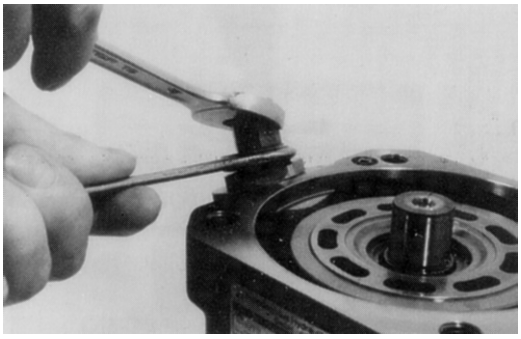
5. Disassemble the taper roller bearing.



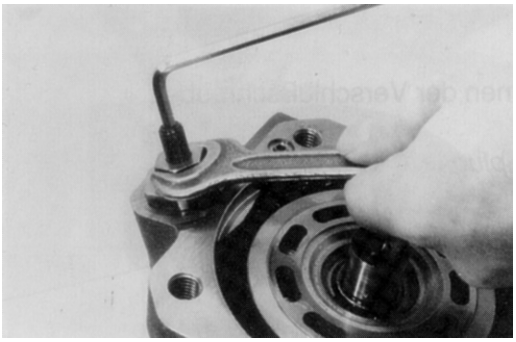
6. Remove the adjustment shim.



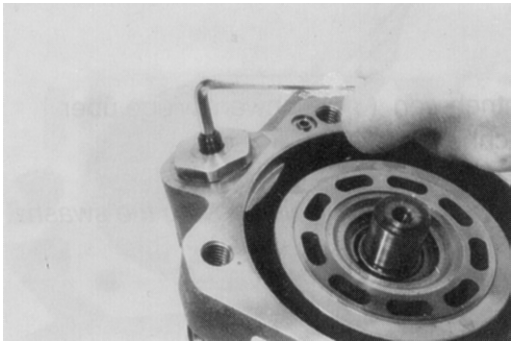
7. Unscrew the cap nut and remove it.



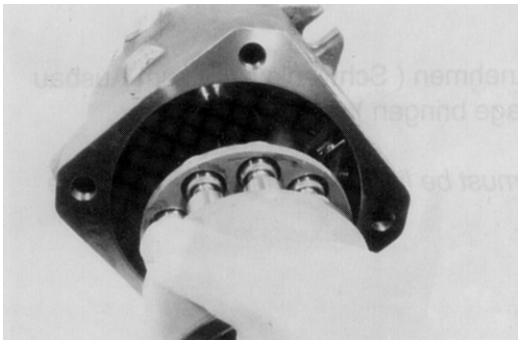
8. Loosen the retaining nut of the stopper max flow and remove it.



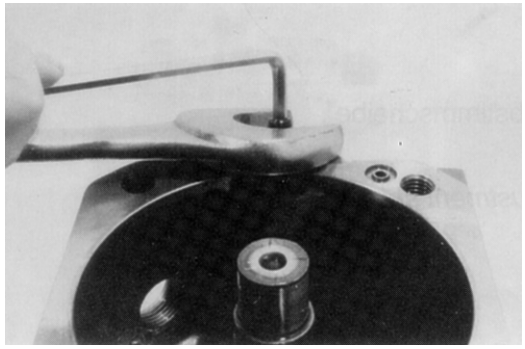
9. Turn in the stopper max flow to get swivel angle zero.



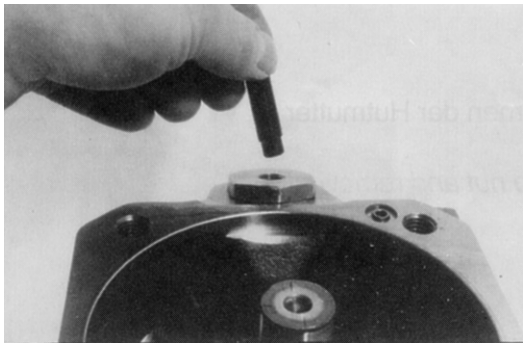
10. Disassemble the rotary group in horizontal position.



11. Disassemble the stopper - max. flow.

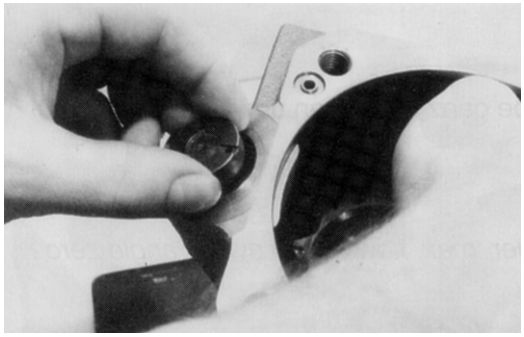


12. Remove the threaded pin (stopper - max.flow)

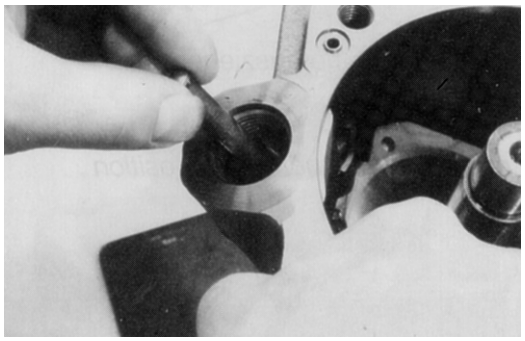


13. Disassemble the plug.

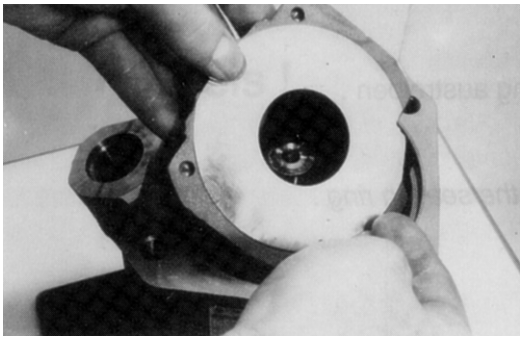
14. Disassemble the control piston while moving the swash plate.



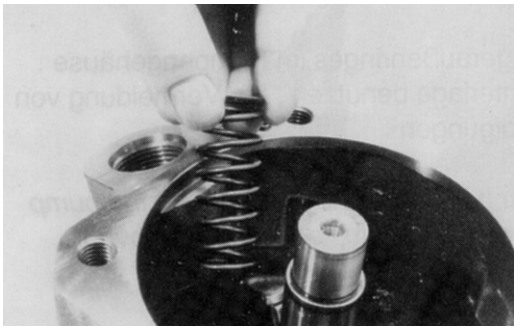
15. The swash plate must be lifted a little bit to disassemble the piston rod.



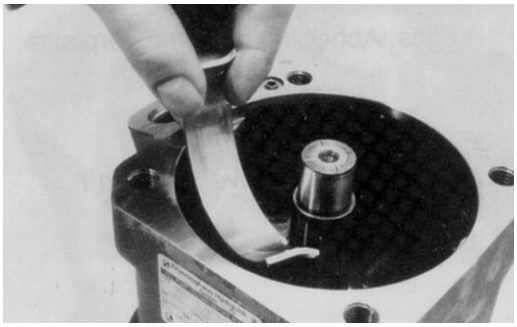
16. Disassembly of the swash plate.



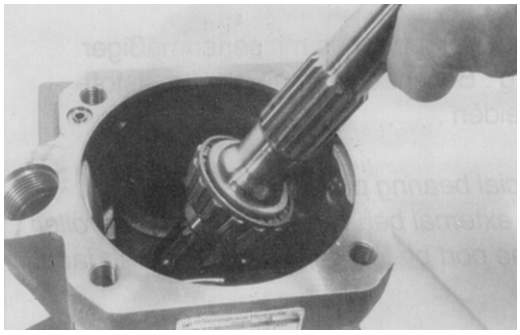
17. Remove the spring.



18. Remove both bearing shells.



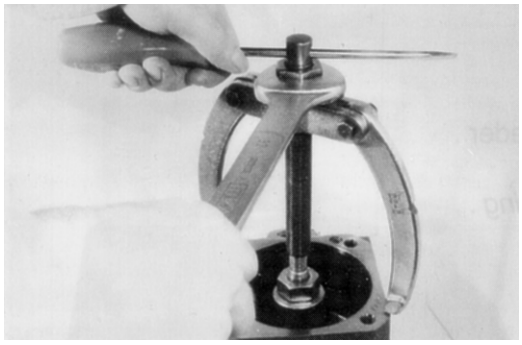
19. Remove the drive shaft.



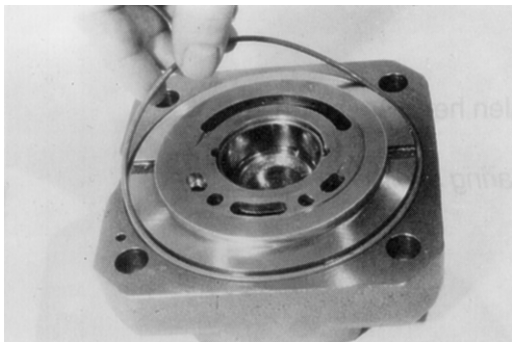
20. Remove the snap ring.

21. Disassemble the sealing ring.

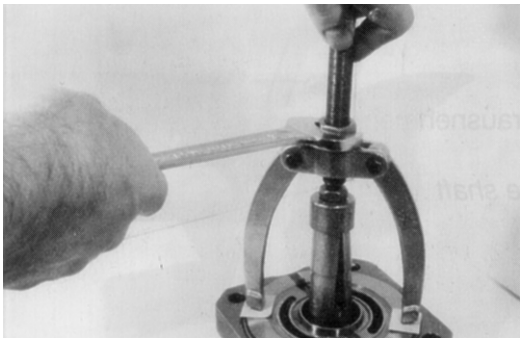
22. The external front bearing ring is pulled out of the pump housing.



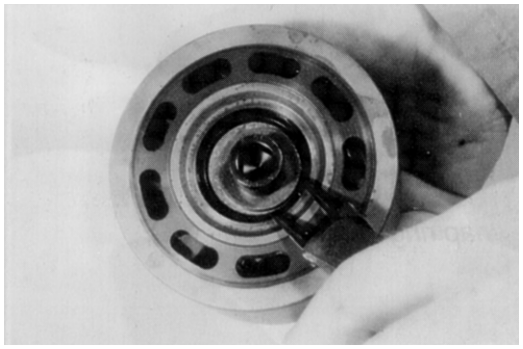
23. Remove the O-ring. Lifting of the valve plate isn't shown.



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

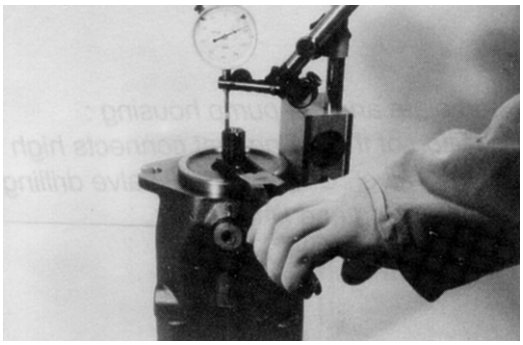


25. The spring has additional pretension while you disassemble the three pressure pins inside the cylinder.

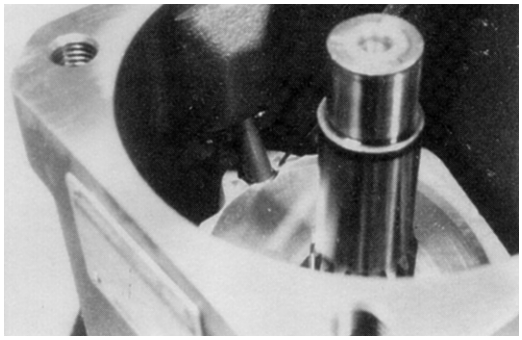


Assembly Notes

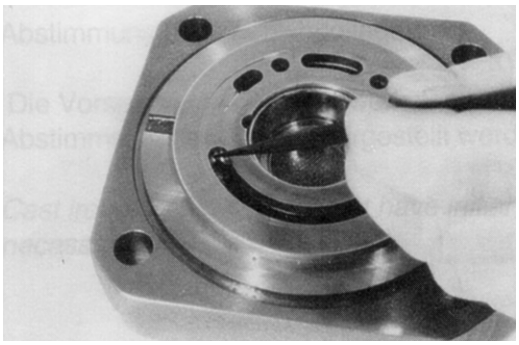
1. Measurement of the taper roller bearing pretension.



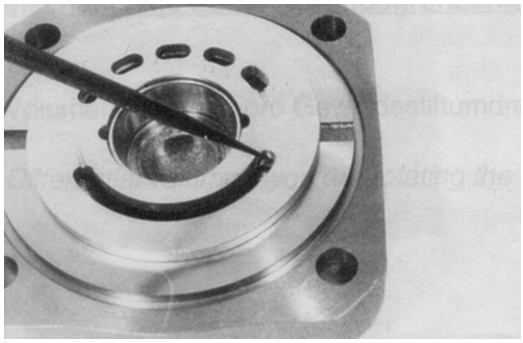
2. Note that there is a correct connection of the piston rod and the swash plate.



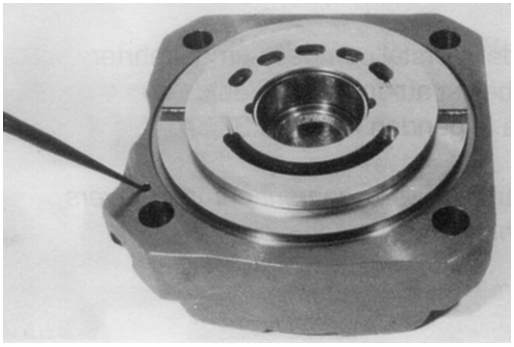
3. Pumps clockwise driven must have a position to the valve plate 4 degrees out of center in the same direction de-centered like drive direction. (Note spare parts exist as cw and ccw valve plates.)



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

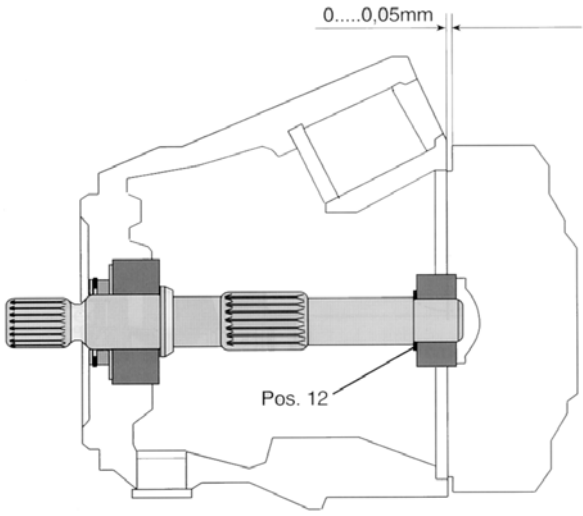


5. Assembly of the port plate and the pump housing: Note the correct position of the drilling that connects high pressure to the control valve. Check control valve drill position at the pump housing and fit together.

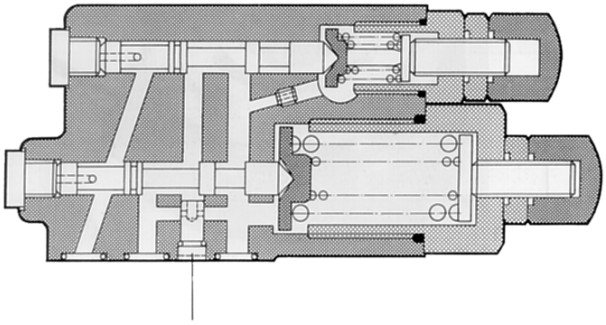


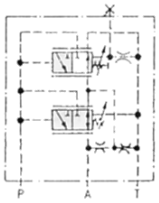
Taper Roller Bearing Initial Tension

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

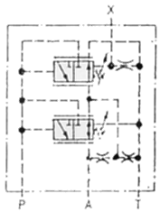


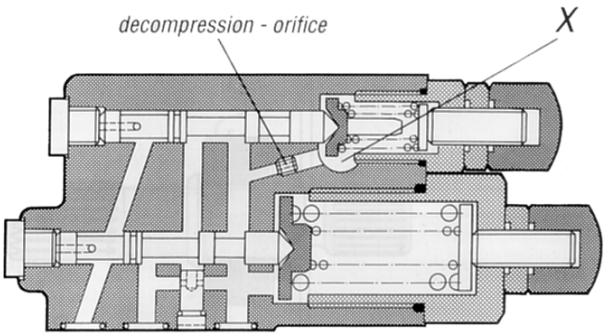
all valves shown here do have open position of the orifice (see picture below "pos. of orifice").



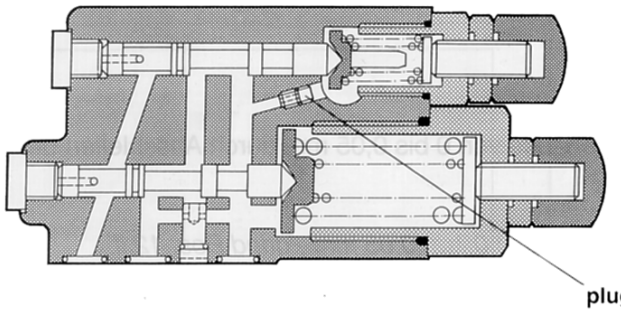


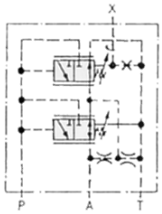
pressure compensator DR
Both X- ports are pluged .
Flow control blocked.



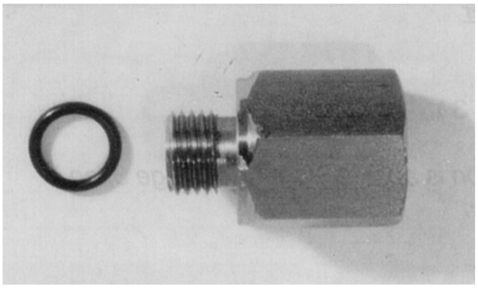


pressure compensator and flow control DFR
One X - port is plugged .





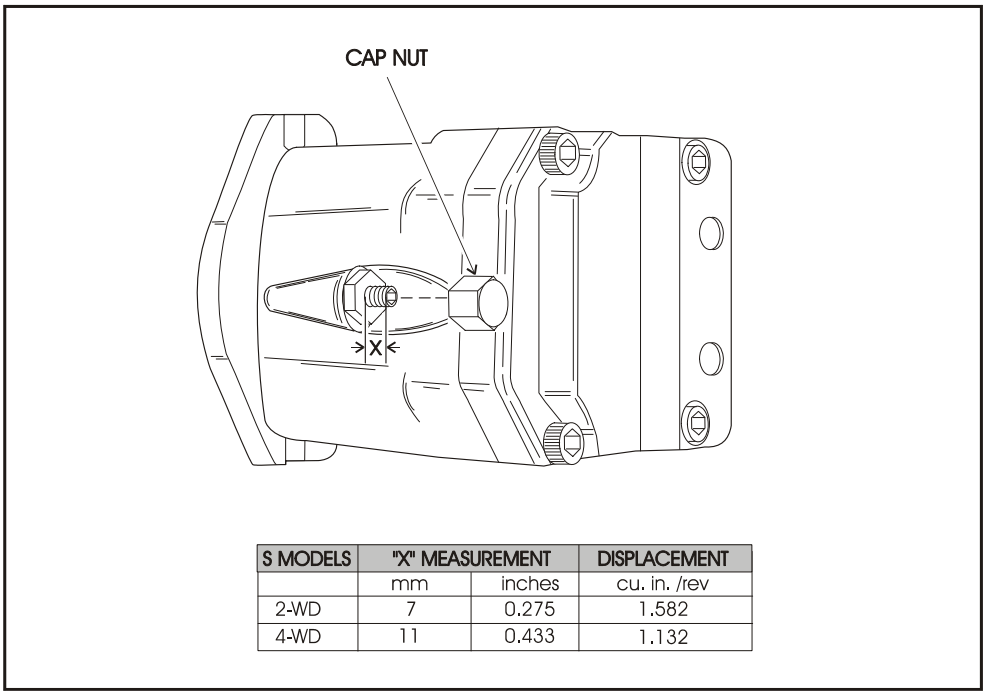
pressure compensator and flow control DFR 1
One X - port is pluged . Decompression orifice X-T is pluged by the plug.



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

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

Figure 3-19. Flow Control Pilot Valves

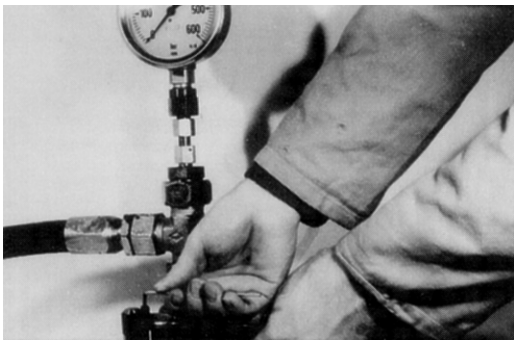


S MODELS	"X" MEASUREMENT		DISPLACEMENT
	mm	inches	cu. in. /rev
2-WD	7	0.275	1.582
4-WD	11	0.433	1.132

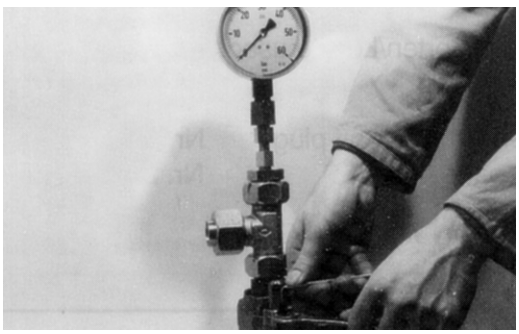
Figure 3-20. Drive Motor Adjustment (S Models)

Testing and Setup

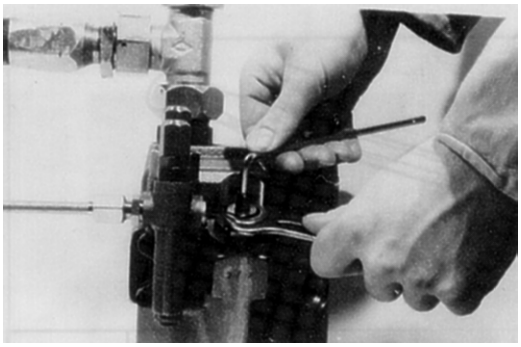
DR: When pressure line is closed adjust the pressure of the controller (if it's DFR design then open the adjustable orifice and increase force of the spring - FR -).



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.



3.7 DRIVE MOTOR ADJUSTMENT PROCEDURE (S MODELS ONLY)

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 3-20., Drive Motor Adjustment (S Models).
4. Tighten jam nut, install cap nut.

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

3.8 OSCILLATING AXLE BLEEDING PROCEDURE AND LOCKOUT TEST

Lockout Cylinder Bleeding

⚠ IMPORTANT

ENSURE PLATFORM IS FULLY LOWERED AND BOOM IS CENTERED OVER REAR AXLE PRIOR TO BEGINNING BLEEDING PROCEDURE.

ENSURE 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.

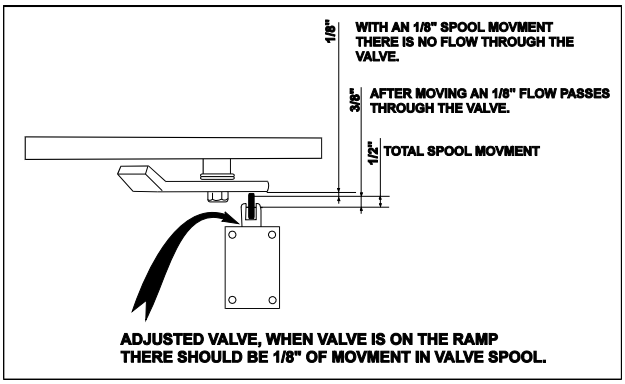


Figure 3-21. Oscillating Valve Adjustment

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

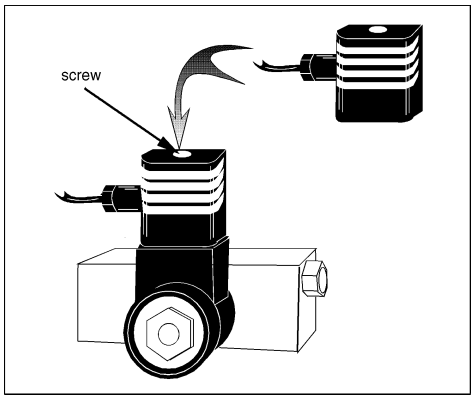


Figure 3-22. Brake Valve Wiring Connection

4. Use suitable containers to retain any residual hydraulic fluid, place containers under each lockout cylinder.
5. Open all four bleeder screws (two on each lockout cylinder).
6. Start the engine, position drive control lever on the main hydraulic pump forward or reverse as shown.

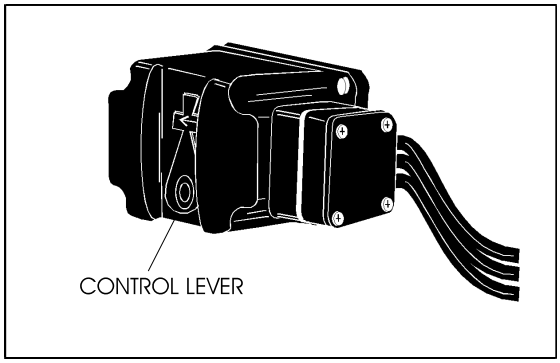


Figure 3-23. Drive Manual Control Valve

7. Close bleeder screws when all air is dissipated (bled).
8. Perform oscillating axle lockout test.
9. If necessary, repeat steps 1 thru 8.

Oscillating Axle Lockout Test

⚠ IMPORTANT

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 15 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.

If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.9 STEER ADJUSTMENTS (S MODELS)

NOTE: *Spindles do not stop on cylinder stroke. Adjust steering stops as follows: Adjust item #1 to achieve 44° inside turn angles. Steer full left and adjust RH item #2 to contact axle. Steer full right and adjust LH item #2 to contact axle. (2WS/2WD)*

Spindles do not stop on cylinder stroke. Adjust steering stops as follows: Adjust item #1 to achieve 39° inside turn angles. Steer full left and adjust RH item #2 to contact axle. Steer full right and adjust LH item #2 to contact axle. (2WS/4WD)

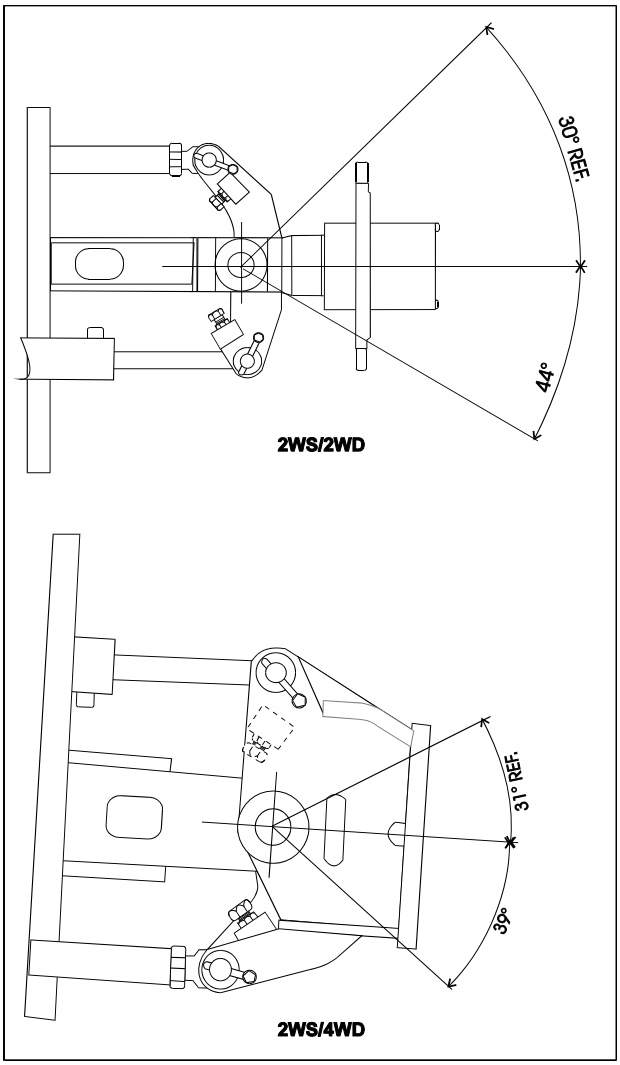


Figure 3-24. Steer Adjustments

3.10 SWING HUB

Adjustment Procedures

NOTE: *The swing bearing high spot is usually marked by colored paint.*

1. Ensure swing drive is located on bearing gear max eccentric tooth (high spot).
2. With mounting free to slide, shim between pinion and bearing gear teeth to achieve .008 - .012 backlash.
3. Install a pry bar into hole in turntable base plate and pry swing hub back tight against shim and bearing.
4. Torque bolts according to the torque chart in Section 1.

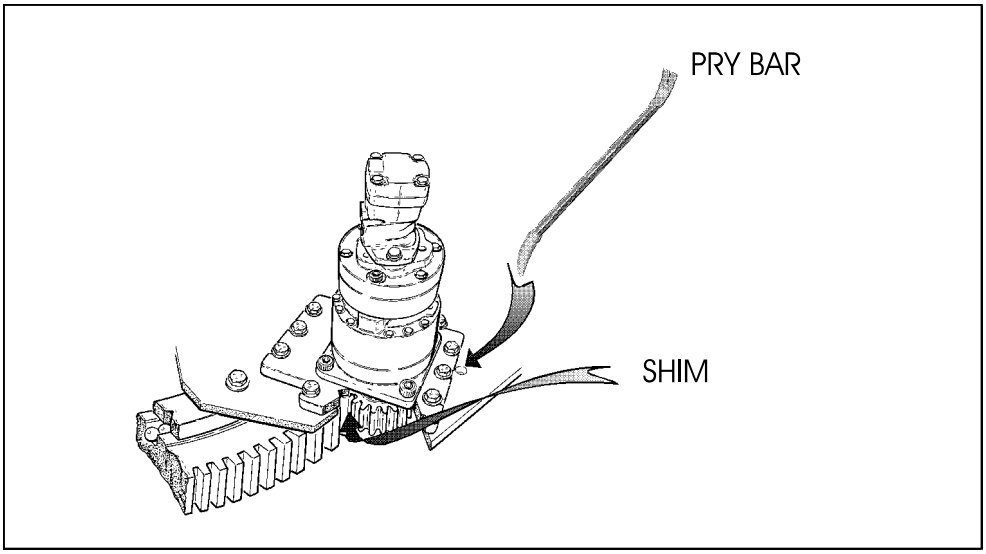


Figure 3-25. Swing Torque Hub Adjustment

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 loctite #271. 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 retracted boom to 70 degrees (full elevation).
   b. At the positions indicated on Figure 3-26., Swing Bearing Bolt Feeler Gauge Check, try and insert the .0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   c. Assure that the .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 boom to 70 degrees (full elevation).
   b. At the positions indicated on Figure 3-26., Swing Bearing Bolt Feeler Gauge Check, try and insert the .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 below, try and insert the .0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

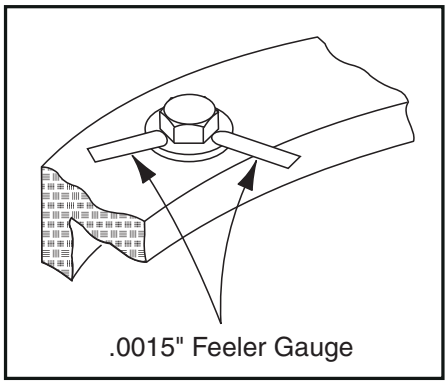


Figure 3-26. Swing Bearing Bolt Feeler Gauge Check

Wear Tolerance.(S & A Models)

1. From the underside of the machine, at rear center, with the boom fully elevated and fully retracted, as shown in (Figure 3-29., Swing Bearing Tolerance Boom Placement (S Models) and Figure 3-28., Swing Bearing Tolerance Boom Placement (A Models), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-27., Swing Bearing Tolerance Measuring Point)

2. At the same point, with the boom at horizontal and fully extended, and the tower boom fully elevated as shown in Figure 3-29., Swing Bearing Tolerance Boom Placement (S Models) and Figure 3-28., Swing Bearing Tolerance Boom Placement (A Models) - Swing Bearing Tolerance Boom Placement) B, using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See Figure 3-27., Swing Bearing Tolerance Measuring Point)

3. If a difference greater than 1.40 mm is determined, the swing bearing should be replaced.

4. If a difference less than 1.40 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.

⚠ IMPORTANT

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.

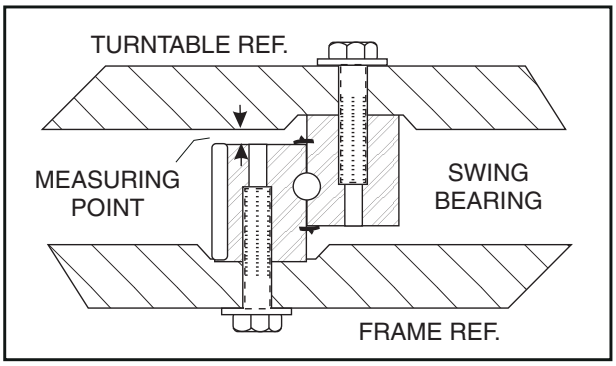


Figure 3-27. Swing Bearing Tolerance Measuring Point

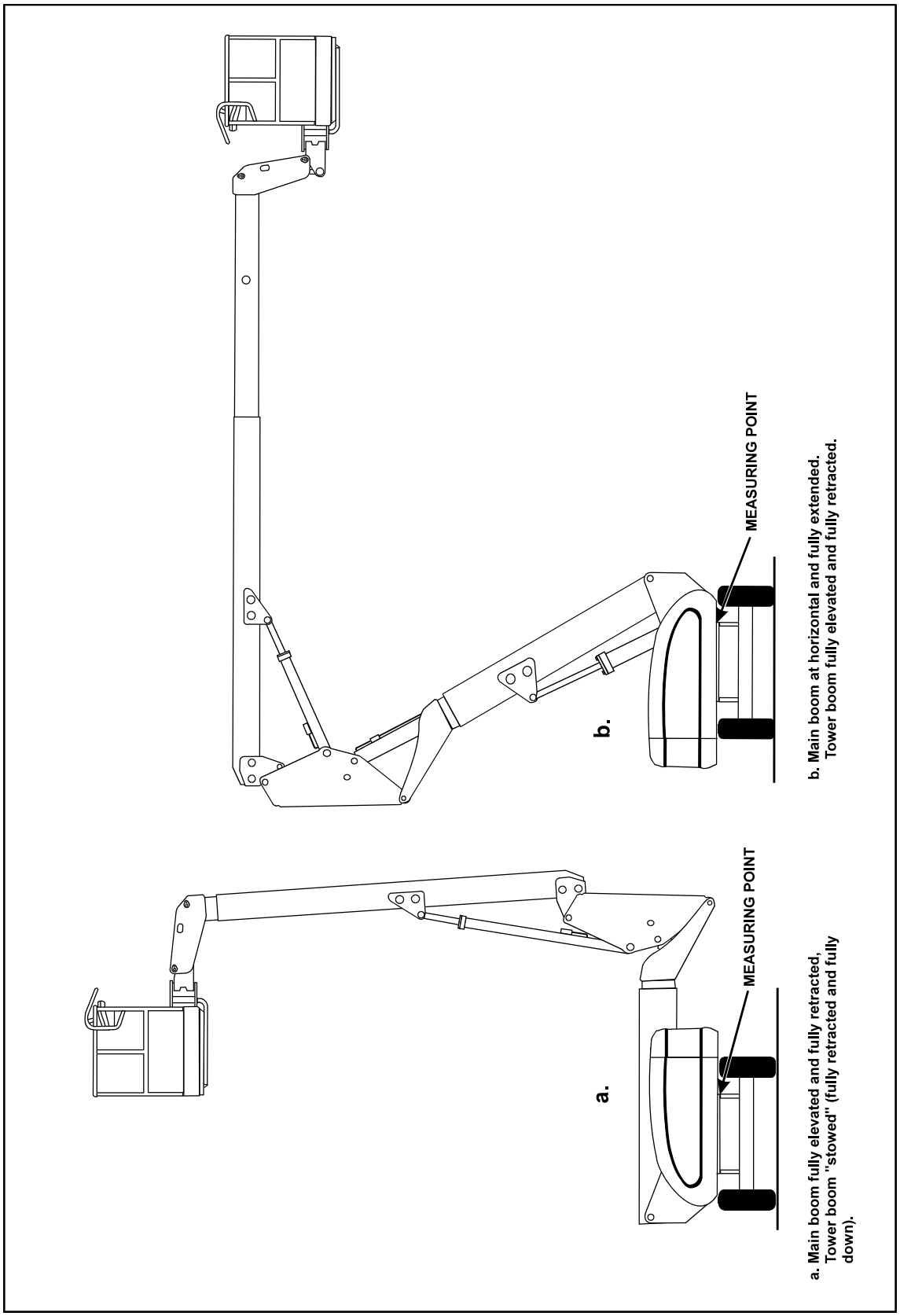


Figure 3-28. Swing Bearing Tolerance Boom Placement (A Models)

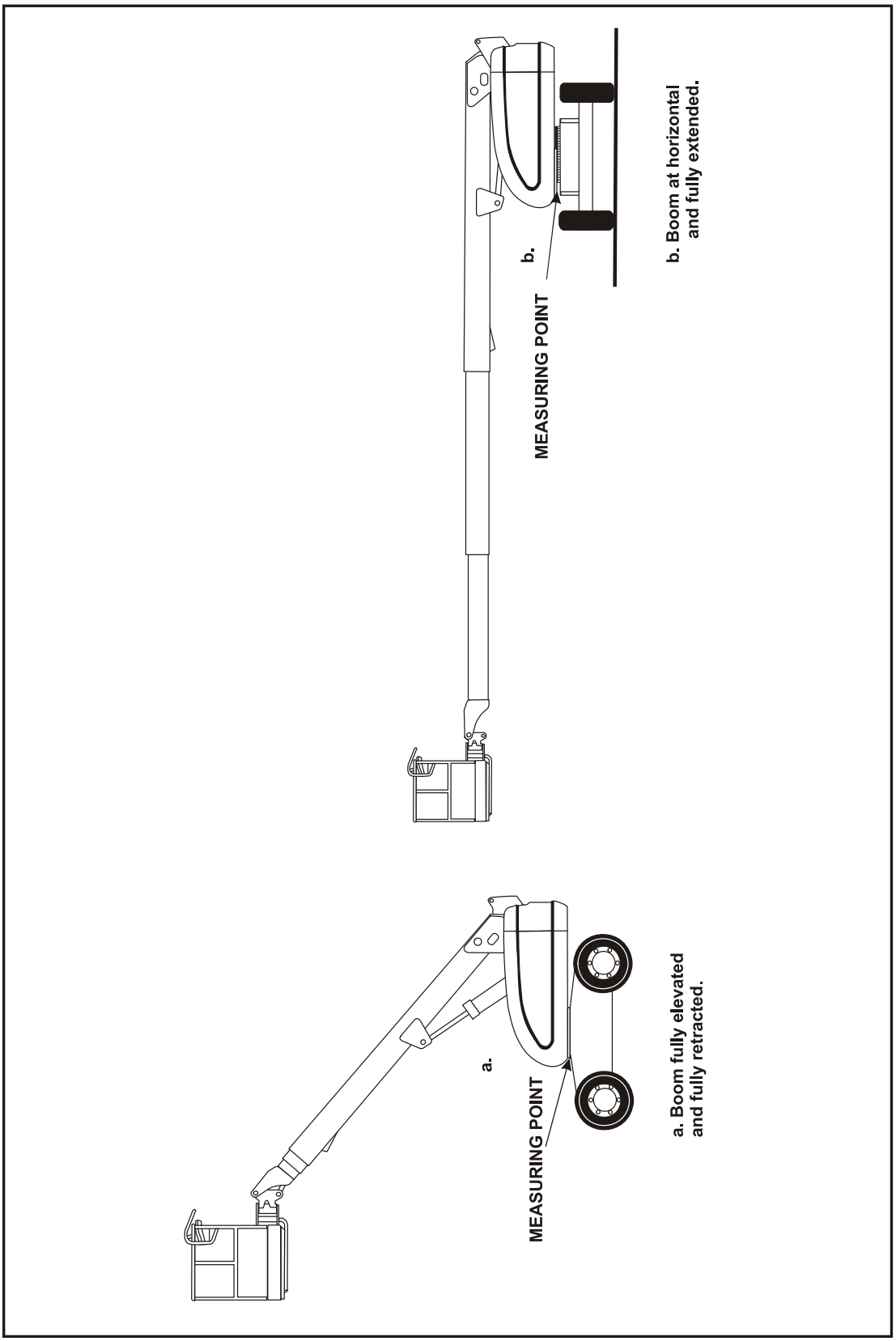


Figure 3-29. Swing Bearing Tolerance Boom Placement (S Models)

Swing Bearing Replacement

1. Removal.

   a. From Ground Control station, operate the boom adequately to provide access to frame opening or, if equipped, 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.

⚠ IMPORTANT

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 Loctite #271 to the new bearing bolts, and loosely install the bolts and washers through the frame and outer race of bearing.

⚠ CAUTION

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 3-30., Swing Bearing Torque Sequence. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts and washers through the frame and outer race of the bearing. Tighten the bolts to an initial torque of 326 Nm w/Loctite.

   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. Spray a light coat of Safety Solvent 13 on the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts and washers through the turntable and inner race of the bearing.

   h. Following the Torque Sequence diagram shown in Figure 3-30., Swing Bearing Torque Sequence, tighten the bolts to a torque of 326 Nm w/Loctite.

   i. Remove the lifting equipment.

   j. Install the rotary coupling retaining yoke brackets, apply a light coating of Loctite #242 to the

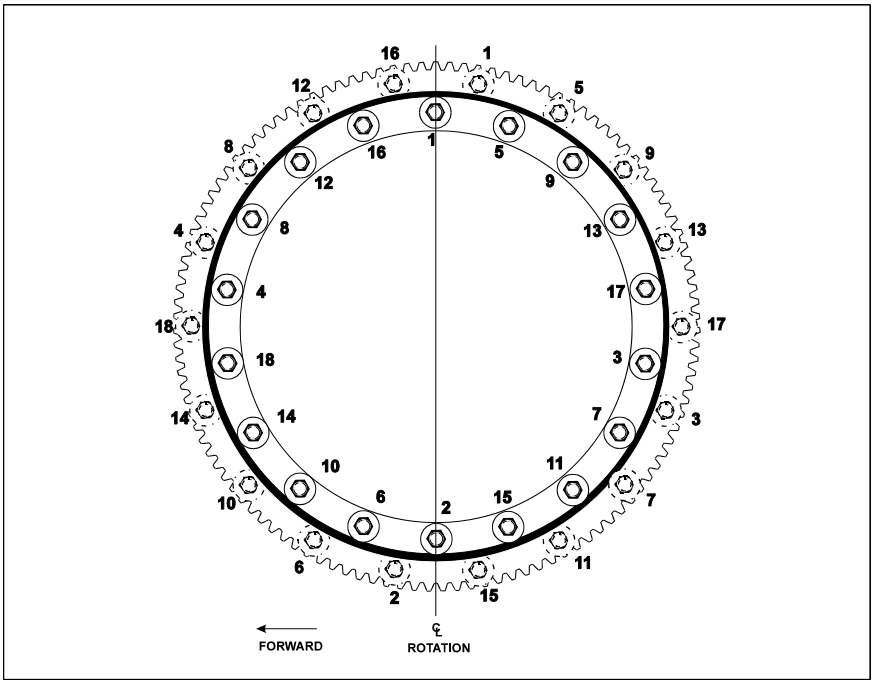


Figure 3-30. Swing Bearing Torque Sequence

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 - 326 Nm w/Loctite, 298 Nm dry.
2. Inner Race - 326 Nm w/Loctite, 298 Nm dry.
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.

3.12 SWING BRAKE - MICO

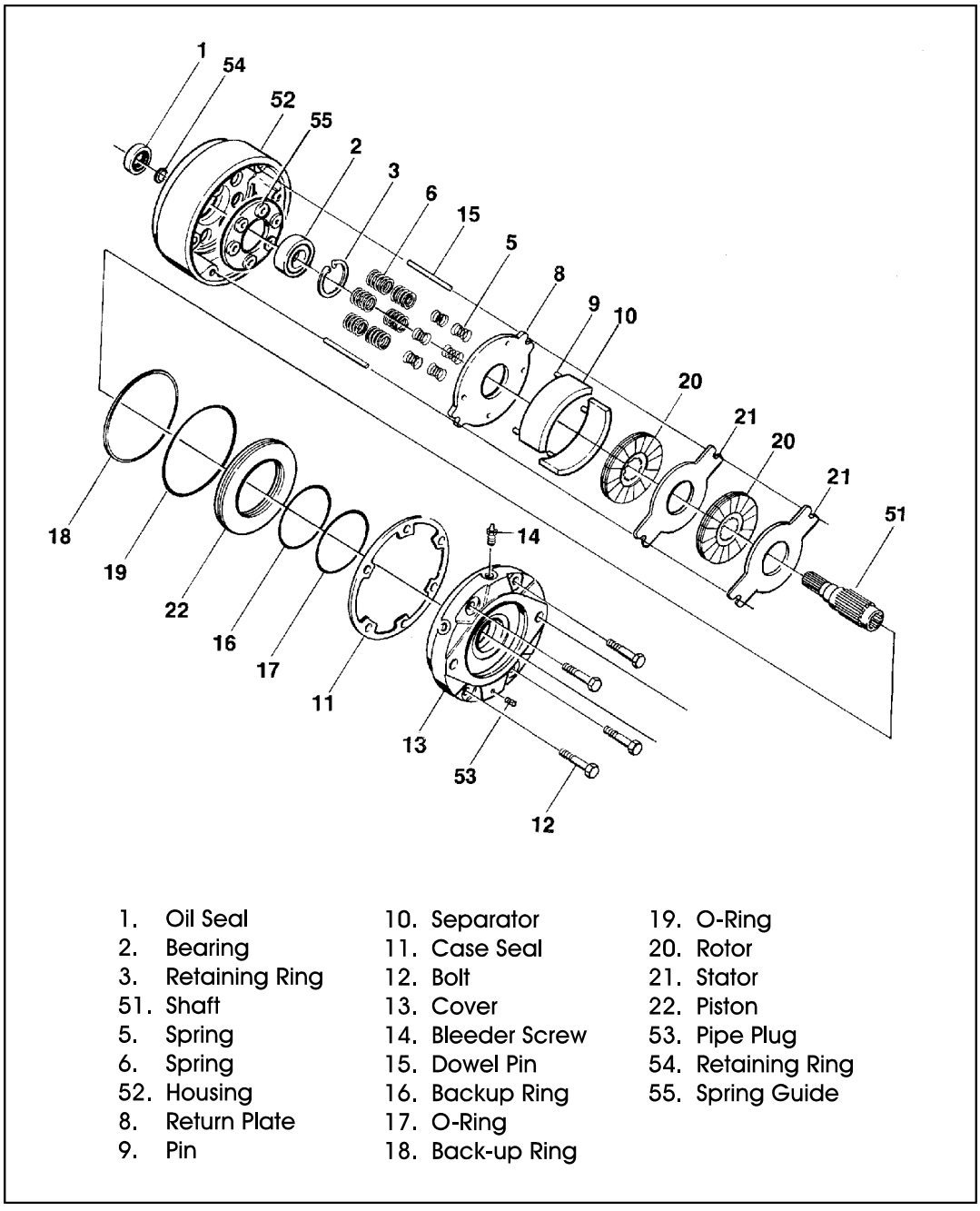
Disassembly

1. With shaft protrusion downward, remove end cover (13) by removing capscrews (12).

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 681 KG. THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (1362 KG MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Remove case seal (11) from housing (7) then remove bleeder screw (14) from end cover (52).
3. Remove piston (22) from end cover (13).
4. Remove o-ring (17), back-up ring (16), o-ring (19) and back-up ring (18) from piston (22).
5. Remove separators (10) from housing (52).
6. Remove stack assembly, consisting of discs (21), return plate (8) and friction discs (20) from housing (52).
7. Remove dowel pins (15), springs (5 & 6) from housing (52).
8. Remove retaining ring (3) from housing (52).



1. Oil Seal
2. Bearing
3. Retaining Ring
51. Shaft
5. Spring
6. Spring
52. Housing
8. Return Plate
9. Pin
10. Separator
11. Case Seal
12. Bolt
13. Cover
14. Bleeder Screw
15. Dowel Pin
16. Backup Ring
17. O-Ring
18. Back-up Ring
19. O-Ring
20. Rotor
21. Stator
22. Piston
53. Pipe Plug
54. Retaining Ring
55. Spring Guide

Figure 3-31. Swing Brake Assembly (Mico)

9. Remove shaft by pressing or using a soft mallet on male end of shaft (51).
10. Remove retaining ring (54) bearing (2) from shaft (51).
11. Press rotary seal (1) from housing (51).

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.*

1. Press new rotary seal (1) into housing (52). Note the direction of seal.
2. Install new bearing (2) on shaft (51).
3. Install shaft assembly and retaining ring (3) into housing (52).
4. Install dowel pins (15), spring retainer (55), and springs (5 & 6) into housing (52).

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

5. Position new large diameter return plate (8) in housing with tabs guided by dowel pins (15) until disc rests on springs (5 & 6).

NOTE: *Discs (21 & 8) and friction discs (20) should remain dry during installation. Oil will contaminate disc surfaces.*

6. Place new disc (20) on shaft (51) until it contacts return plate (8).
7. Add additional discs (21) as required to complete assembly.
8. Insert separators (10) in holes of return plate (8).
9. Install new o-ring (17), new back-up ring (16), new o-ring (19) and new back-up ring (18) on piston (22). Insert piston (22) into end cover (13), being careful not to shear o-rings or back-up rings.
10. Install new case seal (11) in housing (52), then install bleeder screw (14) in end cover.
11. Position end cover (13) on housing (52), aligning dowel pins (15) with holes in end cover.

Insert capscrews (12) and tighten evenly to draw end cover (13) to housing (52). Torque capscrews to 75 Nm.

3.13 TILT ALARM SWITCH (MACHINES W/ EXTERNAL TILT

⚠ 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).

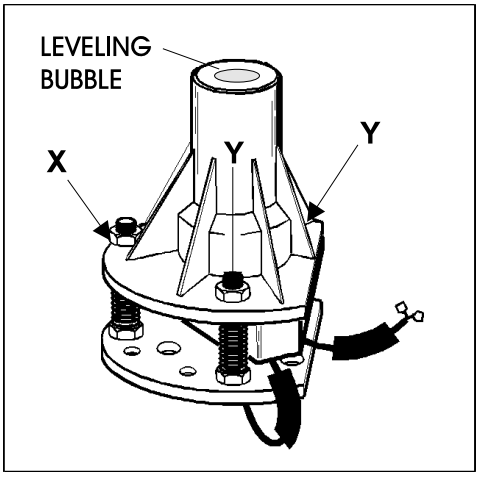


Figure 3-32. Tilt Switch Adjustment

3.14 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.

3.15 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE

General

Four LEDs are incorporated tn 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.

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.*

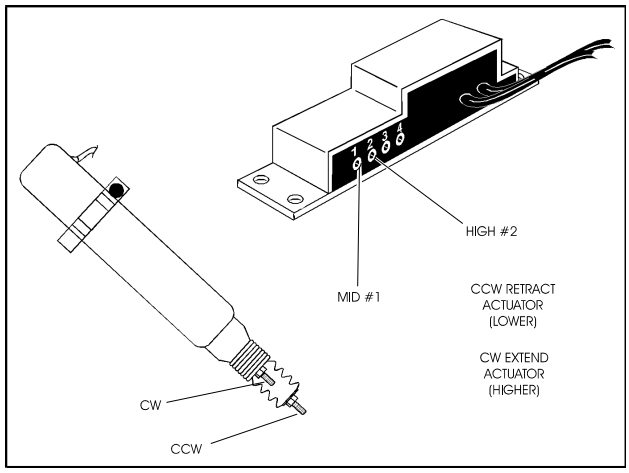


Figure 3-33. Addco Adjustments - Deutz

3.16 THROTTLE CHECKS AND ADJUSTMENTS - TMD 27 CONTINENTAL ENGINE

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 Continental Instruction Manual for procedure.*

1. Remove bolt which secures engine tray to the turntable. Swing engine tray out to gain access to RPM adjustments.
2. Disconnect wire harness from ADDCO, install JLG wire harness kit #4921850 to the ADDCO and engine harness as shown in diagram below. Start the engine and allow it to come up to operating temperature. Position toggle switch to MID engine. Adjust MID #1engine pot on ADDCO CCW, retract actuator (higher), or CW, extend actuator (lower), until MID engine runs at 1800 RPM.
3. Position toggle switch to HIGH engine. Adjust HIGH #2 engine pot on ADDCO CCW, retract actuator (higher), or CW, extend actuator (lower), until MID engine runs at 2800 RPM.

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

4. Remove test harness and re-connect engine harness.

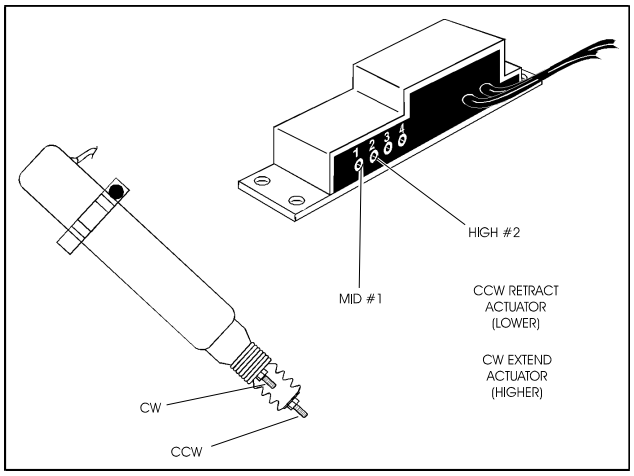


Figure 3-34. Addco Adjustments - Continental

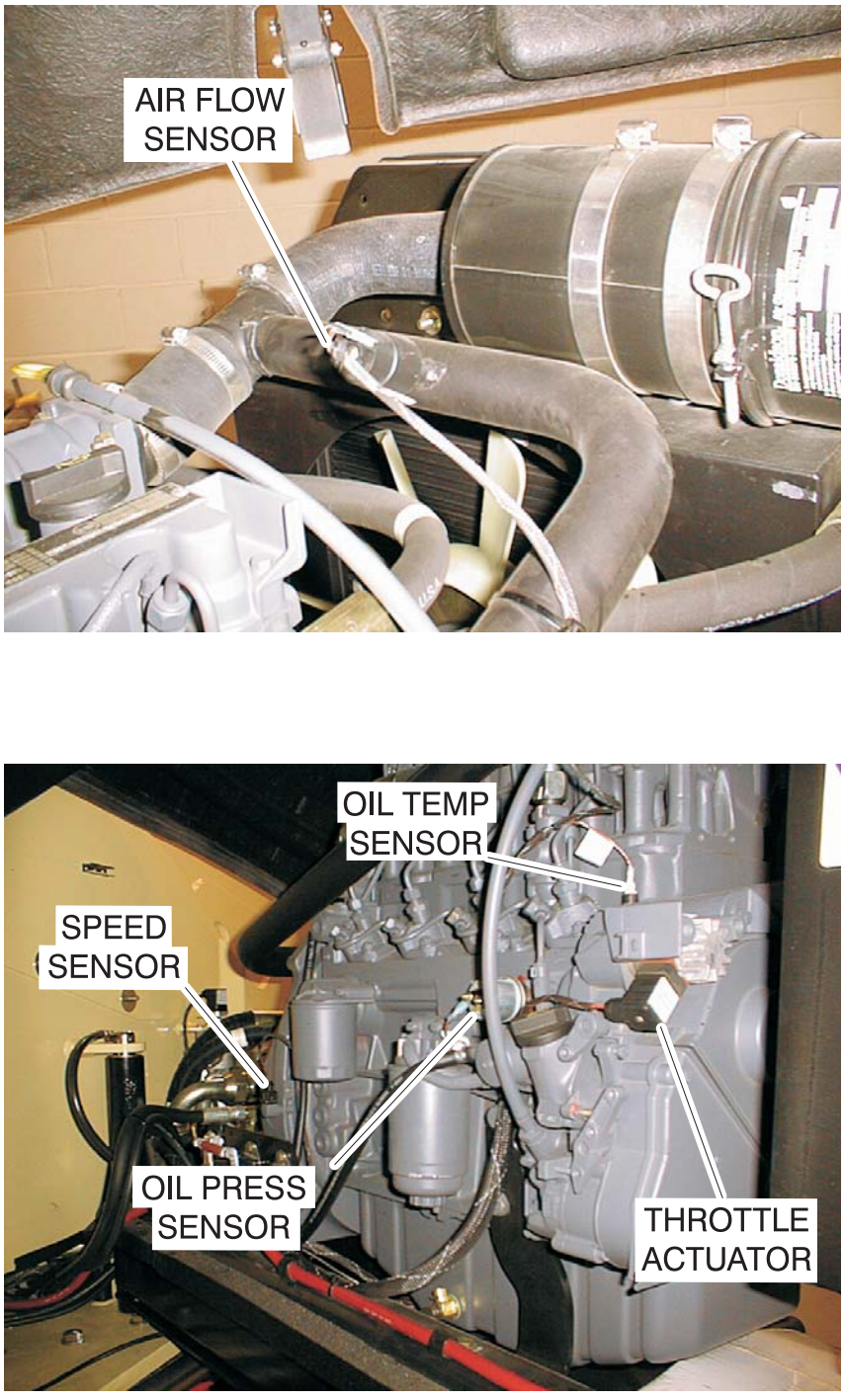


Figure 3-35. Deutz Sensors for JLG Control System

SECTION 4. BOOM & PLATFORM

4.1 BOOM ROPE TORQUING PROCEDURES

Torque Procedures (S Models)

1. Position boom in fully down and fully retracted position.

Model	600S	600SJ/660SJ
Dim. A	26.5 cm	48.5 cm
Dim. B (ref. only)	23 cm	23 cm

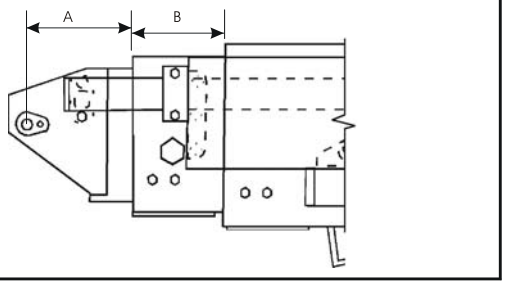


Figure 4-1. Dimensions of Boom Sections

2. Clamp both threaded ends of wire rope to prevent rotation.

NOTE: *Do not clamp on threads.*

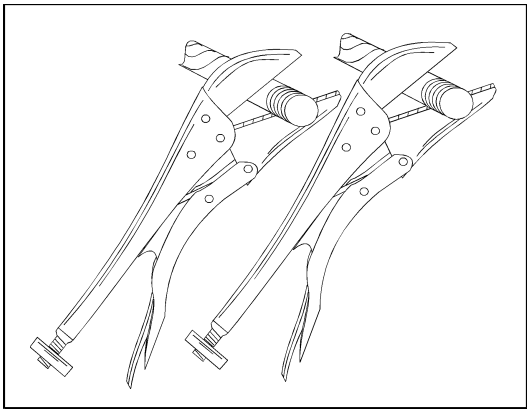


Figure 4-2. Clamping Wire Ropes

3. Install adjusting nuts (or remove nylon collar locknuts if re-adjusting) to both retract and extend wire ropes.
4. Torque retract adjusting nuts (platform end) to 20 Nm alternating between the two wire ropes and keeping approximately the same amount of thread beyond the adjusting nut.

NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

5. Repeat the torque procedure in step #4 to the extend wire ropes (turntable end).
6. Extend the boom 0.6 to 0.9 meters using the telescope function. Repeat step #4.
7. Retract the boom 0.3 to 0.6 meters using the telescope function. Do not bottom out telescope cylinder. Repeat step #5.
8. Extend the boom approximately 0.6 to 0.9 meters again and check torque on the retract wire ropes.
9. Retract the boom without bottoming out telescope cylinder and check torque on the extend wire ropes.

NOTE: *Step #8 and #9 may need to be repeated to equalize the torque on all 4 wire ropes.*

10. After all wire ropes have been properly torqued, install nylon collar locknuts. Remove all clamping devices and install all covers and guards. Check the boom for proper function.

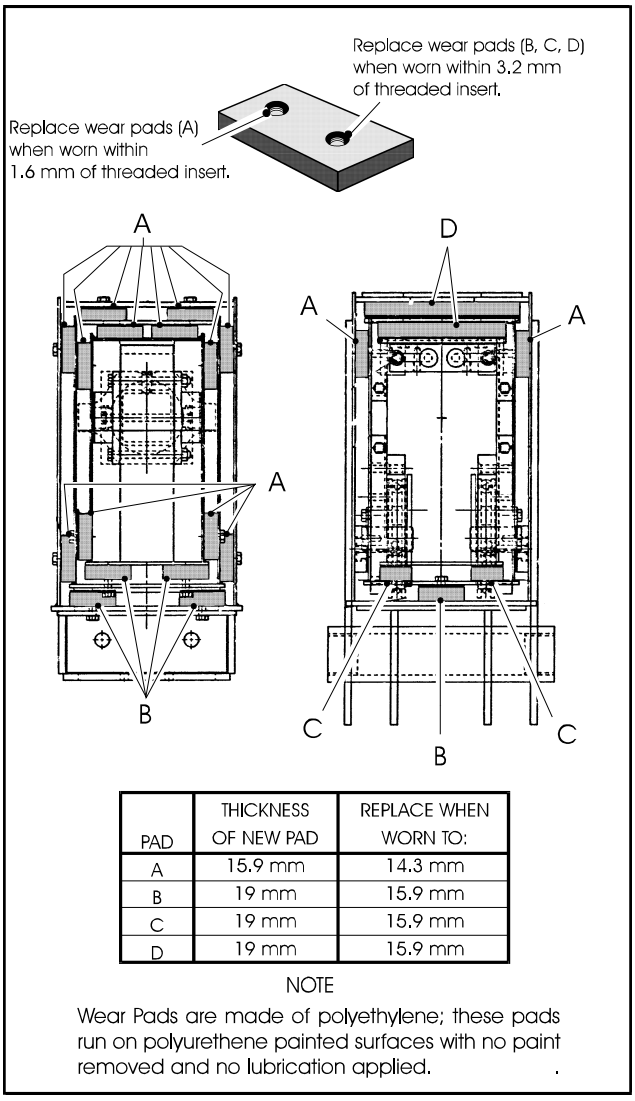
4.2 WEAR PADS

Tower Boom (A Models)

1. Shim up wear pads until snug to adjacent surface.
2. Replace wear pads when worn within 1.6 mm of threaded insert.
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.

Main Boom

1. Shim up wear pads to within 0.8 mm tolerance between wear pad and adjacent surface.
2. Replace wear pads when worn within 1.6 mm and 3.2 mm - B, C, D of threaded insert. See 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.



PAD	THICKNESS OF NEW PAD	REPLACE WHEN WORN TO:
A	15.9 mm	14.3 mm
B	19 mm	15.9 mm
C	19 mm	15.9 mm
D	19 mm	15.9 mm

NOTE

Wear Pads are made of polyethylene; these pads run on polyurethene painted surfaces with no paint removed and no lubrication applied.

Figure 4-3. Location and Thickness of Wear Pads

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

4.3 WIRE ROPE (S MODELS)

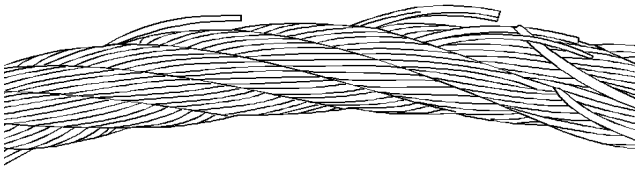
Each day before using the machine:

1. Raise the main boom to approximately horizontal.
2. Extend and retract the boom sections.
3. Check for delayed movement of the fly section, which indicates loose wire ropes.

Inspection

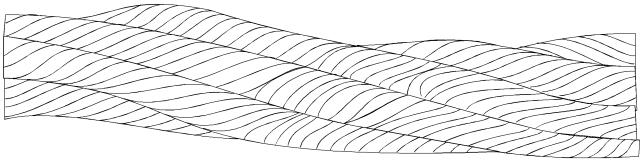
NOTE: *The pictures in this paragraph are just samples to show the replacement criteria of the rope.*

1. Inspect ropes for broken wires, particularly valley wire breaks and breaks at end terminations.



Flexing a wire rope can often expose broken wires hidden in valleys between strands.

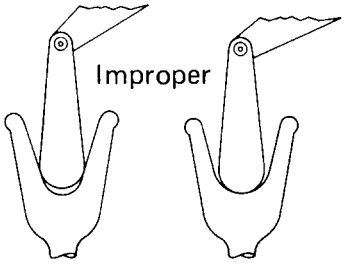
2. Inspect ropes for corrosion.
3. Inspect ropes for kinks or abuse.



A kink is caused by pulling down a loop in a slack line during improper handling, installation, or operation.

4. Inspect sheaves for condition of bearings/pins. (See Dimension Of Sheaves for proper dimension.)
5. Inspect sheaves for condition of flanges. (See Dimension Of Sheaves for proper dimension.)

6. Inspect sheaves with a groove wearout gauge for excessive wear.



Observe the groove so that it may be clearly seen whether the contour of the gauge matches the contour of the bottom of the groove.

7. Ropes passing inspection should be lubricated with wire rope lubricant before reassembly.

Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse, or any signs of abnormalities.
2. Check rope tension by deflecting the ropes by hand...properly tensioned ropes should have little or no movement.

12 Year or 7000 Hour Replacement

1. Mandatory wire rope and sheave replacement.

   Additional inspection required if:

   a. Machine is exposed to hostile environment or conditions.
   b. Erratic boom operation or unusual noise exists.
   c. Machine is idle for an extended period.
   d. Boom is overloaded or sustained a shock load.
   e. Boom exposed to electrical arc...wires may be fused internally.

Additional Replacement Criteria

1. Sheaves and wire rope must be replaced as sets.
2. Rusted or corroded wire ropes.
3. Kinked, “bird caged”, or crushed ropes.
4. Ropes at end of adjustment range.
5. Sheaves failing wearout gage inspection.
6. Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

4.4 BOOM MAINTENANCE (S MODELS)

Removal

1. Remove the platform/support as follows:
   a. Disconnect electrical cable from control console.
   b. Remove the eight (8) bolts securing the platform to the platform support, then remove the platform.
   c. Using an overhead crane or suitable lifting device, strap support the platform support.
   d. Remove the six (6) bolts and locknuts securing the support to the rotator.
   e. Using a suitable brass drift and hammer, remove the rotator shaft, then remove the support from the rotator.

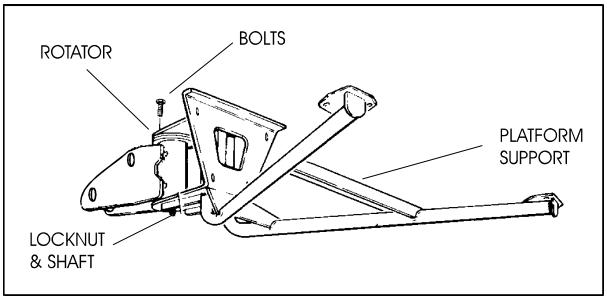


Figure 4-4. Location of Components - Platform Support

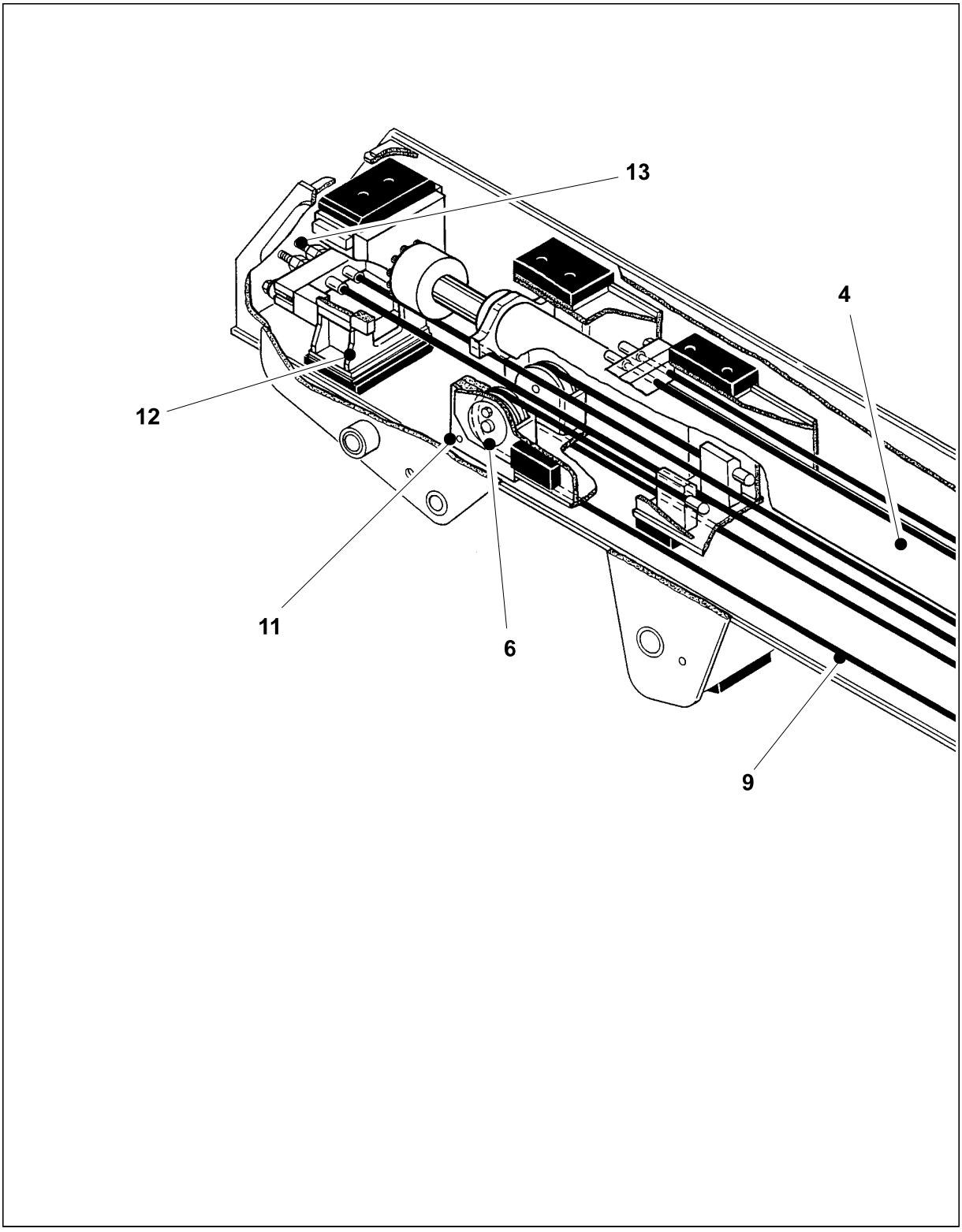


Figure 4-5. Boom Assembly Cutaway - S Models - Sheet 1 of 3

1. Base Boom
2. Mid Boom
3. Fly Boom
4. Telescope Cylinder
5. Extend Sheave
6. Retract Sheave
7. Sheave Block
8. Extend Cable
9. Retract Cable
10. Extend Sheave Guard
11. Retract Sheave Guard
12. Wear Pad Support
13. Extend Cable Adjustment
14. Retract Cable Adjustment

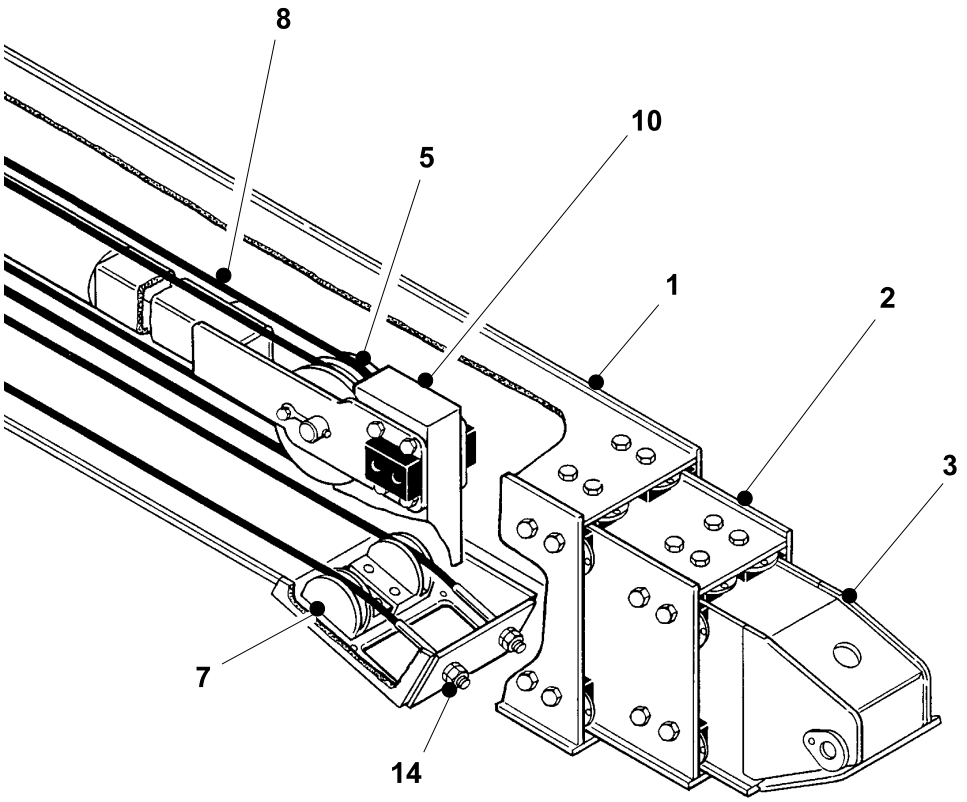


Figure 4-6. Boom Assembly Cutaway - S Models - Sheet 2 of 3

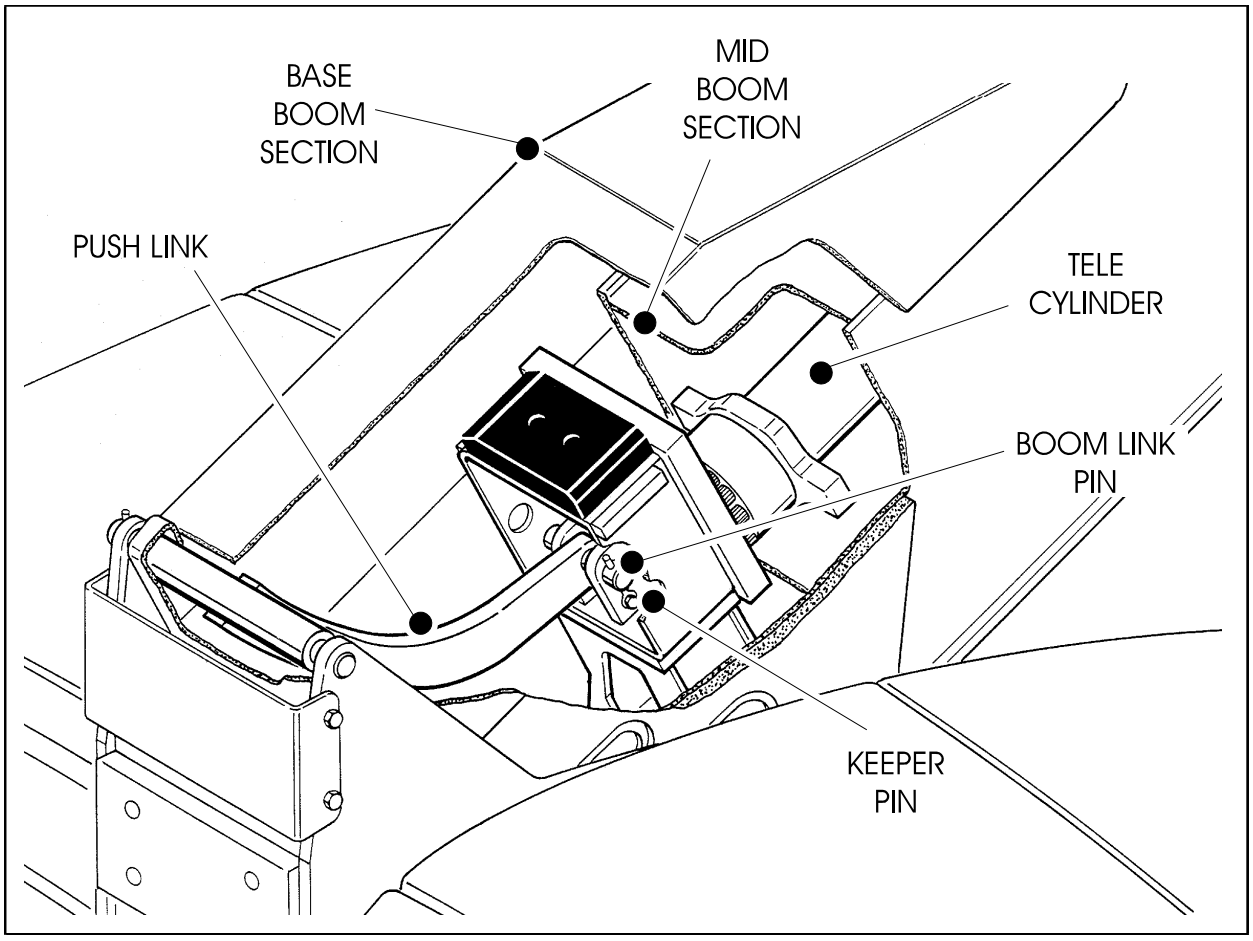


Figure 4-7. Boom Assembly Cutaway - S Models - Sheet 3 of 3

2. Remove the rotator and slave level cylinder from the fly boom as follows:
   a. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
   b. Remove hardware from pin #1. Using a suitable brass drift and hammer remove pin #1 from the fly boom.
   c. 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.
   d. Telescope the fly section out approximately 50.8 cm to gain access to the slave leveling cylinder.
   e. Supporting the slave, cylinder remove the hardware from pin #3. Using a suitable brass drift and hammer remove pin #3 from the fly boom.
   f. 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.

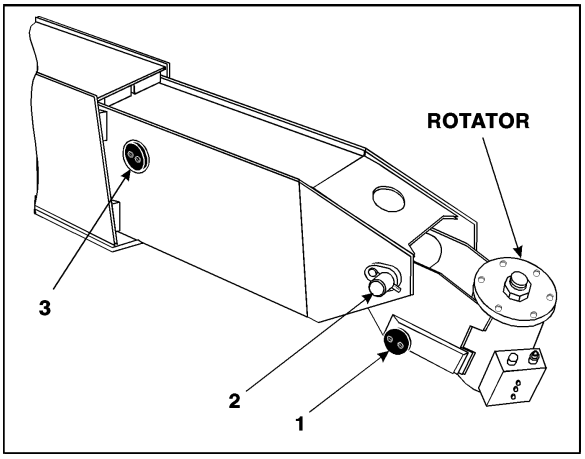


Figure 4-8. Location of Components - Rotator and Leveling Cylinder

3. Remove the powertrack from the boom as follows:

   a. Disconnect wiring harness from ground control box.

⚠ CAUTION

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

   b. Tag and disconnect hydraulic lines from boom to control valve. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

   c. Disconnect the dual capacity indicator limit switch from side of boom section.

   d. Remove hydraulic lines and electrical cables from powertrack.

   e. Using a suitable lifting equipment, adequately support powertrack weight along entire length.

   f. Remove bolts #1 securing the push tube on the fly boom section.

   g. Remove bolts #2 securing the push tube on the mid boom section.

   h. With powertrack support and using all applicable safety precautions, remove bolts #3 and #4 securing rail to the base boom section. Remove powertrack from boom section.

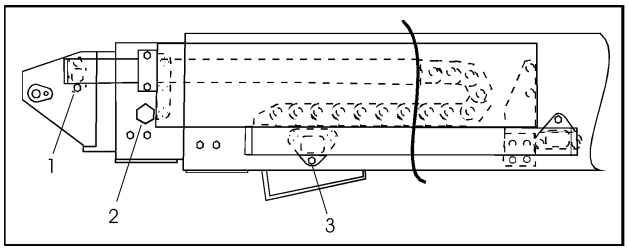


Figure 4-9. Location of Components - Boom Powertrack

4. Remove boom assembly from machine as follows:

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

⚠ CAUTION

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

   b. Tag and disconnect hydraulic lines from telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

   c. Disconnect wire to the proximity switch on the aft end of the boom assembly.

   d. Remove hardware securing the lift cylinder rod end to the base boom section.

   e. Using a suitable brass drift and hammer, remove the lift cylinder pin from the base boom.

   f. Remove hardware securing the master cylinder rod end to the base boom section.

   g. Using a suitable brass drift and hammer, remove the master cylinder pin from the base boom.

   h. Remove hardware securing the pushbar to the turntable upright.

⚠ CAUTION

WHEN REMOVING PIN FROM PUSHBAR. CARE MUST BE TAKEN NOT TO DROP THE PUSHBAR ONTO THE WIRE ROPE ADJUSTMENT THREADS. FAILURE TO DO SO WILL RESULT IN DAMAGING THREADS.

   i. Using a suitable brass drift and hammer, remove the push bar pin from the turntable upright.

   j. Remove hardware securing the boom pivot pin to the turntable upright.

   k. Using a suitable brass drift and hammer, remove the pivot pin from the turntable upright.

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

Disassembly of Boom Sections

1. Remove hardware securing the push bar to aft end of the telescope cylinder, then remove pin from cylinder.
2. Remove hardware securing the cover plate on the bottom front of the base boom section.

NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

3. Clamp both threaded ends of wire rope to prevent rotation. Note: Do not clamp on threads. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.
4. Remove the spring mounting plate, spring, and proximity switch from the aft end of the base section.

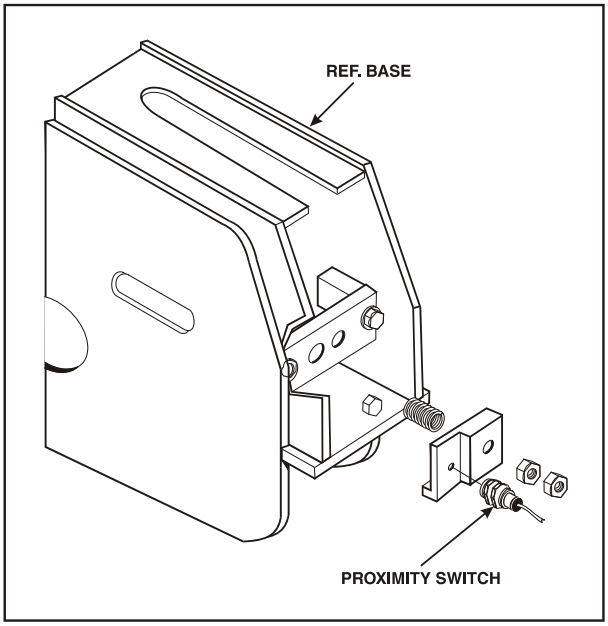


Figure 4-10. Disassembly of Proximity Switch Assembly

5. Remove hardware securing the wire rope adjustment block to aft end of the base boom section and remove the block.
6. Remove hardware securing the telescope cylinder to aft end of the mid boom section.

⚠ CAUTION

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

7. Remove bolts securing wire rope attach bar to top of fly boom section.
8. Pull the telescope cylinder and wire ropes partially from aft end of the base boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
9. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.
   a. Remove hardware from the wear pads; remove wear pads from cylinder.
   b. Remove hardware from the wire rope guard; remove guard from cylinder.
   c. Remove hardware from the sheave pin; remove pin and sheave from cylinder.

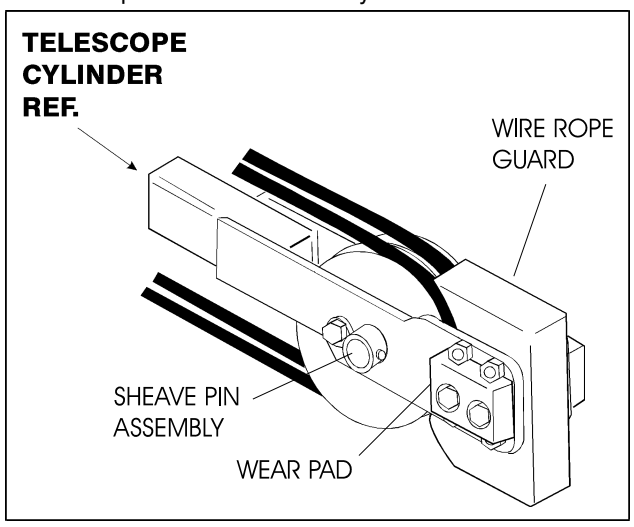


Figure 4-11. Disassembly of Sheave Assembly

10. Remove hardware which secures the wear pads to the front of base boom section; remove wear pads from the top, sides and bottom of the base boom section.
11. Using an overhead crane or suitable lifting device, remove mid and fly boom sections from base section. Note: When removing mid and fly boom sections from base boom section, retract wire rope must be dragged along with boom sections.

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

13. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.

14. Remove hardware which secures the wear pads to the front of mid boom section; remove wear pads from the top, sides and bottom of the mid boom section.

15. Using an overhead crane or suitable lifting device, remove fly boom section from mid section. Note: When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.

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

17. When removing wire rope from fly boom section, push the cable into fly boom. Route wire rope back through holes in the side of the fly boom section.

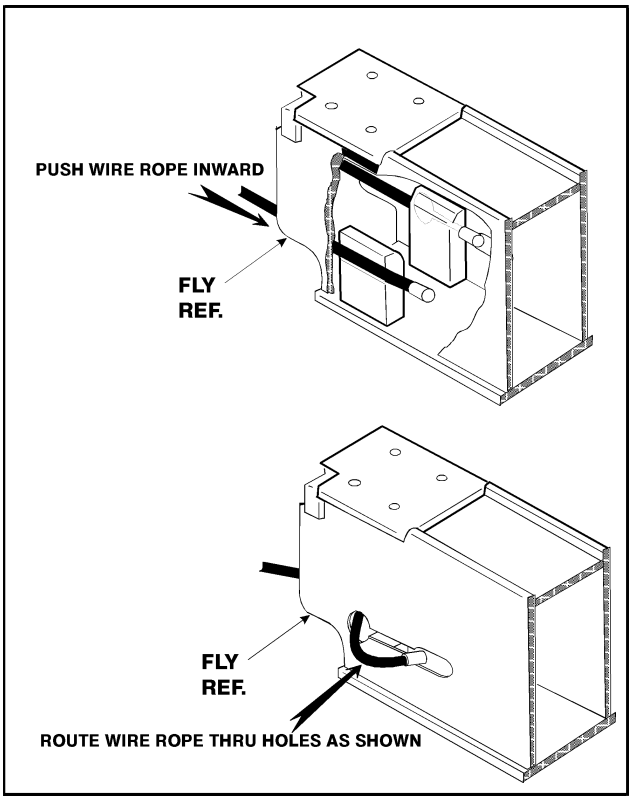


Figure 4-12. Disassembly Wire Rope Routing Procedure

Inspection

NOTE: *When inspecting pins and bearings Ref. to section 2 General.*

1. Inspect all sheaves (extend and retract wire ropes and telescope cylinder) for excessive groove wear, burrs or other damage. Replace sheaves as necessary.

NOTE: *To check the size, contour and amount of wear, a groove gauge is used. Replace the sheave if worn as shown in the following drawing.*

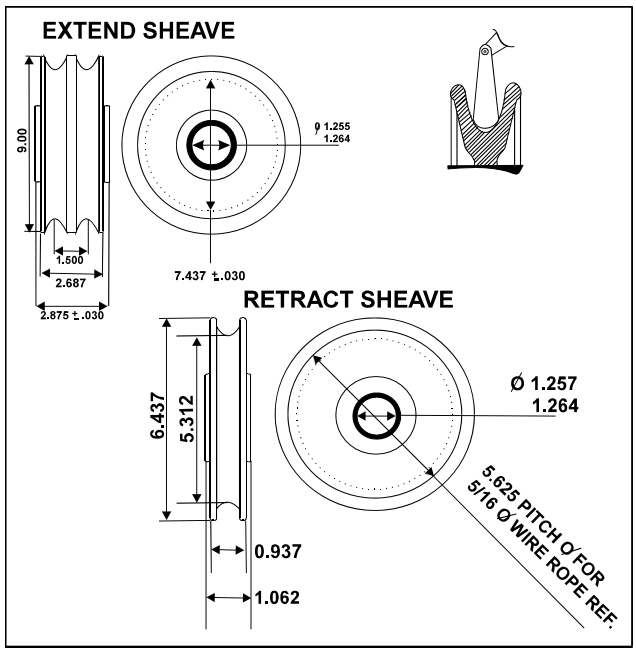


Figure 4-13. Dimension of Sheaves When New

2. Inspect extend and retract wire rope sheave bearings for wear, scoring, or other damage, and for ovality.

3. Inspect extend wire rope and retract wire rope sheave pins for scoring, tapering and ovality. Replace pins as necessary.

4. Inspect telescope cylinder sheave pin for scoring, tapering and ovality. Replace pins as necessary.

5. Inspect boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.

6. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.

7. 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.

8. Inspect inner diameter of boom pivot bushing for scoring, distortion, wear, or other damage. Replace bearing as necessary. (See section 2 General).
9. Inspect all wear pads for excessive wear or other damage. Replace pads when worn to within 3.2 mm of threaded insert.
10. Inspect extend and retract wire rope attach point components for cracks, stretching, distortion, or other damage. Replace components as necessary.
11. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
12. 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 and mid sections to determine the number of shims required for proper lift.
2. Measure inside dimensions of the mid section to determine the number of shims required for proper lift.
3. Install side, top and bottom wear pads to the aft end of fly section; shim evenly to the measurements of the inside of mid section.
4. Install retract wire ropes into aft end of fly section, route wire ropes thru holes in side of fly boom section and pull into slot.

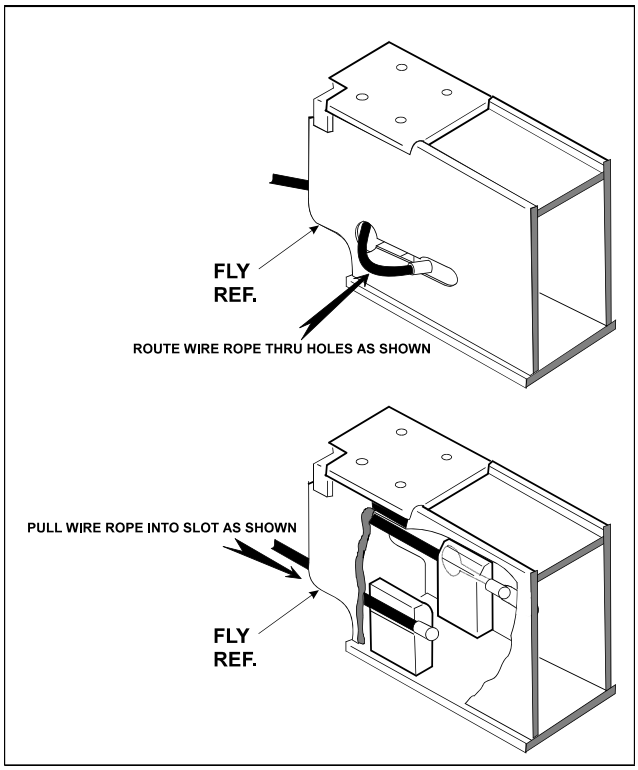


Figure 4-14. Routing Installation of Retract Wire Ropes

5. Install side, top and bottom wear pads to the aft end of mid section; shim evenly to the measurements of the inside of mid section.

⚠ CAUTION

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

6. Shim the insides of the boom sections for a total of 1.6 mm clearance (if the action is centered, there will be 0.8 mm clearance on each side).
7. Slide fly boom section into the mid boom section. Shim boom, if necessary, for a total of 1.6 mm clearance.
8. Install wear pads into the forward position of the mid boom section. Shim boom, if necessary, for a total of 5 mm clearance.
9. Properly position the retraction wire rope sheaves assemblies at the aft end of the mid boom section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pins and secure them

with mounting hardware. Position retract wire ropes onto the sheaves.

10. Install sheave guards to aft end of mid boom section and secure with mounting hardware.
11. Slide mid boom section into the base boom section. Allow the retraction wire ropes to trail between the bottom surfaces of boom sections. Shim boom, if necessary, for a total of 1.6 mm clearance.
12. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 5 mm clearance.
13. Install sheave block to bottom of base boom section and adjust block so that retract wire ropes do not come into contact with boom surfaces.
14. Install wire rope threaded ends thru attachment holes in the bottom of base boom section. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.
15. Align the telescope cylinder barrel-to-sheave attachment point. Install extend sheave pin through the telescope cylinder barrel and sheave assembly; secure pin with mounting hardware.
16. Route extend wire ropes around extend sheave and secure wire ropes to the telescope cylinder.
17. Install extend wire rope mounting blocks, proximity mounting plate and spring to threaded ends of wire ropes. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.When installing wire ropes, care must be taken not to twist or cross the wire ropes.
18. 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 boom assembly.

⚠ CAUTION

WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

19. Align the cylinder with the slots at aft end of mid boom section, then secure cylinder with mounting hardware.
20. Align holes in aft end of the fly boom section with holes in wire rope mounting block, then secure with mounting hardware.
21. Align holes in aft end of the mid boom section with holes in wire rope mounting block, then secure with mounting hardware.

NOTE: *Boom wire ropes must be torqued after installation of the boom assembly.*

22. Align holes in rod end of the telescope cylinder with holes in push bar. Install push bar pin and secure with mounting hardware.
23. Install the hydraulic lines and electrical cables, and the harnessing powertrack components as follows:
    a. Align holes in powertrack rail with attachment holes in side of the base boom section. Secure the rail with mounting hardware.

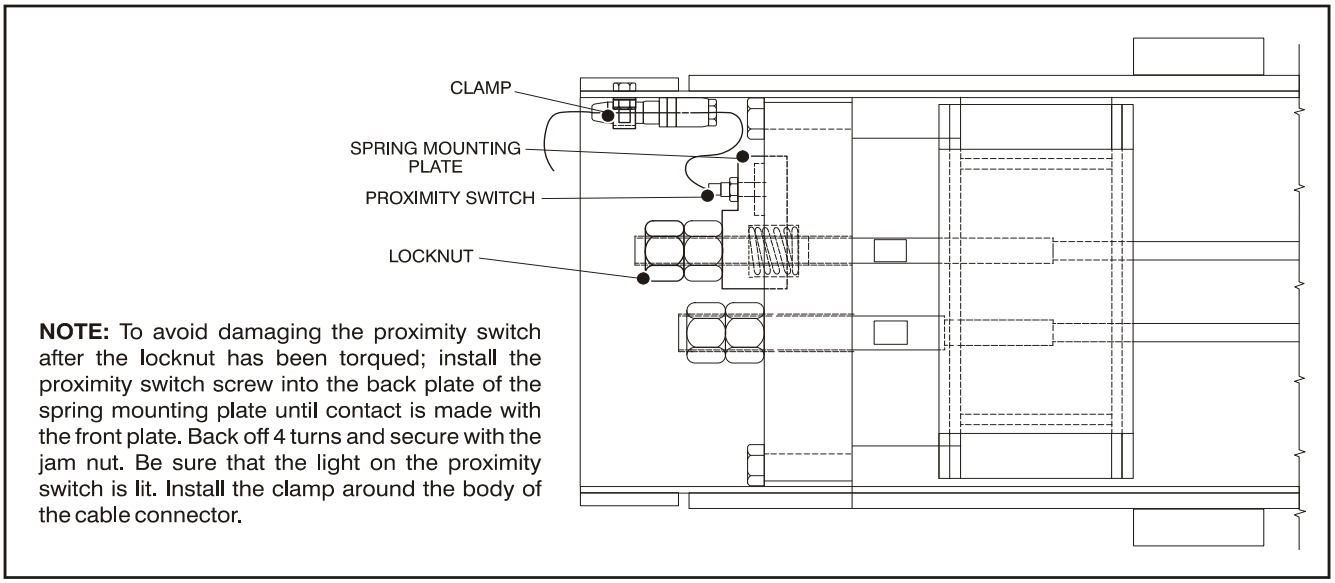


Figure 4-15. Installing the Proximity Switch

b. Install powertrack to rail with mounting hardware.

c. Attach push tube bracket to the side of the mid boom section with mounting hardware.

NOTE: *Do not over tighten attach bolt on push tube bracket. It should pivot freely.*

d. Install slide block and wear pads to the powertrack rail with mounting hardware.

e. Install powertrack to push tube with mounting hardware.

f. Carefully feed the hoses and electrical cables through the aft end of the powertrack rail, powertrack and push tube.

g. Ensure all hoses and cables are properly routed through the powertrack rail, powertrack and push tube. Tighten or install all clamping or securing apparatus to the hoses or cables, as necessary.

h. Install powertrack cover and push tube rods with mounting hardware.

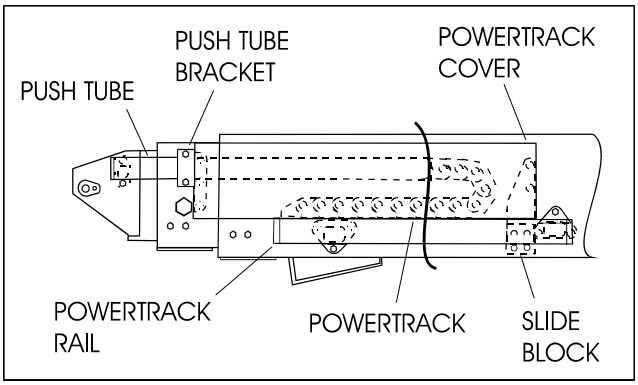


Figure 4-16. Reassembly of Components - Boom Powertrack Assembly

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. Align push bar pivot hole with pivot holes in turntable. Install push bar pivot pin, ensuring that location of hole in pin is aligned with attach point on turntable.
5. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
6. Connect all wiring to the ground control box.
7. Connect all hydraulic lines running along side of boom assembly.
8. 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.
9. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
10. Adjust retract and extend cables to the proper torque. Refer to paragraph 2-6, boom cable torque procedures.
11. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
12. Retract and lower boom, noting the performance of the retraction cycle.

4.5 BOOM MAINTENANCE (A MODELS)

Removal

1. For platform/support removal see platform/support removal diagram. (Boom Maintenance. S Models).
2. Remove rotator and slave level cylinder from fly boom as follows:

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

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

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

   d. Telescope boom fly section out approximately 50 cm to gain access to slave leveling cylinder. (600AJ Model)

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

   f. Tag and disconnect hydraulic lines to slave leveling cylinder. Use suitable container to retain any

residual hydraulic fluid. Cap hydraulic lines and ports. Remove slave cylinder.

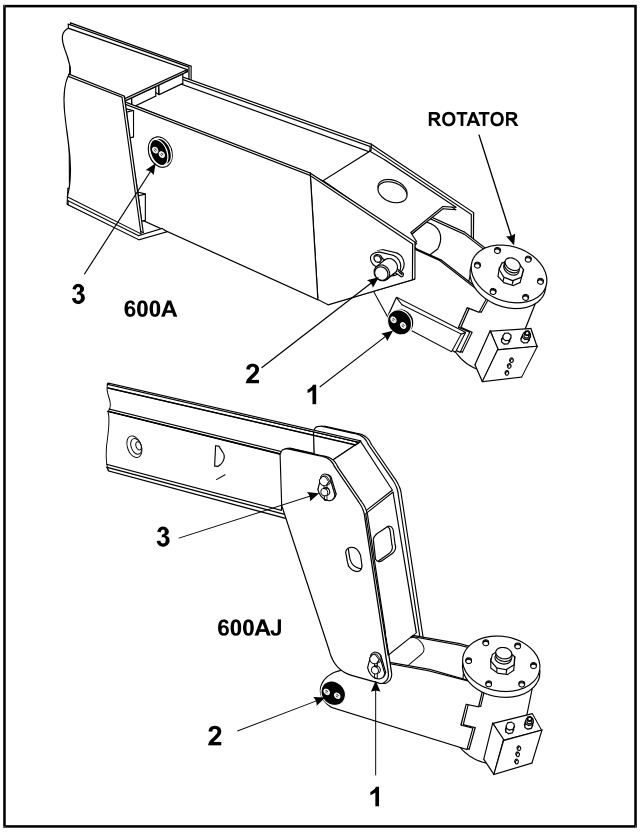


Figure 4-17. Reassembly of Components - Rotator and Slave Leveling Cylinder

3. Remove powertrack from boom as follows:

   a. Disconnect wiring harness connectors located in tower upright.

⚠ CAUTION

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

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

   c. Disconnect dual capacity indicator limit switch from side of boom section.

   d. Remove hydraulic lines and electrical cables from powertrack.

   e. Using suitable lifting equipment, adequately support powertrack weight along entire length.

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

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

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

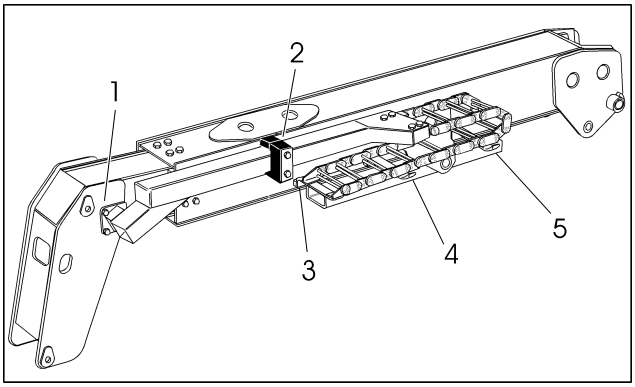


Figure 4-18. Location of Components - Boom Powertrack (A Models)

4. Remove boom assembly from machine as follows:

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

⚠ CAUTION

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

   b. Tag and disconnect hydraulic lines from telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

   c. Remove hardware securing the lift cylinder rod end to the base boom section.

   d. Using a suitable brass drift and hammer, remove the lift cylinder pin from base boom.

   e. Remove hardware securing the master cylinder rod end to the base boom section.

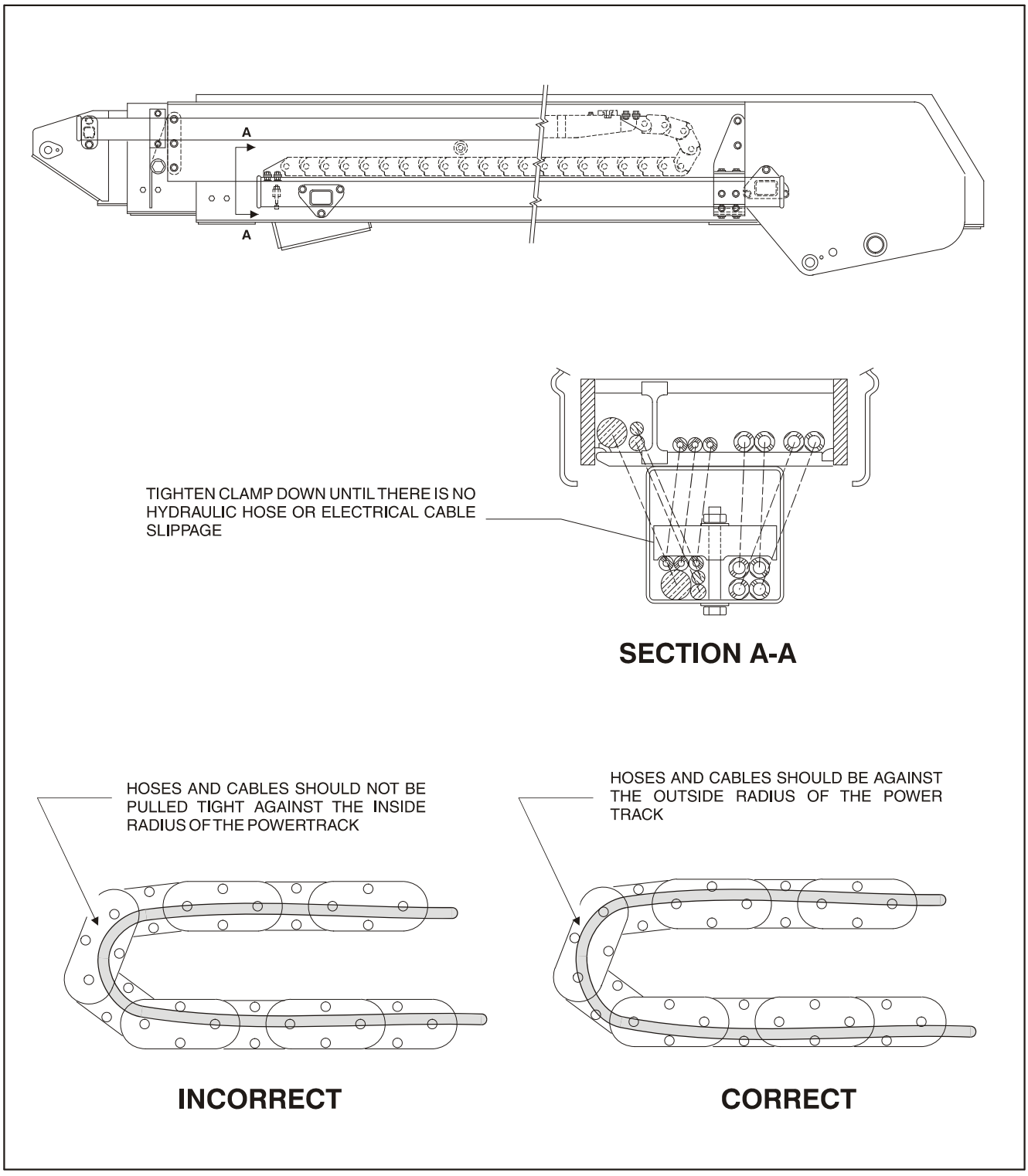


Figure 4-19. Boom Powertrack Installation

f. Using a suitable brass drift and hammer, remove the master cylinder pin from base boom.

g. Remove hardware securing the boom pivot pin to the turntable upright.

h. Using a suitable brass drift and hammer, remove the pivot pin from turntable upright.

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

Disassembly of Boom Sections

1. Remove hardware securing telescope cylinder to aft 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.
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 General.*

1. Inspect 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. (See section 5 For Bearing Replacement).
5. Inspect all wear pads for excessive wear, or other damage. Replace pads when worn to within 3.2 mm of threaded insert.
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 lift.
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.

⚠ CAUTION

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 1.6 mm clearance.
8. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 5 mm clearance.
9. Align the cylinder with the slots at aft end of base boom section, then secure cylinder with mounting hardware.

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 running along side 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. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
8. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
9. Retract and lower boom, noting the performance of the retraction cycle.

4.6 TOWER BOOM

Removal

1. Remove the tower upright as follows:

⚠ CAUTION

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

   a. Tag and disconnect hydraulic lines to upper lift cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
   b. Using suitable lifting device, support the upper lift cylinder.
   c. Remove mounting hardware from upper lift cylinder barrel end. Using a suitable brass drift and hammer remove pin #1 from tower upright.
   d. Tag and disconnect hydraulic lines to master cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
   e. Remove mounting hardware from master cylinder barrel end. Using a suitable brass drift and hammer remove pin #2 from tower upright.
   f. Disconnect wiring hardness to horizontal limit switch and dual capacity limit switch.
   g. Using a suitable lifting device, support the tower upright.
   h. Remove mounting hardware securing hose bracket in tower upright, remove hose bracket.
   i. Remove mounting hardware from tower leveling cylinder. Using a suitable brass drift and hammer remove pin #3 from tower upright.
   j. Remove mounting hardware from upright pivot pin. Using a suitable brass drift and hammer, remove pin #4 from tower upright. Remove upright from tower boom assembly.

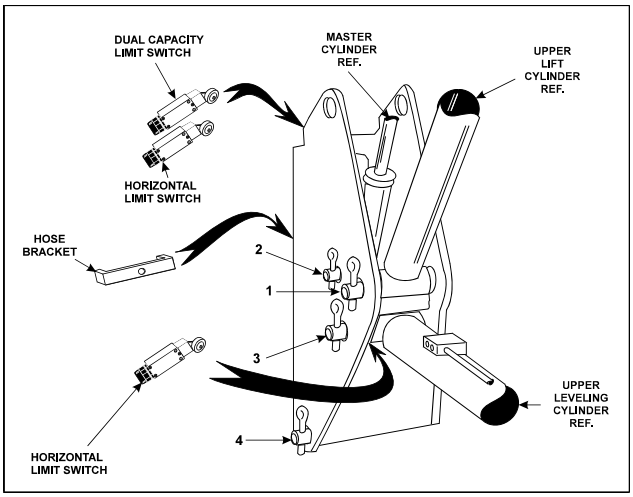


Figure 4-20. Location of Components - Upright

2. Remove the tower boom as follows:

⚠ CAUTION

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

   a. Tag and disconnect all hydraulic lines from the tower boom assembly to turntable components. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
   b. Disconnect wiring harness from the ground control box.

c. Using suitable lifting device, support the tower boom assembly at it's approximate center of gravity.

d. Remove mounting hardware from lower lift cylinder rod end. Using a suitable brass drift and hammer, remove pin #1 from the tower boom assembly.

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

f. Remove tower boom assembly from turntable upright. Place tower boom assembly on a well supported trestles.

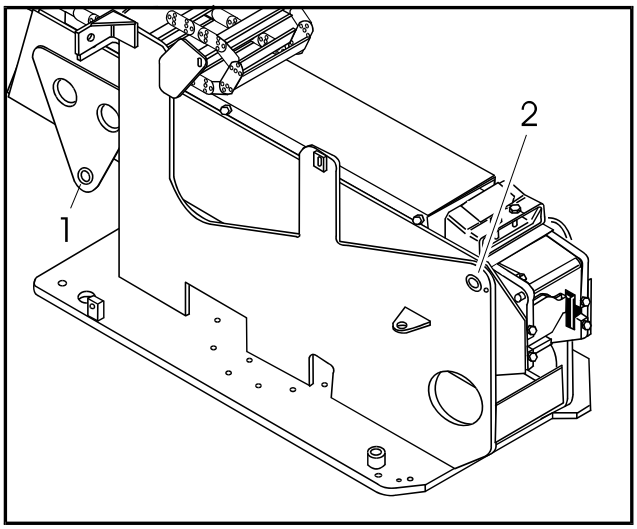


Figure 4-21. Location of Components - Tower Boom

Disassembly

1. Remove brackets securing hoses and wiring harnesses to push tubes and top of tower boom assembly.
2. Mark all hoses and wiring harnesses at bracket on aft end of tower base boom section for future assembly. Remove hoses and wiring harness from tower boom powertrack.
3. Remove mounting hardware which secures the push tubes to the tower fly boom section.
4. Remove mounting hardware which secures the push tubes to the powertrack, then remove push tubes.
5. Remove mounting hardware which secures the powertrack to the top of the tower base section, then remove powertrack.
6. Remove mounting hardware from tower boom telescope cylinder barrel end.
7. Remove mounting hardware which secures the wear pads to front of tower base boom section; remove the wear pads from the top, sides and bottom of the tower base boom.
8. Using an overhead crane or suitable lifting device, remove fly assembly from base section.
9. Remove mounting hardware which secures the tower telescope cylinder to the fly section. Using a suitable brass drift and hammer, remove the pin from the fly boom section.
10. Remove mounting hardware which secures the wear pads to aft end of tower fly boom section; remove the wear pads from the top, sides and bottom of the fly boom.
11. Remove mounting hardware which secures the upright leveling cylinder to the fly section. Using a suitable brass drift and hammer, remove the pin from the fly boom section.
12. Remove hardware which secures the wear pads to the aft end of fly tower boom section; remove the wear pads from the top, sides and bottom of the fly boom section.

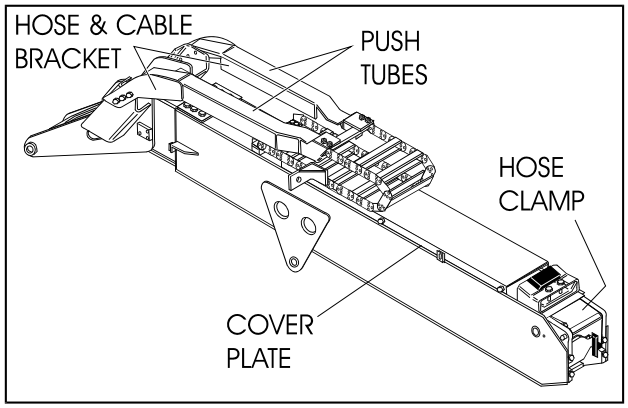


Figure 4-22. Location of Components - Tower Boom Powertrack

Inspection

NOTE: *Refer to section 2 General.*

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. Replace bearings as necessary. (See section 5 For Bearing Replacement).
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. (See section 5 For Bearing Replacement).
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 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 tower base section to determine the number of shims required for proper lift.
2. Install side, top and bottom wear pads to the aft end of tower fly section; shim evenly to the measurements of the inside of base boom section.

⚠ CAUTION

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. Align tower telescope 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.
5. Secure the sling and lifting device at the tower fly boom assembly's approximate center of gravity.
6. Slide tower fly boom assembly into the tower base boom section. Shim boom, if necessary, for a total of 1.6 mm clearance.
7. Install wear pads into the forward position of the tower base boom section. Shim boom, if necessary, for a total of 5 mm clearance.
8. Align the cylinder with the slots at aft end of tower base boom section, then secure cylinder with mounting hardware.
9. Install powertrack to attach point on the tower base boom section, then secure with mounting hardware.
10. Attach push tubes to the powertrack and attach point on the tower fly boom section; with mounting hardware.
11. Properly route the hoses and wiring harnesses through bracket at aft end of tower base boom section.
12. Pull hoses and wiring harnesses through hose bracket to the mark on hoses and harnesses from previous disassembly and clamp for proper length.
13. Route hoses and harnesses through powertrack, push tubes, then through holes in side of tower fly boom nose. Secure hoses and harnesses with hoses brackets.

Installation

1. Using a suitable lifting device, position tower boom assembly on turntable so that the pivot holes in both boom and turntable are aligned.
2. Install tower 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. Using all applicable safety precautions, operate lifting device in order to position lower boom lift cylinder so that holes in the cylinder rod end and tower boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on tower boom.
5. Connect all wiring connections at ground controls.
6. Connect all hydraulic lines running from aft end of tower boom assembly to ground controls.

7. Using suitable lifting device, position upright on tower boom assembly so that the pivot holes in both upright and tower boom are aligned.
8. Using all applicable safety precautions, operate lifting device in order to position upright leveling cylinder so that holes in the cylinder barrel end and upright structure are aligned. Insert the level cylinder pin, ensuring that location of hole in pin is aligned with attach point on upright.
9. Align upper lift cylinder with attach holes in upright. Using a soft head mallet, install the cylinder pin upright and secure with mounting hardware.
10. Align master cylinder with attach holes in upright. Using a soft head mallet, install the cylinder pin upright and secure with mounting hardware.

4.7 ARTICULATING JIB BOOM

Removal

1. For platform/support removal see platform/support removal diagram. See Section 4.4, Boom Maintenance (S Models).
2. Position the articulating jib boom level with ground.
3. Remove mounting hardware from slave leveling cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.

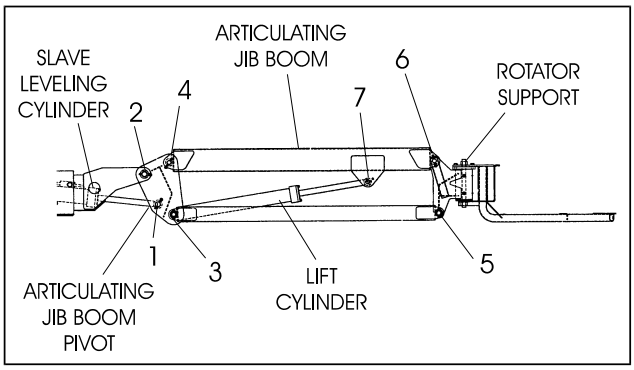


Figure 4-23. Location of Components - Articulating Jib Boom

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: *Refer to Section 2 - General.*

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. Replace bearing as necessary. (See section 5 For Bearing Replacement).
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

NOTE: *For location of components See Section 4-23., Location of Components - Articulating Jib Boom.*

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.)

Main Boom Telescope Cylinder Removal

8. Place machine on a flat and level surface, with main boom in the horizontal position.
9. Shut down engine. Support main boom basket end with a prop. See Figure 4-24., Boom Positioning and Support, Cylinder Repair (S Models).

⚠ CAUTION

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 to telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
11. Remove the hardware securing cover plate on bottom of the base boom section and remove cover.

NOTE: *Do not allow cable to rotate. This may damage the cable.*

12. Clamp both threaded ends of cable to prevent rotation. Note: Do not clamp on threads. Remove jam nuts and loosen adjustment nuts so there is slack in the cables. (See Figure 4-2., Clamping Wire Ropes).
13. Remove the hardware securing push bar to turntable and telescope cylinder.
14. Using a suitable brass drift, carefully drive the push bar pins from the telescope cylinder rod and turntable.
15. Remove hardware securing cable adjustment block to aft end of the base boom section and remove block.

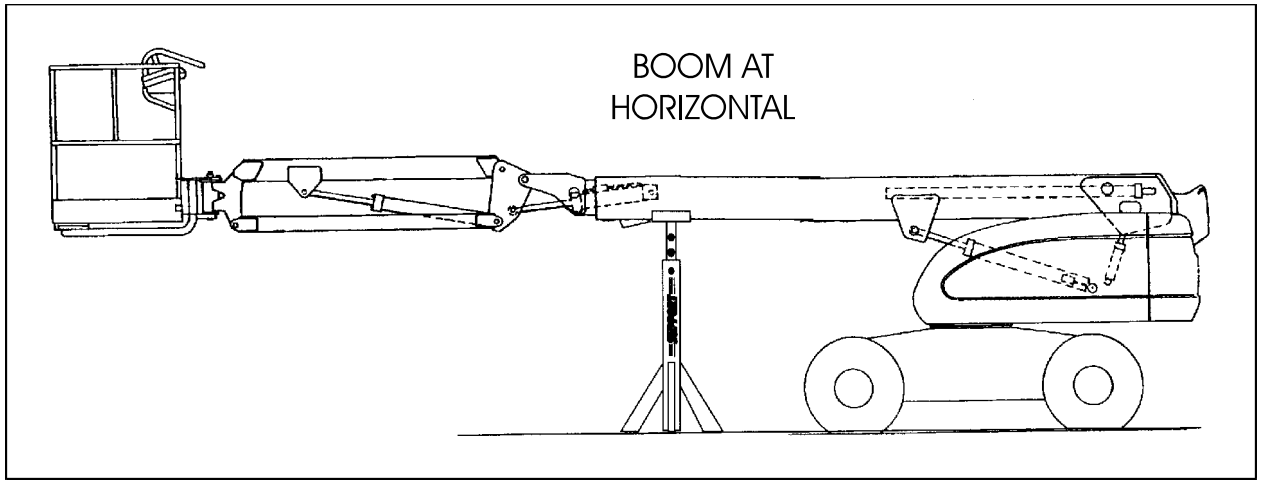


Figure 4-24. Boom Positioning and Support, Cylinder Repair (S Models)

16. Remove hardware securing telescope cylinder to aft end of the mid boom section.

⚠ CAUTION

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

17. Remove bolts securing cable attach bar to top of fly boom section.
18. Pull the telescope cylinder and cables partially from aft end of the base boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
19. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.

Main Boom Telescope Cylinder Installation

1. Route extend cables around extend sheave and secure cables to the telescope cylinder.
2. Install extend cables mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded end of cables.

NOTE: *When installing cables care must be taken not to twist or cross the cables.*

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 boom assembly.
4. Install extend cable mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded ends of cables.

NOTE: *When installing cables, care must be taken not to twist or cross the cables.*

5. 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 boom assembly.

⚠ CAUTION

WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

6. Carefully install the telescope cylinder barrel end support into slots in mid boom and secure with blocks and bolts. Use Loctite #242 on bolts.
7. Align holes in aft end of the fly boom section with holes in cable mounting block, then secure with mounting hardware.
8. Align holes in aft end of the base boom section with holes in cable mounting block, then secure with mounting hardware.
9. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
10. Align holes in rod end of the telescope cylinder with holes in push bar. Install push bar pin and secure with mounting hardware.
11. Align holes in push bar with holes in turntable. Install push bar pin and secure with mounting hardware.

NOTE: *Boom cables must be torqued after installation of the telescope cylinder. (See Section 4.1, Boom Rope Torquing Procedures.)*

Main Boom Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the engine and place the main boom in the horizontal position. Shut down engine and prop the boom. See Section 4-24., Boom Positioning and Support, Cylinder Repair (S Models).
2. Remove the hardware retaining the cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
3. Using auxiliary power, retract the lift cylinder rod completely.
4. Disconnect, cap and tag the main boom lift cylinder hydraulic lines and ports.
5. Remove barrel end attach pin retaining hardware. Using a suitable brass drift drive out the barrel end attach pin from the turntable.
6. Remove the cylinder from the turntable and place in a suitable work area.

Main Boom Lift Cylinder Installation

1. Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the turntable.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the turntable. Secure in place with the pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power, extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable soft mallet, drive the cylinder rod attach pin through the boom and lift cylinder. Secure the pin in place with attaching hardware.
5. Remove boom prop and overhead crane. Activate hydraulic system.
6. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and adjust as necessary.

4.8 LIMIT SWITCHES AND CAM VALVE ADJUSTMENT

Adjust switches and cam valve as shown in Limit Switches Adjustment (S Models) - Limit Switches And Cam Valves Adjustment (A Models).

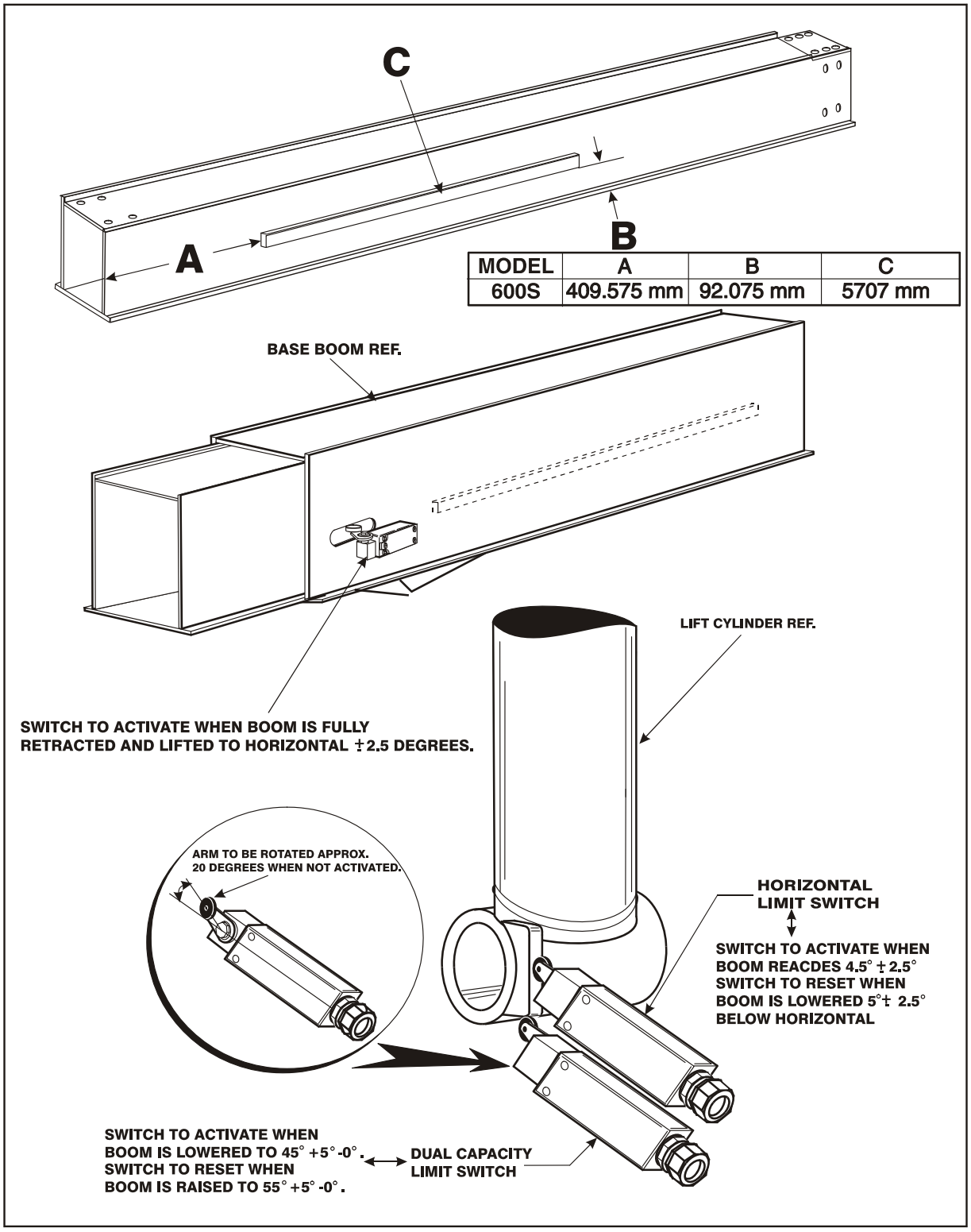


Figure 4-25. Limit Switches Adjustments (S Models)

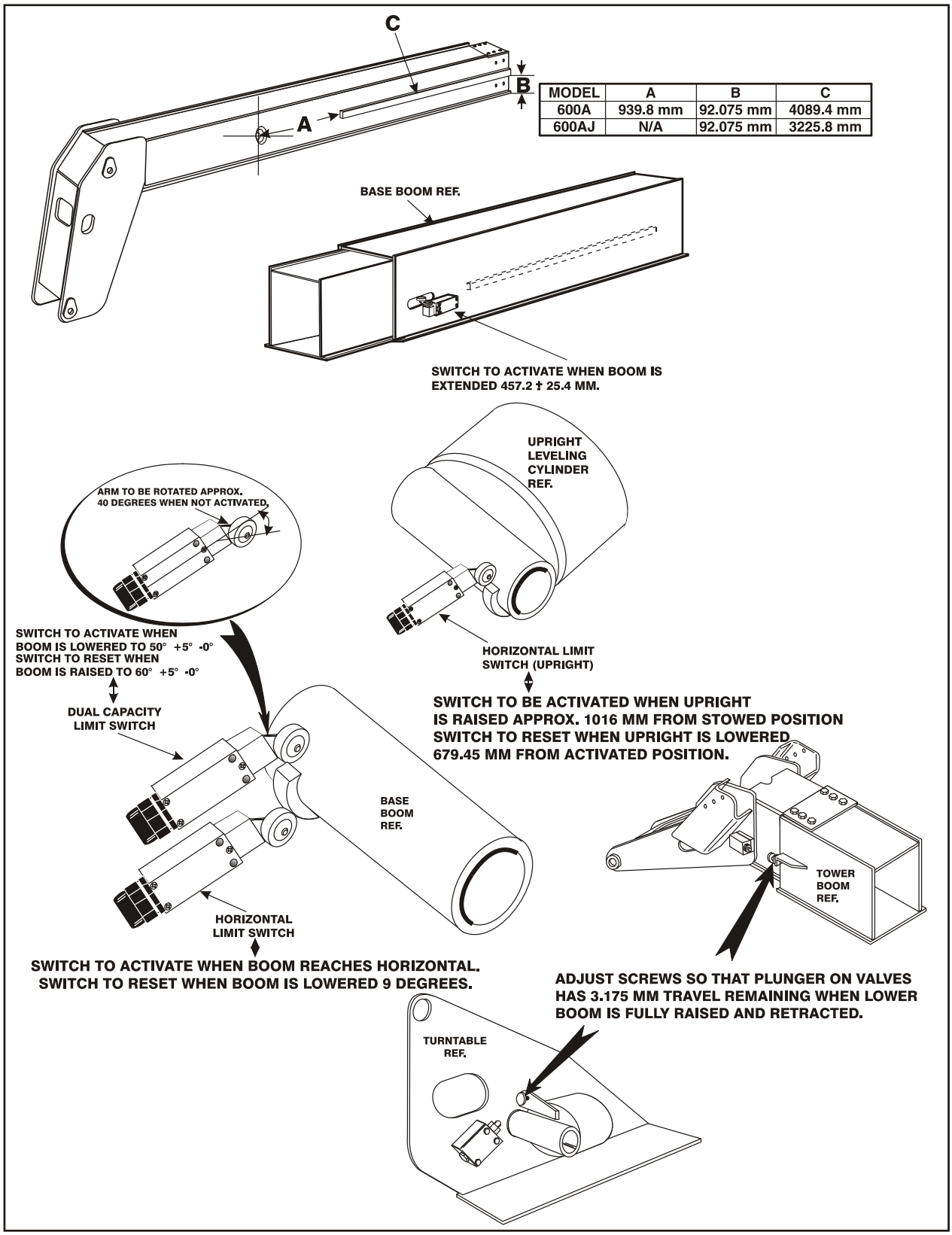


Figure 4-26. Limit Switches Adjustments (A Models)

4.9 PLATFORM

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.

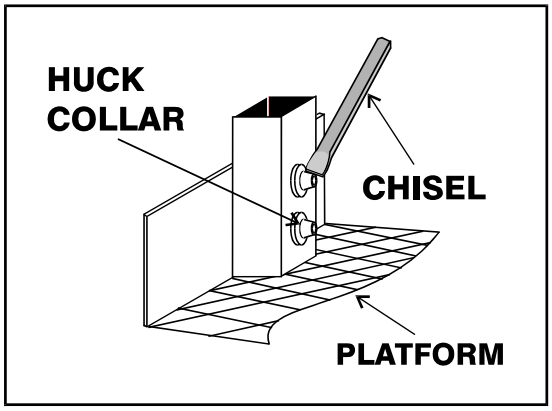


Figure 4-27. Platform Section Replacement

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

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

4.10 ROTATOR - HELAC

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.

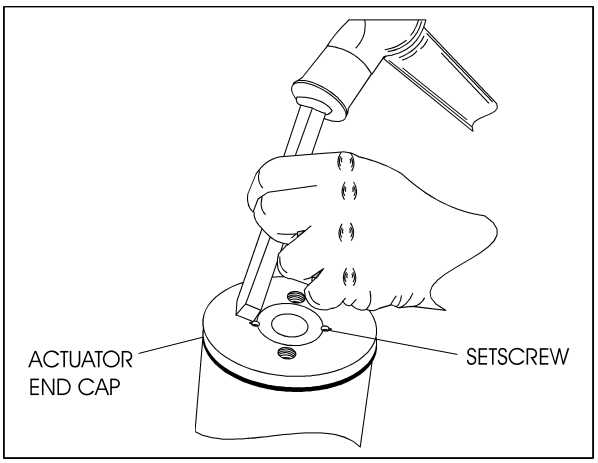


Figure 4-29. Removing Portion of End Cap

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

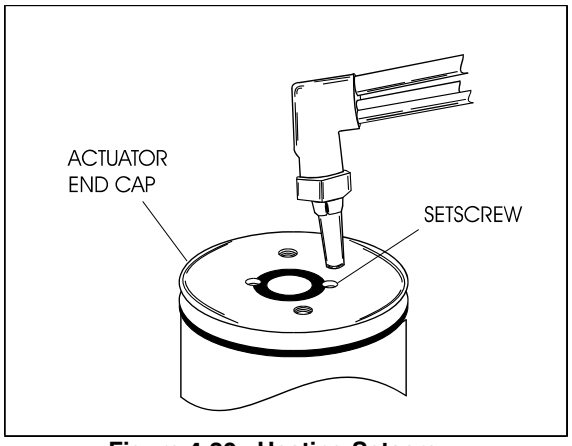


Figure 4-30. Heating Setscrew

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

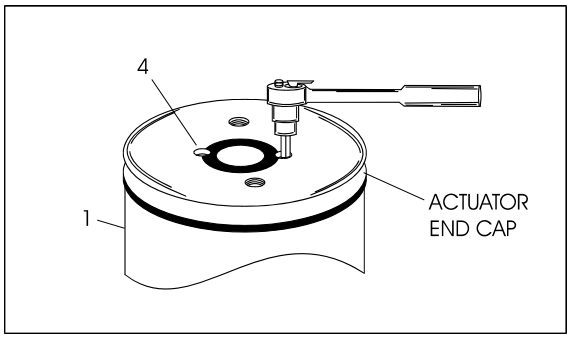
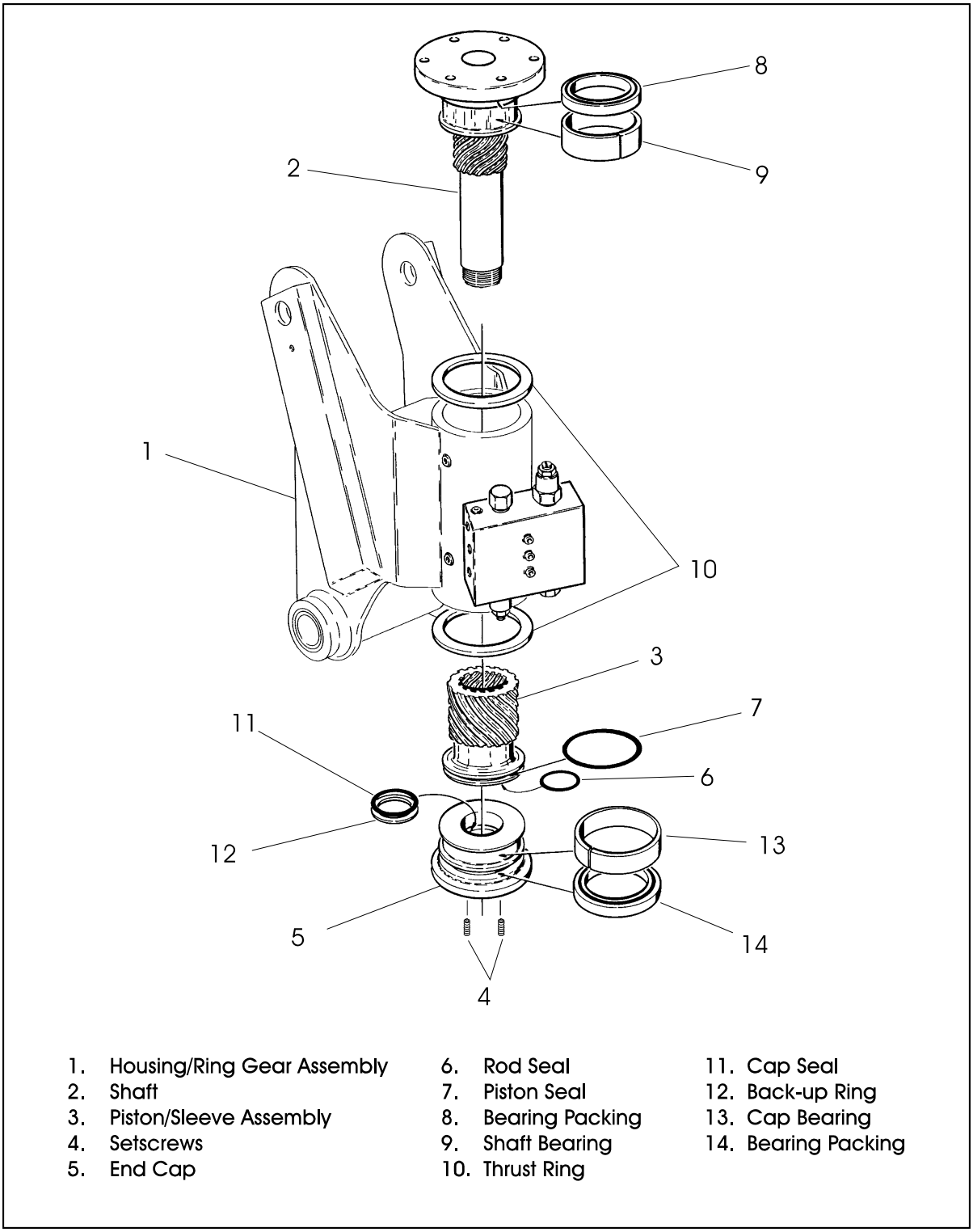


Figure 4-31. Removing Setscrew



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

Figure 4-28. Rotator Assembly (Helac)

6. Place two (2) 3/8"x16NC 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).

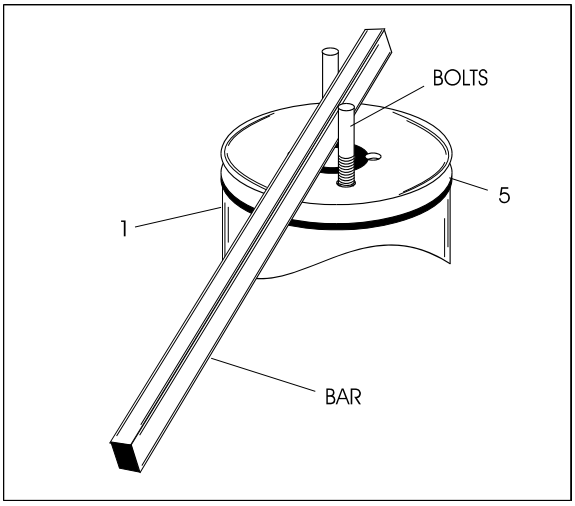


Figure 4-32. Removing End Cap

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

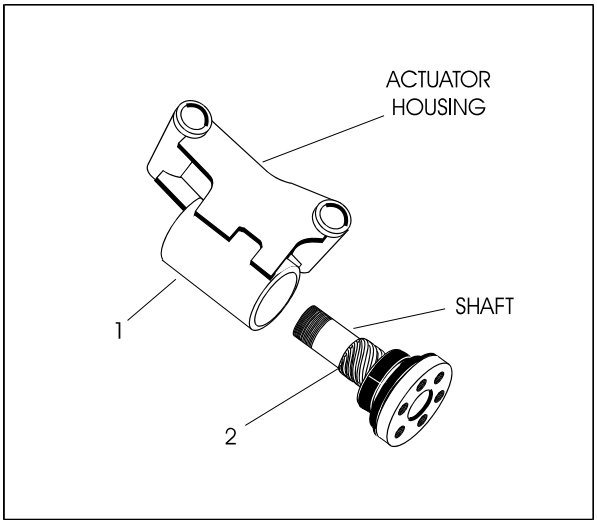


Figure 4-33. Removing Shaft from Housing

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

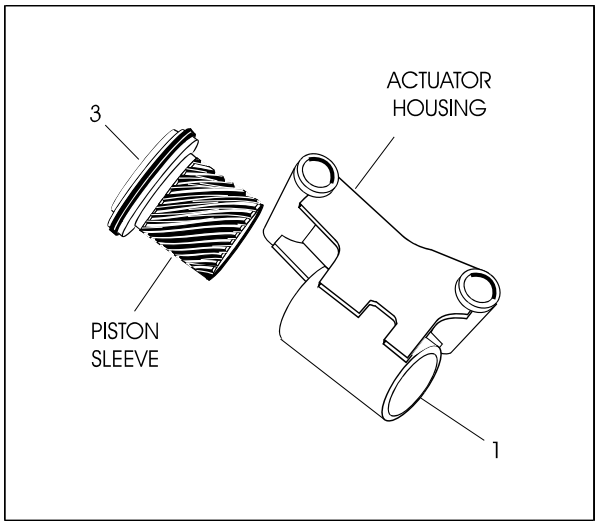


Figure 4-34. Removing Sleeve from Housing

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 new seal (7) and bearing (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).

⚠ CAUTION

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.)
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 54 - 68 Nm, such that the actuator begins rotation at approximately 6.9 Bar pressure.
8. The end cap must be secured against the shaft by installing axial set screws (4).

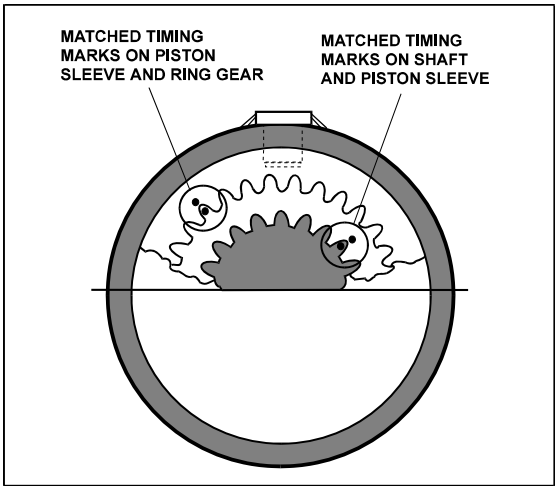
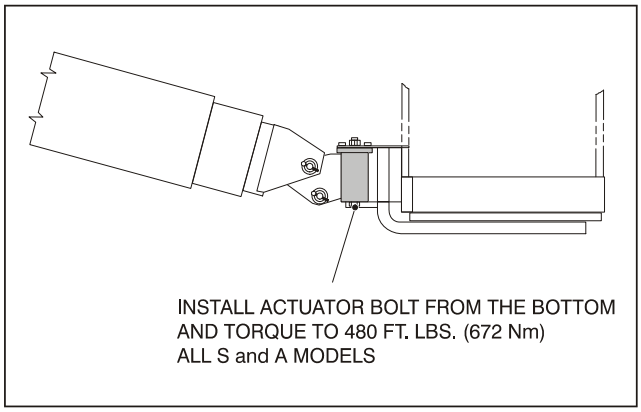


Figure 4-35. Actuator Timing



4.11 DRIVE CARD SETUP PROCEDURES

NOTE: *The following procedures are to be used as a beginning basis for controller adjustment. After completing the procedure, final adjustments are to be made based on the machines function speed.*

Table 4-1. Function Speeds

Function	Function Speed In Seconds
Telescope	
Extend	48-61
Retract	24-32
Lift	
Up	46-60
Down	33-43
Articulating Jib Boom	
Up	22-29
Down	16-22
Swing Speed	
Full 360°	79-101
Platform Rotation	
Left	22-30
Right	22-30
Drive Speed (2WD)	
	28-32 @ 200ft.
Drive Speed (4WD)	
	32-36 @ 200ft.

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 setting given in table #1. 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 #1. 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 2. 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 2. 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 1. 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 1. This sets the maximum current for the card.
3. Set the ramp up and the ramp 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 2. 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 in table 2. Rotating the adjustment potentiometer clockwise will increase the ramp time.

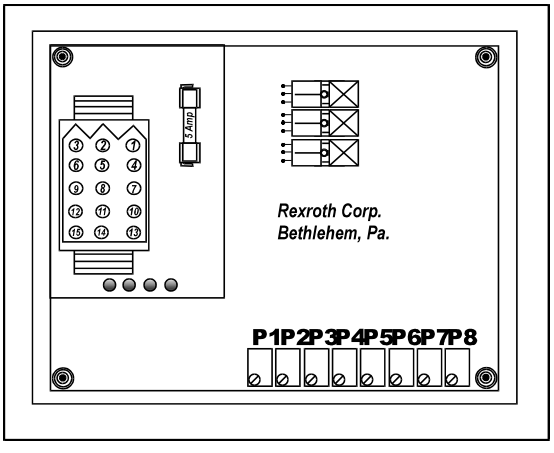


Figure 4-36. Control Card

Table 4-2. Flow Control Card Settings

S Models		
Function	Minimum Current	Maximum Current
Lift Up	450 to 55o mA	1400 to 1500 mA
Lift Down	450 to 550 mA	1400 to 1500 mA
Swing Right	450 to 550 mA	1400 to 1500 mA
Swing Left	450 to 550 mA	1400 to 1500 mA
Flow Control	750 to 850 mA	1400 to 1500 mA
Drive Forward	40 to 60 mA	150 to 200 mA
Drive Reverse	40 to 60 mA	150 to 200 mA
A Models		
Lift Up	450 to 550 mA	900 to 1000 mA
Lift Down	450 to 550 mA	1400 to 1500 mA
Swing Right	450 to 550 mA	1400 to 1500 mA
Swing Left	450 to 550 mA	1400 to 1500 mA
Flow Control	750 to 850 mA	1400 to 1500 mA
Drive Forward	50 to 60 mA	150 to 200 mA
Drive Reverse	50 to 60 mA	150 to 200 mA

Table 4-3. Flow Control Card Ramp Time

Function	Ramp Time
Lift Up	Ramp Up Time = 4:00 sec. Ramp Down Time = 3:00 sec.
Lift Down	Ramp Up Time = 4:00 sec. Ramp Down Time = 3:00 sec.
Swing Right	Ramp Up Time = 4:00 sec. Ramp Down Time = 3:00 sec.
Swing Left	Ramp Up Time = 4:00 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 = 2:30 sec.
Flow Control	Ramp Up Time = 3:00 sec. Ramp Down Time = 0:00 sec.

4.12 FOOT SWITCH ADJUSTMENT

Adjust so that functions will operate when pedal is at center of travel. If switch operates within last 6.35 mm of travel, top or bottom, it should be adjusted.

4.13 BOOM SYNCHRONIZING PROCEDURE (A MODELS ONLY)

NOTE: *If the Lower Boom assembly does not fully lower:*

1. Remove all personnel from the platform.
2. Pull the red knob located under the manual descent control valve.
3. From Ground Control, activate the lift control switch, raise Lower Boom 2meters.
4. After raising Lower Boom, release the red knob.
5. Activate Lower Boom Down, fully lower boom.

Repeat step 1 thru 5 if necessary.

SECTION 5. HYDRAULICS

5.1 CYLINDERS - THEORY OF OPERATION

Systems Incorporating Double Acting Cylinders

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: (S Models) - Slave Level, Master Level, Lift, Telescope, Articulating Jib Boom Lift, Axle Lockout and Steer; (A Models) - 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 (S Models) - Lift, Telescope, Lockout, Slave Level and Articulating Jib Boom Lift - (A Models) - 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.

5.2 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 Cylinder

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

Upper Lift Cylinder.

⚠ IMPORTANT

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 PLACE A BOOM PROP APPROXIMATELY 2.5 CM BELOW THE MAIN BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE PROP 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 main 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, Lower Lift, Upright level, Main Telescope and Tower Telescope.

⚠ IMPORTANT

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 MAIN BOOM WITH TELESCOPE CYLINDER FULLY RETRACTED AND ATTACH AN OVERHEAD CRANE TO THE UPRIGHT FOR SUPPORT, LEAVING APPROXIMATELY 2.5 CM OF SLACK IN CHAIN OR SLING FOR TEST PURPOSES. IF WORKING ON THE UPRIGHT LEVEL, RAISE THE TOWER BOOM HALFWAY, THEN RAISE MAIN BOOM TO HORIZONTAL AND POSITION A SUITABLE BOOM PROP APPROXIMATELY 2.5 CM BELOW MAIN 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 main boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

5.3 CYLINDER REPAIR

NOTE: *The following are general procedures that apply to all of the cylinders on this machine. Procedures that apply to a specific cylinder will be so noted.*

Disassembly

⚠ IMPORTANT

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.

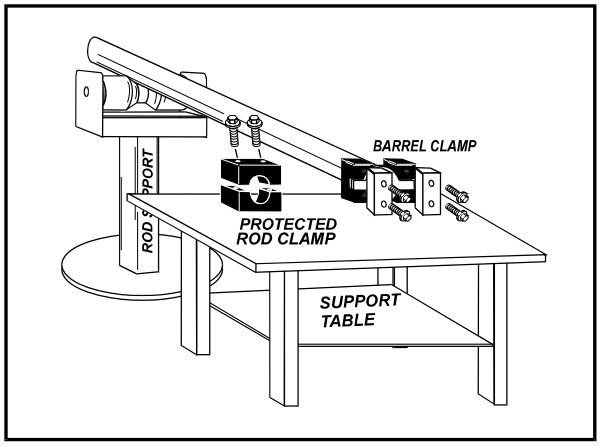


Figure 5-1. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight (8) cylinder head retainer cap screws, and remove cap screws from cylinder barrel.

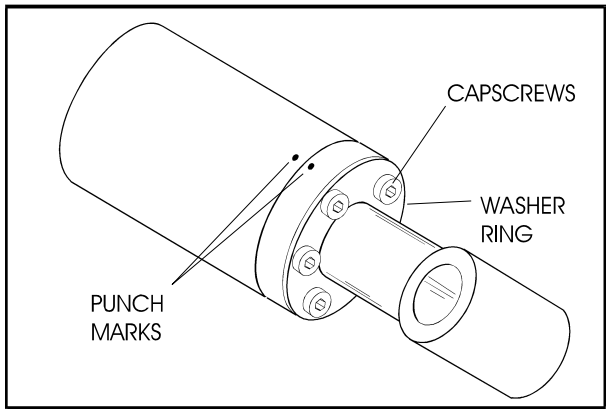
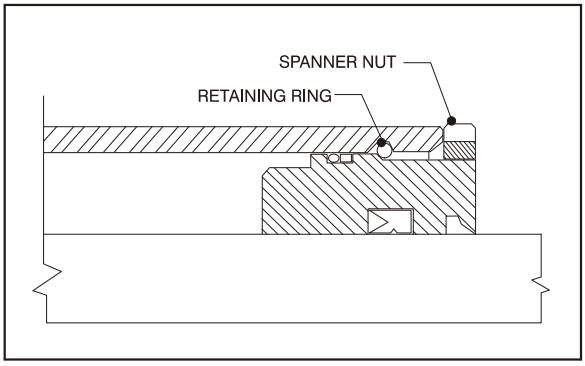


Figure 5-2. Cap Screw Removal

NOTE: *Steps 6 and 7 apply only to the steer cylinder.*

6. Using a spanner wrench, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.

7. Being careful not to mar the surface of the rod, use a punch or wooden dowel and hammer to drive the rod guide about one inch down into the cylinder bore. Using a screw driver, carefully push one end of the round retaining ring back towards the inside of the cylinder and then slip the screwdriver tip under that end. Pull the ring out of the groove toward the wall mouth. Once one end of the retaining ring is free from the groove, the remainder can be easily pried free using ones fingers or pliers.



8. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

⚠ IMPORTANT

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.

9. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

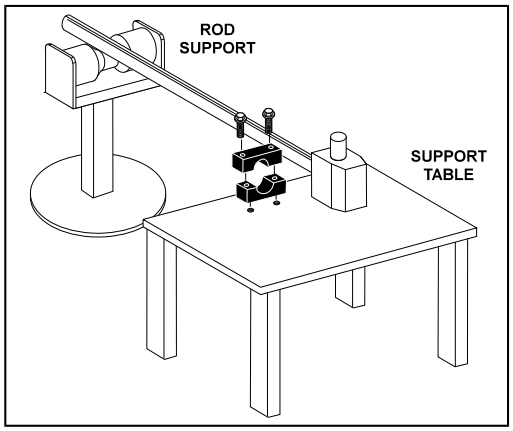


Figure 5-3. Cylinder Rod Support

10. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

NOTE: *Step 11 applies only to the steer cylinder.*

11. Loosen and remove nut which attaches the piston to the rod, and remove the piston.

12. Loosen and remove the cap screw(s), if applicable, which attach the tapered bushing to the piston.

13. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively

tighten the cap screw(s) until the bushing is loose on the piston.

14. Remove the bushing from the piston.

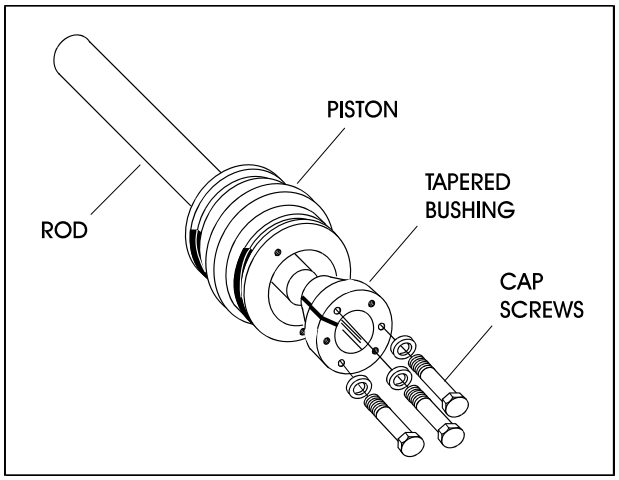


Figure 5-4. Tapered Bushing Removal

15. Screw the piston CCW, by hand, and remove the piston from cylinder rod.
16. Remove and discard the piston o-rings, seal rings, and backup rings.
17. Remove piston spacer, if applicable, from the rod.
18. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer plate, 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.*

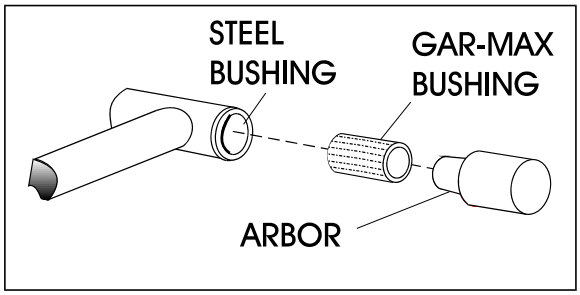


Figure 5-5. Composite Bearing Installation

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.*

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.

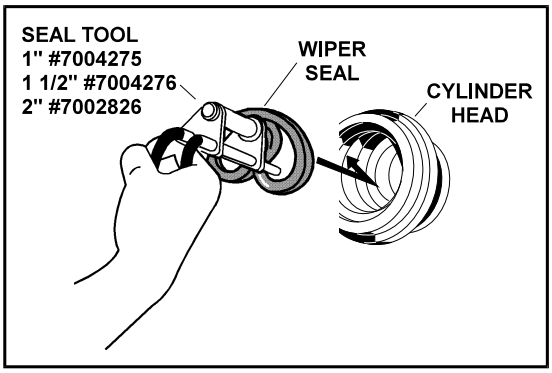


Figure 5-6. Rod Seal Installation

⚠ IMPORTANT

WHEN INSTALLING 'POLY-PAK' PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO WIPER SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

⚠ IMPORTANT

WHEN INSTALLING THE WIPER SEAL ON THE LOWER (TOWER) LIFT CYLINDER, APPLY LOCTITE #609 ON THE WIPER SEAL IN THREE EVENLY SPACED PLACES TO AID IN RETENTION OF THE SEAL.

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.

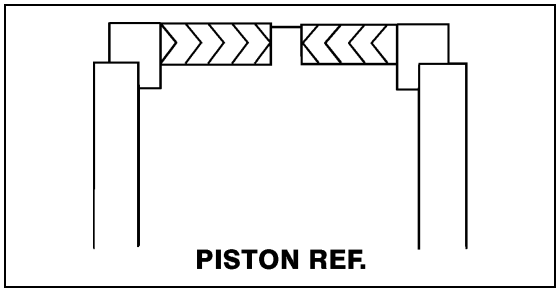


Figure 5-7. Poly-Pak Piston Seal Installation

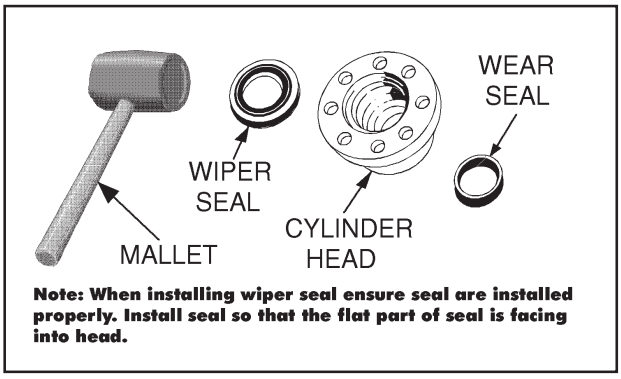


Figure 5-8. Wiper Seal Installation

3. Place a new "o"ring and back-up seal in the applicable outside diameter groove of the cylinder head.

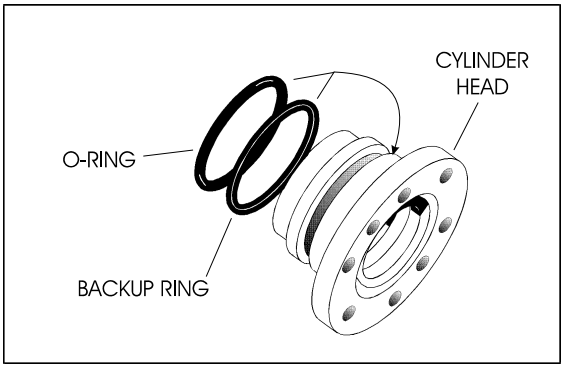


Figure 5-9. Installation of Head Seal Kit

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. If applicable, correctly place new o-ring in the inner piston diameter groove. (The backup ring side facing the O-ring is grooved.)

7. If applicable, correctly place new seals and guide lock 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.)

NOTE: *The backup rings for the solid seal have a radius on one side. This side faces the solid seal.(See magnified insert in Figure 5-10.)The split of seals and backup rings are to be positioned so as not to be in alignment with each other.*

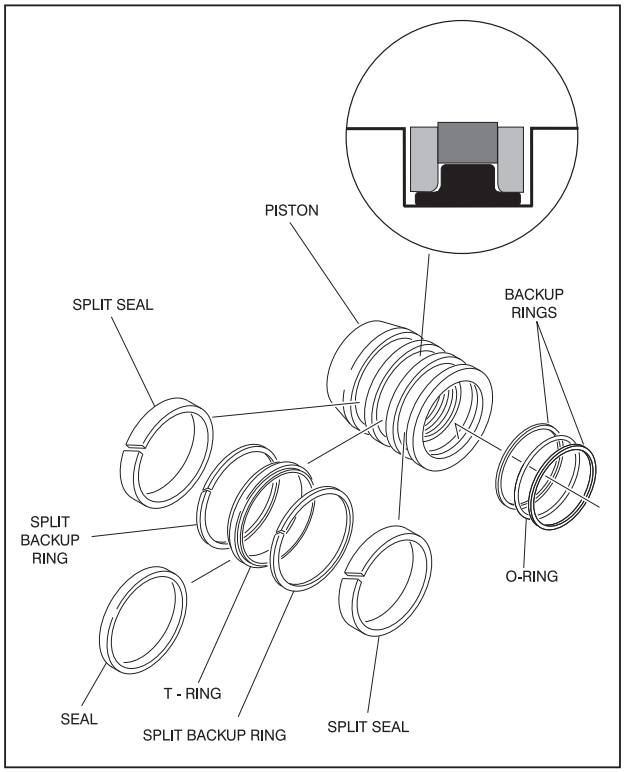


Figure 5-10. Piston Seal Kit Installation

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.*

⚠ WARNING

WHEN REBUILDING THE MASTER, SLAVE, LOWER LIFT, UPPER LIFT, ARTICULATING FLY BOOM LIFT, UPRIGHT LEVEL, TOWER TELESCOPE, OR UPPER TELESCOPE CYLINDERS, TIGHTEN SECURELY. (SEE TABLE 2-1 AND 2-3. TORQUE SPECIFICATIONS).

11. Assemble the tapered bushing loosely into the piston and insert JLG capscrews (not vendor capscrews) through the drilled holes in the bushing and into the tapped holes in the piston.

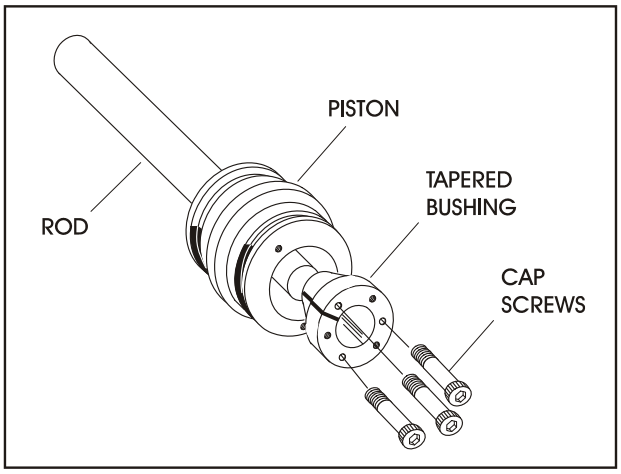


Figure 5-11. Tapered Bushing Installation

12. Tighten the capscrews evenly and progressively in rotation to the specified torque value. (See Table 5-1, Cylinder Head and Tapered Bushing Torque Specifications. (S Models) and Table 5-3, Cylinder Head and Tapered Bushing Torque Specifications. (A Models).

13. 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.

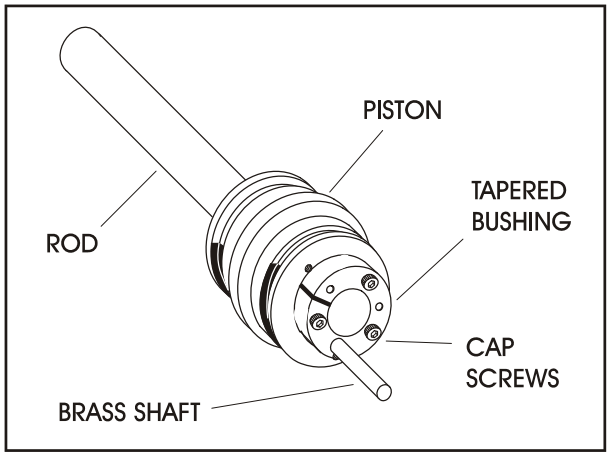


Figure 5-12. Seating the Tapered Bearing

14. Retorque the capscrews evenly and progressively in rotation to the specified torque value. (See Table 5-1, Cylinder Head and Tapered Bushing Torque Specifications. (S Models) and Table 5-3, Cylinder Head and Tapered Bushing Torque Specifications. (A Models).

15. Remove the cylinder rod from the holding fixture.

16. Place new guide locks and seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 5-10.)

17. Position the cylinder barrel in a suitable holding fixture.

⚠ IMPORTANT

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.

20. Secure the cylinder head gland using the washer ring and socket head bolts. (See Table 5-1 and Table 5-3.)

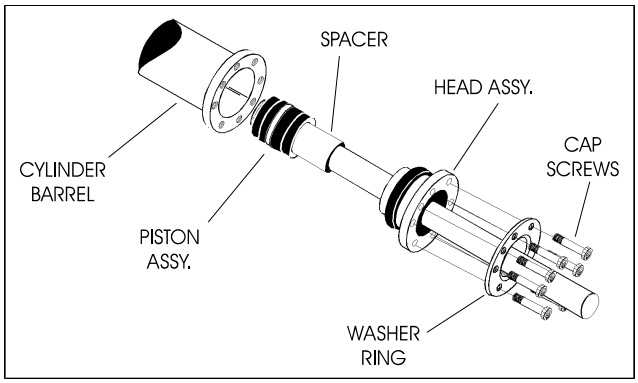


Figure 5-13. Rod Assembly Installation

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. (See Table 5-2, Holding Valve Torque Specifications).

Table 5-1. Cylinder Head and Tapered Bushing Torque Specifications. (S Models)

Description	Head Torque Value (Wet)	Tapered Bushing Torque Value (Wet)
Lift Cylinder	275 ft. lbs. (373 Nm)	30 ft. lbs. (41 Nm)
Articulating Lift Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Slave Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Master Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Telescope Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Lockout Cylinder	80 ft. lbs. (109 Nm)	N/A
Articulating Slave Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Articulating Master Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Steer Cylinder Piston Nut Torque Specifications		
Steer Cylinder	LBS.	NM
	150 ft. lbs	204 Nm

Table 5-2. Holding Valve Torque Specifications

Description	Torque Value
SUN - 7/8 HEX M20 X 1.5 THDS.	30-35 ft. lbs. (41-48 Nm)
SUN - 1 1/8 HEX 1 -14 UNS THDS.	45-50 ft. lbs. (61-68 Nm)
SUN - 1 1/4 HEX M36 X 2 THDS.	150-160 ft. lbs. (204-217 Nm)
RACINE - 1 1/8 HEX 1 1/16 - 12 THDS.	50-55 ft. lbs. (68-75 Nm)
RACINE - 1 3/8 HEX 1 3/16 - 12 THDS.	75-80 ft. lbs. (102-109 Nm)
RACINE - 1 7/8 HEX 1 5/8 - 12 THDS.	100-110 ft. lbs. (136-149 Nm)

Table 5-3. Cylinder Head and Tapered Bushing Torque Specifications. (A Models)

Description	Head Torque Value (Wet)	Tapered Bushing Torque Value (Wet)
Upper Lift Cylinder	80 ft. lbs. (109 Nm)	9 ft. lbs. (12 Nm)
Lower Lift Cylinder	420 ft. lbs. (570 Nm)	30 ft. lbs. (41 Nm)
Articulating Lift Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Articulating Slave Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Articulating Master Cylinder	50 ft. lbs. (68 Nm)	9 ft. lbs. (12 Nm)
Master Cylinder	30 ft. lbs. (41 Nm)	5 ft. lbs. (9 Nm)
Upper Telescope Cylinder	30 ft. lbs. (41 Nm)	9 ft. lbs. (12 Nm)
Tower Telescope Cylinder	30 ft. lbs. (41 Nm)	9 ft. lbs. (12 Nm)
Upright Level Cylinder	275 ft. lbs. (373 Nm)	30 ft. lbs. (41 Nm)
Lockout Cylinder	80 ft. lbs. (109 Nm)	N/A
Slave Cylinder	30 ft. lbs. (41 Nm)	9 ft. lbs. (12 Nm)
Steer Cylinder Piston Nut Torque Specifications		
Steer Cylinder	LBS.	Nm
	150 ft. lbs	204 Nm

⚠ CAUTION

IF THE CYLINDER IS TO BE TESTED PRIOR TO INSTALLATION ON THE MACHINE, EXTREME CARE SHOULD BE USED TO INSURE THAT THE OUTER END OF THE ROD IS SUPPORTED. USE EITHER A TRAVELING OVERHEAD HOIST, FORK-LIFT, OR OTHER MEANS TO SUPPORT THE OVERHANGING WEIGHT OF THE EXTENDING ROD.

5.4 CYLINDER REMOVAL AND INSTALLATION (S MODELS)

Main Boom Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position.
2. Shut down engine. Support main boom basket end with a prop. See Figure 5-14., Boom Positioning and Support, Cylinder Repair (S Models).

⚠ CAUTION

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

3. Tag and disconnect hydraulic lines to telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
4. Remove the hardware securing cover plate on bottom of the base boom section and remove cover.

NOTE: *Do not allow cable to rotate. This may damage the cable.*

5. Clamp both threaded ends of cable to prevent rotation. Note: Do not clamp on threads. Remove jam nuts and loosen adjustment nuts so there is slack in the cables. (See section 4).
6. Remove the hardware securing push bar to turntable and telescope cylinder.
7. Using a suitable brass drift, carefully drive the push bar pins from the telescope cylinder rod and turntable.
8. Remove hardware securing cable adjustment block to aft end of the base boom section and remove block.
9. Remove hardware securing telescope cylinder to aft end of the mid boom section.

⚠ CAUTION

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

10. Remove bolts securing cable attach bar to top of fly boom section.
11. Pull the telescope cylinder and cables partially from aft end of the base boom section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
12. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.

Main Boom Telescope Cylinder Installation

1. Route extend cables around extend sheave and secure cables to the telescope cylinder.
2. Install extend cables mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded end of cables.

NOTE: *When installing cables care must be taken not to twist or cross the cables.*

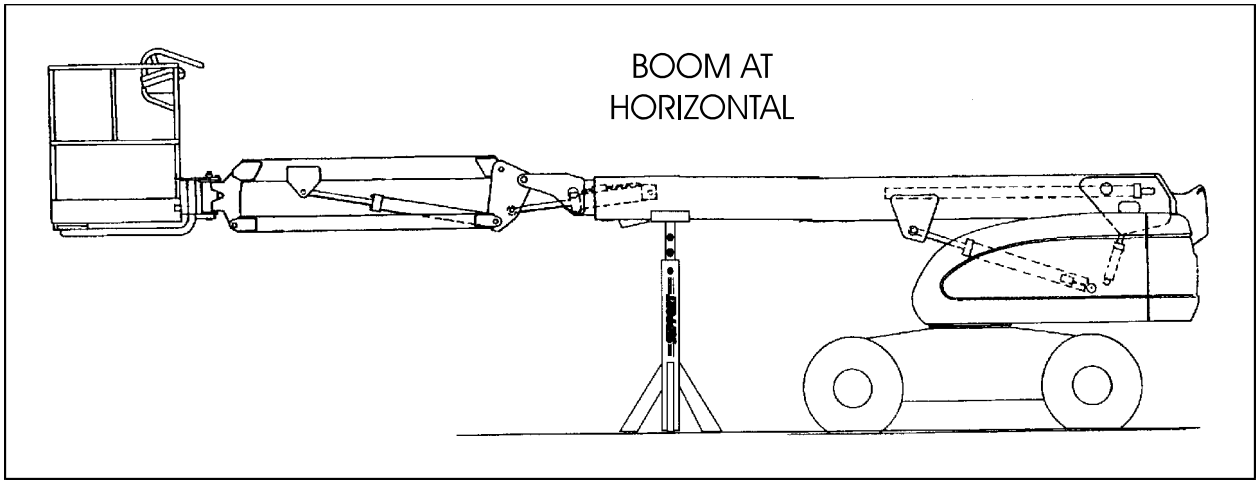


Figure 5-14. Boom Positioning and Support, Cylinder Repair (S Models)

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 boom assembly.
4. Install extend cable mounting blocks to threaded ends of cables. Loosely install nuts and jam nuts onto the threaded ends of cables.

NOTE: *When installing cables, care must be taken not to twist or cross the cables.*

5. 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 boom assembly.

⚠ CAUTION

WHEN INSERTING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO POSITION: DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

6. Carefully install the telescope cylinder barrel end support into slots in mid boom and secure with blocks and bolts. Use Loctite #242 on bolts.
7. Align holes in aft end of the fly boom section with holes in cable mounting block, then secure with mounting hardware.
8. Align holes in aft end of the base boom section with holes in cable mounting block, then secure with mounting hardware.
9. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
10. Align holes in rod end of the telescope cylinder with holes in push bar. Install push bar pin and secure with mounting hardware.
11. Align holes in push bar with holes in turntable. Install push bar pin and secure with mounting hardware.

NOTE: *Boom cables must be torqued after installation of the telescope cylinder. (See section 4.)*

Main Boom Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the engine and place the main boom in the horizontal position. Shut down engine and prop the boom. See Section 5-14., Boom Positioning and Support, Cylinder Repair (S Models).
2. Remove the hardware retaining the cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
3. Using auxiliary power, retract the lift cylinder rod completely.
4. Disconnect, cap and tag the main boom lift cylinder hydraulic lines and ports.
5. Remove barrel end attach pin retaining hardware. Using a suitable brass drift drive out the barrel end attach pin from the turntable.
6. Remove the cylinder from the turntable and place in a suitable work area.

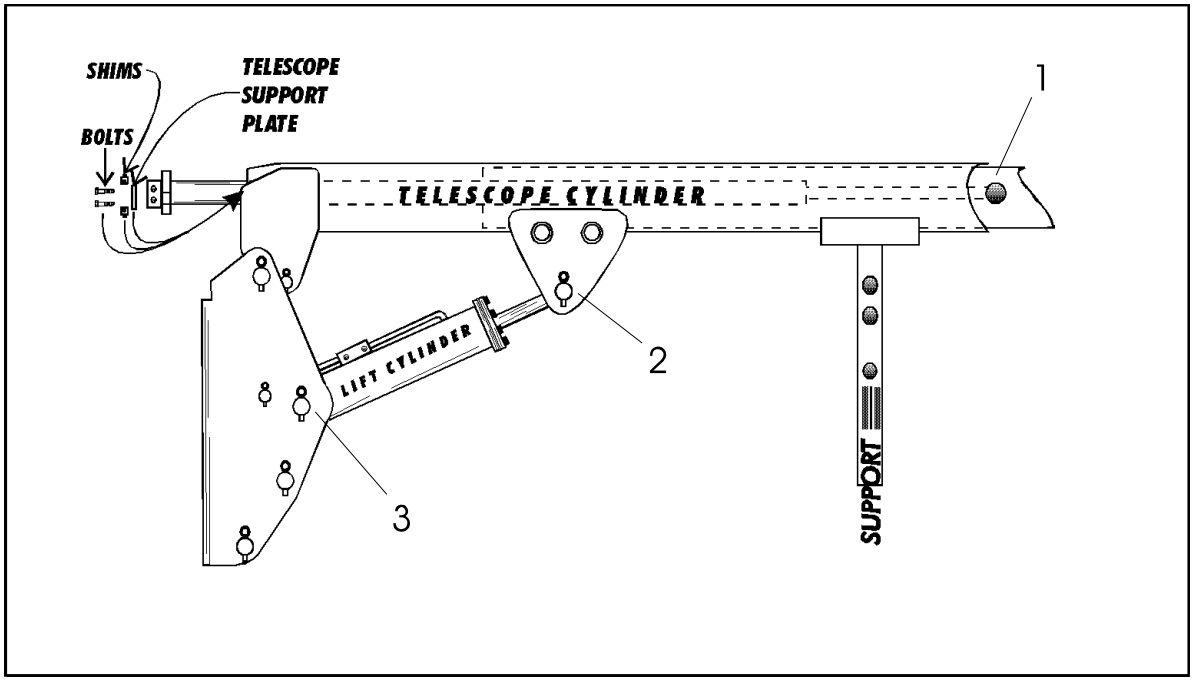


Figure 5-15. Location of Components - Telescope and Lift Cylinder

Main Boom Lift Cylinder Installation

1. Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the turntable.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the turntable. Secure in place with the pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power, extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable soft mallet, drive the cylinder rod attach pin through the boom and lift cylinder. Secure the pin in place with attaching hardware.
5. Remove boom prop and overhead crane. Activate hydraulic system.
6. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and adjust as necessary.

5.5 CYLINDER REMOVAL AND INSTALLATION (A MODELS)

Main Boom Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position. Extend telescope up to gain to pin #1.
2. Shut down engine. Support main boom basket end with a prop (See Figure 5-19., Boom Positioning and Support, Cylinder Repair (A Models).

⚠ CAUTION

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

3. Tag and disconnect hydraulic lines to telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

4. Remove the retaining rings that retain the telescope cylinder rod to the fly boom.
5. Using a suitable brass drift, carefully drive telescope cylinder rod pin #1 from the fly boom.
6. Remove mounting hardware securing the telescope cylinder barrel end to the base boom.
7. Attach a suitable sling to the telescope cylinder. Using a suitable lifting device attached to the sling, carefully pull the cylinder partially from the aft end boom assembly.
8. Secure the cylinder with a suitable sling and lifting device at the approximate center of gravity.
9. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

Main Boom Telescope Cylinder Installation

1. Attach a hydraulic power supply to the telescope cylinder ports. Using suitable supports or lifting devices at each end of the cylinder, extend the rod so that the cylinder pin attach holes are the same distance apart as the boom pin attach holes.
2. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.
3. Install the cylinder into the boom assembly.
4. Remove the lifting devices from the telescope cylinder.
5. Carefully install telescope cylinder rod pin #1 through the fly boom and secure it with the retaining rings.
6. Carefully install the telescope cylinder barrel end support into slots in base boom and secure with blocks and bolts. Use Loctite #242 on bolts. Shim as necessary.
7. Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
8. Remove boom prop and overhead crane. Activate hydraulic system.
9. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
10. Check fluid level of hydraulic tank and adjust as necessary.

Main Boom Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the engine and place the main boom in the horizontal position. Shut down engine and prop the boom. (See Figure 5-19., Boom Positioning and Support, Cylinder Repair (A Models).
2. Remove the hardware retaining the cylinder rod attach pin #2 to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
3. Using auxiliary power, retract the lift cylinder rod completely.
4. Disconnect, cap and tag the main boom lift cylinder hydraulic lines and ports.
5. Remove barrel end attach pin #3 retaining hardware. Using a suitable brass drift drive out the barrel end attach pin from the upright.
6. Remove the cylinder from the boom and place in a suitable work area.

Main Boom Lift Cylinder Installation

1. Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the upright.
2. Using a suitable drift, drive barrel end attach pin #3 through the mounting holes in the lift cylinder and the upright. Secure in place with the pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable drift drive cylinder rod attach pin #2 through the aligned holes, taking care to align the grooved pin holes. Secure the pin in place with attaching hardware.
5. Remove boom prop and overhead crane. Activate hydraulic system.
6. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
7. Check fluid level of hydraulic tank and adjust as necessary.

Upright Level Cylinder Removal

1. With the aid of an assistant, manually override the Plunger Valve with a pry bar, and from Ground Control, using auxiliary power, extend the tower telescope out to gain access to leveling cylinder rod end pin #3.

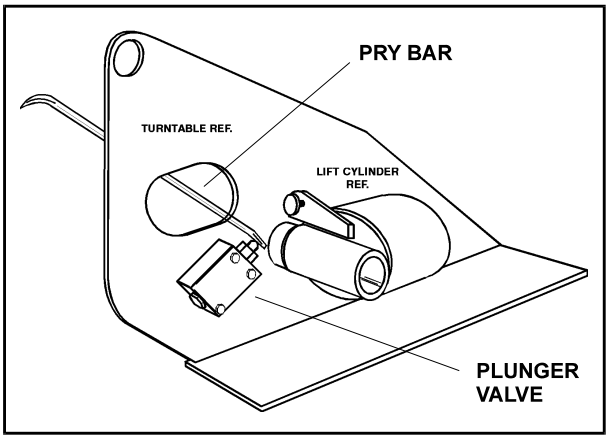


Figure 5-17. Overriding the Plunger Valve

2. With the main boom positioned and supported as shown in Leveling Cylinder Removal, prepare to remove the upright level cylinder.
3. Remove the mounting hardware from pin #1, securing leveling cylinder to upright.

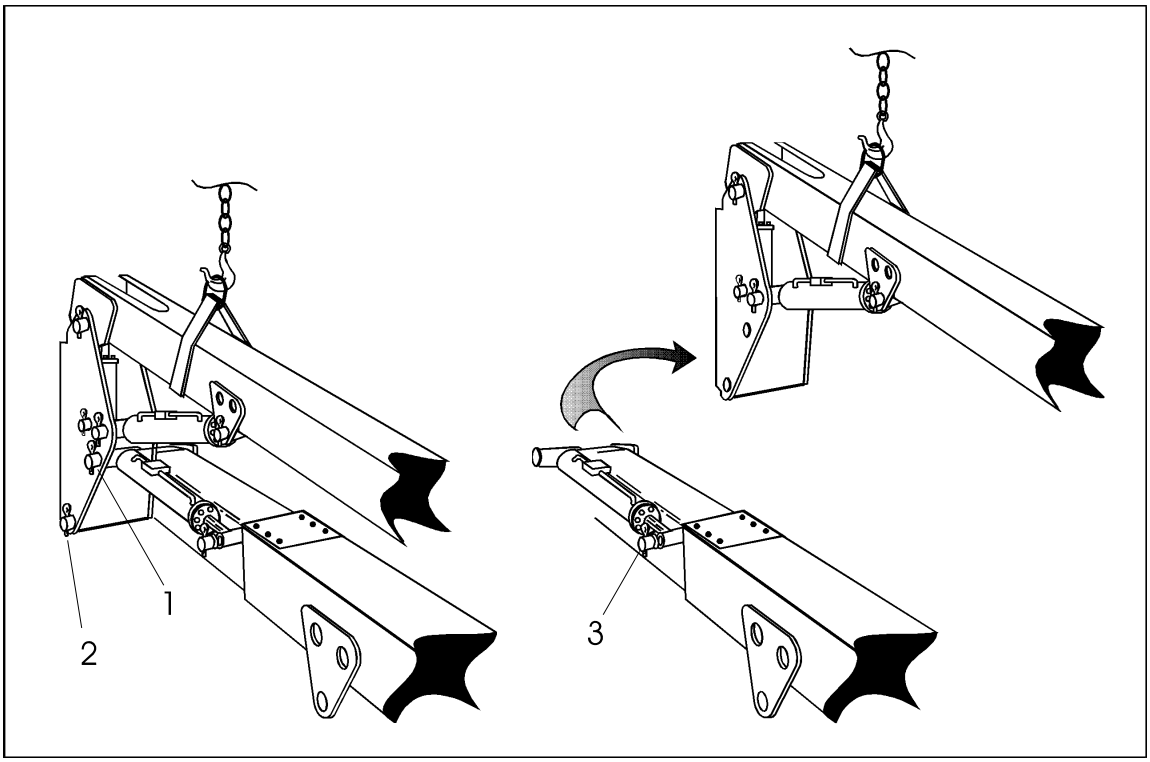


Figure 5-16. Leveling Cylinder Removal

4. With overhead crane supporting upper boom assembly. Raise boom until tension is released from cylinder pin #1.
5. Using a suitable drift, drive the barrel end attach pin #1 through the mounting holes in the upright and leveling cylinder.
6. Remove the mounting hardware from upright pivot pin #2 which secures upright to tower boom assembly.
7. Using a suitable drift, drive pivot pin #2 through the mounting holes in the upright and tower boom assembly.
8. Using all applicable safety precautions, operate the overhead crane to move upright and upper boom assembly forward to clear tower boom.
9. Using all applicable safety precautions, operate the overhead crane to move upright and upper boom assembly forward to clear tower boom.
10. After moving assemblies forward, operate overhead crane to the left far enough to remove leveling cylinder.
11. Tag, disconnect and cap hydraulic lines to level cylinder.
12. Remove the mounting hardware from leveling cylinder rod end pin #3 which secures cylinder to tower boom fly assembly.
13. Using a suitable drift, drive leveling cylinder pin #3 through the mounting holes in the tower boom fly and leveling cylinder, then remove leveling cylinder.

Upright Level Cylinder Installation

1. Place the leveling cylinder in position in the tower boom, then align holes in tower boom and leveling cylinder. Install leveling cylinder attach pin #3 using a suitable rubber mallet.
2. Secure pin to tower boom with mounting hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using all applicable safety precautions, operate the overhead crane to move upright and upper boom assembly in proper position with tower boom.
5. Align holes in upright and tower boom assembly and install upright pivot pin #2 using a suitable rubber mallet. Secure pin with mounting hardware.
6. Align holes in upright and leveling cylinder barrel end and install leveling cylinder pin #1 using a suitable rubber mallet. Secure pin with mounting hardware.
7. Remove overhead crane from upper boom. Activate hydraulic system.
8. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
9. Check fluid level of hydraulic tank and adjust as necessary.

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 (See Figure 5-19., Boom Positioning and Support, Cylinder Repair (A Models).
2. Support the main boom with a prop. Support the upright with an overhead crane. (See Figure 5-19., Boom Positioning and Support, Cylinder Repair (A Models).
3. Using slings restrain tower lift cylinder.
4. Remove mounting hardware securing the cylinder rod pin to the tower boom. Using a suitable brass drift, drive out the cylinder rod attach pin.
5. Tag, disconnect and cap the tower lift cylinder hydraulic lines and ports.
6. Remove mounting hardware securing the cylinder barrel pin to the turntable. Using a suitable brass drift, drive out the cylinder barrel pin.
7. Carefully remove restraining slings and remove tower lift cylinder from turntable. Place in a suitable work area.
8. If necessary, use an auxiliary power source and fully retract lift cylinder.

Tower Lift Cylinder Installation

1. With the main boom and tower boom positioned and supported as in Figure 5-19., Boom Positioning and Support, Cylinder Repair (A Models), place the tower lift cylinder in position on the turntable and secure in place using slings.
2. Align holes in turntable and lift cylinder. Using a suitable rubber mallet, install the cylinder barrel pin and secure with mounting hardware.
3. Connect an auxiliary power source to the cylinder and extend cylinder rod until the cylinder rod bushing aligns with bushings on boom.

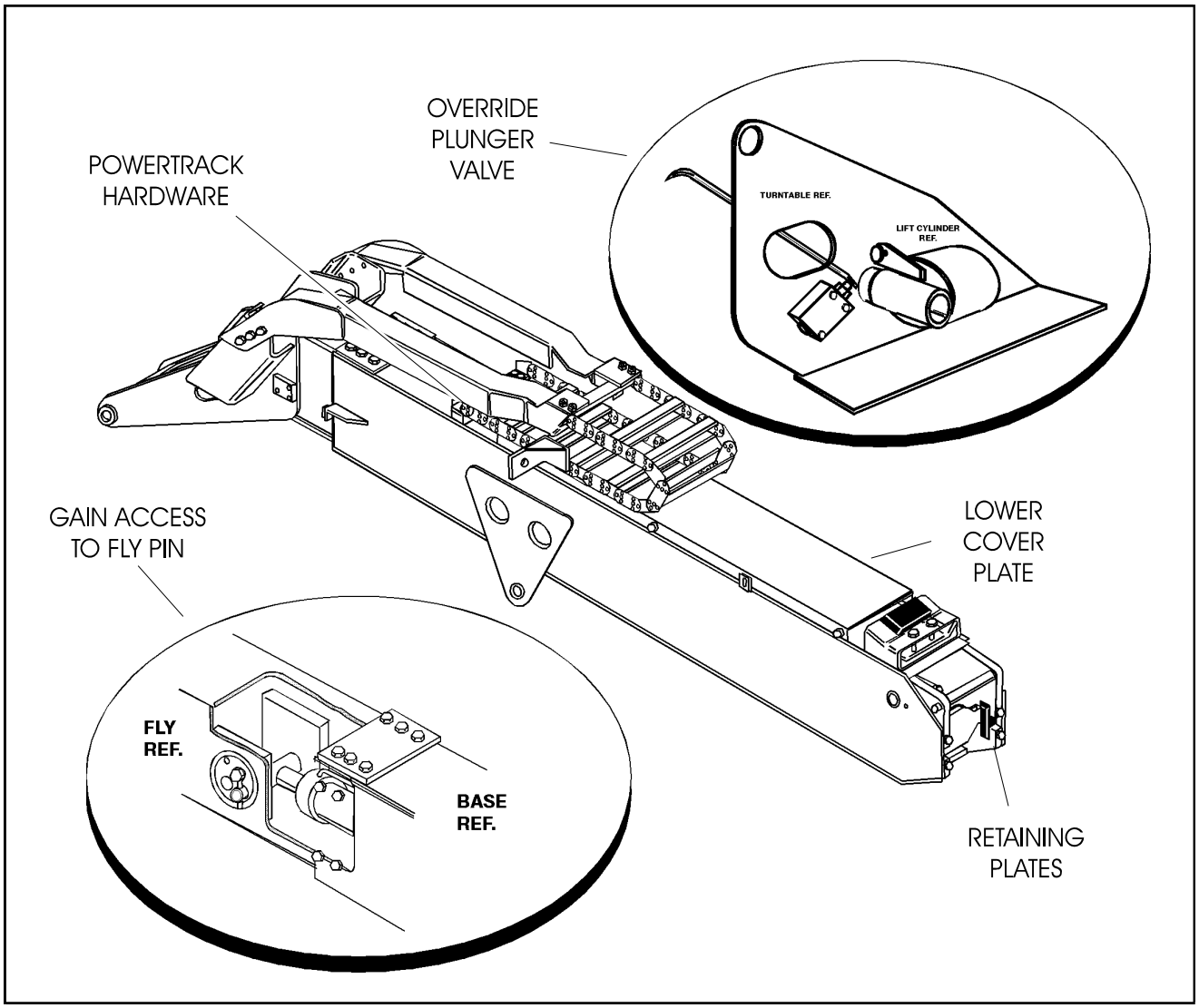


Figure 5-18. Tower Telescope Cylinder Removal

4. Using an appropriate brass drift, drive the rod attach pin through the aligned bushings. Secure pin with attaching hardware.
5. Remove caps from cylinder hydraulic lines and correctly install lines to cylinder as previously tagged during Removal.
6. Remove boom prop and overhead crane. Activate hydraulic system.
7. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
8. Check fluid level of hydraulic tank and adjust as necessary.

Tower Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom in the horizontal position. Shut down engine and prop the boom See Figure 5-18., Tower Telescope Cylinder Removal.
2. With the aid of an assistant, manually override the Plunger Valve with a pry bar, and from Ground Control, using auxiliary power, extend the tower telescope out to gain access to fly attach pin.
3. Remove lower cover plate.

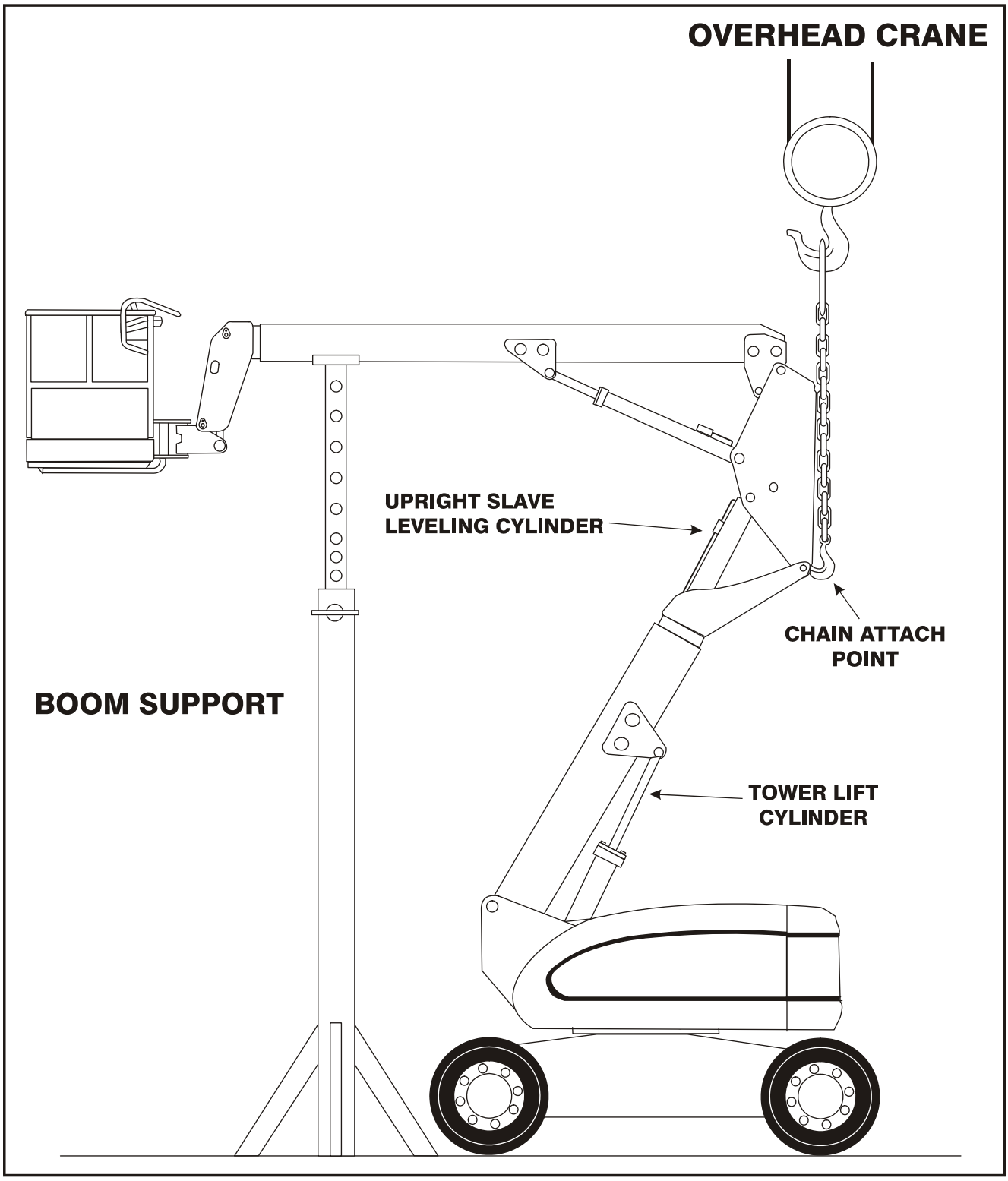
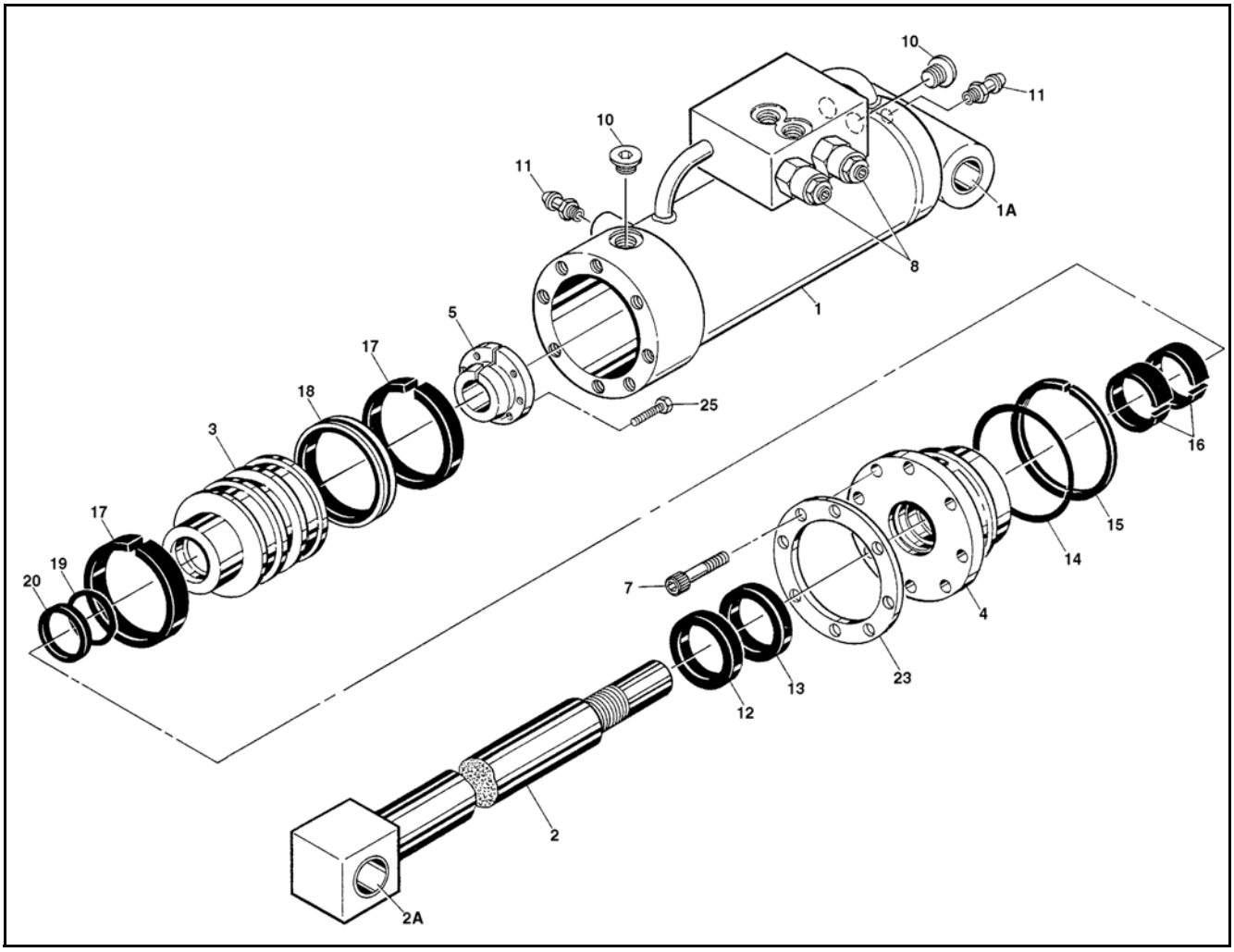


Figure 5-19. Boom Positioning and Support, Cylinder Repair (A Models)

4. Remove mounting hardware securing powertrack to tower boom assembly. After removing mounting hardware, slide powertrack backward far enough to move holes and wiring harness to the side to gain access to telescope cylinder.
5. Tag, disconnect and cap hydraulic hoses to Tower Telescope Cylinder. Plug cylinder ports.
6. Remove mounting hardware securing upper cylinder pin to fly boom. Using a suitable brass drift, drive out the cylinder rod pin.
7. Remove mounting hardware attaching retaining plates to base boom and remove plate.
8. Carefully slide the telescope cylinder from the boom. Place cylinder on a suitable work area.

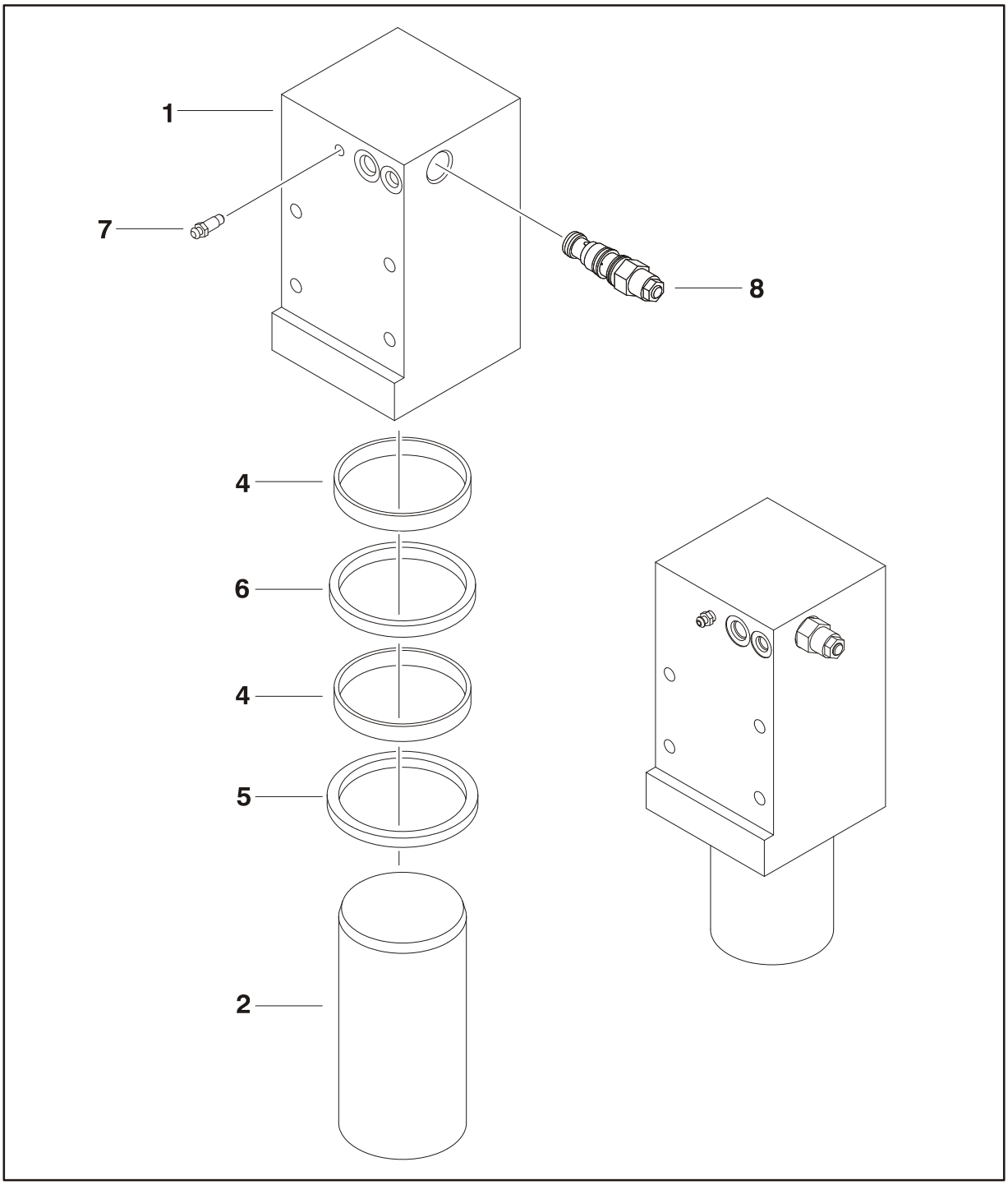
Tower Telescope Cylinder Installation

1. With the boom positioned as in Figure 5-18., Tower Telescope Cylinder Removal, slide the telescope cylinder into the boom, aligning the cylinder port block end with slotted holes in Base Boom. Secure telescope cylinder with mounting hardware.
2. Remove caps and plugs from hydraulic lines and ports. Properly connect hydraulic lines to cylinder. Reinstall cover plate.
3. Start engine. With the aid of an assistant, manually override the plunger valve. Activate Tower telescope out to align attaching pin holes in Fly Boom. Shut down engine.
4. Using a brass drift, drive in the attach pin. Secure in place with mounting hardware.
5. Align holes in base boom and powertrack. Secure the powertrack with mounting hardware.
6. Remove boom prop and overhead crane. Activate hydraulic system.
7. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
8. Check fluid level of hydraulic tank and adjust as necessary.



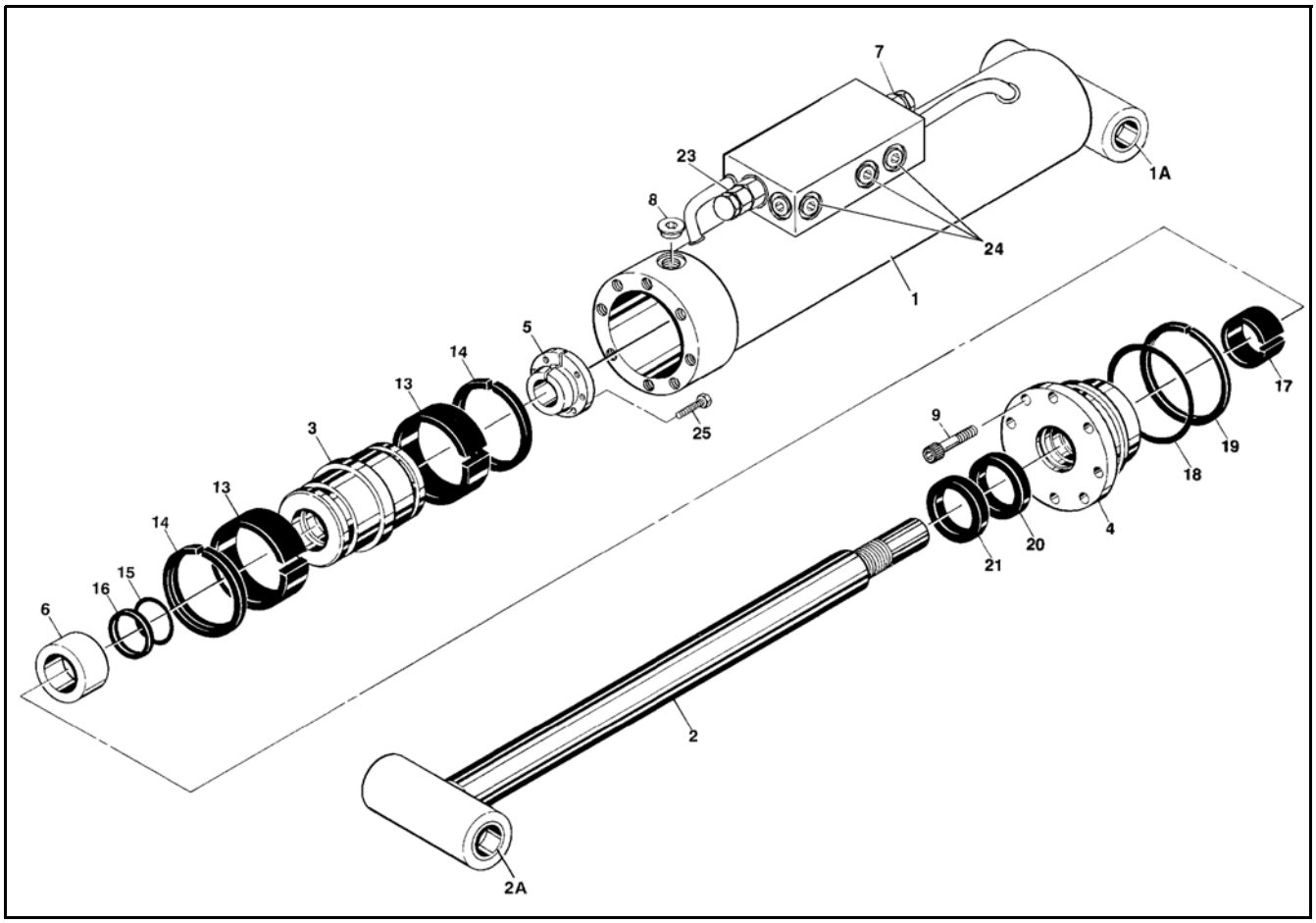
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Piston
4. Head
5. Tapered Bushing
6. Not Used
7. Bolt
8. Cartridge, Counterbalance
9. O-Ring Plug
10. O-Ring Plug
11. Bleeder Valve
12. Wiper Ring
13. Seal, Rod
14. O-Ring
15. Back-Up Ring
16. Wear Ring
17. Wear Ring
18. T Seal
19. O-Ring
20. Back-Up Ring
21. Loctite #242 (Not Sh0wn)
22. Locking Primer (Not Shown)
23. Washer Ring
24. Not Used
25. Socket Head Screw

Figure 5-20. 600S Axle Lockout Cylinder (Prior to S/N 75606)



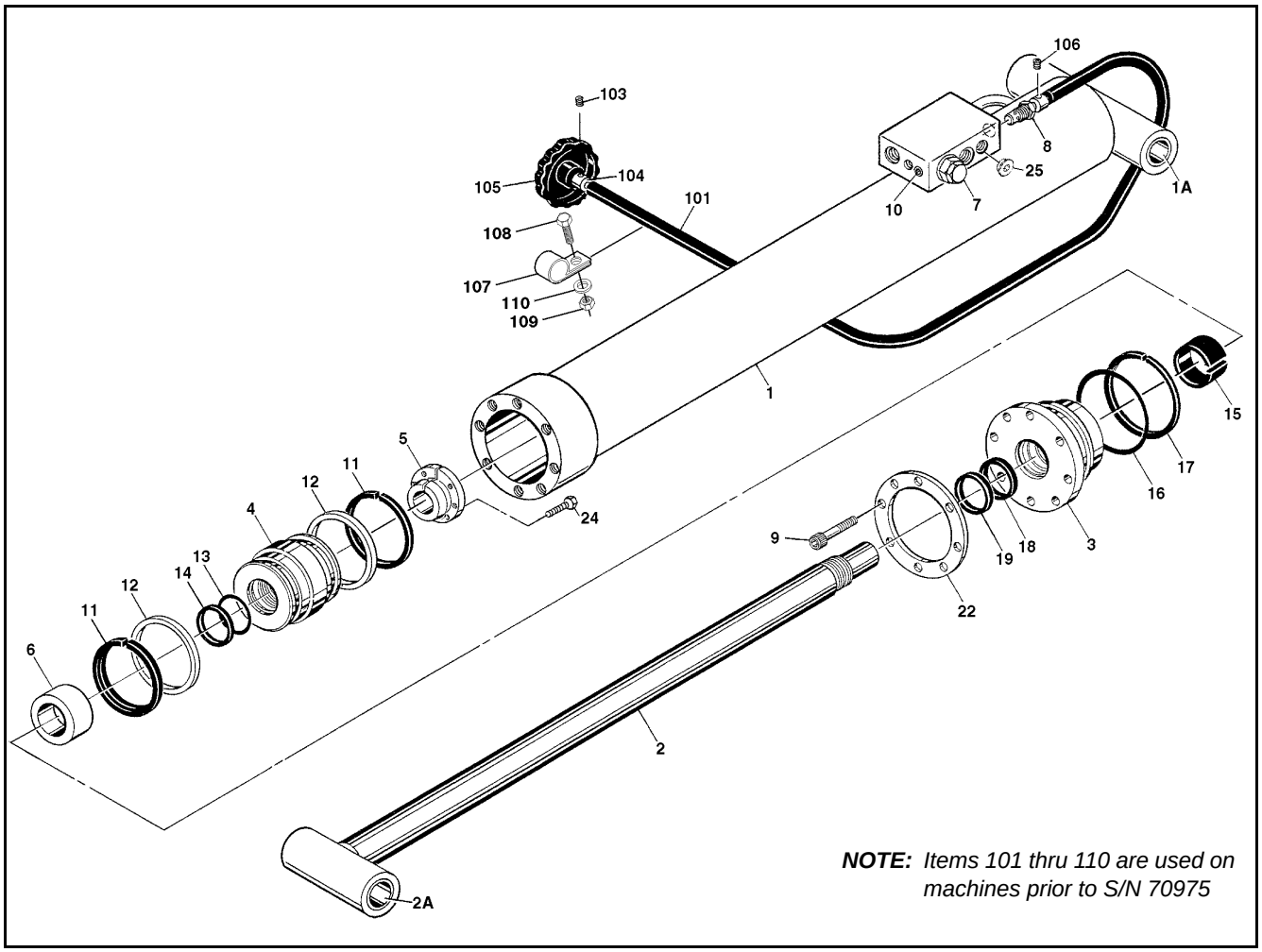
1. Barrel
2. Rod
3. Not Used
4. Wear Ring
5. Wiper Ring
6. Rod Seal
7. Bleeder
8. Cartridge Valve

Figure 5-21. 600S Axle Lockout Cylinder (S/N 75606 to Present)



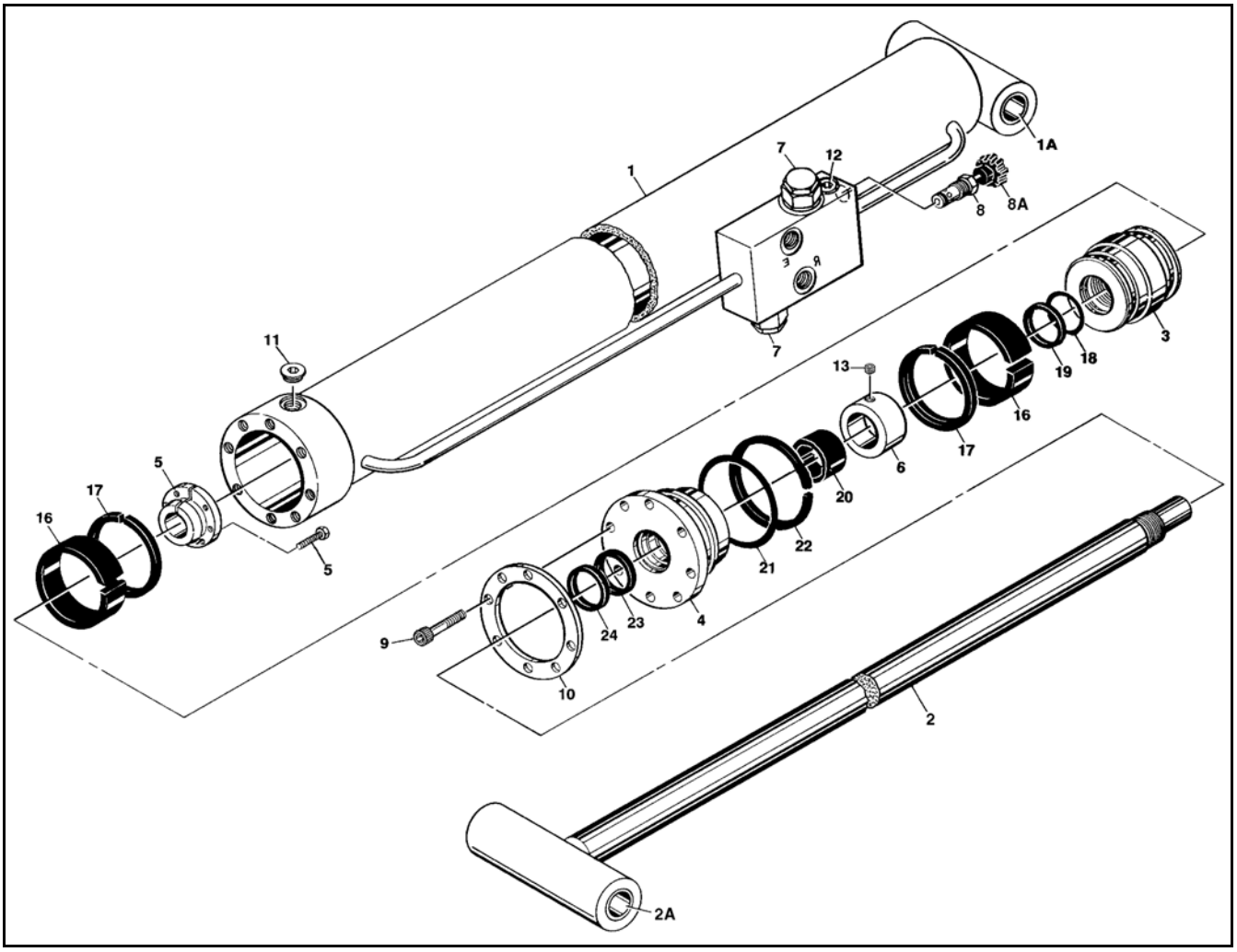
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Piston
4. Head
5. Tapered Bushing
6. Spacer
7. Cartridge Valve
8. O-Ring Plug
9. Socket Head Capscrew
10. Washer Ring
11. Loctite #242 (Not Shown)
12. Locking Primer (Not Shown)
13. Seal
14. Lock Ring
15. O-Ring
16. Back-Up Ring
17. Wear Ring
18. O-Ring
19. Back-Up Ring
20. Rod Seal
21. Wiper Ring
22. Not Used
23. Valve Cartridge
24. O-Ring Plug
25. Socket Head Screw

Figure 5-22. 600S, 600SJ, 660SJ & 600A Level Cylinder



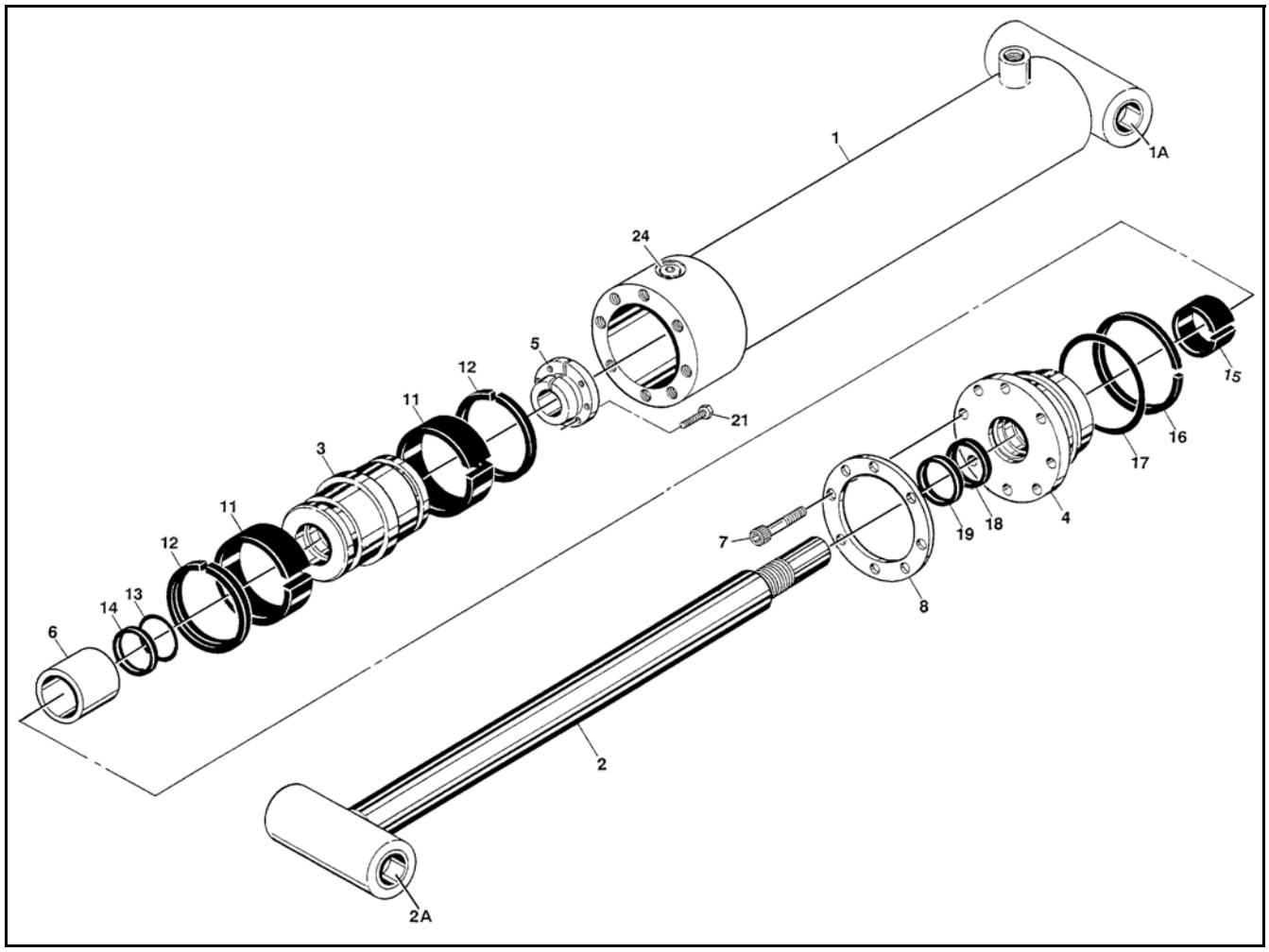
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Head
4. Piston
5. Tapered Bushing
6. Spacer
7. Cartridge Valve
8. Cartridge Valve
9. Socket Head Cap-screw
10. O-Ring Plug
11. Lock Ring
12. Hydrolock Seal
13. O-Ring
14. Back-Up Ring
15. Wear Ring
16. O-Ring
17. Back-Up Ring
18. Rod Seal
19. Wiper
20. Loctite #242 (Not Shown)
21. Locking Primer (Not Shown)
22. Washer Ring
23. Not Used
24. Socket Head Screw
25. O-Ring Plug
26. Loctite #609 (Not Shown)
101. Cable
102. Not Used
103. Setscrew
104. Adapter
105. Knob
106. Setscrew
107. Clamp

Figure 5-23. 600S Lift Cylinder



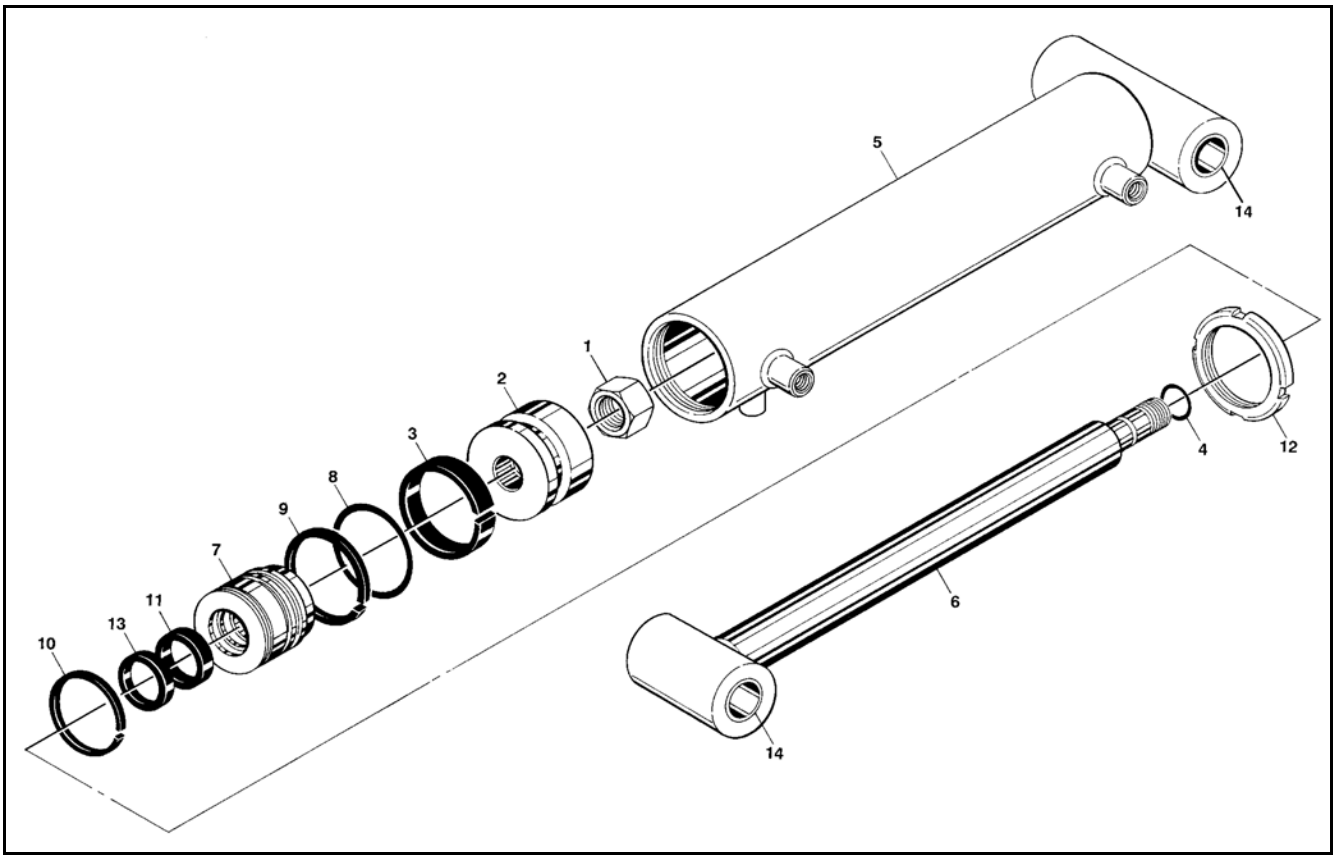
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Piston
4. Head
5. Tapered Bushing
6. Spacer
7. Cartridge Valve
8. Cartridge Valve
8A. Knob
9. Socket Head Capscrew
10. Washer Ring
11. O-Ring Plug
12. O-Ring Plug
13. Setscrew
14. Loctite #242 (Not Shown)
15. Locking Primer (Not Shown)
16. Seal
17. Lock Ring
18. O-Ring
19. Back-Up Ring
20. Wear Ring
21. O-Ring
22. Back-Up Ring
23. Rod Seal
24. Wiper
25. Loctite #609 (Not Shown)
26. Socket Head Capscrew

Figure 5-24. 600S & 600A Jib Lift Cylinder



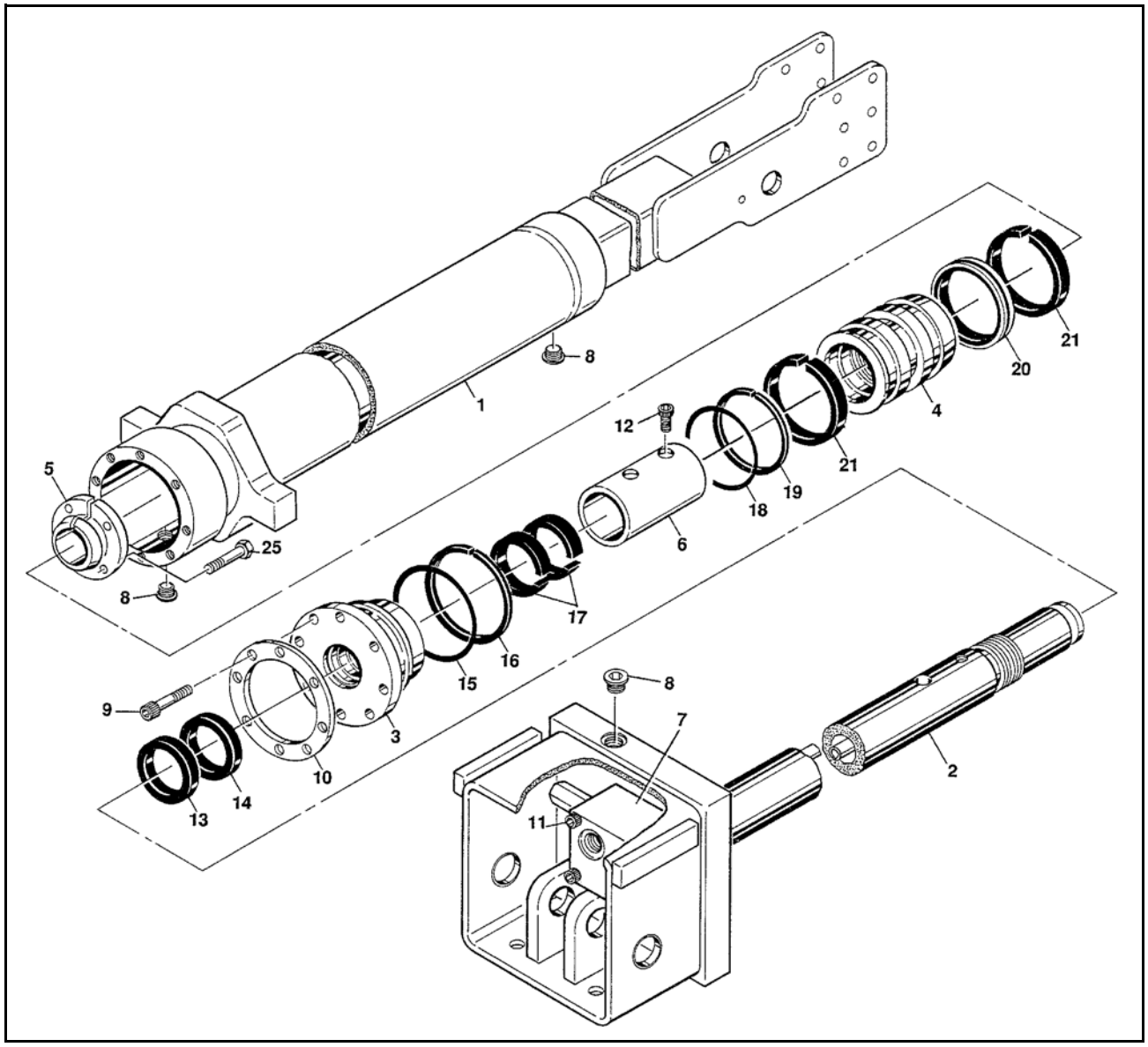
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Piston
4. Head
5. Tapered Bushing
6. Spacer
7. Capscrew
8. Washer Ring
9. Loctite #242 (Not Shown)
10. Locking Primer (Not Shown)
11. Seal
12. Lock Ring
13. O-Ring
14. Back-Up Ring
15. Wear Ring
16. O-Ring
17. Back-Up Ring
18. Rod Seal
19. Wiper
20. Not Used
21. Socket Head Capscrew
22. Loctite #609 (Not Shown)
23. Not Used
24. Plug Fitting

Figure 5-25. 600S & 600A Master Cylinder



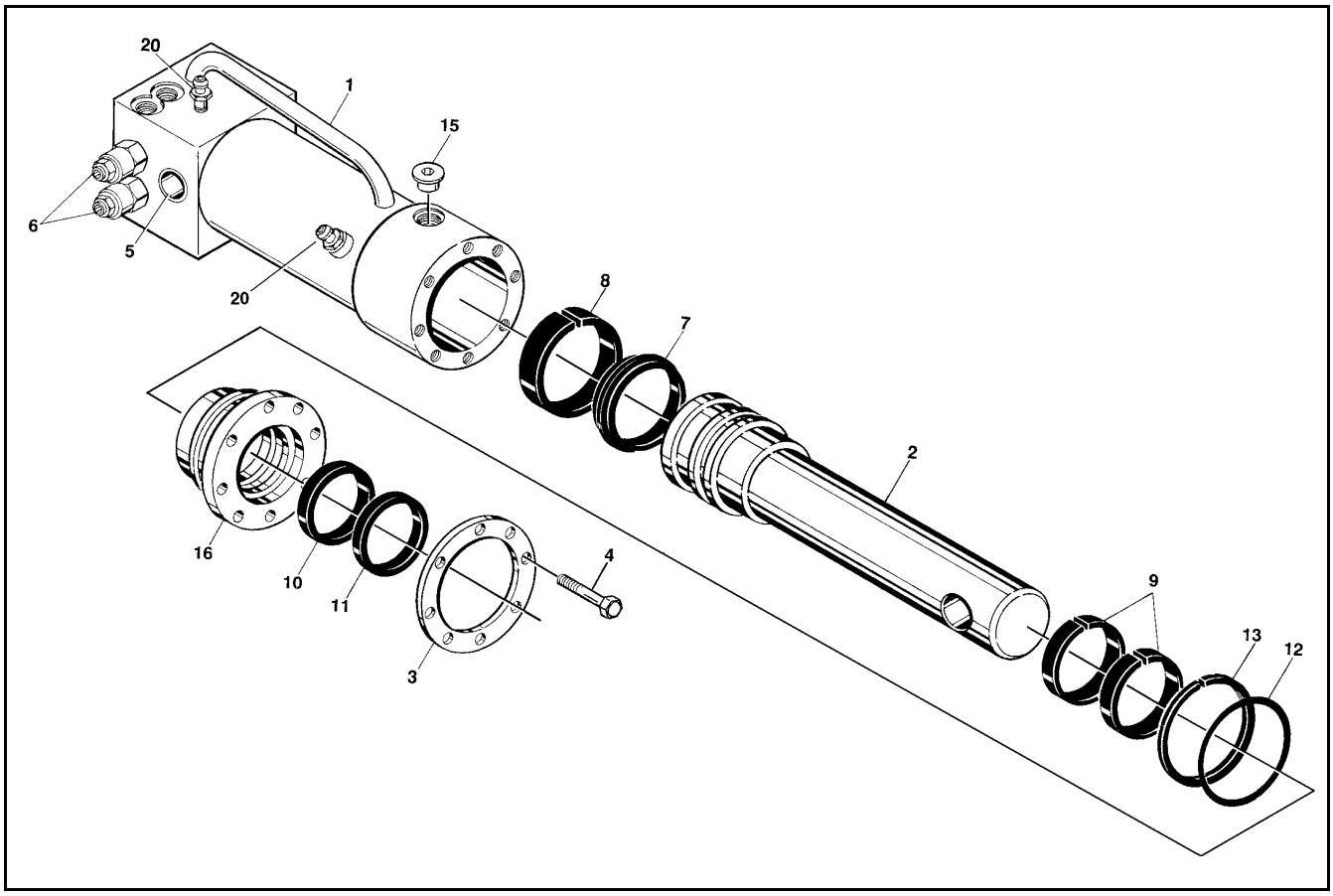
1. Locknut	6. Rod	11. Lip Seal
2. Piston	7. Capscrew	12. Spanner Nut
3. Seal	8. O-Ring	13. Wiper
4. O-Ring	9. Back-Up Ring	14. Bushing
5. Barrel	10. Retainer Ring	

Figure 5-26. 600S & 600A Steer Cylinder



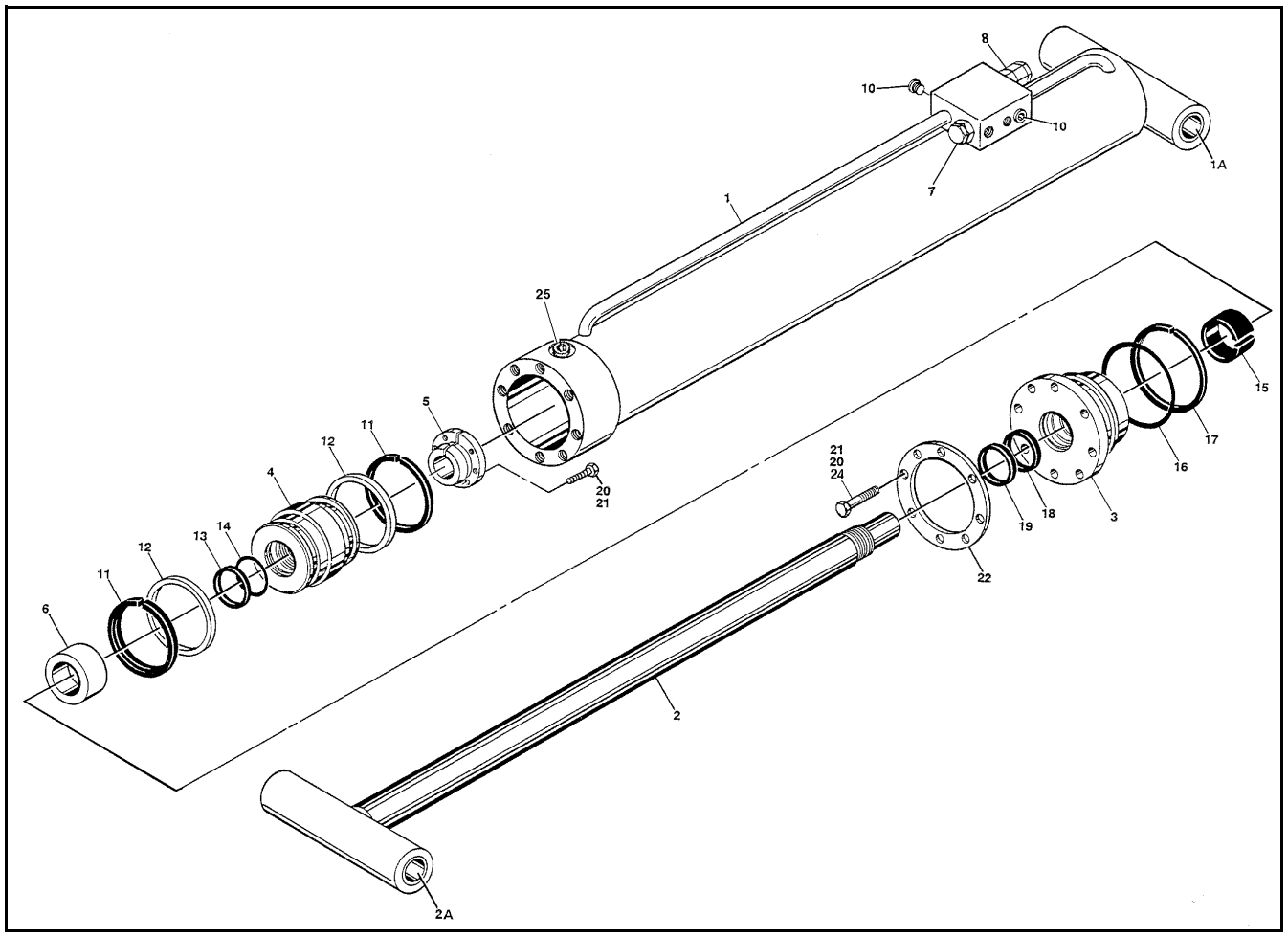
1. Barrel	7. Valve	13. Wiper	19. Back-Up Ring
2. Rod	8. O-Ring Plug	14. Rod Seal	20. T-Seal
3. Head	9. Capscrew	15. O-Ring	21. Wear Ring
4. Piston	10. Washer Ring	16. Back-Up Ring	22. Loctite #242 (Not Shown)
5. Tapered Bushing	11. Capscrew	17. Wear Ring	23. Locking Primer (Not Shown)
6. Spacer	12. Capscrew	18. O-Ring	24. Not Used

Figure 5-27. 600S Telescope Cylinder



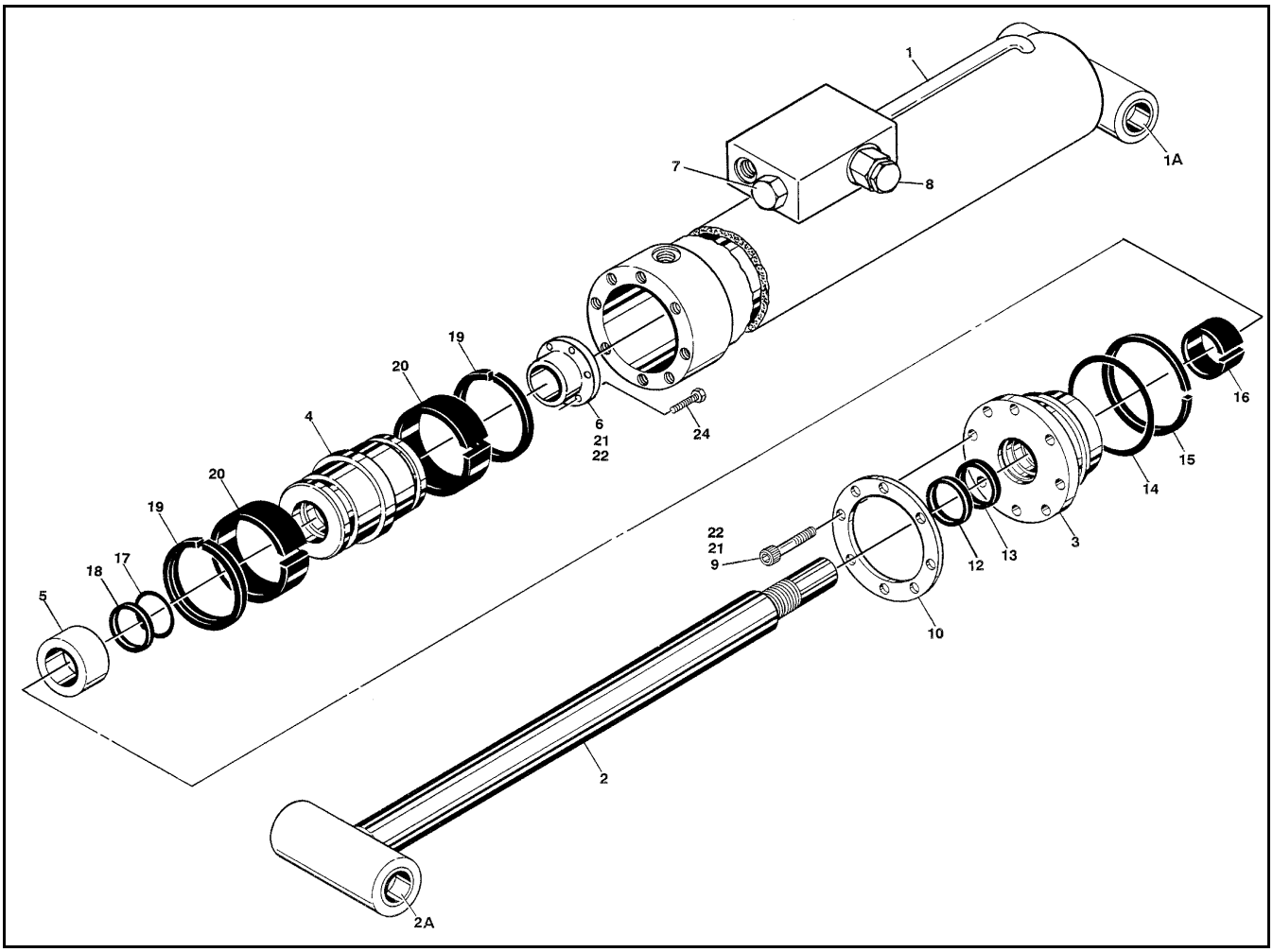
1. Barrel
2. Rod
3. Washer Ring
4. Bolt
5. Bushing
6. Cartridge Valve
7. Seal
8. Wear Ring
9. Wear Ring
10. Rod Seal
11. Rod Wiper
12. O- Ring
13. Back-Up Ring
14. Loctite RC #609
15. O-Ring Plug
16. Head
17. Loctite #242 (Not Sh0wn)
18. Locking Primer (Not Shown)
19. Not Used
20. Back-Up Ring
21. Bleeder Valve

Figure 5-28. 600A Axle Lockout Cylinder



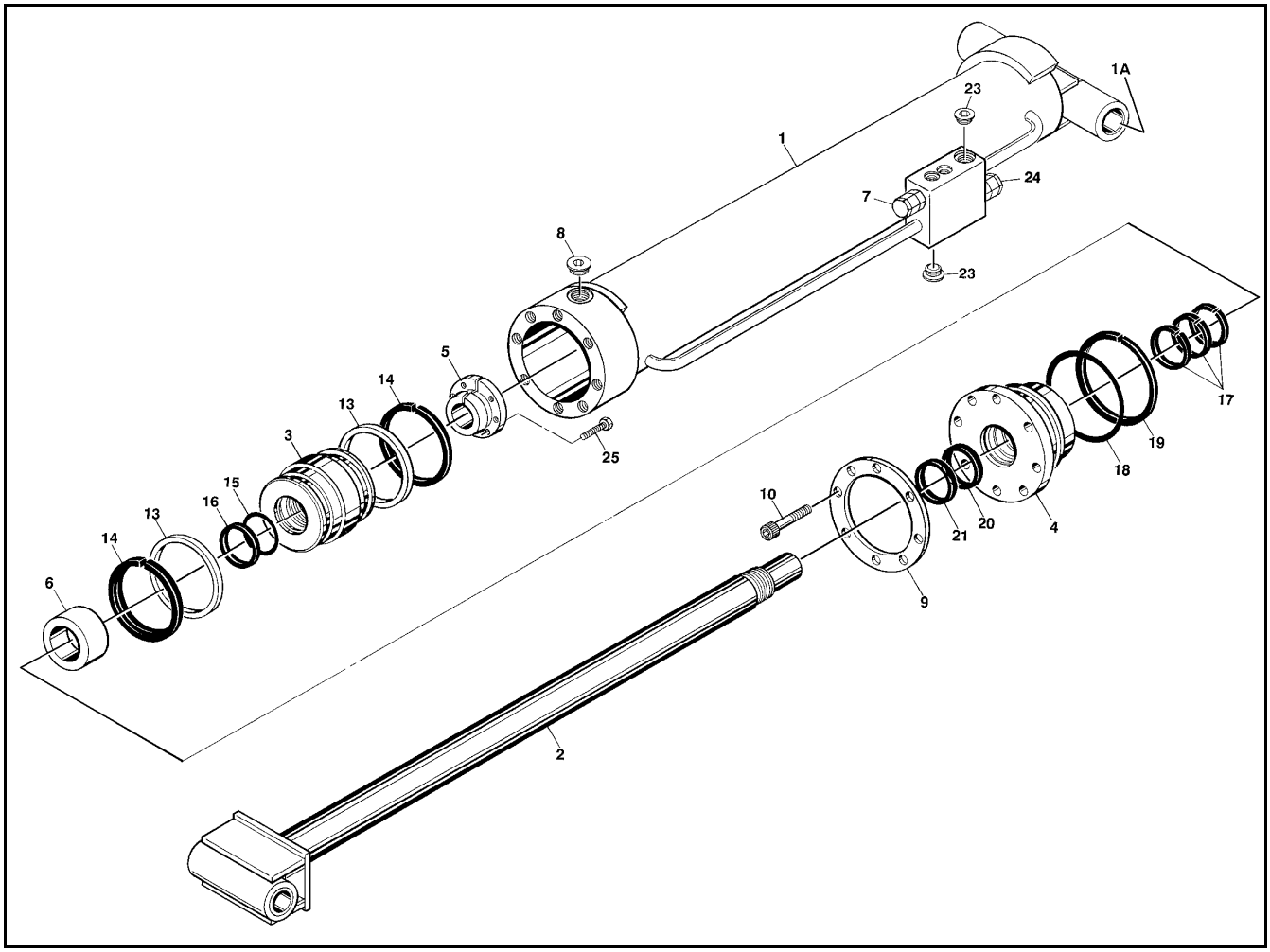
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Head
4. Piston
5. Tapered Bushing
6. Tube Spacer
7. Valve Cartridge
8. Valve Cartridge
9. Socket Head Capscrew
10. O-Ring Plug
11. Lock Ring
12. Hydrolock Seal
13. O-Ring
14. Back-Up Ring
15. Wear Ring
16. O-Ring
17. Back-Up Ring
18. Rod Seal
19. Wiper Ring
20. Loctite #242 (Not Shown)
21. Locking Primer (Not Shown)
22. Washer Ring
23. Not Used
24. Bolt
25. O-Ring Plug
26. Loctite #609

Figure 5-29. 600A Level (Upright) Cylinder



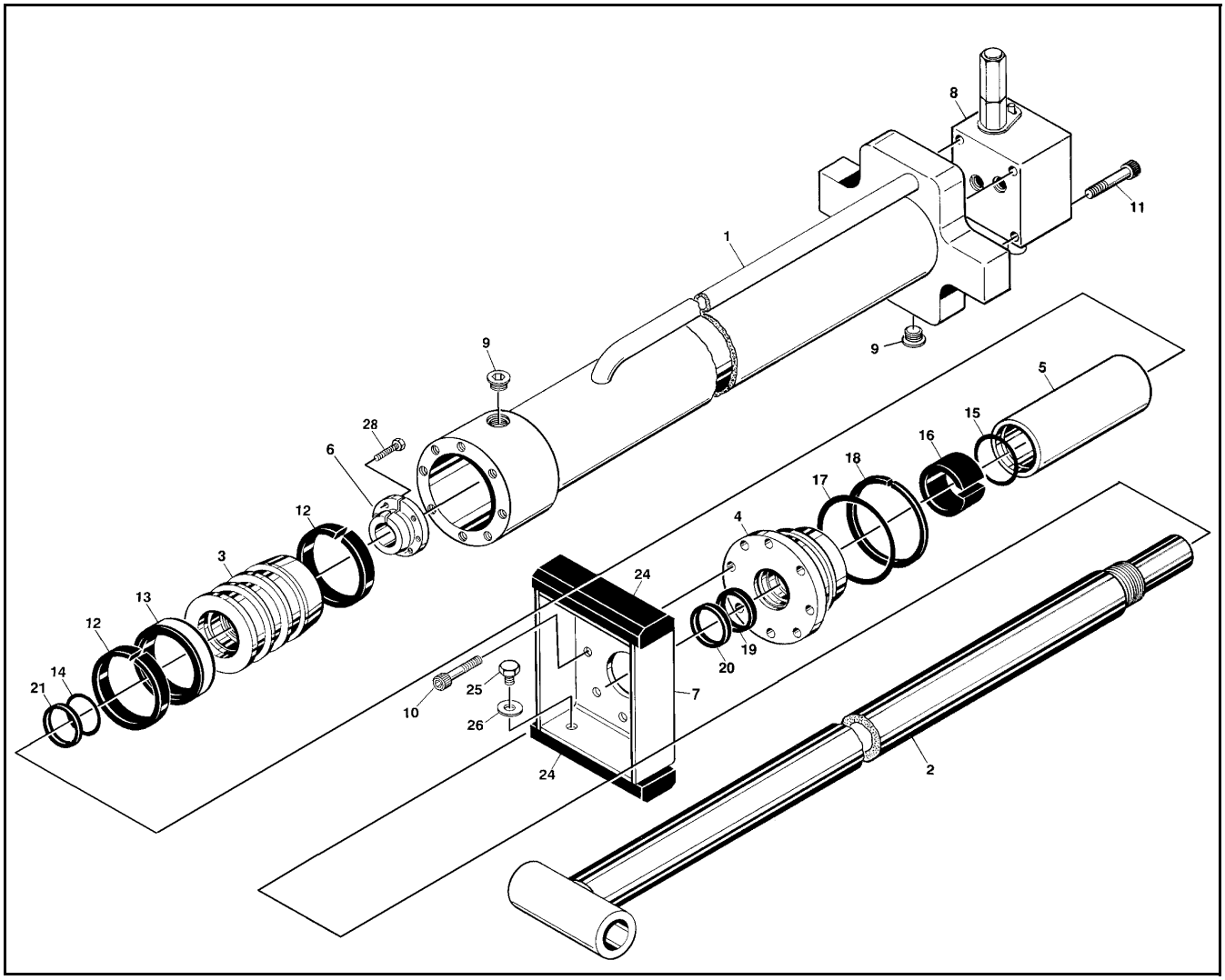
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Head
4. Piston
5. Spacer
6. Tapered Bushing
7. Cartridge Valve
8. Cartridge Valve
9. Socket Head Capscrew
10. Washer Ring
11. O-Ring Plug
12. Wiper
13. Rod Seal
14. O-Ring
15. Back-Up Ring
16. Wear Ring
17. O-Ring
18. Back-Up Ring
19. Lock Ring
20. Seal
21. Loctite #242 (Not Shown)
22. Locking Primer (Not Shown)
23. Not Used
24. Bolt

Figure 5-30. 600A Main Boom Lift Cylinder



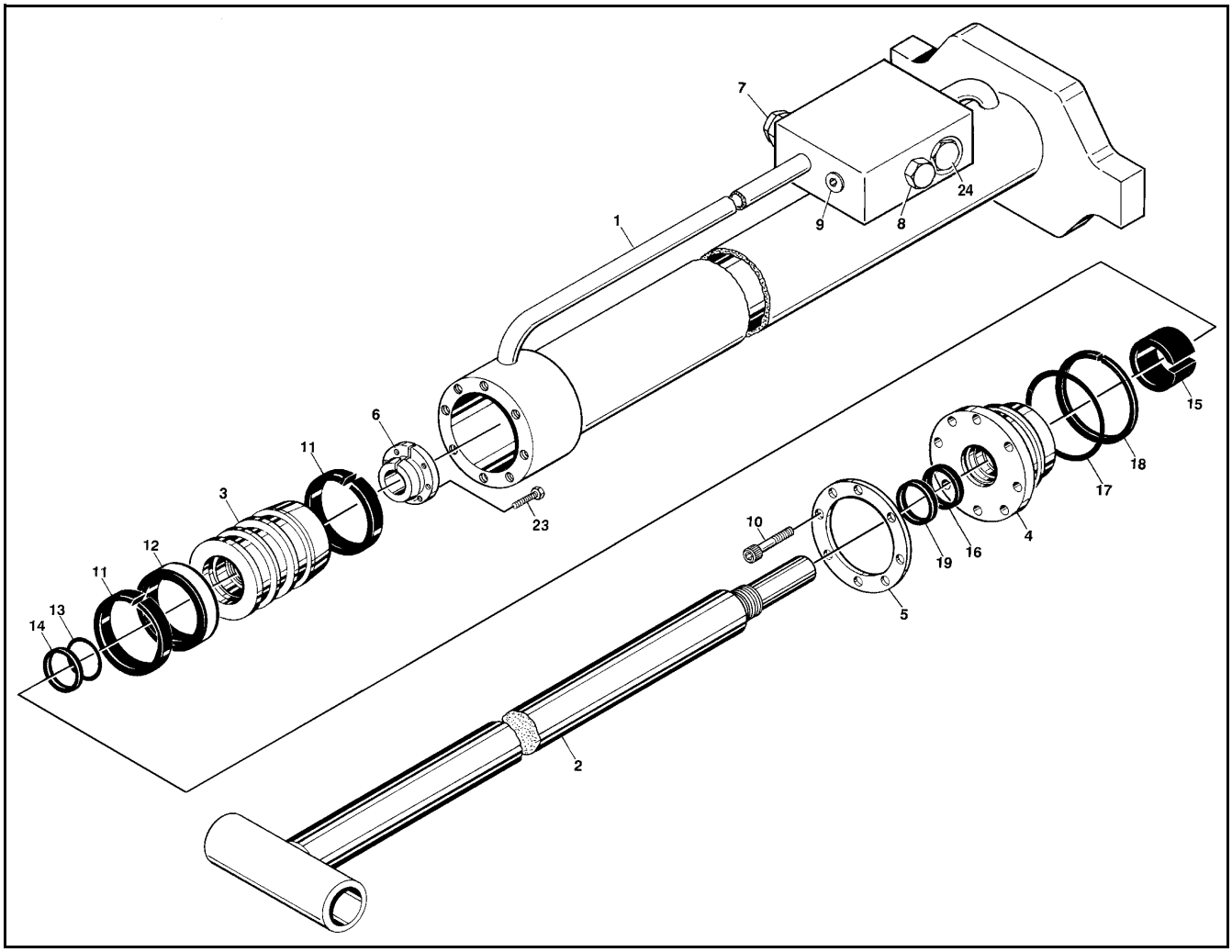
1. Barrel
1A. Bushing
2. Rod
2A. Bushing
3. Piston
4. Head
5. Tapered Bushing
6. Spacer
7. Cartridge Valve
8. O-Ring Plug
9. Washer Ring
10. Socket Head Capscrew
11. Loctite #242 (Not Shown)
12. Locking Primer (Not Shown)
13. Seal
14. Lock Ring
15. O-Ring
16. Back-Up Ring
17. Wear Ring
18. O-Ring
19. Back-Up Ring
20. Rod Seal
21. Wiper
22. Not Used
23. O-Ring Plug
24. Counterbalance Valve
25. Bolt
26. Loctite #609

Figure 5-31. 600A Tower Boom Lift Cylinder



1. Barrel
2. Rod
3. Piston
4. Head
5. Spacer
6. Tapered Bushing
7. Plate
8. Valve Block
9. O-Ring Plug
10. Socket Head Capscrew
11. Socket Head Capscrew
12. Wear Ring
13. Seal
14. O-Ring
15. O-Ring
16. Wear Ring
17. O-Ring
18. Back-Up Ring
19. Rod Seal
20. Wiper
21. Back-Up Ring
22. Locking Primer (Not Shown)
23. Loctite #242 (Not Shown)
24. Wear Pad
25. Bolt
26. Flatwasher
27. Not Used
28. Bolt

Figure 5-32. 600A Main Boom Telescope Cylinder



1. Barrel
2. Rod
3. Piston
4. Head
5. Washer Ring
6. Tapered Bushing
7. Valve Cartridge
8. Valve Cartridge
9. O-Ring Plug
10. Socket Head Capscrew
11. Wear Ring
12. T-Seal
13. O-Ring
14. Back-Up Ring
15. Wear Ring
16. Rod Seal
17. O-Ring
18. Back-Up Ring
19. Wiper
20. Locking Primer (Not Shown)
21. Loctite #242 (Not Shown)
22. Not Used
23. Bolt
24. Valve Cartridge

Figure 5-33. 600A Main Boom Telescope Cylinder

5.6 VARIABLE DISPLACEMENT PUMP (M46 SERIES)

Troubleshooting

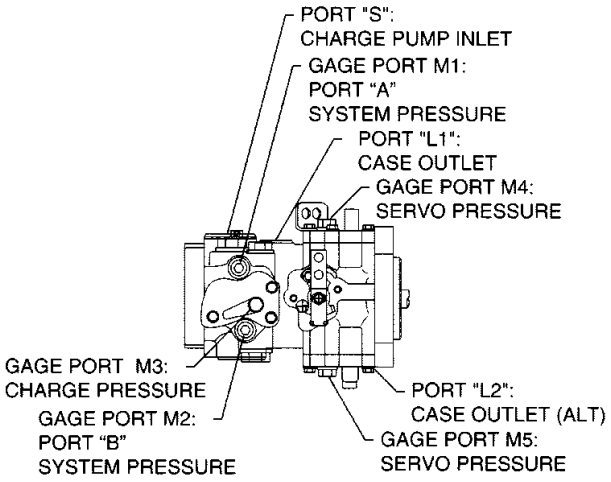
GAUGE INSTALLATION

It will be necessary to install a high pressure gauge into the system pressure gauge ports to check the setting of the high pressure relief valves.

Measuring the charge pump inlet vacuum will help locate restrictions in the inlet lines, filter, etc.

Case pressure readings can help locate restrictions in the return lines, oil cooler, and return filter.

Gauge Information		
M1	System Pressure Port A	10, 000 PSI or 600 Bar Gauge
		9/16-18 O-ring Fitting
M2	System Pressure Port B	10, 000 PSI or 600 Bar Gauge
		9/16-18 O-ring Fitting
M3	Charge Pressure	1000 PSI or 60 Bar Gauge
		9/16-18 O-ring Fitting or Tee into Charge Pressure Filter Outlet Line
L1 L2	Case Pressure	1000 PSI or 60 Bar Gauge
		1-1/16-12 O-ring Fitting
S	Charge Pump Inlet Vacuum	Vacuum Gauge
		Tee into Charge Pump Inlet Line
M4	Servo Pressure	1000 PSI or 60 Bar Gauge
		9/16-18 O-ring Fitting
M5	Servo Pressure	1000 PSI or 60 Bar Gauge
		9/16-18 O-ring Fitting



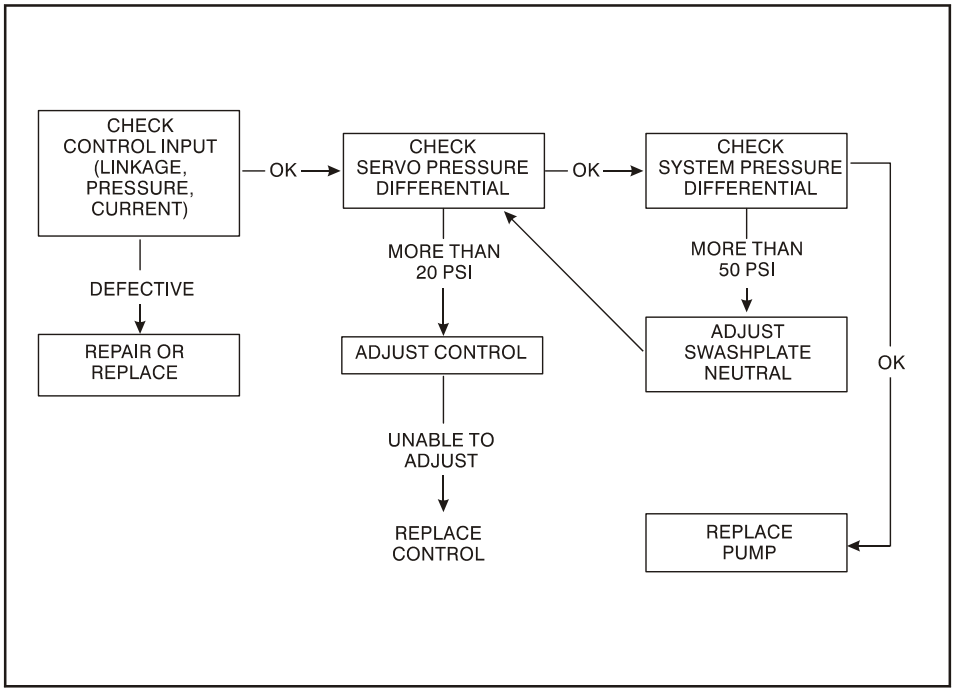


Figure 5-34. Troubleshooting - Neutral Difficult or Impossible to Find

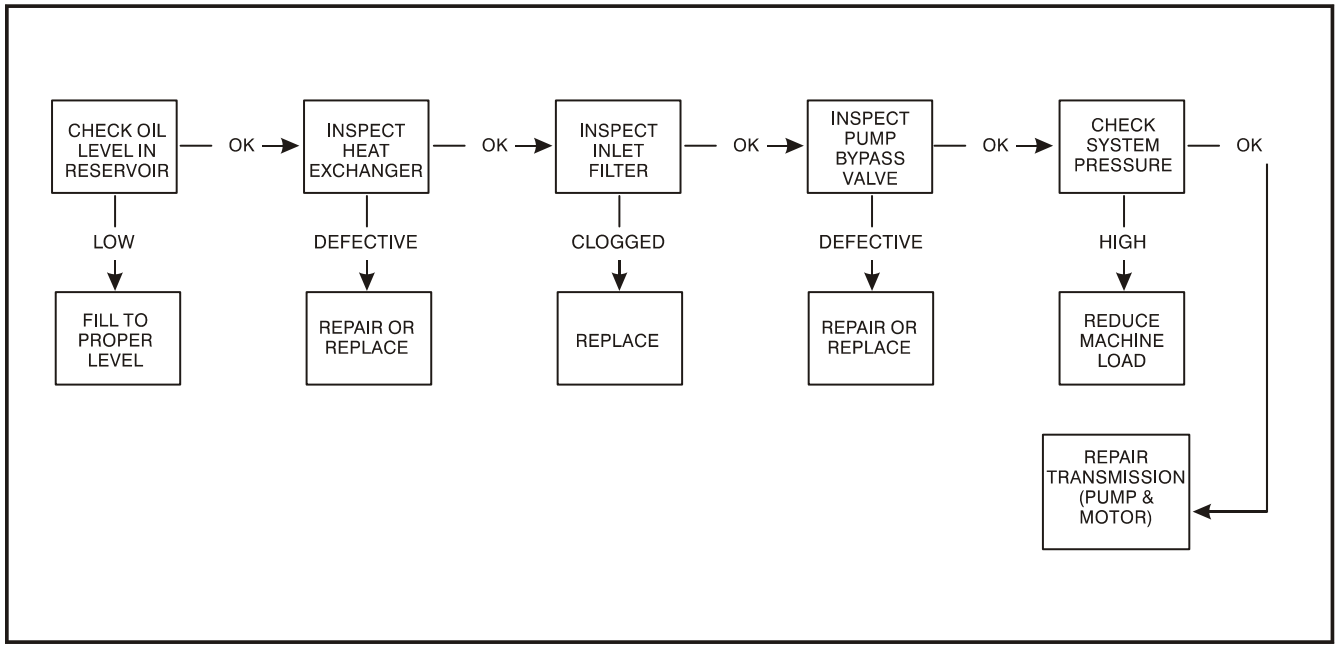


Figure 5-35. Troubleshooting - System Operating Hot

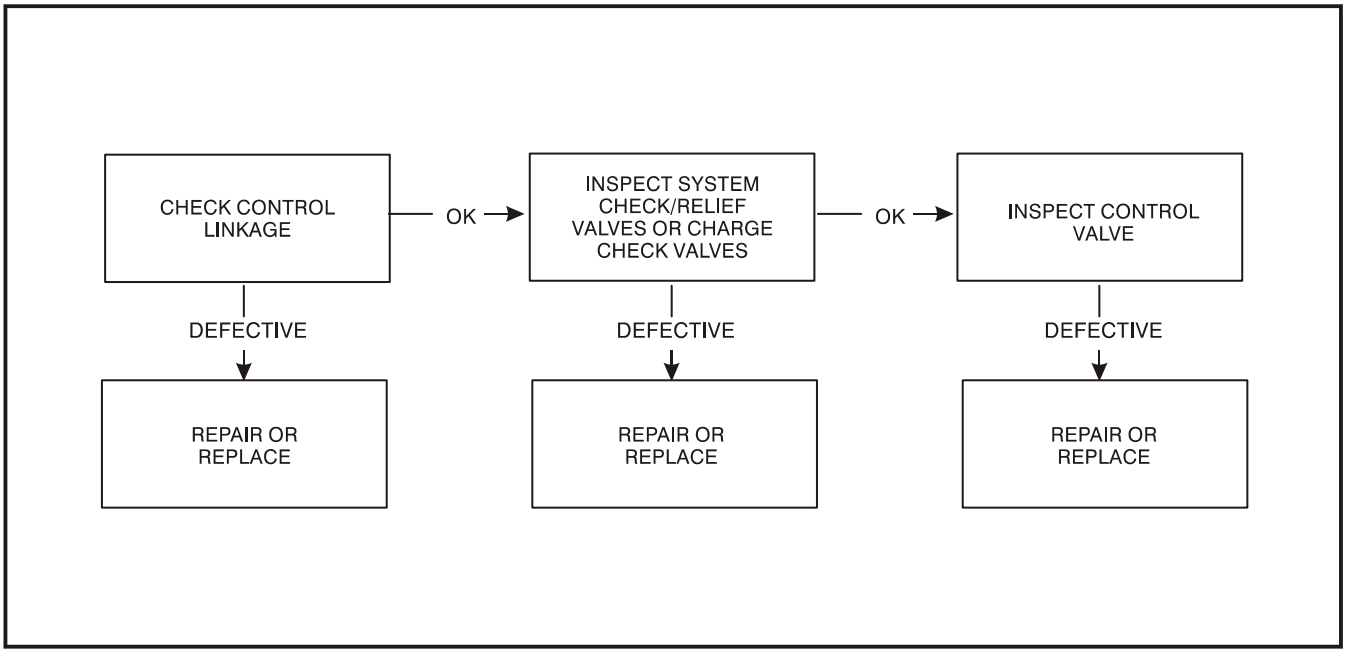


Figure 5-36. Troubleshooting - Transmission Operates in One Direction Only

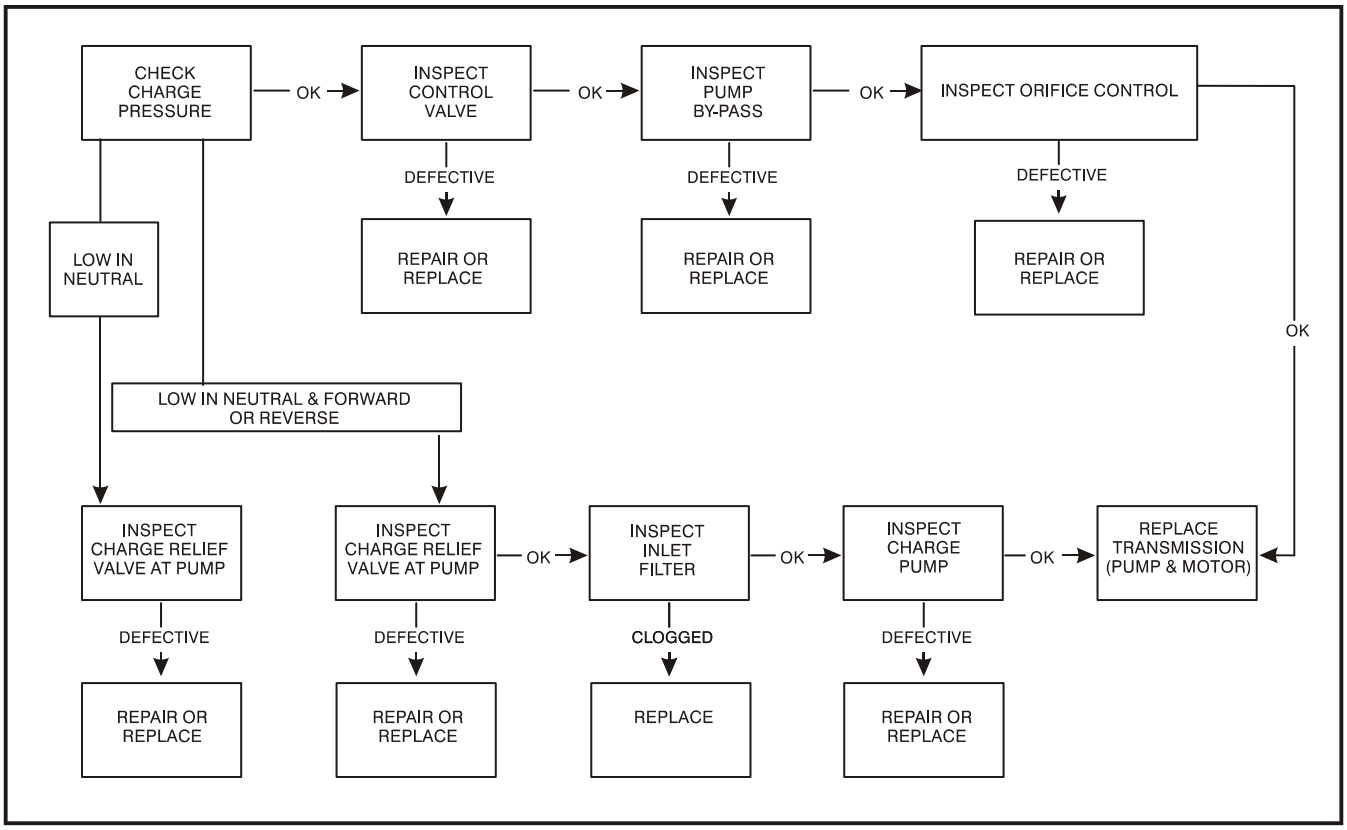


Figure 5-37. Troubleshooting - System Response is Sluggish

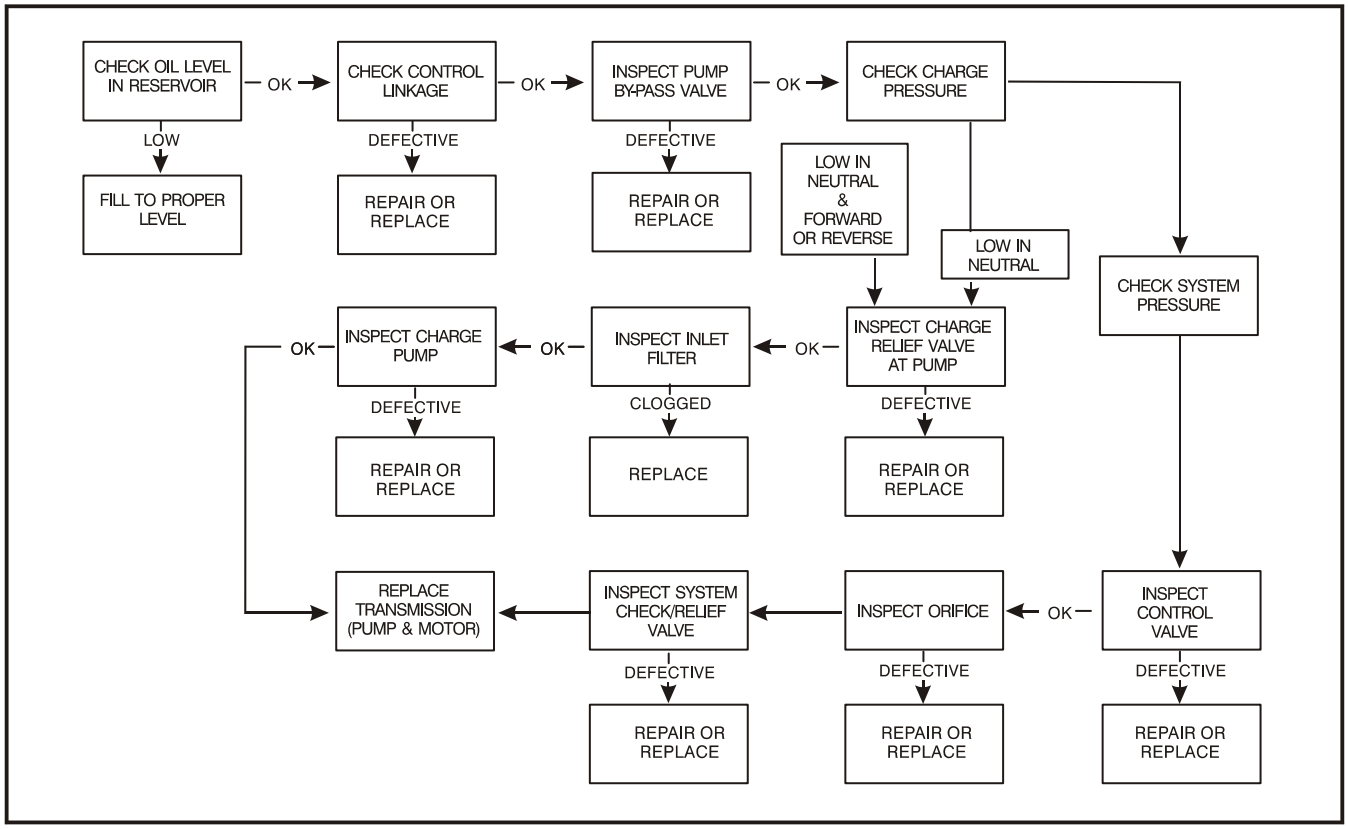
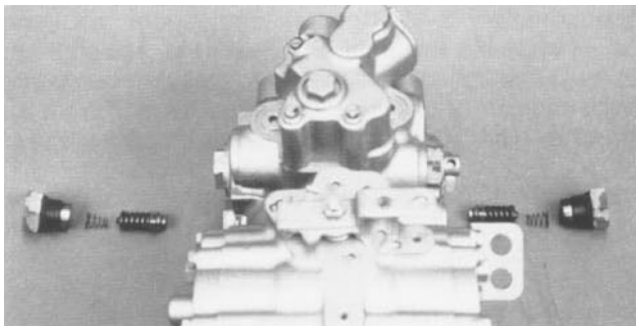


Figure 5-38. Troubleshooting - System Will Not Operate in Either Direction

Inspections and Adjustments

CHECK/HIGH PRESSURE RELIEF VALVES

The system check/relief valves have the dual purpose of providing make-up oil during by-directional rotation and providing protection from system over pressure. When the problem occurs in one direction only, interchange the check/relief valves to see if the problem changes to the other direction. If so, one check/relief valve cartridge is either malfunctioning or does not have the proper setting.



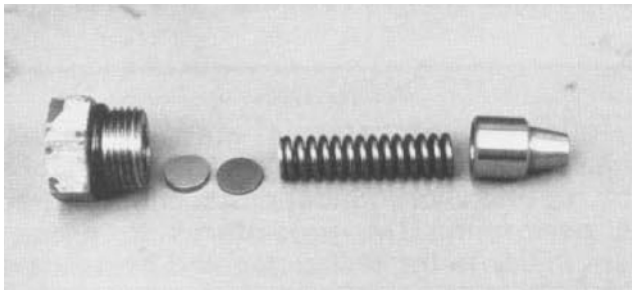
⚠ CAUTION

THE RELIEF VALVES ARE FACTORY SET AND SHOULD NOT BE TAMPERED WITH EXCEPT FOR REPLACING THE ENTIRE CARTRIDGE. DISASSEMBLY MAY CHANGE THE SETTING AND CAUSE ERRATIC UNIT OPERATION OR PREMATURE FAILURE.

PUMP CHARGE RELIEF VALVE

If charge pressure is low (less than 220 psi [15.2 Bar] above case pressure), the charge relief valve should be inspected. Inspect for foreign material holding the poppet open, and for scoring or wear on the poppet and seat in the housing.

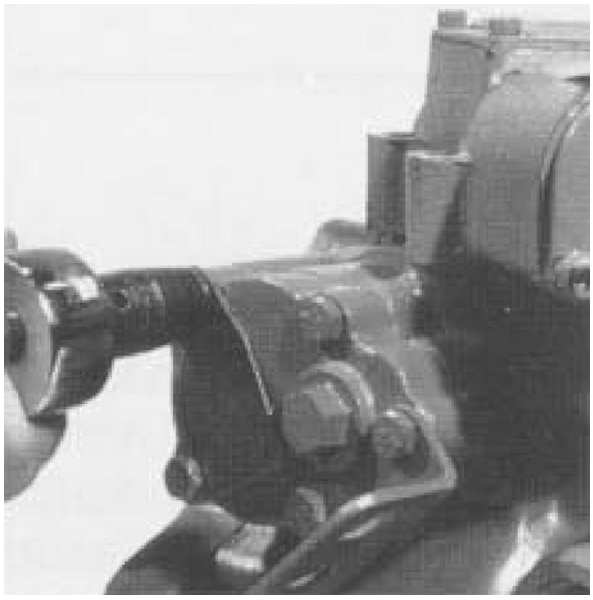
Adjustments of the charge pressure is accomplished by changing the shim thickness behind the spring.



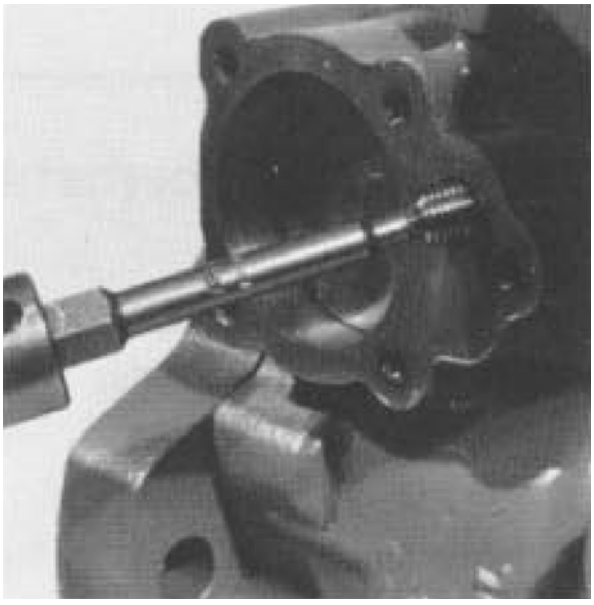
ELECTRICAL DISPLACEMENT CONTROL ORIFICES

NOTE: *The pump should have two control orifices located under the servo covers.*

1. With a 7/16" wrench, remove the five bolts from the servo cover opposite the neutral adjustment (cover without the adjustment screw).

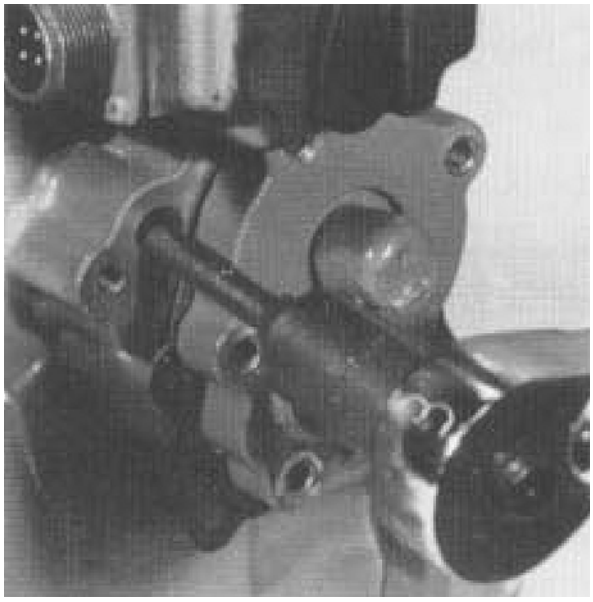


2. With a 7/32" internal wrench, remove and inspect the orifice.



3. Remove the bolts from the servo cover on the neutral adjustment side. Install a spacer or sprocket, approximately 0.75 in. (19 mm) long, under the servo cover opposite the neutral adjustment.

4. Re-install the bolts and tighten until the servo cover on the neutral adjustment side of the pump separates 0.125 in. (3 mm) from the housing. Turn the cover and remove and inspect the orifice.

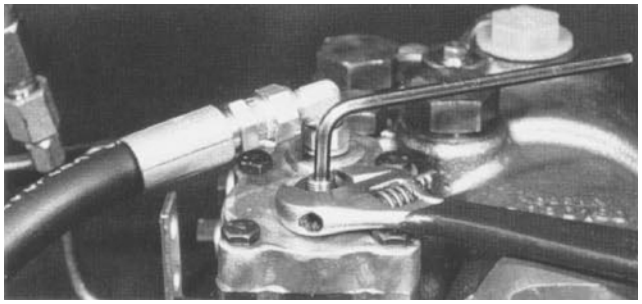


NOTE: *The Displacement Control may first have to be removed in order to rotate the servo cover.*

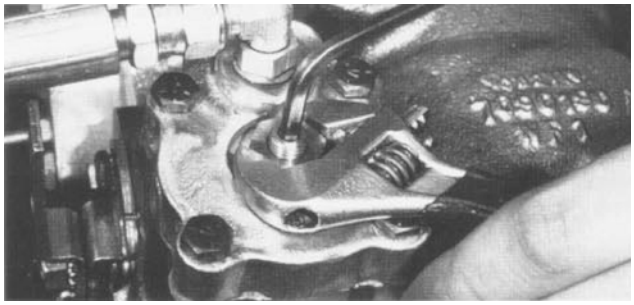
5. Remove spacer, re-install orifices, gaskets, and covers. Torque grade 5 bolts 8 to 11 ft.lbs. (10.8 to 14.9 Nm) and grade 8 bolts 11 to 13 ft.lbs. (14.9 to 17.8 Nm).

SWASHPLATE NEUTRAL ADJUSTMENT

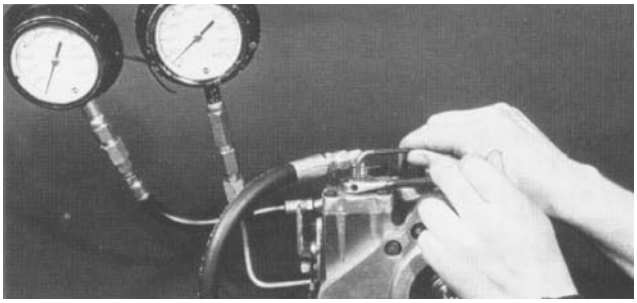
1. Using a low pressure line (500 psi [35 Bar] min.), cross port servo port F to servo port G. This removes the effects of any control pressure on the servo piston.



2. Install pressure gauges (10,000 psi [690 Bar]) in the system pressure gauge ports. Start the engine and slowly accelerate to normal operating RPM.
3. Remove the protective cap and loosen the servo lock nut while holding the servo adjustment screw in position.



4. Turn the servo adjustment screw until the two system pressure gauge readings are equal.
5. Turn the servo adjustment screw clockwise until one of the system pressures starts to increase.



6. Noting the amount of rotation, turn the servo adjustment screw counter-clockwise until the other system pressure starts to increase.
7. Turn the servo adjustment screw clockwise half the amount of rotation noted above.
8. While holding the servo adjustment screw from turning, torque the servo lock nut 13 to 18 ft.lbs. (17.6 to 24.4 Nm). Stop the engine, install a new protective cap, remove the servo cross-port line, and proceed to the appropriate control adjustment.

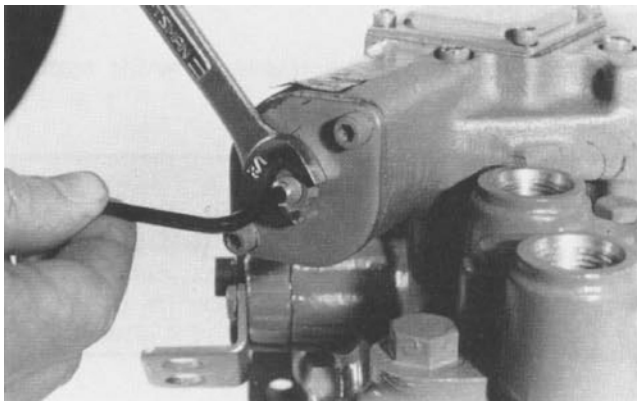
EDC NEUTRAL ADJUSTMENT

1. Remove the electrical connector at the EDC. Remove the servo cross port line (installed while making the swash plate neutral adjustment) and install a 0 to 300 PSI (0 to 21 BAR) gauge in each servo port.

⚠ WARNING

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTION DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURES IN ORDER TO PREVENT INJURY TO THE TECHNICIAN AND BYSTANDERS.

2. Start the engine and accelerate to normal operating RPM.
3. Loosen lock nut with 1/2” wrench and slowly rotate the neutral adjustment screw, with 5/32” internal hex wrench, until the pressure is equal on both servo gauges.



4. Slowly rotate the neutral adjustment screw until one of the servo gauges starts to increase in pressure.
5. Noting the amount of rotation, slowly rotate the neutral adjust screw in the opposite direction until the other servo gauge begins to increase in pressure.
6. Turn the neutral adjust screw back one - half the amount noted above. Hold the neutral adjust screw and torque the lock nut to 25 to 30 in.lbs. (2.8 to 3.4 NM).
7. Stop the engine. Connect the control input. Remove the servo pressure gauges. Return the machine to normal operating condition. Restart the engine and assure that the hydrostatic system is in neutral.

Minor Repair and Replacement

Minor repairs may be performed, following the procedures in this section.

Cleanliness is a primary means of assuring satisfactory transmission life, on either new or repaired units. Cleaning parts by using solvent wash and air drying is usually adequate. As with any precision equipment, all parts must be kept free of foreign materials and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all gaskets and O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly. All gasket sealing surfaces must be cleaned prior to installing new gaskets.

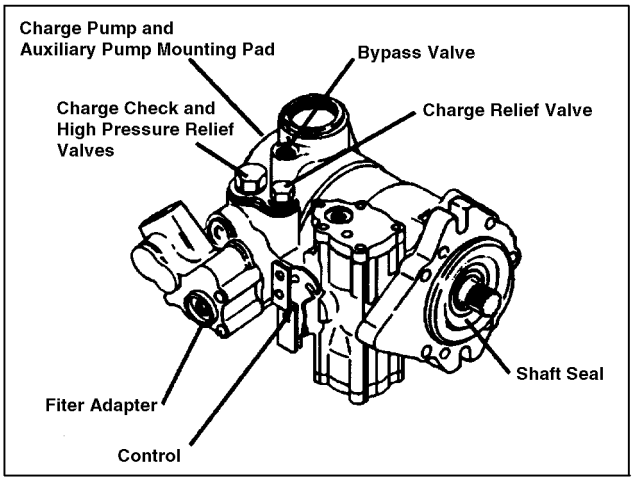


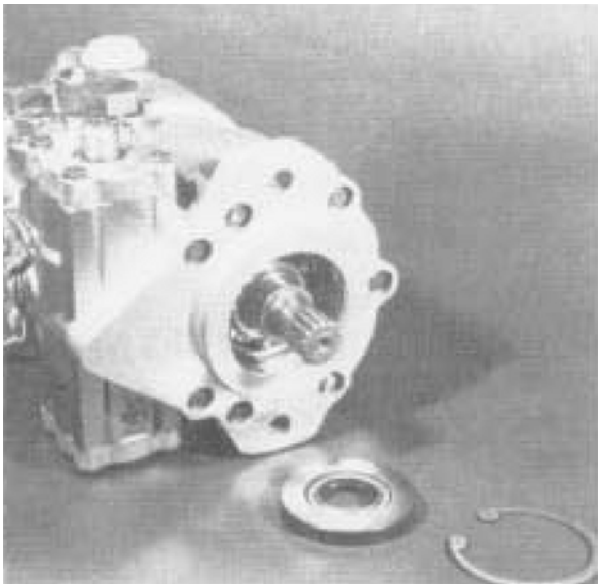
Figure 5-39. Variable Displacement Pump

SHAFT SEAL

Lip type shafts are used on Series 40 - M46 pumps and motors. These seals can be replaced without major disassembly of the unit. However, replacement of the shaft seal requires removal of the pump from the machine.

1. Remove the retaining ring from the housing.

2. Carefully remove the seal from the housing bore. The face of the seal may be punctured with a sharp instrument (such as a screw driver) to aid in prying the seal out, or a slide hammer type puller may be used to remove the seal. Care must be taken so as not to damage the housing bore or shaft. Once removed, the seal is not reusable.

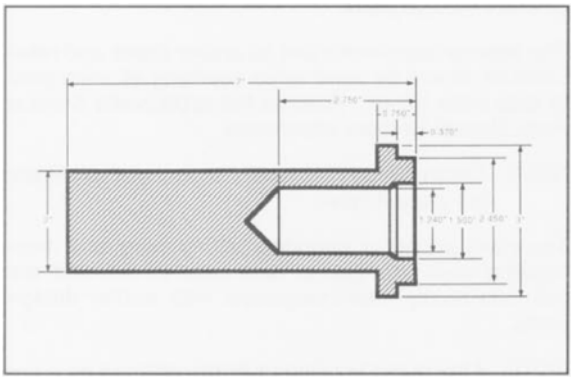


3. Prior to installing the new seal, inspect the sealing area on the shaft for rust, wear, or contamination. Polish the sealing area on the shaft if necessary.

4. Wrap the spline or key end of the shaft with thin plastic to prevent damage to the seal lip during installation. Lubricate the inside diameter of the new seal with petroleum jelly.

NOTE: *The outside diameter of the seal may be lightly coated with sealant (such as Loctite High Performance Sealant #59231) prior to installation. This will aid in preventing leaks caused by damage to the housing seal bore.*

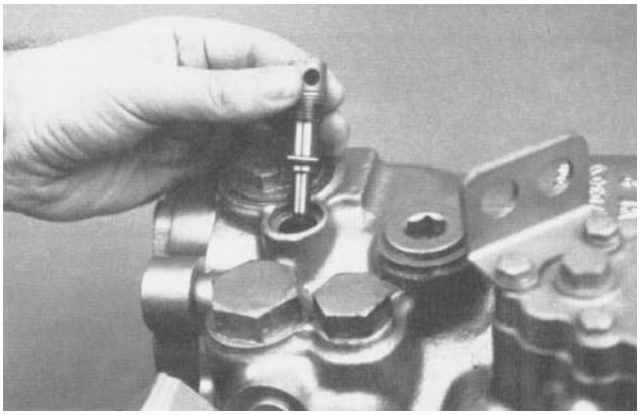
5. Slide the new seal over the shaft and press it into the housing bore. Be careful not to damage seal. A seal installer tool can be made to aid in installing the seal.



6. Reinstall the seal retaining ring.

BYPASS VALVE (PUMP)

1. Unscrew the bypass valve from the housing. Inspect the valve and mating seat for damage or foreign material. It is recommended that the O-ring and back - up ring be replaced.

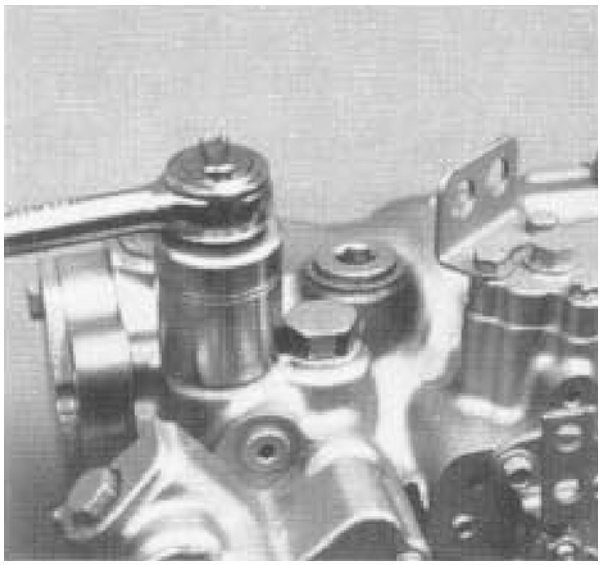


NOTE: *Bypass valves are available with integral bypass orifices for specific applications. Refer to the appropriate Service Parts Manual for more information.*

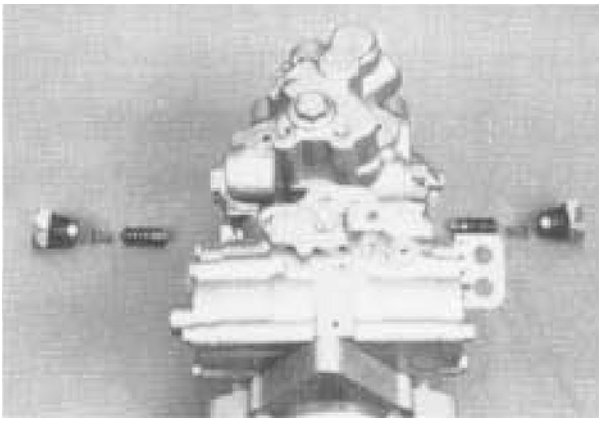
2. Reinstall the bypass valve into the housing. Torque to 7 to 10 ft. lbs. (9.5 - 13.6 Nm).

CHARGE CHECK AND HIGH PRESSURE RELIEF VALVES

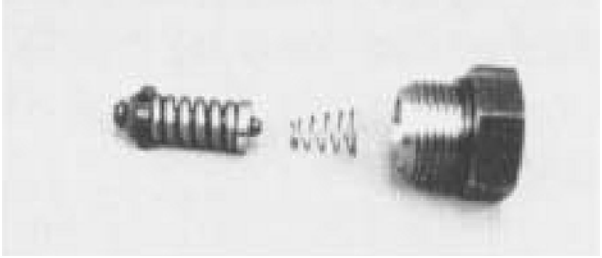
1. Remove the charge check and high pressure relief valve hex plug.



2. Remove the spring and check poppet or valve cartridge from the housing. Inspect the valve and mating seat in the housing for damage or foreign material. It will be necessary to replace the housing if the seat is damaged.



3. Several designs of charge check and high pressure relief valves have been used. Do not attempt to mix different vintage parts.



The appropriate check valve kit and/ or check and relief valve kit should be used. Refer to appropriate Service Parts Manual.

NOTE: *Always replace ball type charge check valves with the poppet type.*

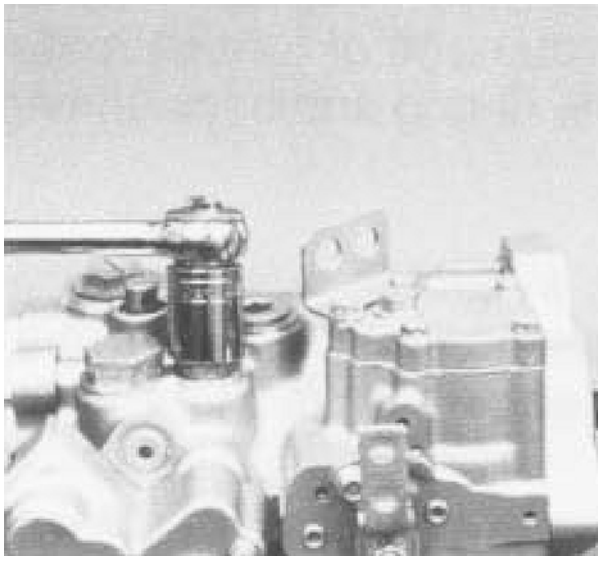
4. Reinstall the valve cartridge, spring, and plug (with O-ring) into the housing. Torque the plug to 30 to 70 ft. lbs. (41 to 95 Nm).

⚠ CAUTION

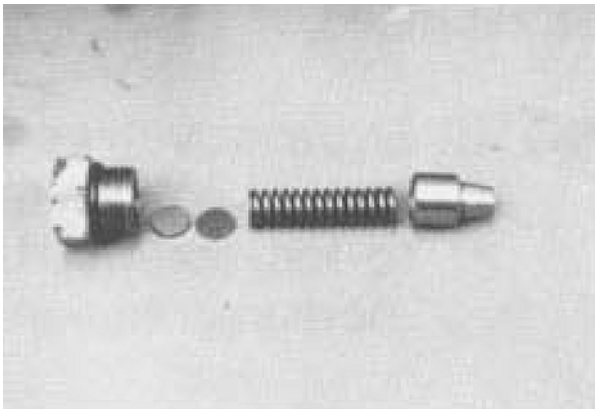
THE RELIEF VALVES ARE FACTORY SET AND SHOULD NOT BE TAMPERED WITH EXCEPT FOR REPLACING THE ENTIRE CARTRIDGE. DISASSEMBLY MAY CHANGE THE SETTING AND CAUSE ERRATIC UNIT OPERATION OR PREMATURE FAILURE.

CHARGE PRESSURE RELIEF VALVE

1. Remove charge relief valve hex plug.



2. Remove the spring and poppet from the housing. Do not alter the shims or interchange parts with another valve. Inspect the poppet and mating seat in the end cap for damage or foreign material.



3. Reinstall the poppet, spring, and plug (with shims and O-ring) into the housing. Torque the plug to 30 to 70 ft. lbs.(41 to 95 Nm).

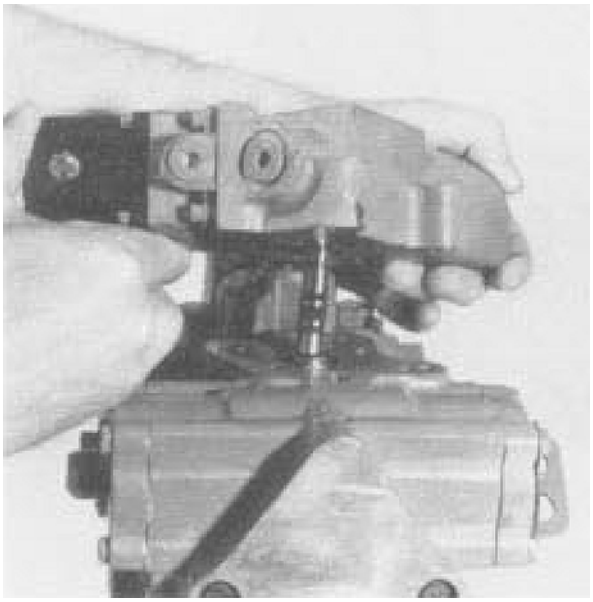
ELECTRICAL DISPLACEMENT CONTROLS (EDC)

⚠ CAUTION

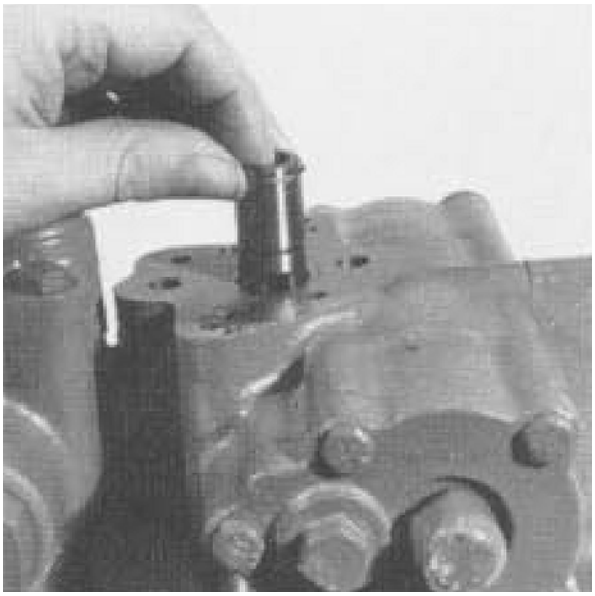
THE REMOVAL OF ANY PORTION OF THE CONTROL MECHANISM MAY RESULT IN LOSS OF NEUTRAL, WHICH WILL NECESSITATE READJUSTMENT.

1. Remove the four control mounting screws using an internal hex wrench (3/16”).

2. Carefully lift the control off the pump housing.

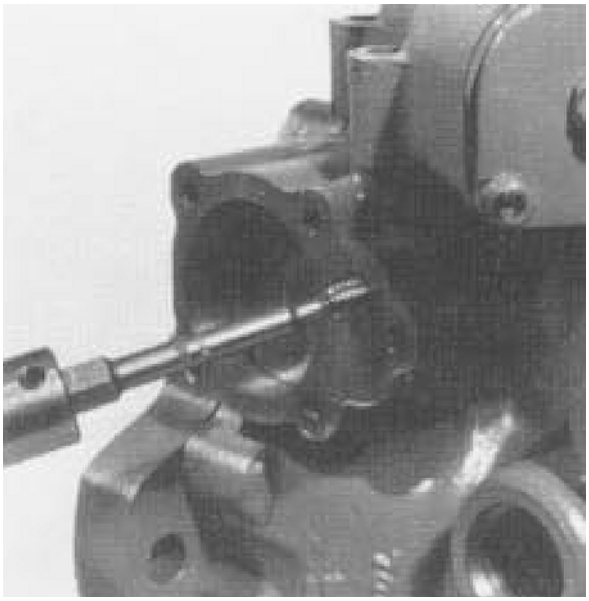


3. Remove the control sleeve from the pump.

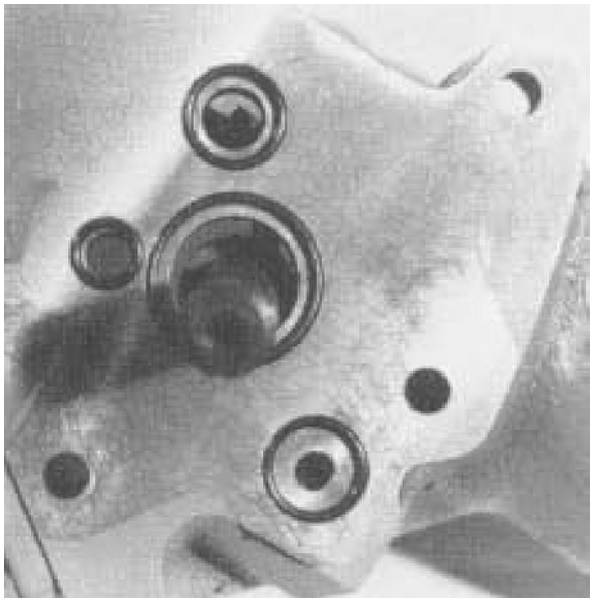


4. Remove the control inlet screen plug from the inlet passage next to the control sleeve bore, using an internal hex wrench (5/32”).

5. The control orifice plugs are located in threaded passages under the servo piston cover. Remove the servo piston cover and gasket, and remove the orifice plugs using an internal hex wrench (7/32”).

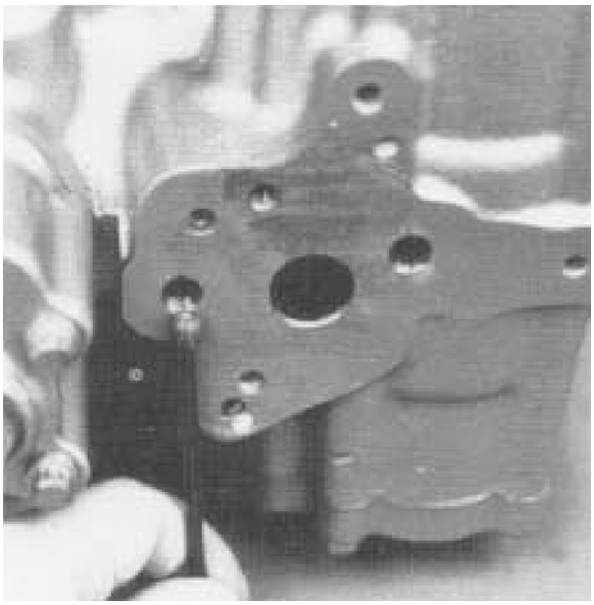


6. Replace the O-ring on the bottom of the control housing.Lightly lubricate all O-rings with clean petroleum jelly prior to assembly. The control spool and sleeve are a matched set and are not available separately.

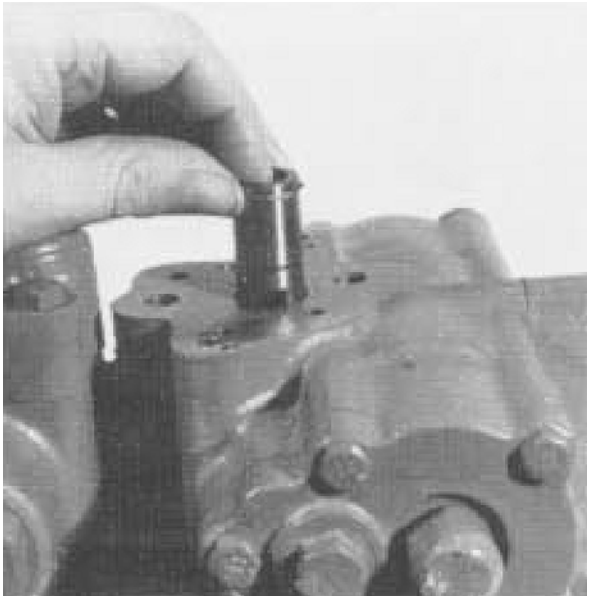


7. Reinstall the control orifice plugs into their passages and replace the servo piston covers.

8. Install the control inlet screen plug and torque to 20 to 30 in.lbs. (2.2 to 3.4 Nm). Always install a screen plug (with a 0.156" (3.96 mm.) thru hole) when servicing earlier production pumps. Pumps prior to date c ode 86 - 14 use a plug with a thread that is different from later units. Refer to the Service Parts Manual for plug part numbers.



9. Align the control sleeve so its slot will engage the swash plate feedback pin (slot positioned toward the pump cover) and insert the sleeve into the housing. Carefully align the control spool with the sleeve and install the control onto the pump housing. Install the four mounting screws and torque to 10 to 11 ft.lbs. (13 to 14 Nm).



10. Install the four cover screws and torque to 18 to 24 in. lbs. (2.0 to 2.7 Nm).
11. Readjust the neutral position of the control. Refer to the instructions in the Inspections and Adjustment.

5.7 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.

5.8 PRESSURE SETTING PROCEDURES (S AND A MODELS)

⚠ IMPORTANT

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 ALSO RECOMMENDS USING A CALIBRATED GAUGE. PRESSURE READINGS ARE ACCEPTABLE IF WITHIN +/- 5% OF SPECIFIED PRESSURES.

Main Relief, Steer, Swing and Lift Down

1. Install pressure gauge at quick disconnect on port MP on main valve.
2. With the aid of an assistant, activate telescope in.
3. While monitoring pressure gauge, adjust main relief to 207 Bar.
4. With the aid of an assistant, activate steer left.
5. While monitoring pressure gauge, adjust steer left relief to 124 Bar.
6. With the aid of an assistant, activate steer right.
7. While monitoring pressure gauge, adjust steer right relief to 124 Bar.
8. With the aid of an assistant, activate swing left or right.
9. While monitoring pressure gauge, adjust swing relief to 117 Bar.
10. With the aid of an assistant, activate lift down.
11. While monitoring pressure gauge, adjust lift down relief to 103 Bar - S Models 83 Bar - A Models.

Platform Level

1. Install pressure gauge at quick disconnect on port M3 on main valve.
2. With the aid of an assistant, activate platform level forward.
3. While monitoring pressure gauge, adjust platform level relief to 193 Bar.
4. Install pressure gauge at quick disconnect on port M4 on main valve.
5. With the aid of an assistant, activate platform level backward.
6. While monitoring pressure gauge, adjust platform level relief to 124 Bar.

Articulating Jib Boom (If Equipped)

1. Install pressure gauge at quick disconnect on articulating valve.
2. With the aid of an assistant, activate articulating jib up.
3. While monitoring pressure gauge, adjust articulating jib up relief to 103 Bar.
4. With the aid of an assistant, activate articulating jib down.
5. While monitoring pressure gauge, adjust activate articulating jib down relief to 83 Bar.

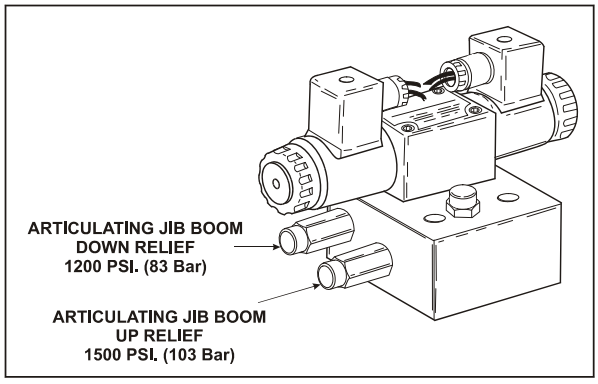
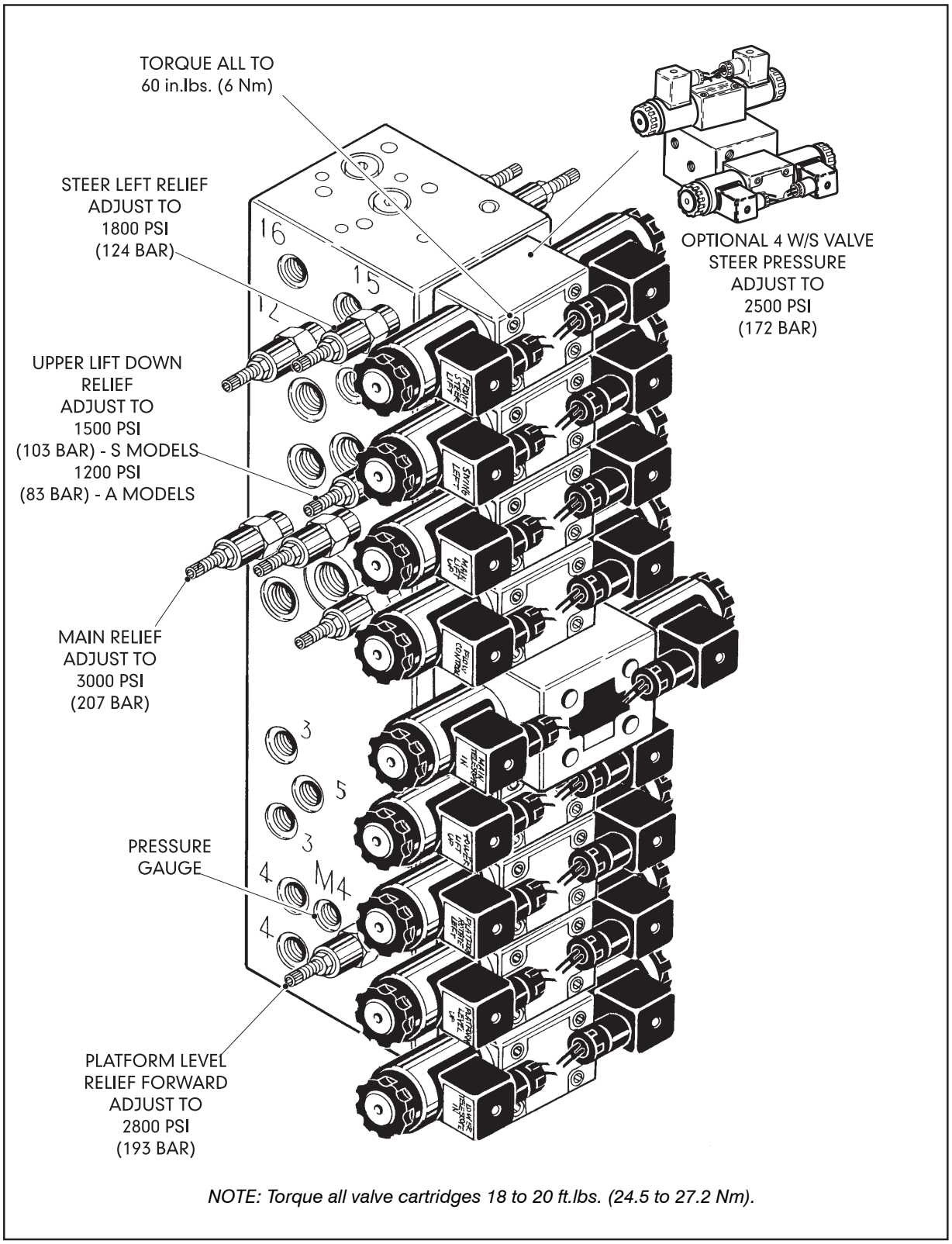


Figure 5-40. Articulating Jib Boom Pressure Adjustments

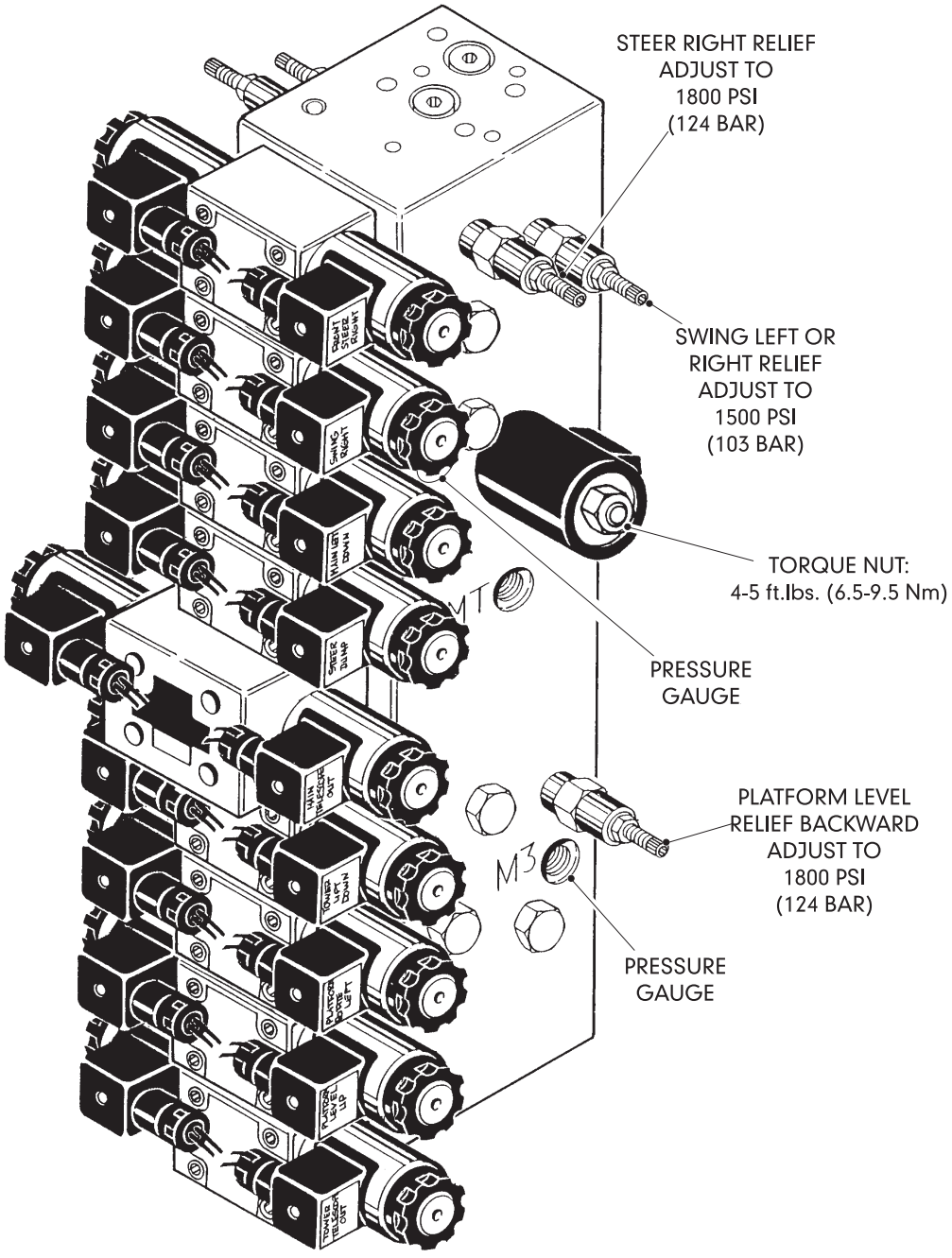
4 Wheel Steer (If Equipped)

1. At the platform console using the steer select switch activate " 2 wheel steer".
2. Install a pressure gauge in port MP on main control valve.
3. With the aid of an assistant, activate steer left and right, adjust front steer relief valve to 172 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 MP on main control valve.
7. With the aid of an assistant, activate steer left and right, adjust rear steer relief valve to 172 Bar. Reading at the valve bank 172 Bar will give you 138 Bar at the cylinders.
8. Re-connect the front steer din connectors at the valve bank.



NOTE: Torque all valve cartridges 18 to 20 ft.lbs. (24.5 to 27.2 Nm).

Figure 5-41. Main Control Valve Pressure Adjustments - Sheet 1 of 2



NOTE: Torque all valve cartridges 18 to 20 ft.lbs. (24.5 to 27.2 Nm).

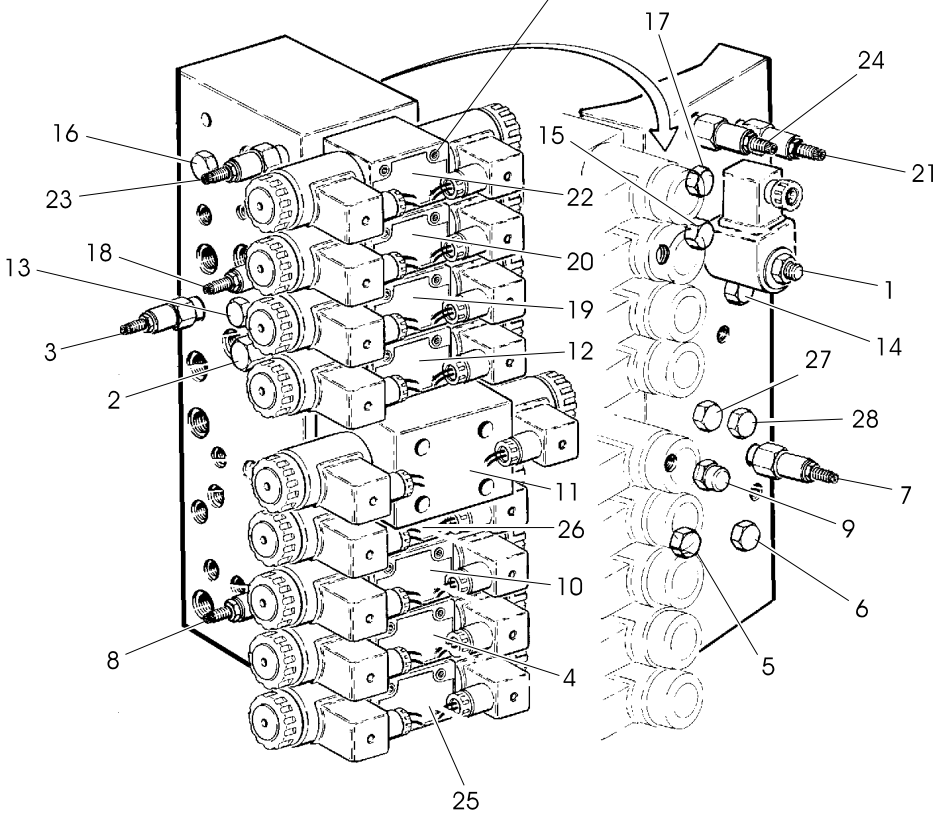
Figure 5-42. Main Control Valve Pressure Adjustments - Sheet 2 of 2

Note

When removing the directional control valve, 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 on the valve that was removed. The bolt pattern on the directional valve 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 would result in cross-threading. Check the tag and, if necessary, rotate the directional control valve 180 degrees and reinstall the bolts.

Note

Torque valve bolts to 60 in. lbs. (7 Nm).



1. Solenoid Operated 2-Way Valve (N/O)
2. Pressure Control Load Sense Cartridge
3. Direct Operated Relief Valve (Main Relief)
4. Directional Control Valve (Platform Level)
5. Pilot Operated Check
6. Pilot Operated Check
7. Direct Operated Relief Valve
8. Direct Operated Relief Valve
9. Pressure Compensated Flow Control (Fixed 0.2 GPM)
10. Directional Control Valve (Platform Rotator)
11. Directional Control Valve (Upper Tele)
12. Directional Control Valve (Flow Control)
13. Load Shuttle Valve
14. Load Shuttle Valve
15. Load Shuttle Valve
16. Load Shuttle Valve
17. Load Shuttle Valve
18. Direct Operated Relief Valve
19. Directional Control Valve (Upper Lift)
20. Directional Control Valve (Swing)
21. Direct Operated Relief Valve
22. Directional Control Valve (Steer)
23. Direct Operated Relief Valve
24. Direct Operated Relief Valve
25. Directional Control Valve (Lower Tele)
26. Directional Control Valve (Lower Lift)
27. Check Valve

Figure 5-43. Location of Components - Main Control Valve

5.9 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.

5.10 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.

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SECTION 6. JLG CONTROL SYSTEM

6.1 INTRODUCTION

⚠ IMPORTANT

WHEN INSTALLING A NEW GROUND MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

⚠ IMPORTANT

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 motor 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.

NOTE: *Each module has a label with the JLG part number and a serial number which contains a date code.*

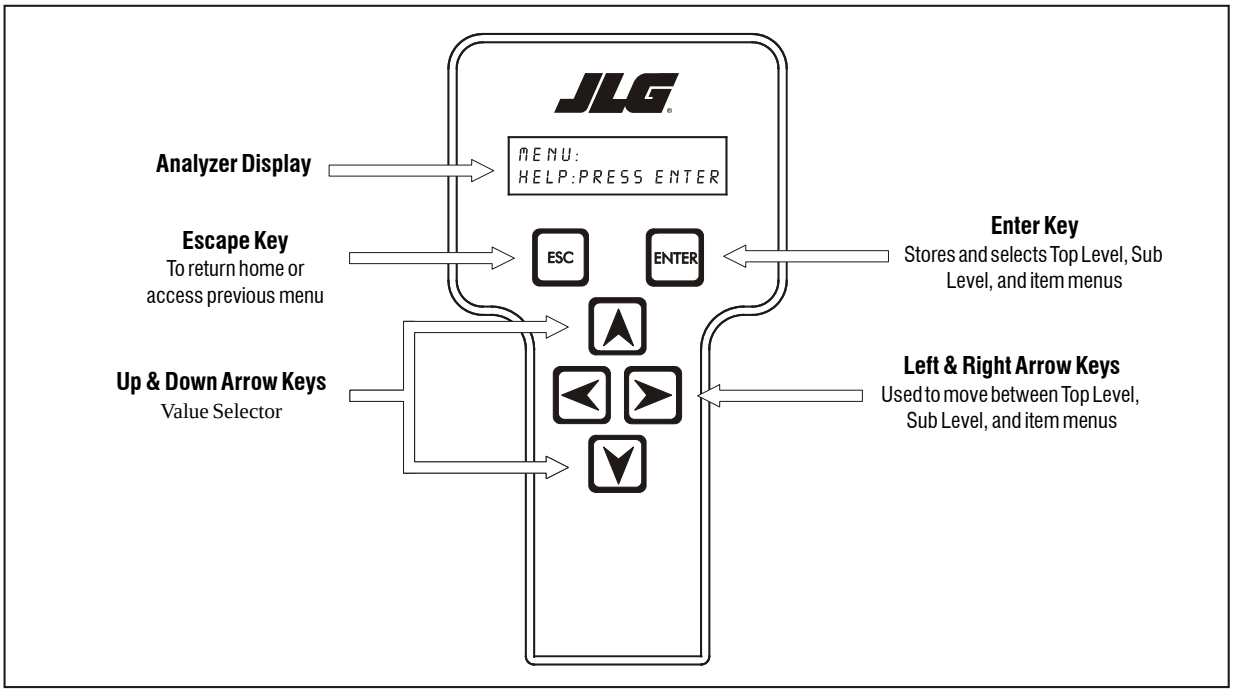


Figure 6-1. Hand Held Analyzer

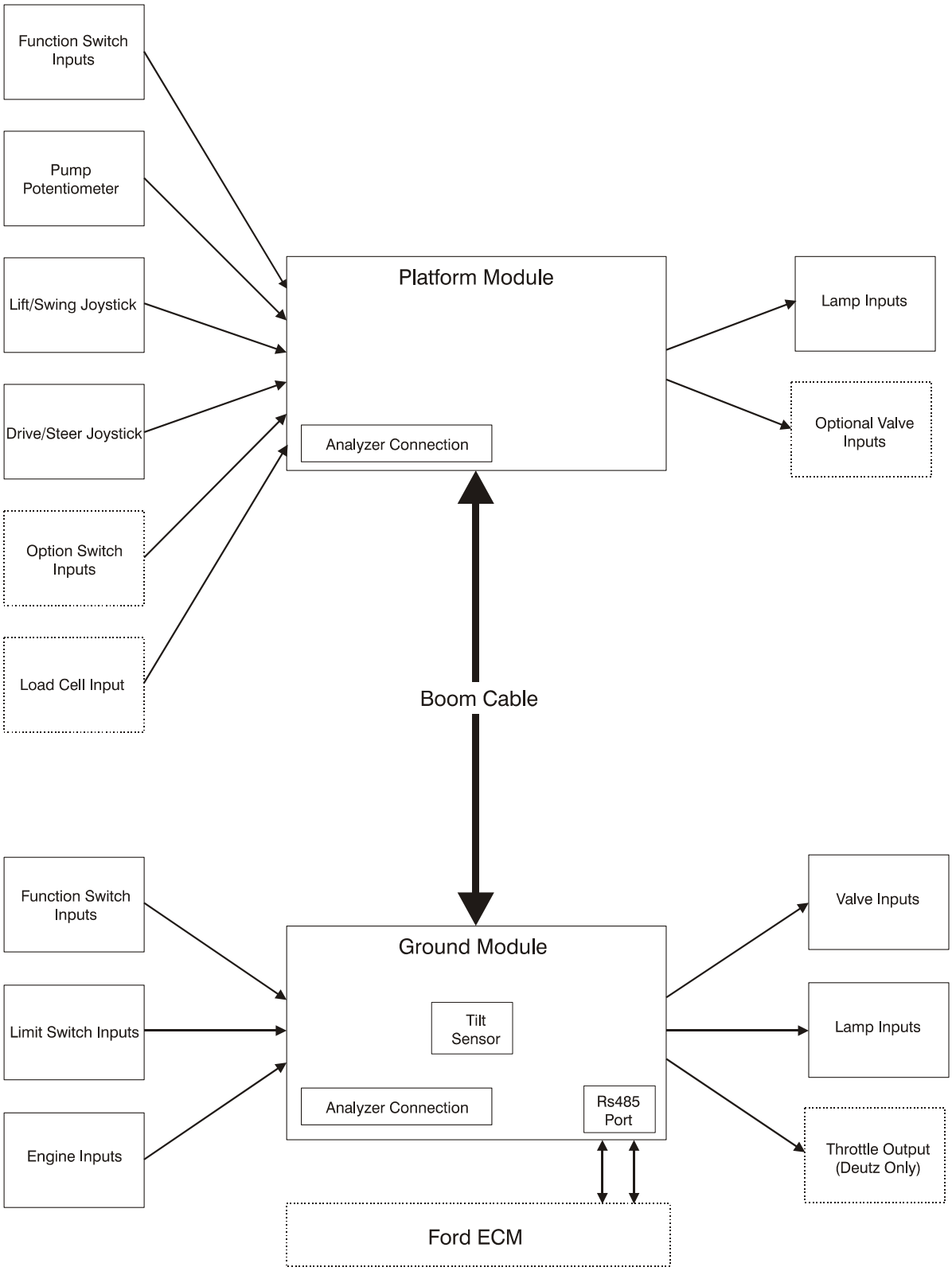


Figure 6-2. ADE Block Diagram

6.2 TO CONNECT THE JLG CONTROL SYSTEM ANALYZER

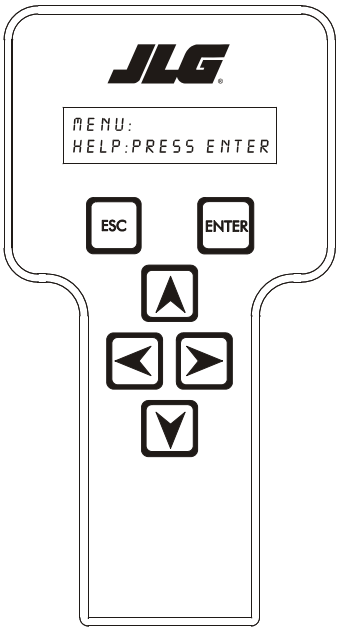
1. Connect the four pin end of the cable supplied with the analyzer, to the controller module located in the platform box or at the controller module in the ground control box and connect the remaining end of the cable to the analyzer.

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.

6.3 USING THE ANALYZER

With the machine power on and the analyzer connected properly, the analyzer will display the following:



HELP:
PRESS ENTER

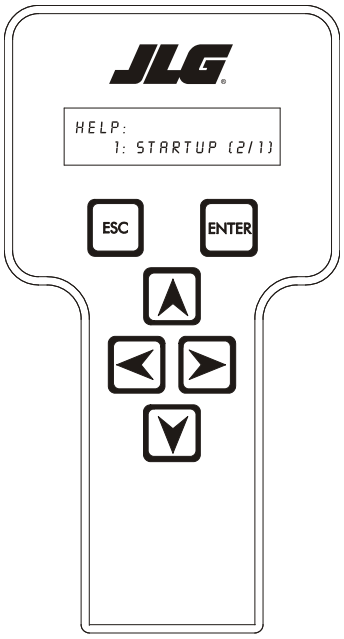
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER**. To cancel a selected menu item, press ESC.; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
SYSTEM TEST
ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
CALIBRATIONS (view only)

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.**

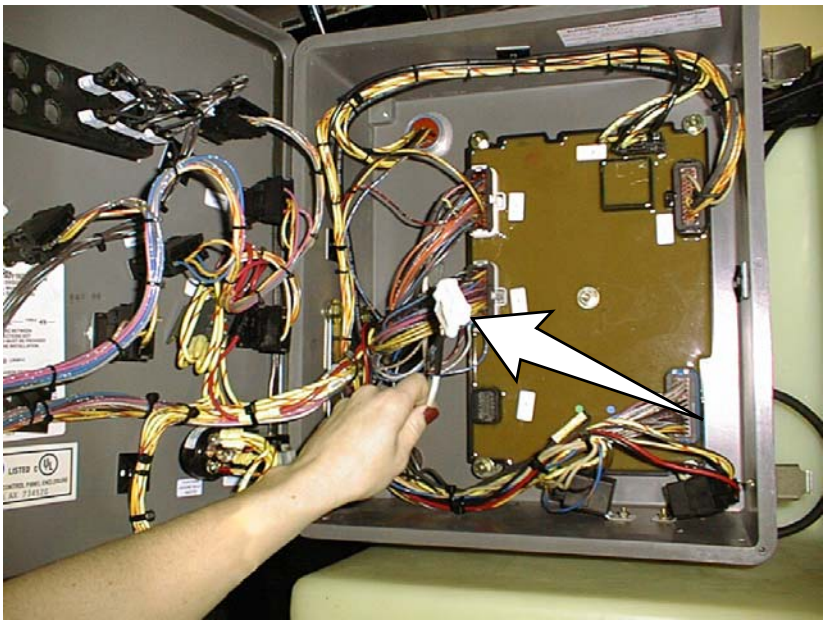
If **ENTER** is pressed again, the display moves to the following display:



LOGGED HELP
1: POWER CYCLE (0/0)

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. **POWER CYCLE (0/0)** indicates a power up.

PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-3. Analyzer Connecting Points

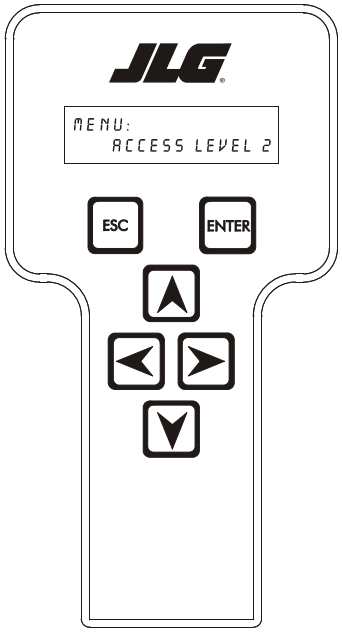
When a top level menu is selected, a new set of menu items may be offered: for example:

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.

6.4 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.

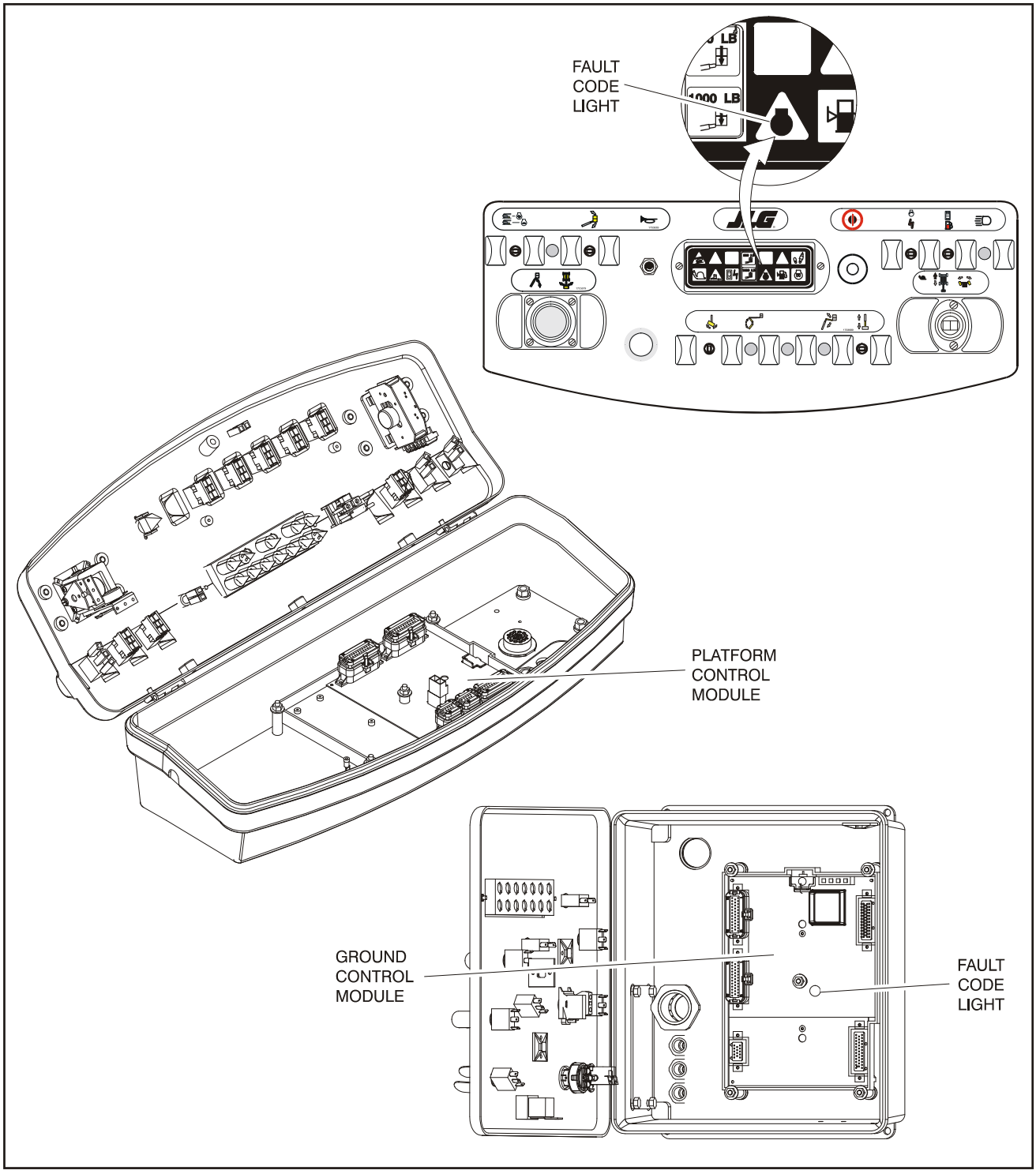
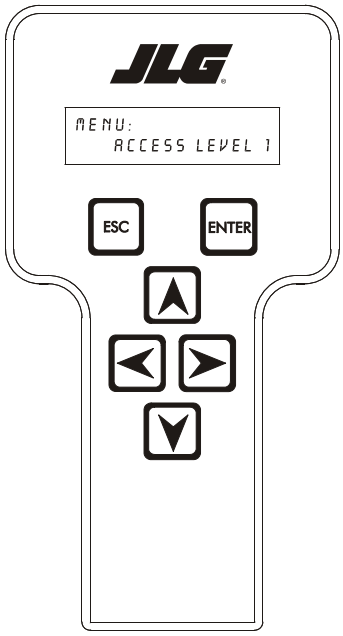


Figure 6-4. Control Module Location

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:

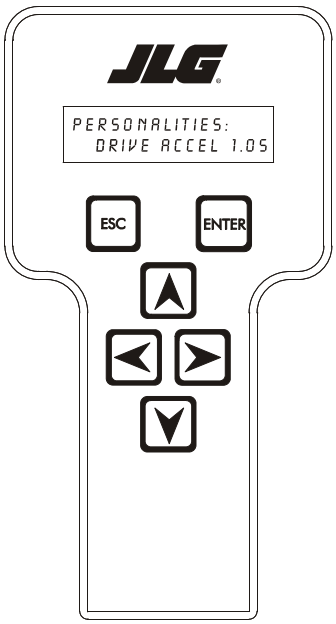


MENU:
ACCESS LEVEL 1

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

6.5 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:

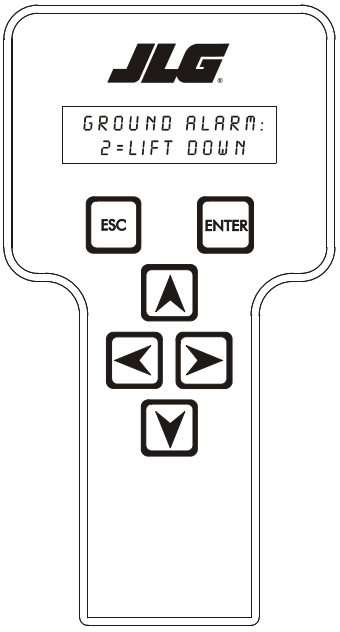


PERSONALITIES:
DRIVE ACCEL 1.0s

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.

6.6 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 6-1, 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.

⚠ IMPORTANT

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.

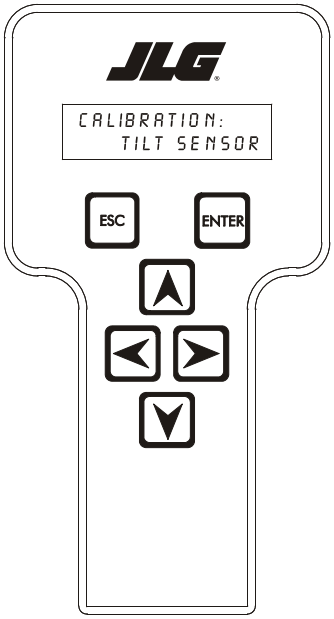
6.7 LEVEL VEHICLE DESCRIPTION

⚠ IMPORTANT

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.

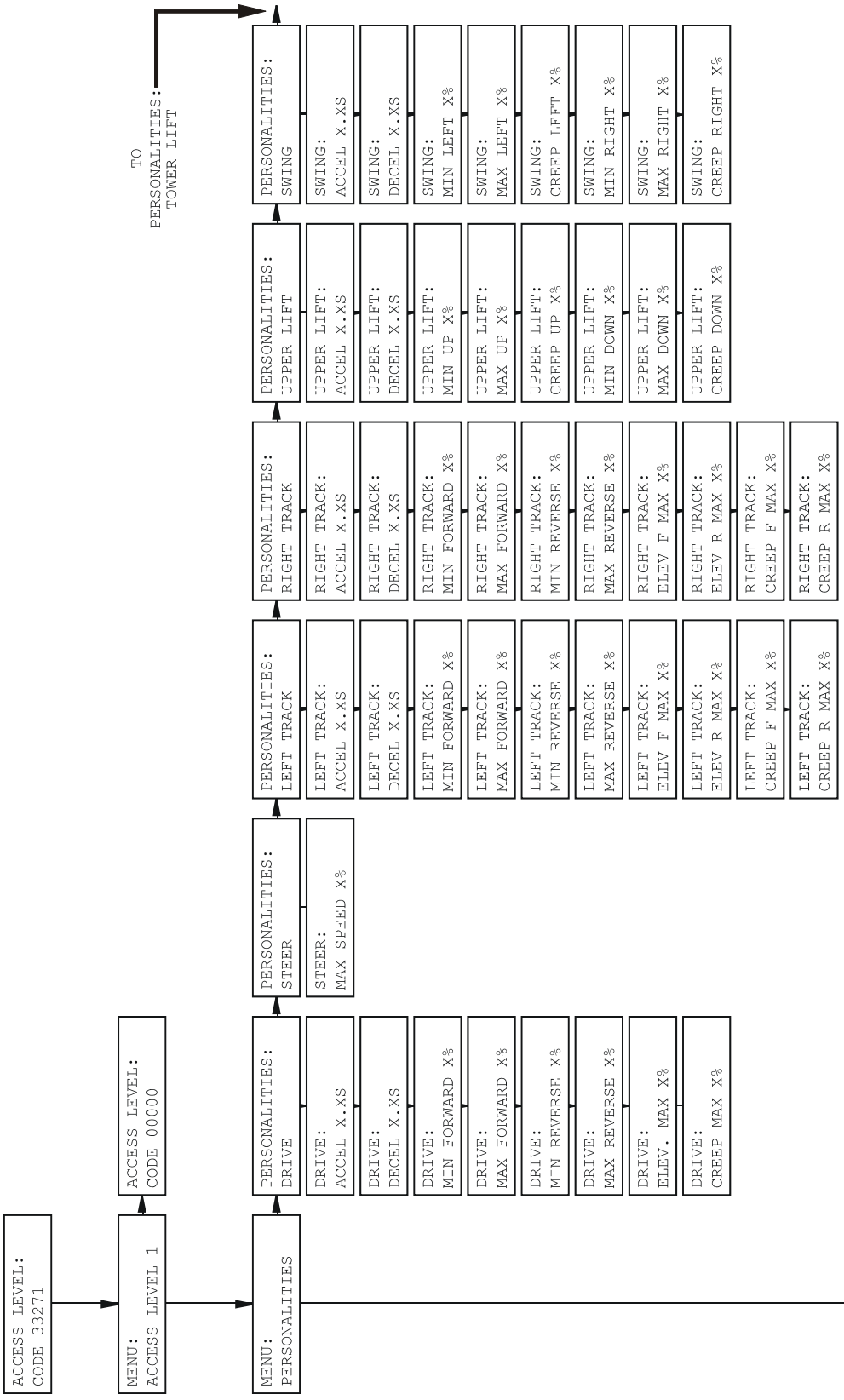
To level machine chose:

CALIBRATION:
TILT SENSOR

Press ENTER.

When prompted, swing machine 180°

Press ENTER.



Note: Some screens may not be available depending upon machine configuration.

Figure 6-5. Analyzer Flow Chart - Sheet 1 of 4

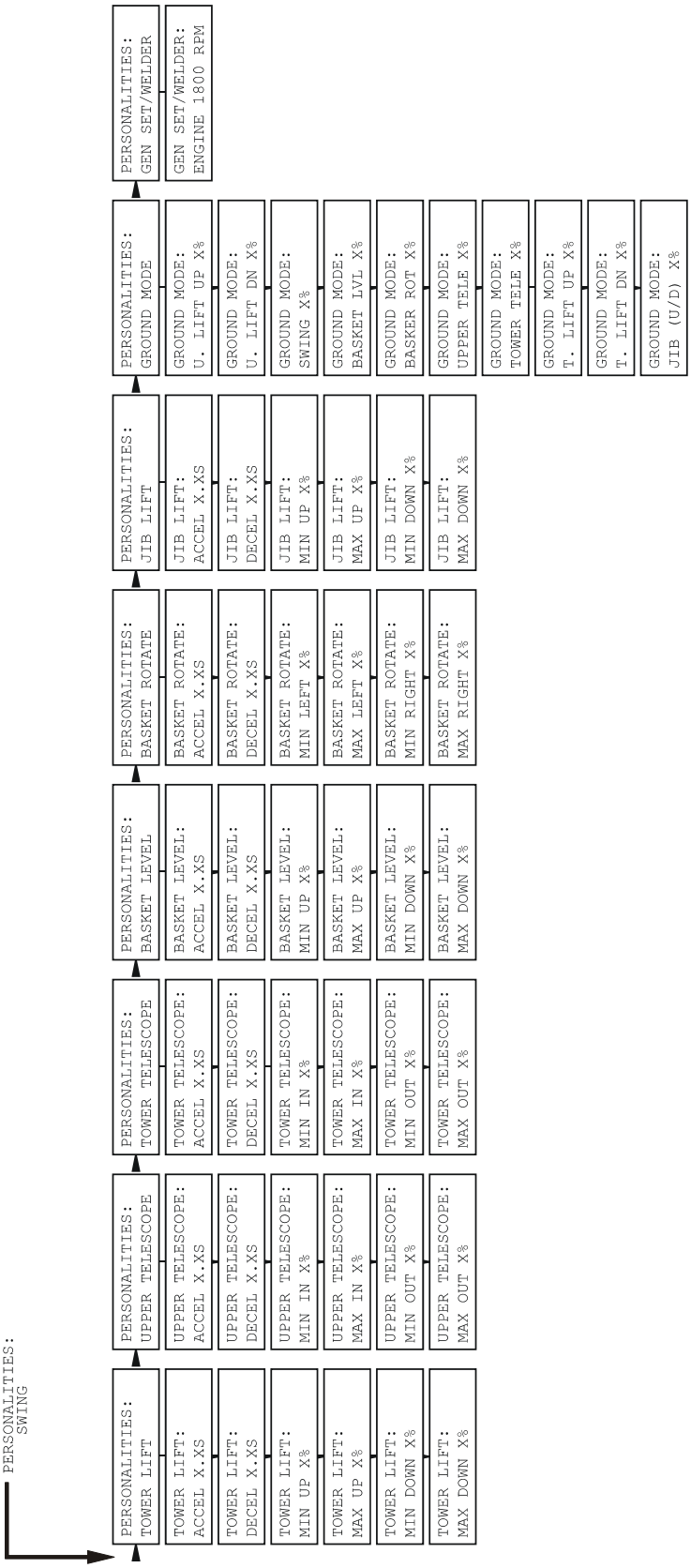


Figure 6-6. Analyzer Flow Chart - Sheet 2 of 4

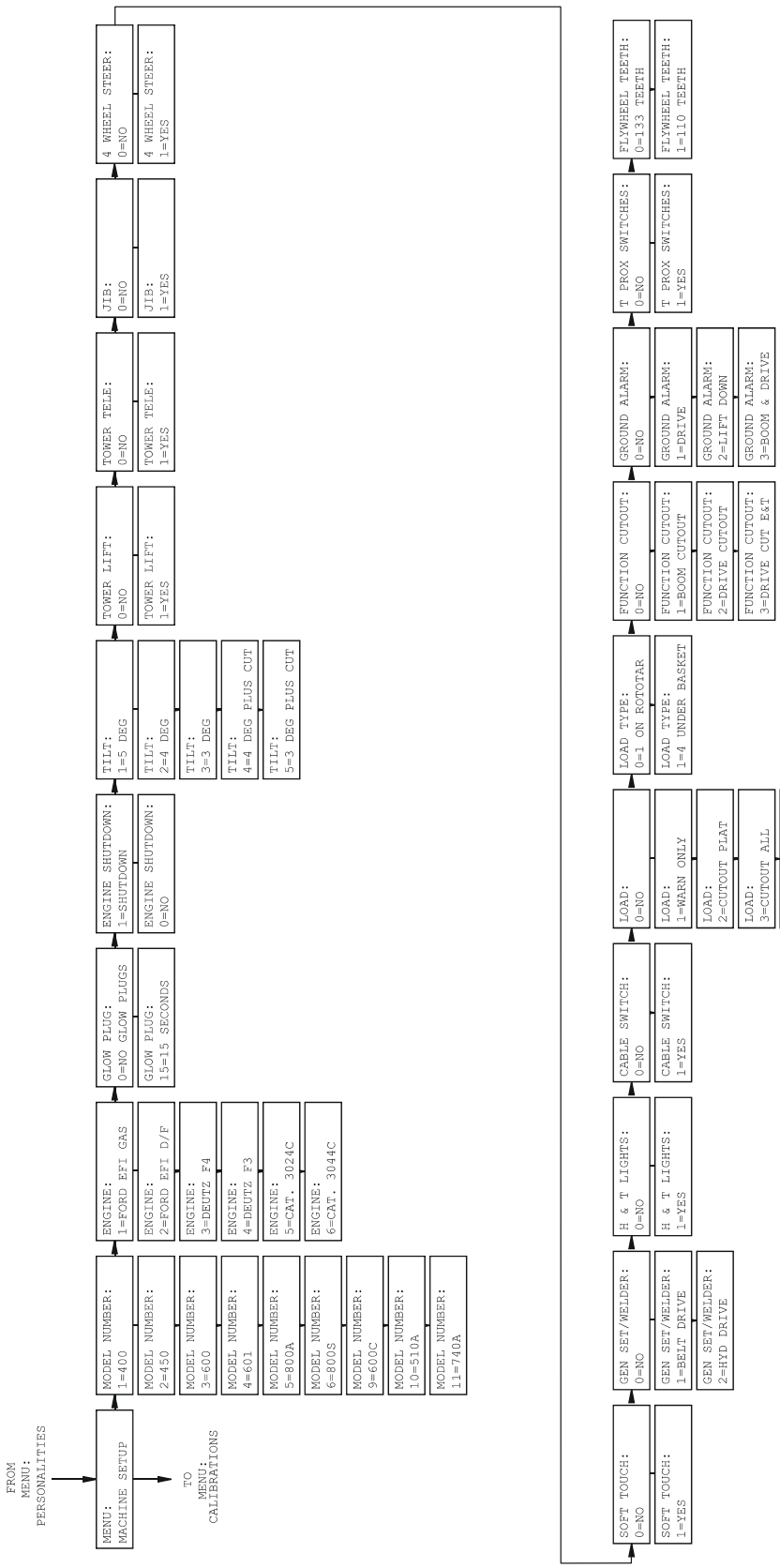


Figure 6-7. Analyzer Flow Chart - Sheet 3 of 4

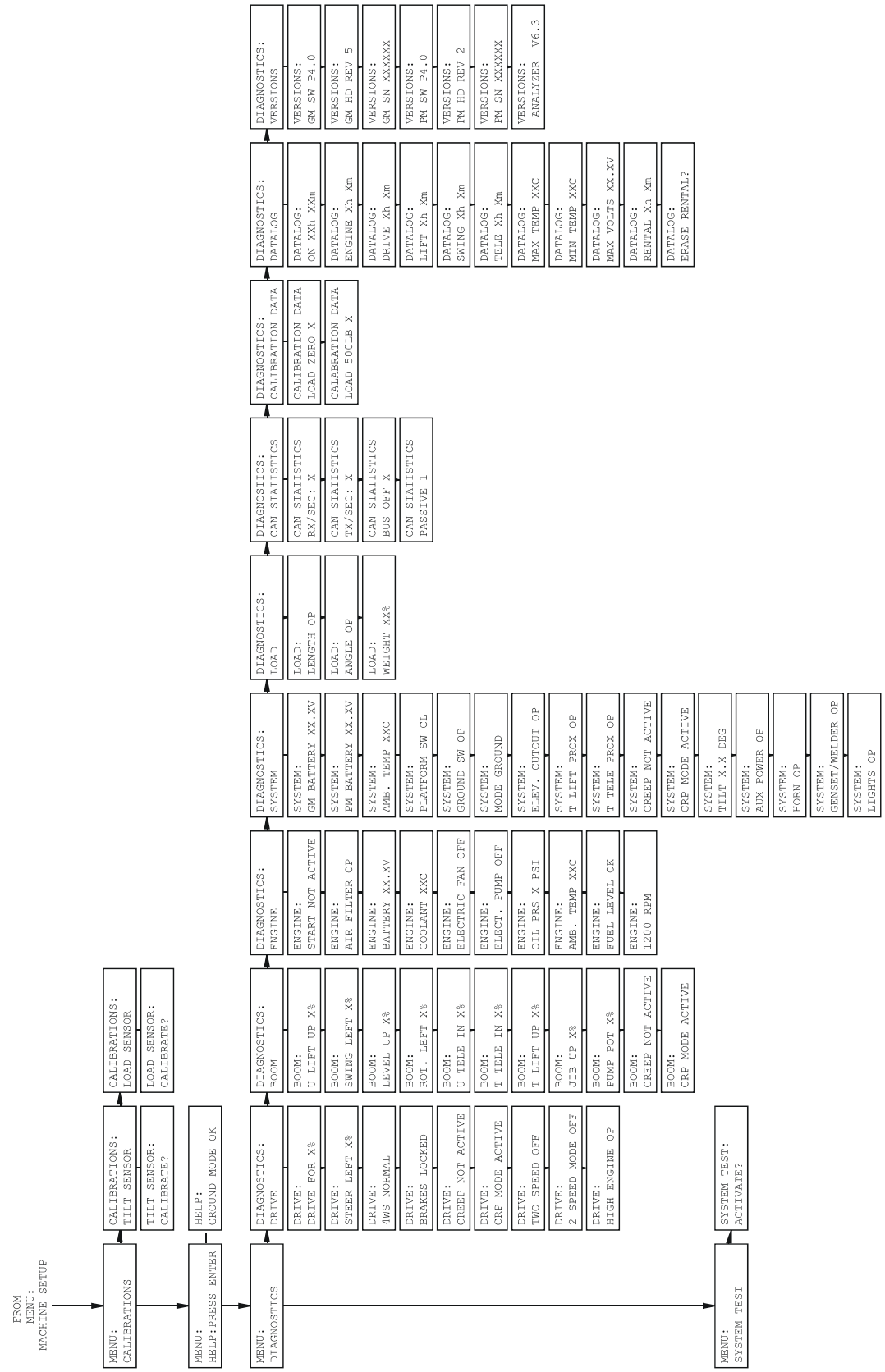


Figure 6-8. Analyzer Flow Chart - Sheet 4 of 4

6.8 MACHINE PERSONALITY SETTINGS

NOTE: *Personality settings can be adjusted within the adjustment range in order to achieve optimum machine performance.*

Table 6-1. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS - 600S	DEFAULTS - 600A
DRIVE	ACCELeration	0.1s to 5.0s	2.0	2.0
	DECELeration	0.1s to 3.0s	2.0	2.0
	Forward MINimum speed	0 to 35%	4	4
	Forward MAXimum speed	0 to 100%	35	35
	REVerse MINimum speed	0 to 35%	4	4
	REVerse MAXimum speed	0 to 100%	35	22
	ELEVATED MAXimum speed	0 to 50%	15	10
	CREEP MAXimum speed	0 to 50%	25	25
	Engine RPM	800 to 2900	1800	1800
TOWER LIFT	ACCELeration	0.1 to 5.0	N/A	1.0
	DECELeration	0.1 to 3.0	N/A	0.5
	MINimum UP speed	0 to 60%	N/A	50
	MAXimum UP speed	0 to 100%	N/A	100
	MINimum DOWN speed	0 to 60%	N/A	50
	MAXimum DOWN speed	0 to 100%	N/A	100
	Engine RPM	800 to 2900	N/A	1800
UPPER LIFT	ACCELeration	0.1 to 5.0	2.0	2.0
	DECELeration	0.1 to 3.0	1.0	0.7
	MINimum UP speed	0 to 60%	40	30
	MAXimum UP speed	0 to 100%	80	55
	CREEP Maximum UP speed	0 to 65%	55	55
	MINimum DOWN speed	0 to 60%	40	40
	MAXimum DOWN speed	0 to 100%	70	65
	CREEP maximum DOWN speed	0 to 75%	55	55
	Engine RPM	800 to 2900	1800	1800

Table 6-1. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS - 600S	DEFAULTS - 600A
SWING	ACCELeration	0.1 to 5.0s	2.0	2.0
	DECELeration	0.1 to 3.0s	1.8	1.8
	MINimum LEFT speed	0 to 50%	30	30
	MAXimum LEFT speed	0 to 100%	65	95
	CREEP maximum LEFT speed	0 to 65%	45	53
	MINimum RIGHT speed	0 to 50%	30	30
	MAXimum RIGHT speed	0 to 100%	65	95
	CREEP maximum RIGHT speed	0 to 65%	45	53
	Engine RPM	800 to 2900	1400	1400
TELESCOPE UPPER	ACCELeration	0.1 to 5.0	3.5	3.5
	DECELeration	0.1 to 3.0	0.8	0.8
	MINimum IN speed	0 to 65%	45	45
	MAXimum IN speed	0 to 100%	75	75
	MINimum OUT speed	0 to 65%	45	45
	MAXimum OUT speed	0 to 100%	70	70
	Engine RPM	800 to 2900	1800	1800
TELESCOPE TOWER	ACCELeration	0.1 to 5.0	N/A	1.0
	DECELeration	0.1 to 3.0	N/A	0.5
	MINimum IN speed	0 to 65%	N/A	50
	MAXimum IN speed	0 to 100%	N/A	100
	MINimum OUT speed	0 to 65%	N/A	50
	MAXimum OUT speed	0 to 100%	N/A	100
	Engine RPM	800 to 2900	N/A	1800
BASKET LEVEL	ACCELeration	0.1 to 5.0	2.5	2.5
	DECELeration	0.1 to 3.0	0.5	0.5
	MINimum UP speed	0 to 65%	48	48
	MAXimum UP speed	0 to 100%	52	52
	MINimum DOWN speed	0 to 65%	45	45
	MAXimum DOWN speed	0 to 100%	50	50
	Engine RPM	800 to 2900	1500	1500

Table 6-1. Personality Ranges/Defaults

FUNCTION	PERSONALITY	RANGE	DEFAULTS - 600S	DEFAULTS - 600A
BASKET ROTATE	ACCELeration	0.1 to 5.0	1.8	1.8
	DECELeration	0.1 to 3.0	0.7	0.7
	MINimum LEFT speed	0 to 65%	46	46
	MAXimum LEFT speed	0 to 100%	50	50
	MINimum RIGHT speed	0 to 65%	46	46
	MAXimum RIGHT speed	0 to 100%	50	50
	Engine RPM	800 to 2900	1500	1500
JIB LIFT	ACCELeration	0.1 to 5.0	5.0	5.0
	DECELeration	0.1 to 3.0	1.0	1.0
	MINimum UP speed	0 to 65%	46	46
	MAXimum UP speed	0 to 100%	52	52
	MINimum DOWN speed	0 to 65%	45	45
	MAXimum DOWN speed	0 to 100%	52	52
	Engine RPM	800 to 2900	1800	1800
STEER	MAXimum speed	0 to 100%	100	100
	Engine RPM	800 to 2900	1800	1800
GROUND MODE	Tower LIFT UP speed	0 to 100%	N/A	100
	Tower LIFT DOWN speed	0 to 100%	N/A	100
	Upper LIFT UP	0 to 100%	60	60
	Upper LIFT DOWN	0 to 100%	60	60
	SWING speed	0 to 100%	60	60
	Upper TELEscope speed	0 to 100%	70	70
	Tower TELEscope speed	0 to 100%	N/A	100
	BASKET ROTATE speed	0 to 100%	50	50
	BASKET LEVEL speed	0 to 100%	50	50
	JIB LIFT speed	0 to 100%	50	50

NOTE: *Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.*

4150365-3

Table 6-2. Help Fault Codes, Displayed Faults, and Descriptions - Prior to S/N 66437

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.	

Table 6-2. Help Fault Codes, Displayed Faults, and Descriptions - Prior to S/N 66437

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 foot-switch 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.	
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 6-2. Help Fault Codes, Displayed Faults, and Descriptions - Prior to S/N 66437

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.	
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 6-2. Help Fault Codes, Displayed Faults, and Descriptions - Prior to S/N 66437

9/9	Flash code 9/9 indicates problems with the controller.		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	

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

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	
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.	

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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.	
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 DIAGNOSTICS/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 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.	
	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**

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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 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.	
	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**
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		

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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		
	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		

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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		
	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		

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	TOWER UP SHORT TO GROUND		
	TOWER UP OPEN CIRCUIT		
	TOWER UP SHORT TO BATTERY		
	TOWER DOWN SHORT TO GROUND		
	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		

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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		
	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**	

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
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.	
	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.	
7/7		**Flash code 7/7 indicates problems with a motor. NOT REQUIRED**	
9/9		**Flash code 9/9 indicates problems with the controller.**	**11**

Table 6-3. Help Fault Codes, Displayed Faults, and Descriptions - S/N 66937 to Present

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
	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 V(Low) 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.	

Table 6-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
1 (Model #)	1 2 3 4 5 6 7 8 9 10 11	400 450 600 601 800A 800S 1350SJP 1200SJP 600C 510A 740A	1
2 (Engine)	1 2 3 4 5 6	Ford LRG425 EFI Gas Ford LRG425 EFI Gas with dual fuel Deutz F4M1011F Diesel Deutz F3M1011F Diesel CAT 3024C Diesel CAT 3044C Diesel	1
3 (Glow Plugs)	0 1-60	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 allowing the start engine function.	0
4 (Engine Shutdown)	0 1	No Engine Shutdown Shutdown engine when coolant temperature is greater than 230 deg. F (110 deg. C) or the oil pressure is less than 8 psi (0.5 Bar).	1

Table 6-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
5 (Tilt Switch)	1	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 1350/1200SJP ALL MARKETS	1
	2	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 – 400S, 450, & 800S	
	3	3 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 – 600, 601, 740AJ, & 800 A	
	4	4 degree - reduces the maximum speed of all boom functions to creep when tilted and above elevation and disallows tower lift up, drive, upper telescope out, and upper lift up.	
	5	3 degree - reduces the maximum speed of all boom functions to creep when tilted and above elevation and disallows tower lift up, drive, upper telescope out, and upper 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 tilted and above elevation.	
6 (Tower Lift)	0	No Tower Lift Installed	0
	1	Yes	
7 (Tower Tele)	0	No Tower Telescope Installed	0
	1	Yes	
8 (Jib)	0	No JIB installed.	0
	1	JIB installed which has up and down movements only.	
	2	JIB installed which has up and down movements and side to side movements.	
9 (4WS)	0	No Four-Wheel Steer installed.	0
	1	Yes	
10 (Soft Touch System)	0	No Soft Touch System Installed	0
	1	Yes	
11 (Gen Set/ Welder)	0	No Generator Installed	0
	1	Belt Driven	
	2	Hydraulic Driven	

Table 6-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
12 (Head and Tail Lights)	0 1	No Head and Tail Lights Installed Yes	0
13 (Broken Cable Switch)	0 1	No Broken Cable Switch Installed Yes	0
14 (Load Sensor)	0 1 2 3 4	No Load Sensor installed - (DOM - STD) Functions in Creep, Overload Lamp Lit, Platform Alarm Beeps (5 sec. ON, 2 sec OFF) All functions cutout, flash overload light (500mS on, 500mS off), Platform Alarm beeps (5 sec ON, 2 sec OFF) - (CE - STD) All functions cutout, Overload Lamp Lit, Platform Alarm Beeps (5 sec ON, 2 sec OFF) Special = Functions in Creep, Overload Lamp Lit, Platform Alarm Beeps (5 sec ON, 2 sec OFF), disables Upper Telescope Out & Upper Lift Up	0
15* (Load Sensor) (*Only visible if Load Sensor Menu selection is not 0)	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	0
16 (Function Cutout)	0 1 2 3	No Drive Cutout - (DOM - STD) Boom function cutout while driving above elevation. (CE - STD) Drive Cutout above elevation Drive Cutout above elevation and tilted	0
17 (Ground Alarm)	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**	0
18 (Tower Prox Switches)	0 1	No Tower Prox Switches Installed Tower Prox Switches Installed - 450A,510, 600A, 740AJ, 800A	0
19 (Drive)	0 1	4 Wheel Drive 2 Wheel Drive	
20* (Flywheel Teeth) (*Only visible if a Deutz engine is selected)	0 1	133 Teeth (F3M Prior to 11/16/01; F4M1011 Prior to 1/1/02) 110 Teeth (Deutz 2011, F3M after 11/16/01; F4M 1011 after 1/1/02	

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Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
OK	0	0	CLEARS WHEN FAULT IS REMOVED
DRIVING AT CREEP - TILTED	0	0	CLEARS WHEN FAULT IS REMOVED
FSW OPEN	0	0	CLEARS WHEN FAULT IS REMOVED
RUNNING AT CREEP - CREEP SWITCH OPEN	0	0	CLEARS WHEN FAULT IS REMOVED
RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	0	0	CLEARS WHEN FAULT IS REMOVED
RUNNING AT CUTBACK - ABOVE ELEVATION	0	0	CLEARS WHEN FAULT IS REMOVED
TILT SENSOR OUT OF RANGE	0	0	CLEARS WHEN FAULT IS REMOVED
LOAD SENSOR READING UNDER WEIGHT	0	0	CLEARS WHEN FAULT IS REMOVED
FSW FAULTY	2	1	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
KEYSWITCH FAULTY	2	1	CLEARS WHEN FAULT IS REMOVED
DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	2	2	CLEARS WHEN FAULT IS REMOVED
FSW INTERLOCK TRIPPED	2	2	CLEARS WHEN FAULT IS REMOVED
STEER LOCKED - SELECTED BEFORE FOOTSWITCH	2	2	CLEARS WHEN FAULT IS REMOVED
STEER SWITCHES FAULTY	2	2	CLEARS WHEN FAULT IS REMOVED
D/S JOY. QPROX BAD	2	2	CLEARS WHEN FAULT IS REMOVED
L/S JOY. QPROX BAD	2	3	CLEARS WHEN FAULT IS REMOVED
D/S JOY. OUT OF RANGE LOW	2	2	CLEARS WHEN FAULT IS REMOVED
D/S JOY. OUT OF RANGE HIGH	2	2	CLEARS WHEN FAULT IS REMOVED
L/S JOY. OUT OF RANGE LOW	2	3	CLEARS WHEN FAULT IS REMOVED
L/S JOY. OUT OF RANGE HIGH	2	3	CLEARS WHEN FAULT IS REMOVED
D/S JOY. CENTER TAP BAD	2	2	CLEARS WHEN FAULT IS REMOVED
L/S JOY. CENTER TAP BAD	2	3	CLEARS WHEN FAULT IS REMOVED
WAITING FOR FSW TO BE OPEN	2	2	CLEARS WHEN FAULT IS REMOVED
PUMP POT FAULTY	2	3	CLEARS WHEN FAULT IS REMOVED
PUMP SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	2	3	CLEARS WHEN FAULT IS REMOVED
PUMP SWITCHES LOCKED - SELECTED BEFORE FOOTSWITCH	2	3	CLEARS WHEN FAULT IS REMOVED
PUMP SWITCHES LOCKED - SELECTED BEFORE START SWITCH	2	3	CLEARS WHEN FAULT IS REMOVED
FOOTSWITCH SELECTED BEFORE START	2	3	CLEARS WHEN FAULT IS REMOVED
BOOM PREVENTED - DRIVE SELECTED	2	5	CLEARS WHEN FAULT IS REMOVED
DRIVE PREVENTED - ABOVE ELEVATION	2	5	CLEARS WHEN FAULT IS REMOVED
DRIVE PREVENTED - TILTED & ABOVE ELEVATION	2	5	CLEARS WHEN FAULT IS REMOVED
DRIVE PREVENTED - BOOM SELECTED	2	5	CLEARS WHEN FAULT IS REMOVED

Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
FORD ECM POWER SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HORN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HORN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HORN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
AUX POWER SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
AUX POWER OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
AUX POWER SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GLOW PLUG SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GLOW PLUG OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GLOW PLUG SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP LOCK SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP LOCK OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP LOCK SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP START ASSIST SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP START ASSIST OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
LP START ASSIST SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
MAIN DUMP SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
MAIN DUMP OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
MAIN DUMP SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
PARKING BRAKE SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
PARKING BRAKE OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
PARKING BRAKE SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
START SOLENOID SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
START SOLENOID OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
START SOLENOID SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
STEER DUMP SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
STEER DUMP OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
STEER DUMP SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TWO SPEED SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TWO SPEED OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TWO SPEED SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
ALARM SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
ALARM OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT

Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
ALARM SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GENERATOR SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GENERATOR OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
GENERATOR SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HEAD TAIL LIGHT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HEAD TAIL LIGHT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HEAD TAIL LIGHT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HOUR METER SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
HOUR METER SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET UP SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET UP OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET UP SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET DOWN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET DOWN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET DOWN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET LEFT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET LEFT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET LEFT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET RIGHT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET RIGHT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BASKET RIGHT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB UP SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB UP OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB UP SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB DOWN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB DOWN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB DOWN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB LEFT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB LEFT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB LEFT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB RIGHT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB RIGHT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
JIB RIGHT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT

Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
TOWER UP SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER UP OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER UP SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER DOWN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER DOWN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER DOWN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER IN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER IN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER IN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER OUT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER OUT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
TOWER OUT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER IN SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER IN OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER IN SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER OUT SHORT TO GROUND	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER OUT OPEN CIRCUIT	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
UPPER OUT SHORT TO BATTERY	3	3	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
FUEL SENSOR SHORT TO BATTERY	3	3	CLEARS WHEN FAULT IS REMOVED
FUEL SENSOR SHORT TO GROUND	3	3	CLEARS WHEN FAULT IS REMOVED
OIL PRESSURE SHORT TO BATTERY	4	3	CLEARS WHEN FAULT IS REMOVED
OIL PRESSURE SHORT TO GROUND	4	3	CLEARS WHEN FAULT IS REMOVED
COOLANT TEMPERATURE SHORT TO GROUND	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 12	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 13	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 14	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 15	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 21	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 22	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 23	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 24	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 25	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 26	4	3	CLEARS WHEN FAULT IS REMOVED

Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
FORD FAULT CODE 31	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 32	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 33	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 34	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 35	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 36	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 41	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 42	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 43	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 44	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 45	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 46	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 51	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 52	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 53	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 54	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 55	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 56	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 57	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 61	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 62	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 63	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 64	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE UNKNOWN	4	3	CLEARS WHEN FAULT IS REMOVED
RETURN FILTER BYPASSED	2	8	CLEARS WHEN FAULT IS REMOVED
CHARGE PUMP FILTER BYPASSED	2	8	CLEARS WHEN FAULT IS REMOVED
BATTERY LOW	4	4	CLEARS WHEN FAULT IS REMOVED
BATTERY TOO HIGH - SYSTEM SHUT DOWN	4	4	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BATTERY TOO LOW - SYSTEM SHUT DOWN	4	4	CLEARS WHEN FAULT IS REMOVED
SPEED SENSOR READING INVALID SPEED	5	5	CLEARS WHEN FAULT IS REMOVED
SPEED INPUT LOST	5	5	CLEARS WHEN FAULT IS REMOVED
ENGINE TEMP HIGH	4	3	CLEARS WHEN FAULT IS REMOVED
AIR FILTER BYPASSED	4	3	CLEARS WHEN FAULT IS REMOVED

Table 6-5. Fault Code Listing

HELP MESSAGE	FAULT		FAULT REMOVAL
NO ALTERNATOR OUTPUT	4	3	CLEARS WHEN FAULT IS REMOVED
OIL PRESSURE LOW	4	3	CLEARS WHEN FAULT IS REMOVED
485 COMMUNICATIONS LOST	4	3	CLEARS WHEN FAULT IS REMOVED
CAN BUS FAILURE	6	6	CLEARS WHEN FAULT IS REMOVED
LOAD SENSOR NOT CALIBRATED	9	9	CLEARS WHEN FAULT IS REMOVED
TILT SENSOR NOT CALIBRATED	9	9	CLEARS WHEN FAULT IS REMOVED
EEPROM FAILURE - CHECK ALL SETTINGS	9	9	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
PLATFORM MODULE FAILURE: HWFS CODE 1	9	9	CLEARS WHEN FAULT IS REMOVED
GROUND MODULE FAILURE: HWFS CODE 1	9	9	CLEARS WHEN FAULT IS REMOVED

6.9 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/DOWN arrow keys alter a value if allowed

Table 6-6. 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

Table 6-6. Adjustments - Personality Descriptions

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
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

Table 6-6. Adjustments - Personality Descriptions

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
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 6-7. 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 6-7. 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. SCHEMATICS

7.1 GENERAL

This section contains 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.

7.2 TROUBLESHOOTING

It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.

It should be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems.

The first rule for troubleshooting any circuit that is hydraulically operated and electrically controlled is to determine if the circuit is lacking hydraulic oil and electrical control power. This can be ascertained by overriding the bypass valve (mechanically or electrically) so that oil is available to the function valve, then overriding the function valve mechanically. If the function performs satisfactorily, the problem exists with the control circuit.

7.3 HYDRAULIC CIRCUIT CHECKS

The best place to begin the problem analysis is at the power source (pump). Once it is determined that the pump is serviceable, then a systematic check of the circuit components, beginning with the control, would follow. For aid in troubleshooting, refer to the Illustrated Parts Manual for hydraulic diagrams of the various circuits

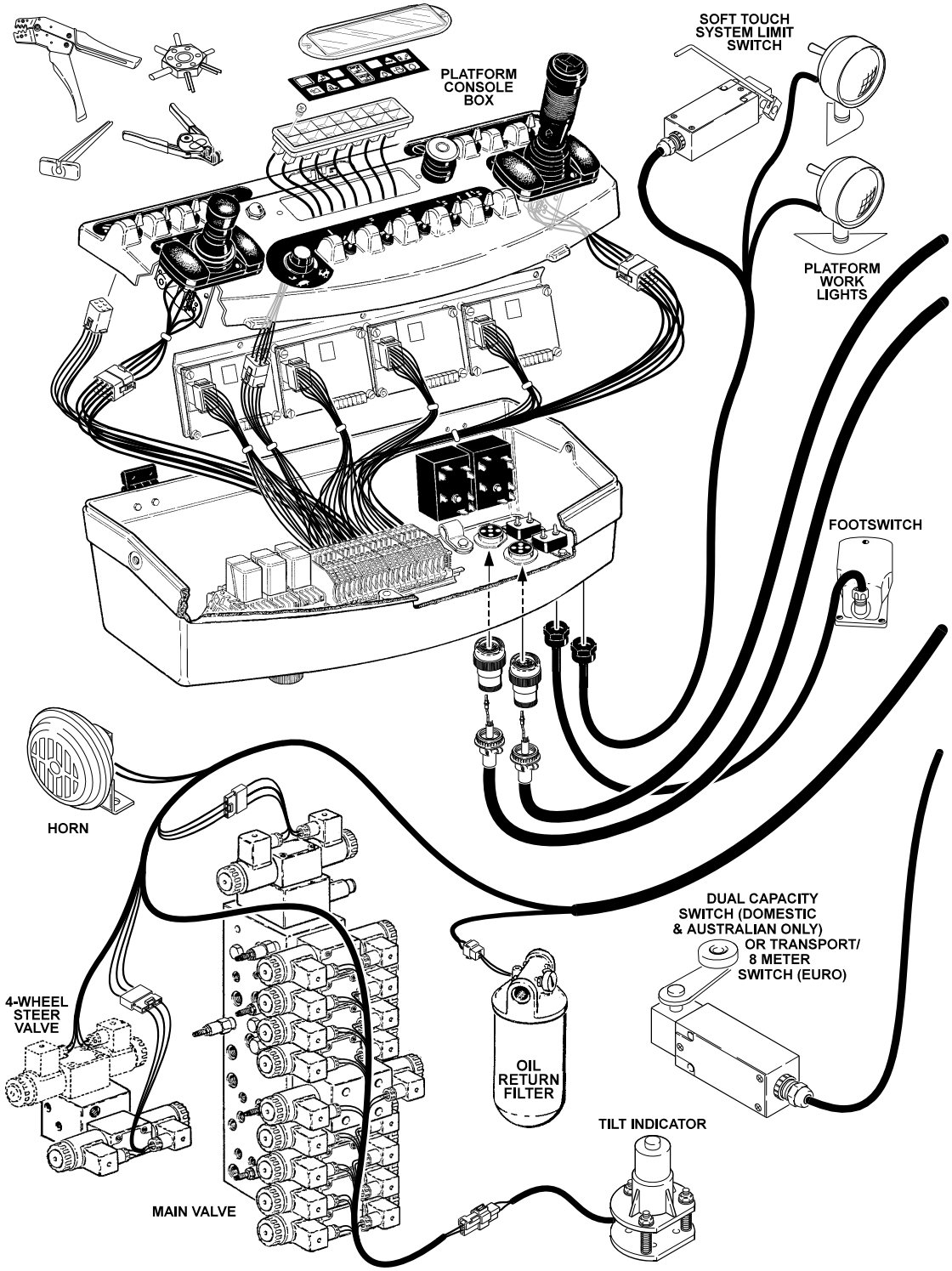

Figure 7-1. Electrical Harness - S Models (Prior to S/N 61927) - Sheet 1 of 2

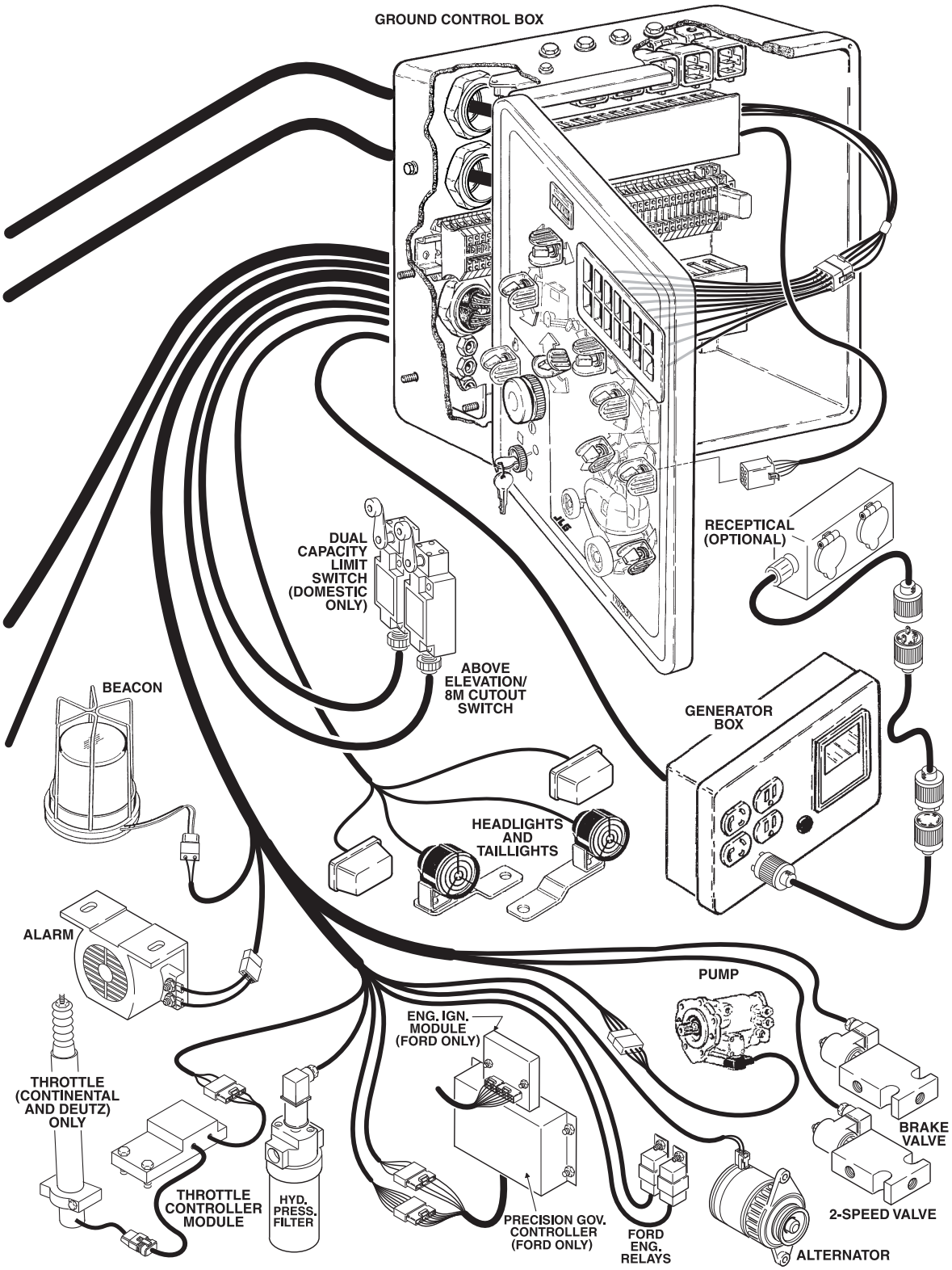

Figure 7-2. Electrical Harness - S Models (Prior to S/N 61927) - Sheet 2

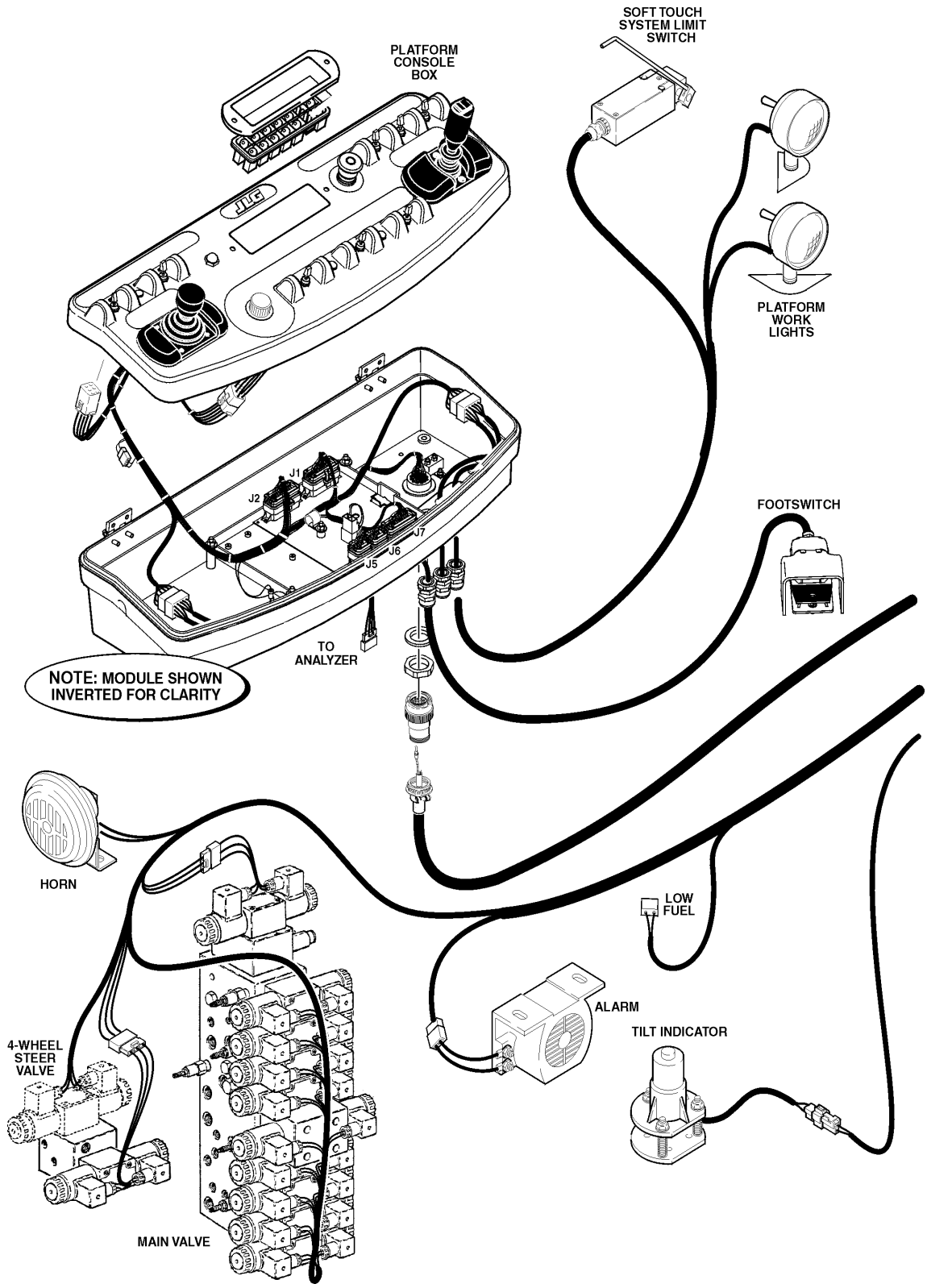

Figure 7-3. Electrical Harness - S Models (S/N 61927 to S/N 63909) - Sheet 1 of 2

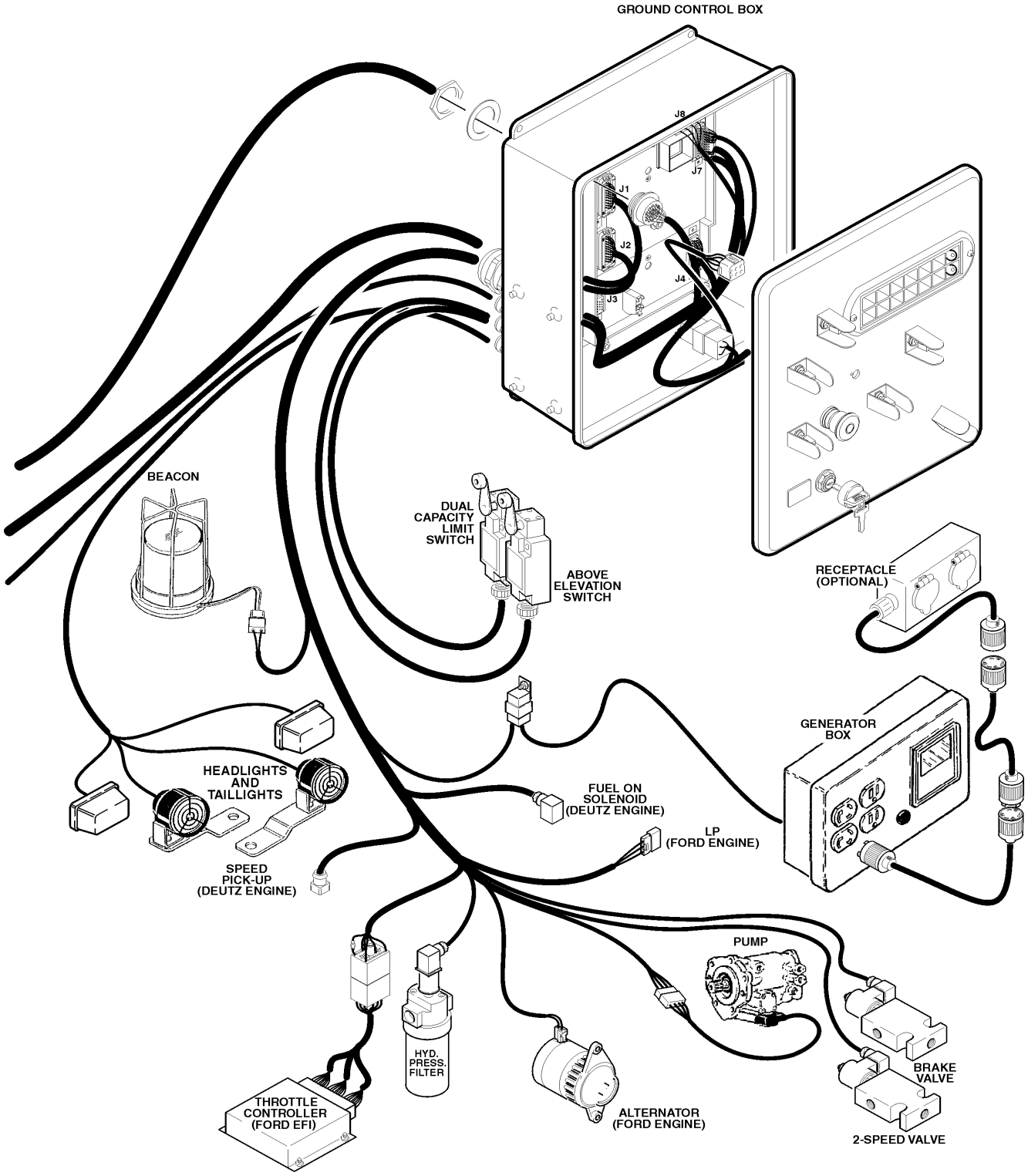

Figure 7-4. Electrical Harness - S Models (S/N 61927 to S/N 63909) - Sheet 2 of 2

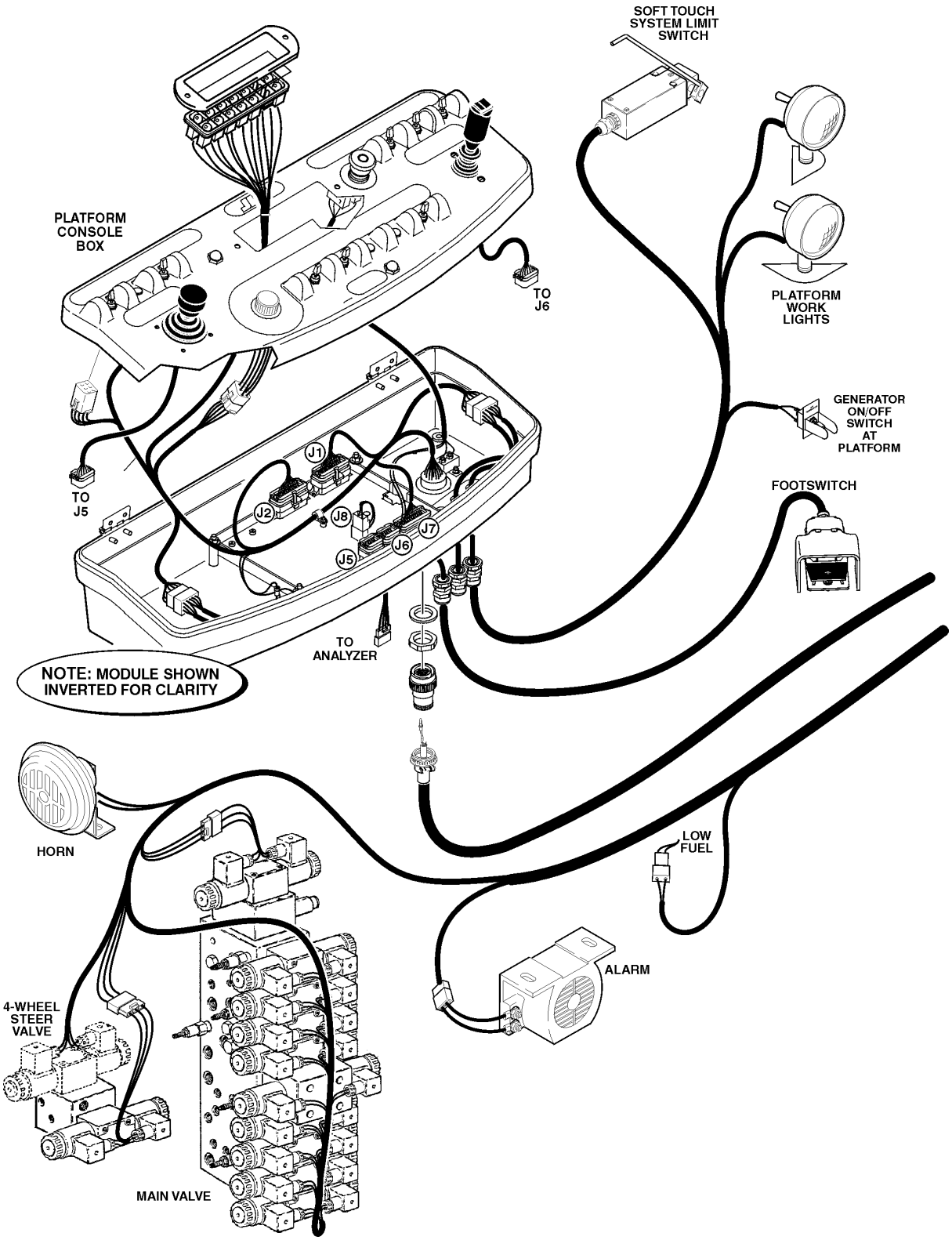

Figure 7-5. Electrical Harness - S Models (S/N 63909 to 75606) - Sheet 1 of 2

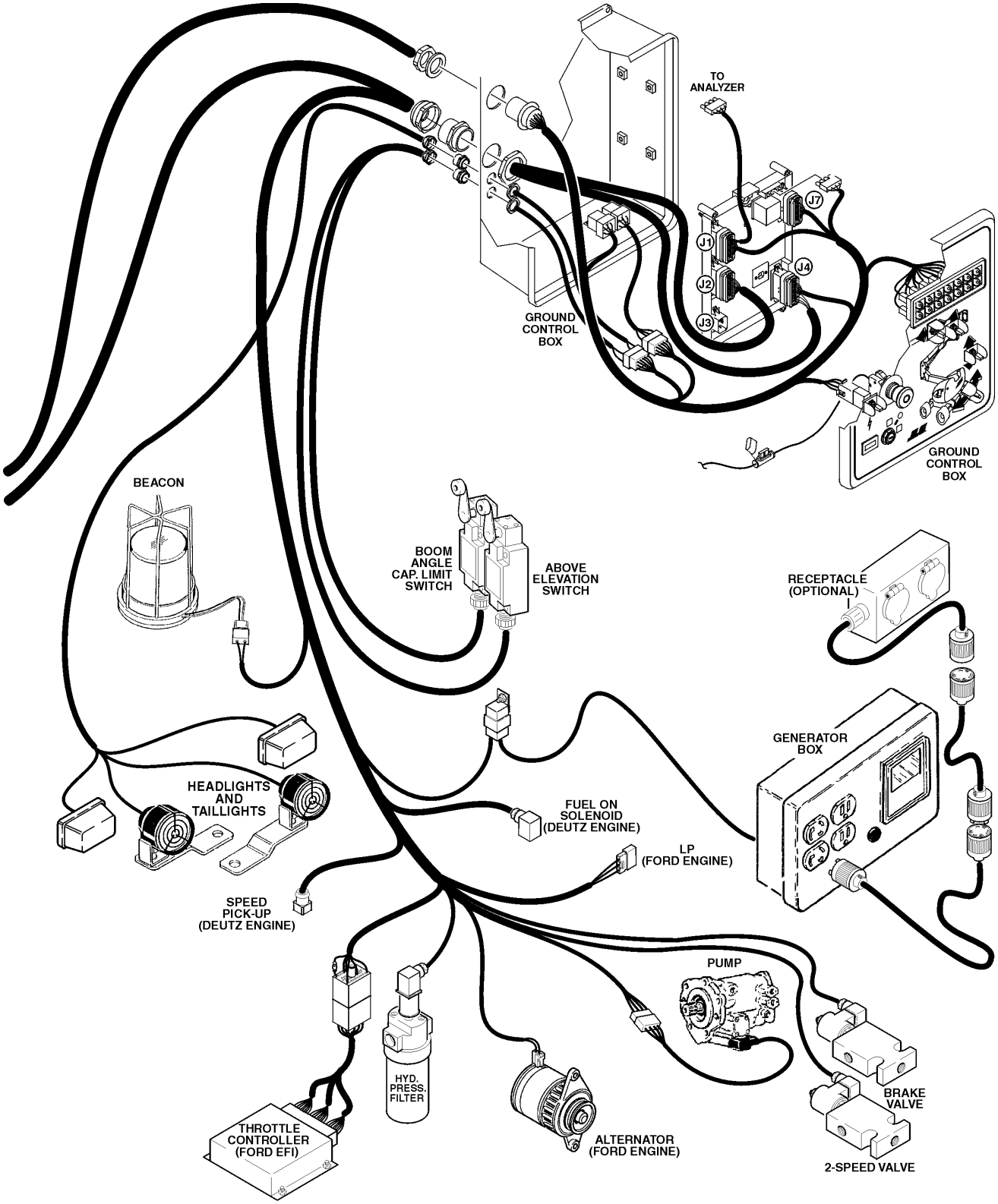

Figure 7-6. Electrical Harness - S Models (S/N 63909 to 75606) - Sheet 2 of 2

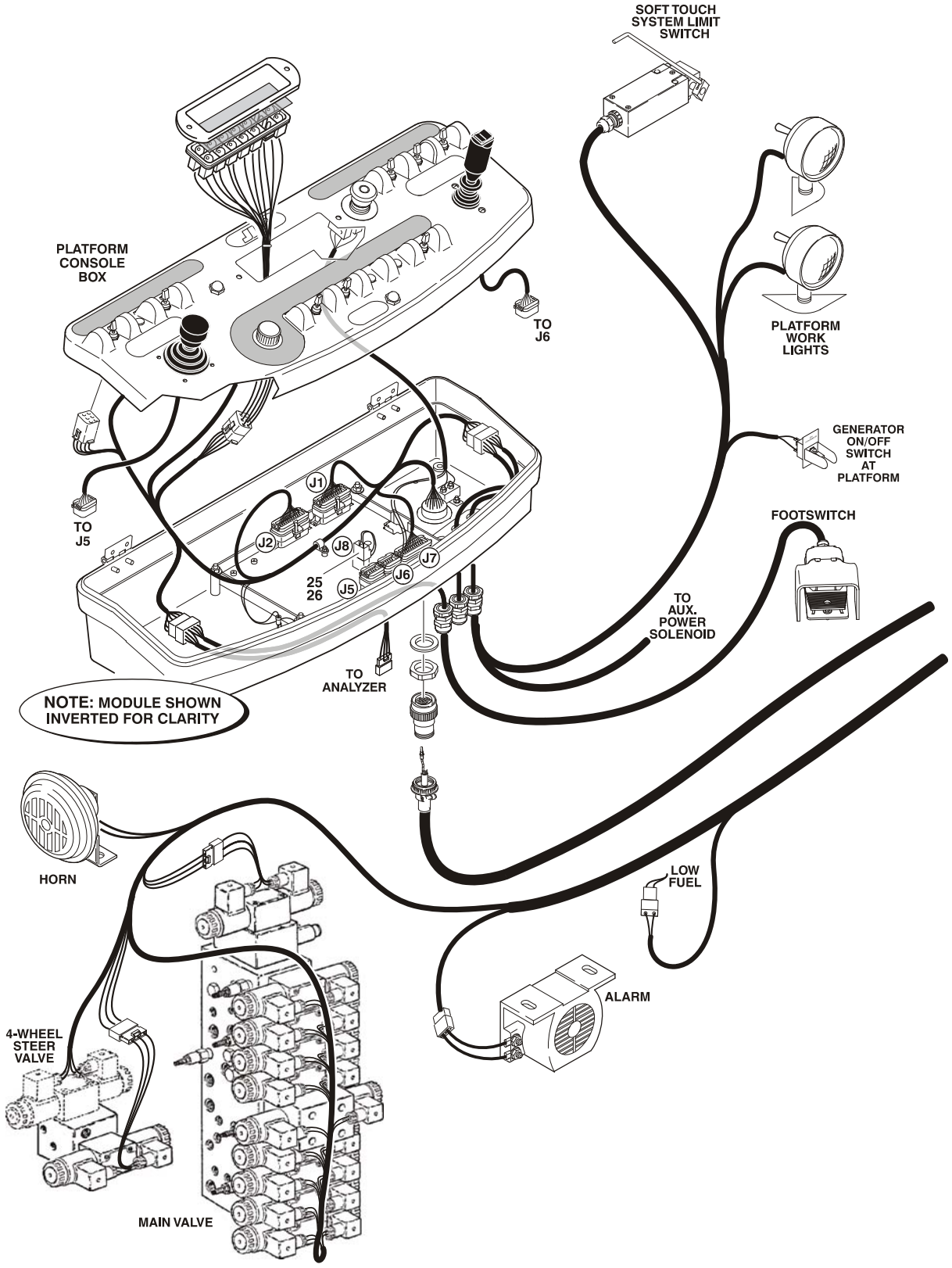

Figure 7-7. Electrical Harness - S Models (S/N 75606 to Present) - Sheet 1 of 2

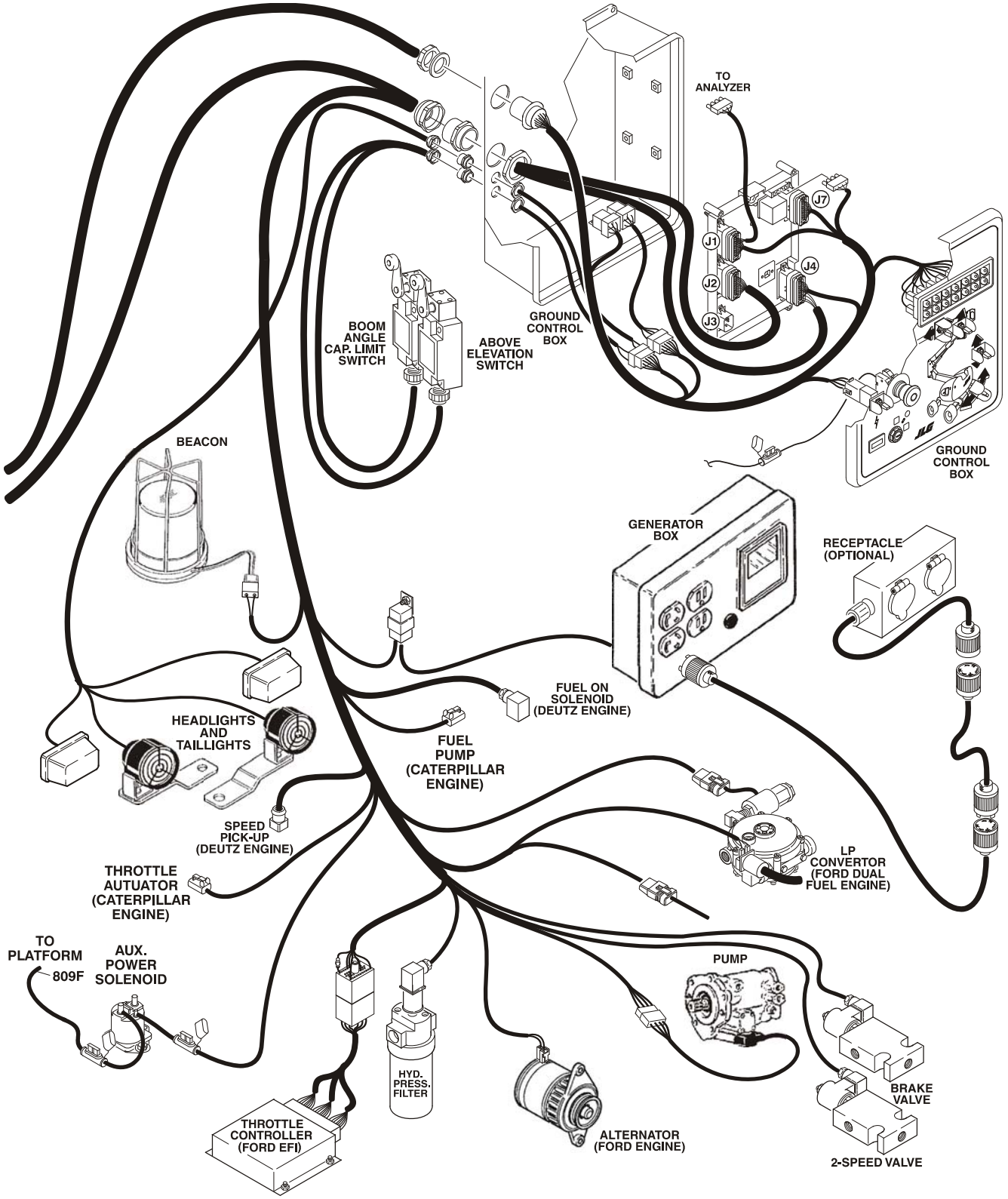

Figure 7-8. Electrical Harness - S Models (S/N 75606 to Present) - Sheet 2 of 2

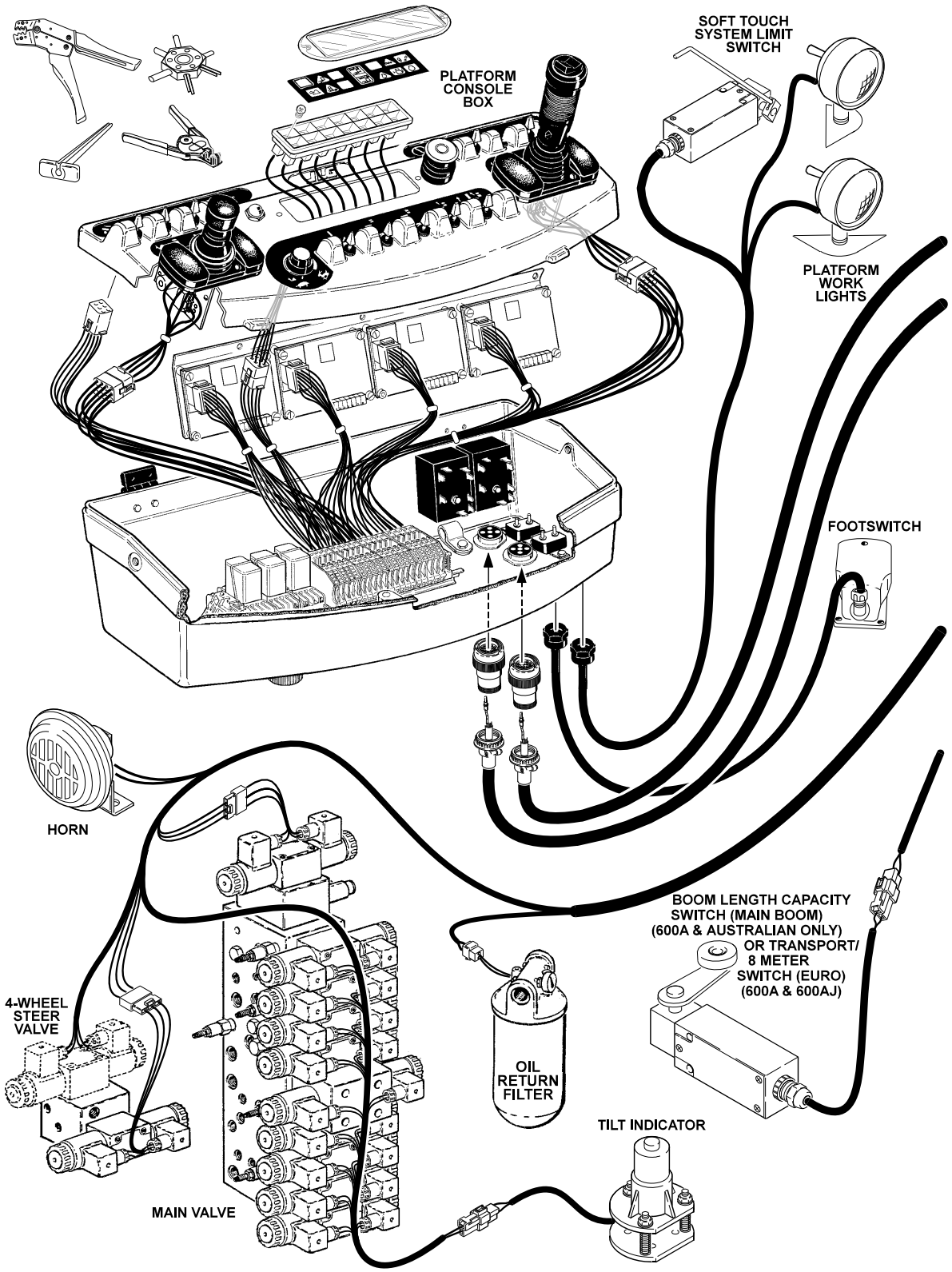

Figure 7-9. Electrical Harness - A Models (Prior to S/N 61927) - Sheet 1 of 2

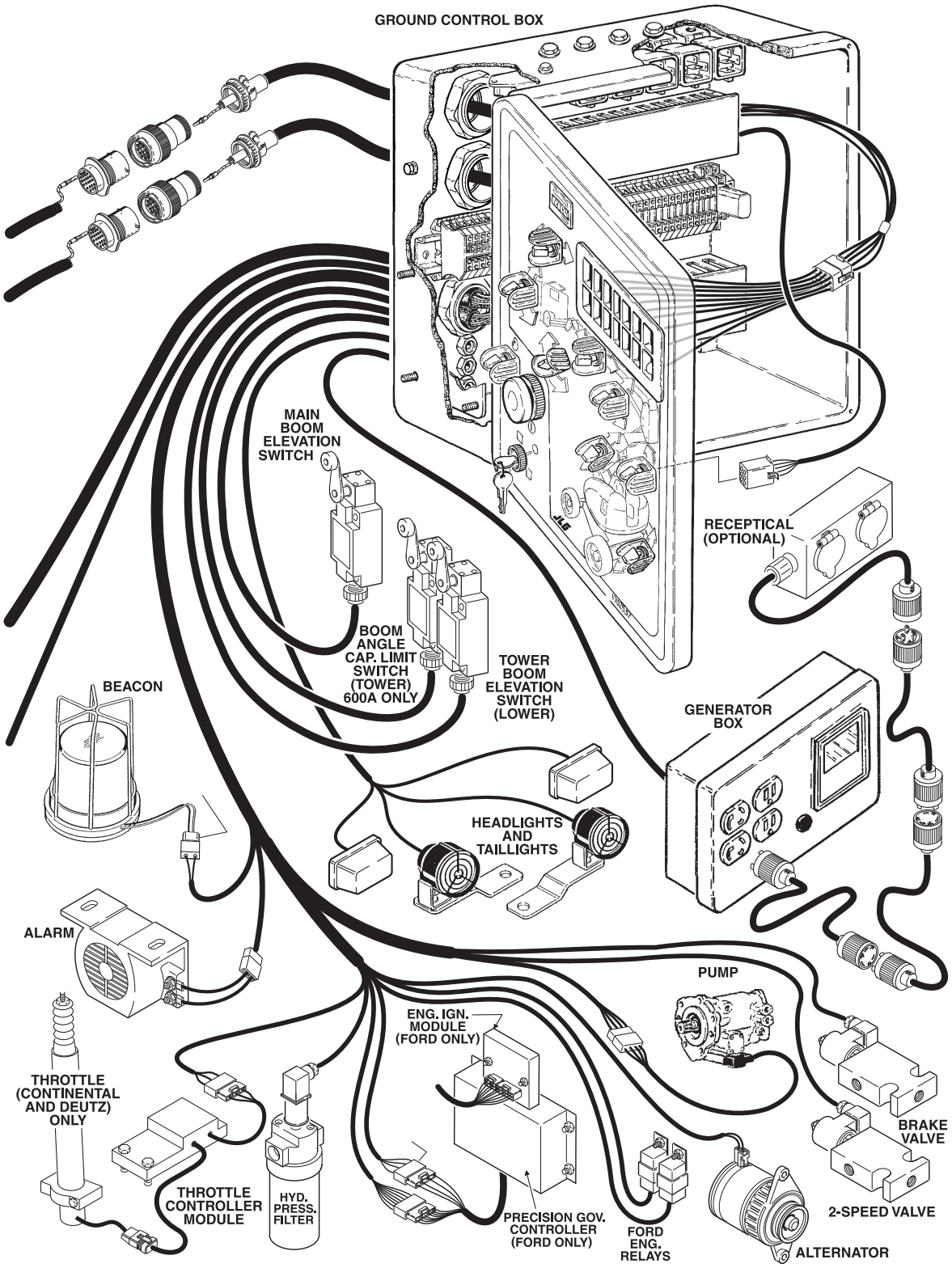

Figure 7-10. Electrical Harness - A Models (Prior to S/N 61927) - Sheet 2 of 2

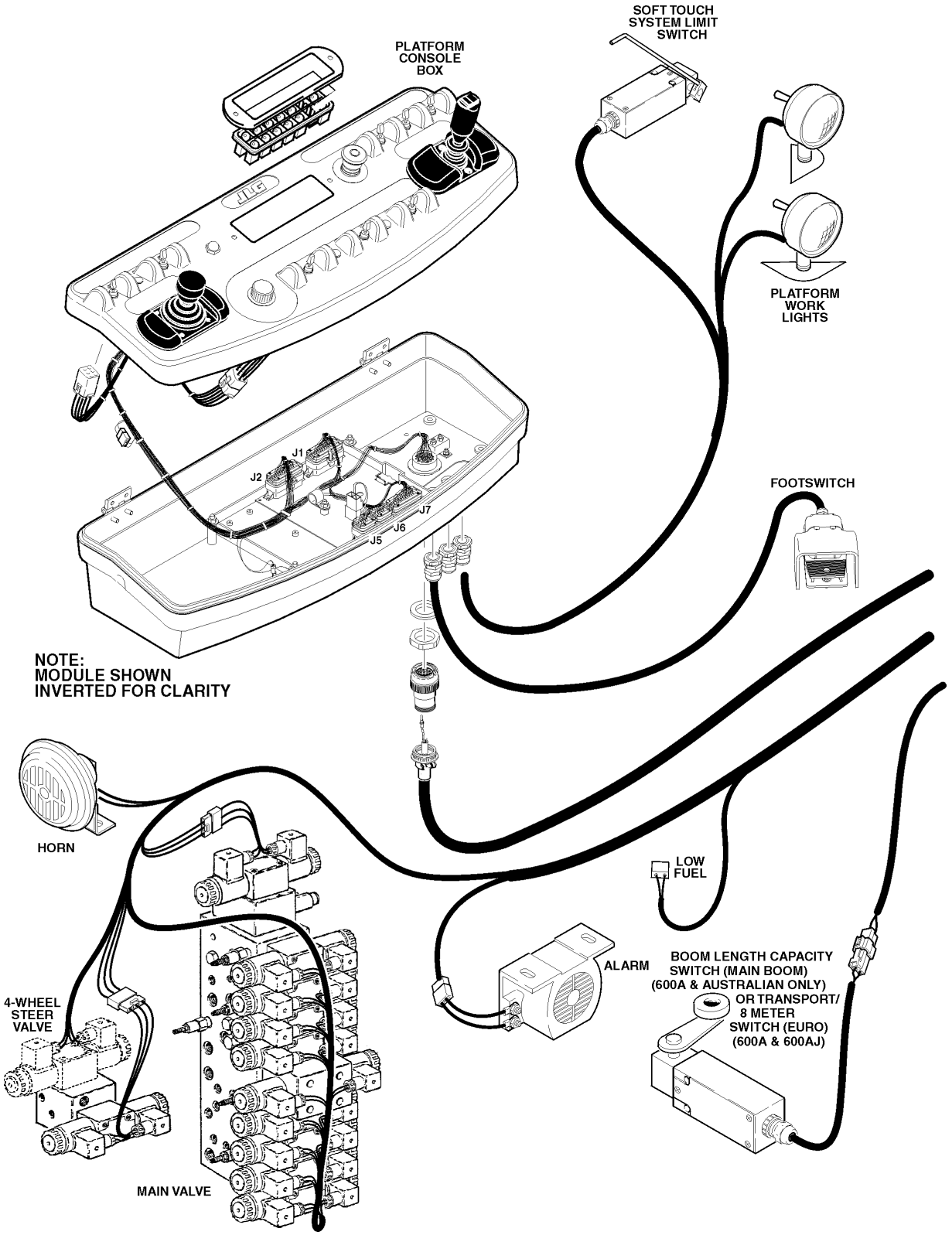

Figure 7-11. Electrical Harness - A Models (S/N 64249 to S/N 64270) - Sheet 1 of 2

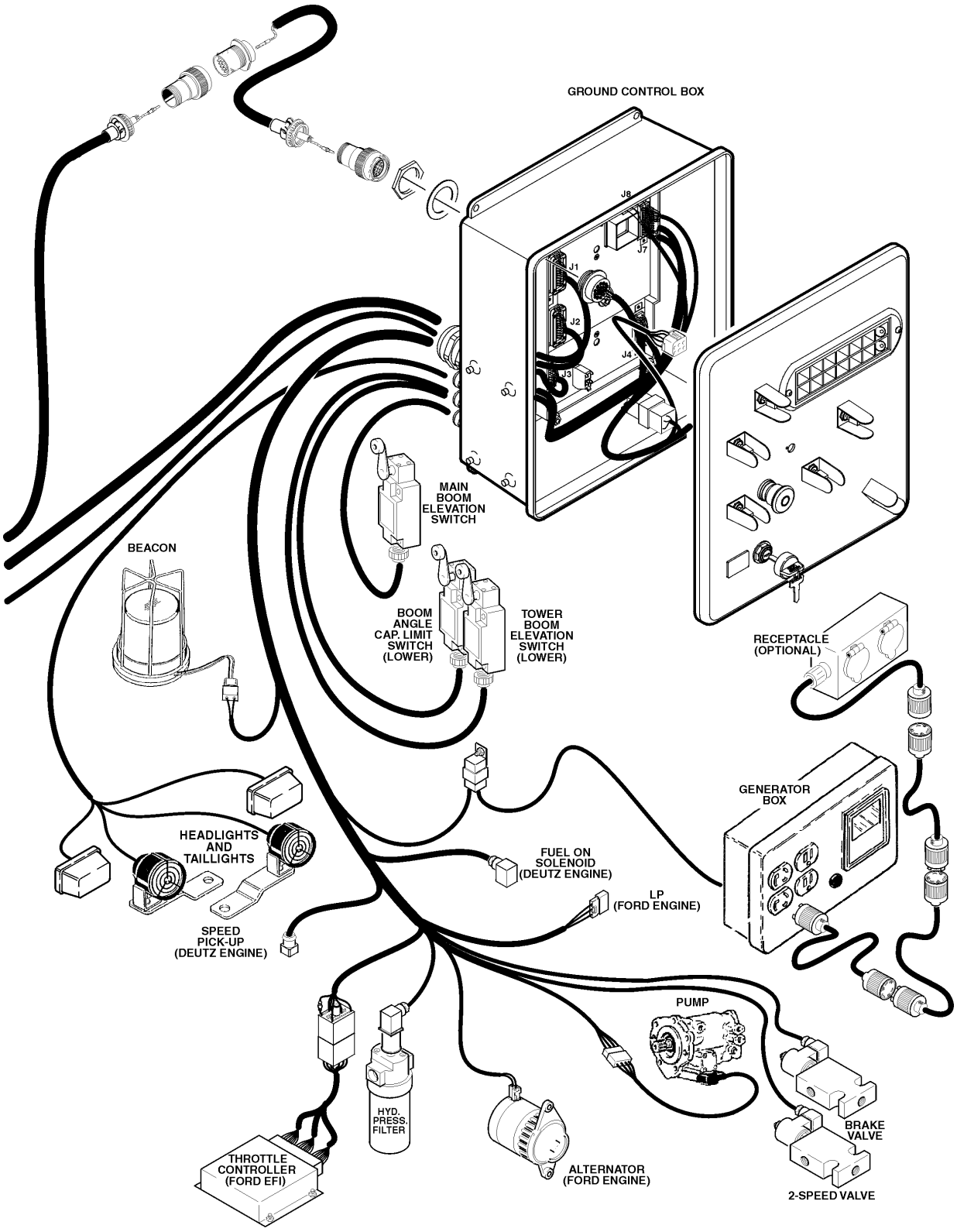

Figure 7-12. Electrical Harness - A Models (S/N 64249 to S/N 64270) - Sheet 2 of 2

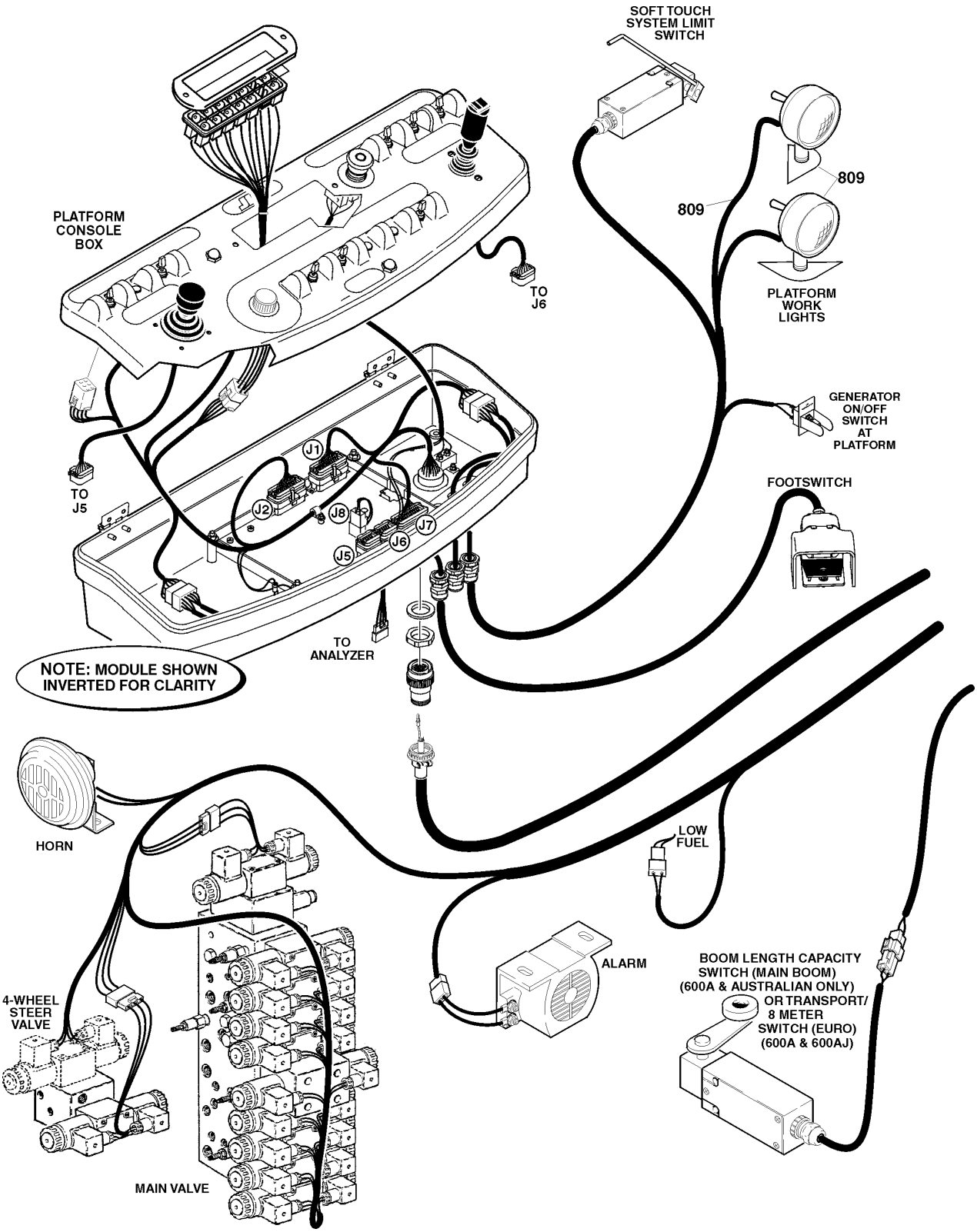

Figure 7-13. Electrical Harness - A Models (S/N 64270 to Present) - Sheet 1 of 2

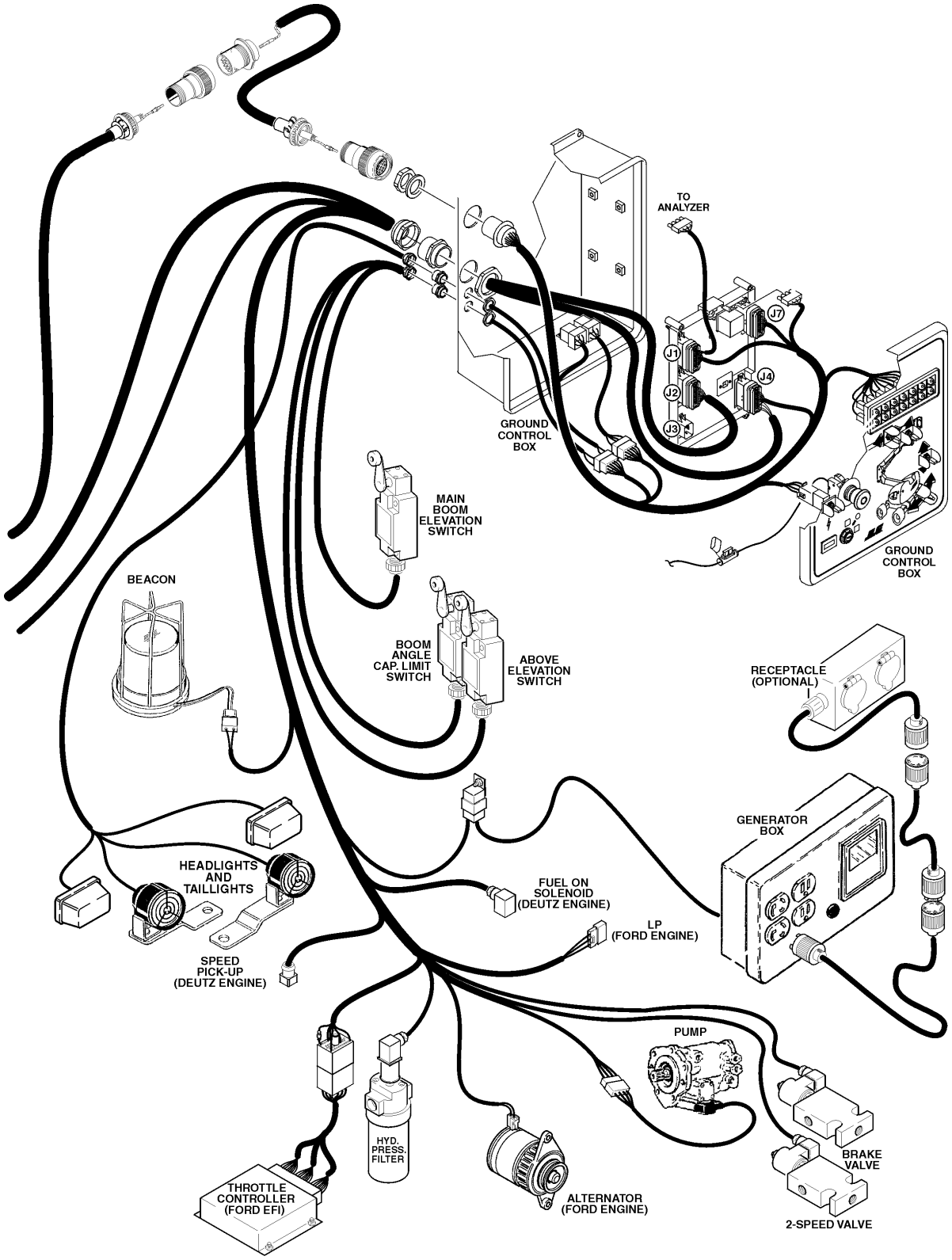

Figure 7-14. Electrical Harness - A Models (S/N 64270 to Present) - Sheet 2 of 2

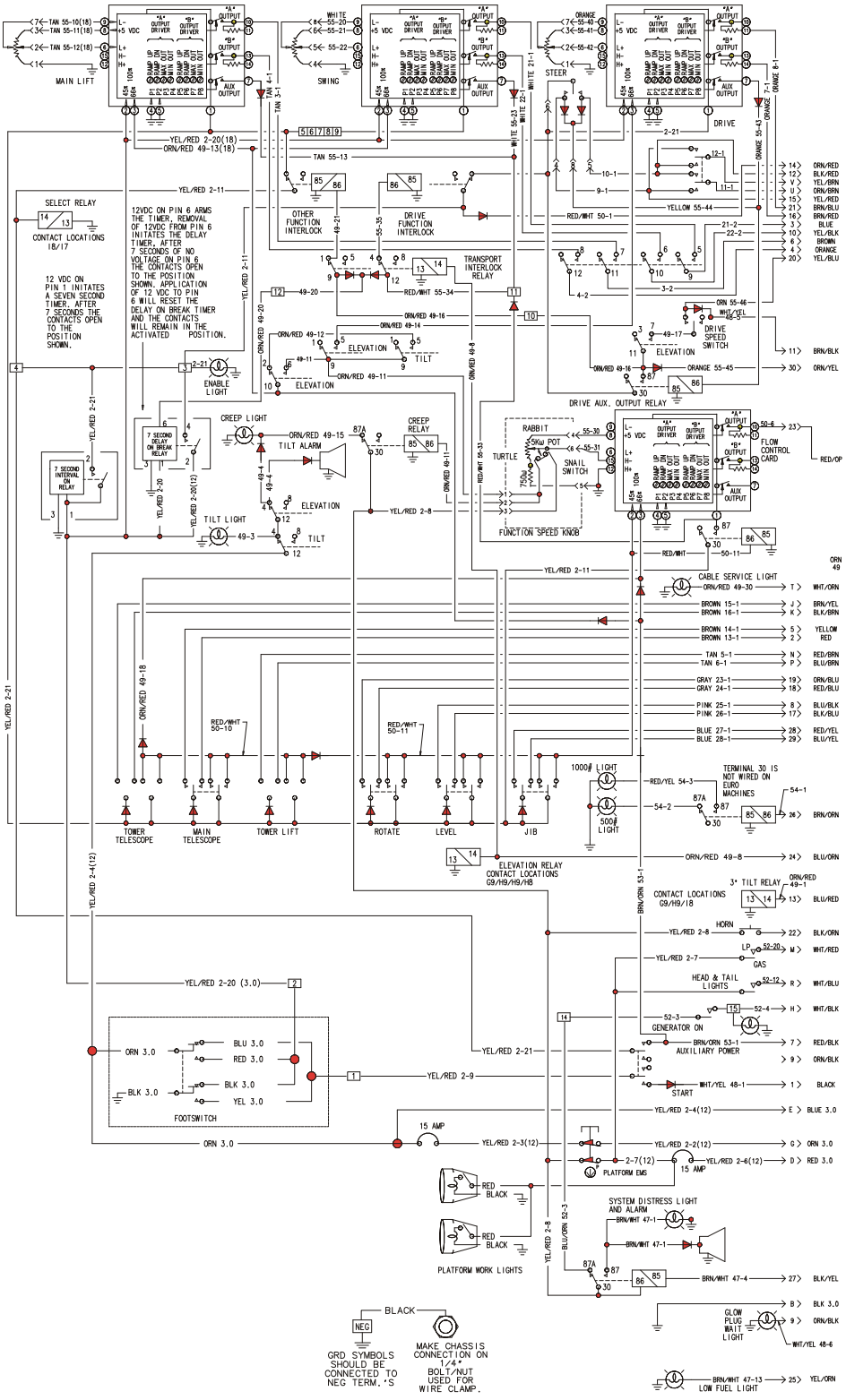

Figure 7-15. Electrical Schematic - S & SJ Models with Deutz Engine - Sheet 1

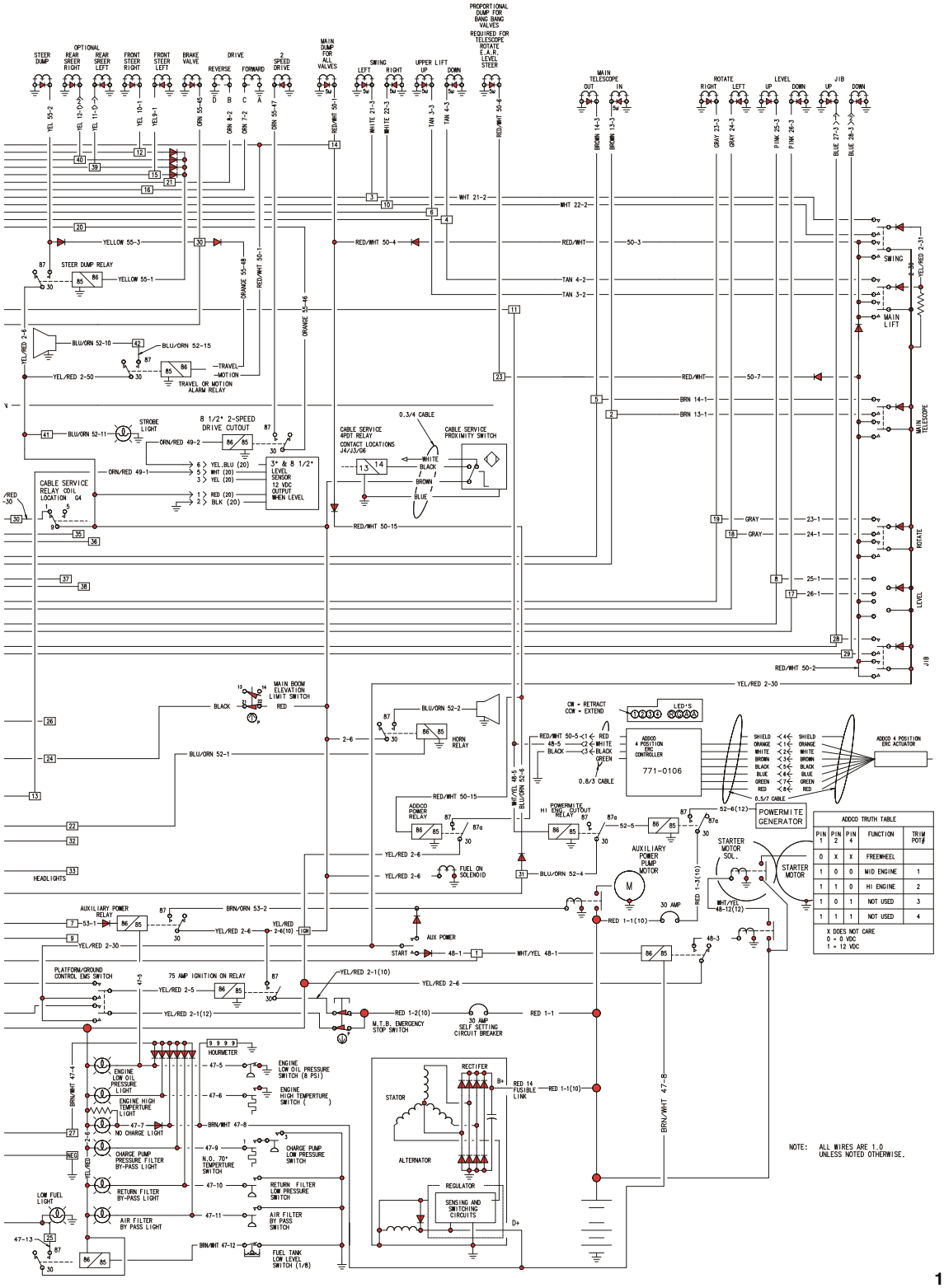

Figure 7-16. Electrical Schematic - S & SJ Models with Deutz Engine - Sheet 2

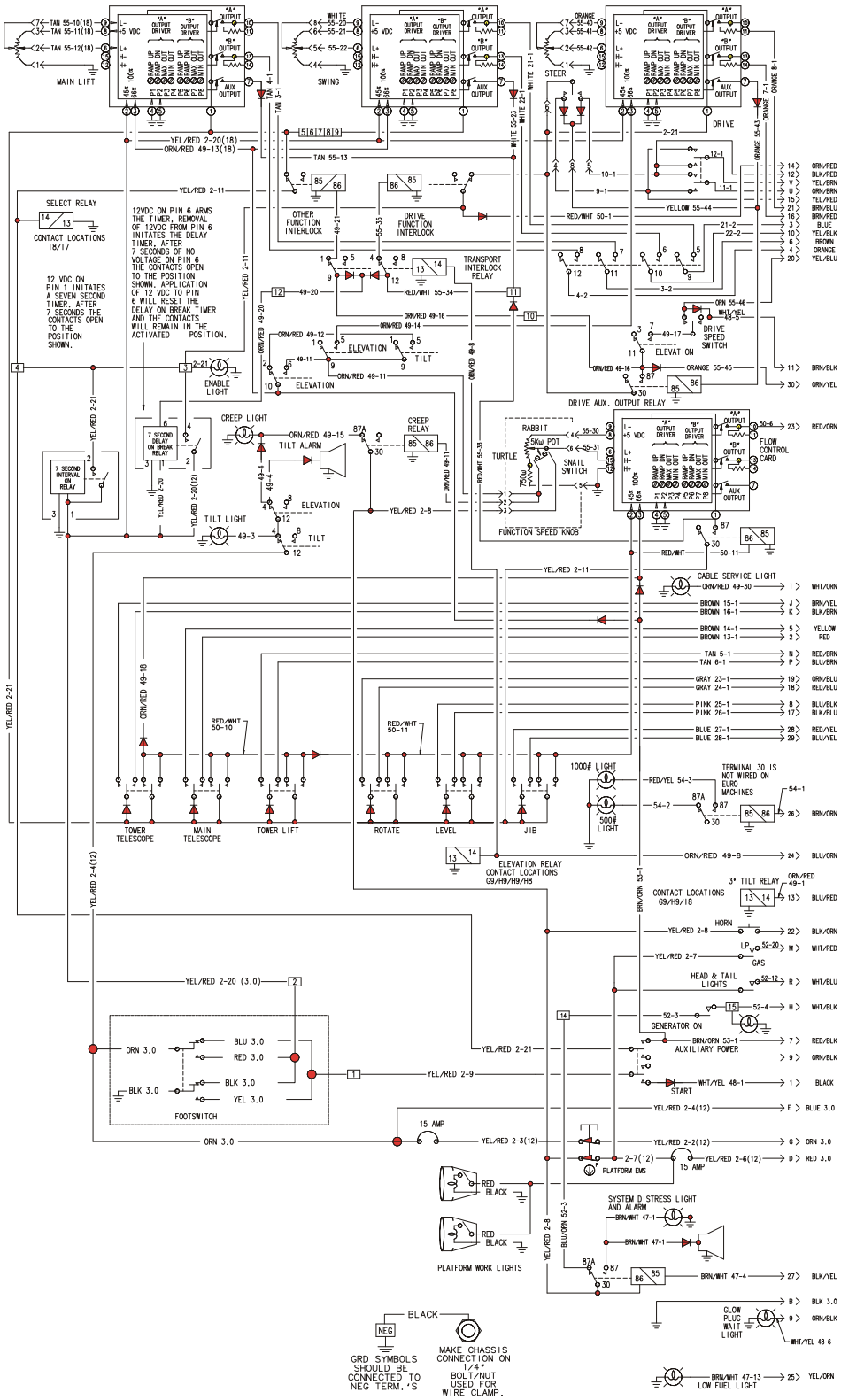

Figure 7-17. Electrical Schematic - A & AJ Models with Deutz Engine - Sheet 1

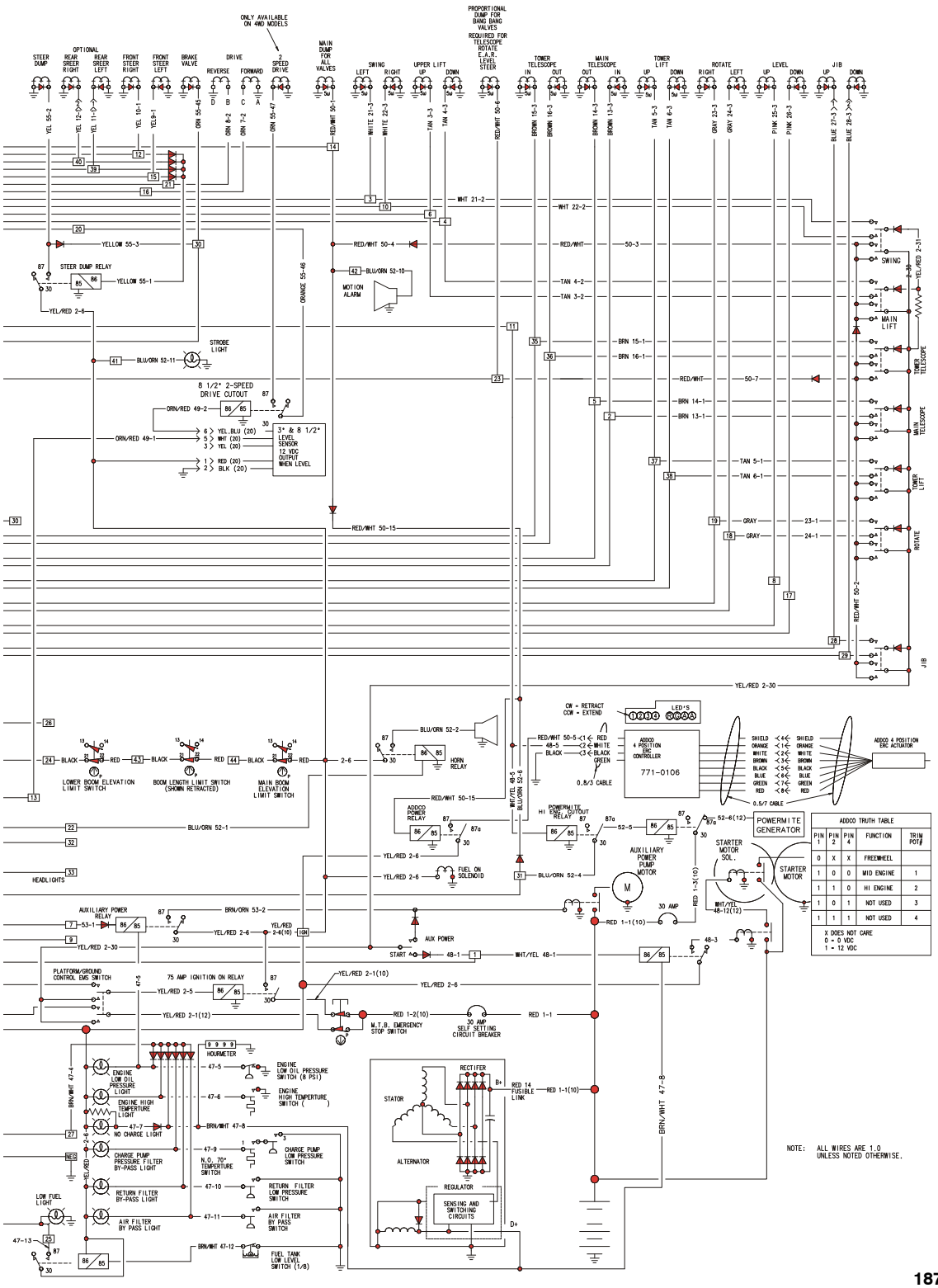

Figure 7-18. Electrical Schematic - A & AJ Models with Deutz Engine - Sheet 2

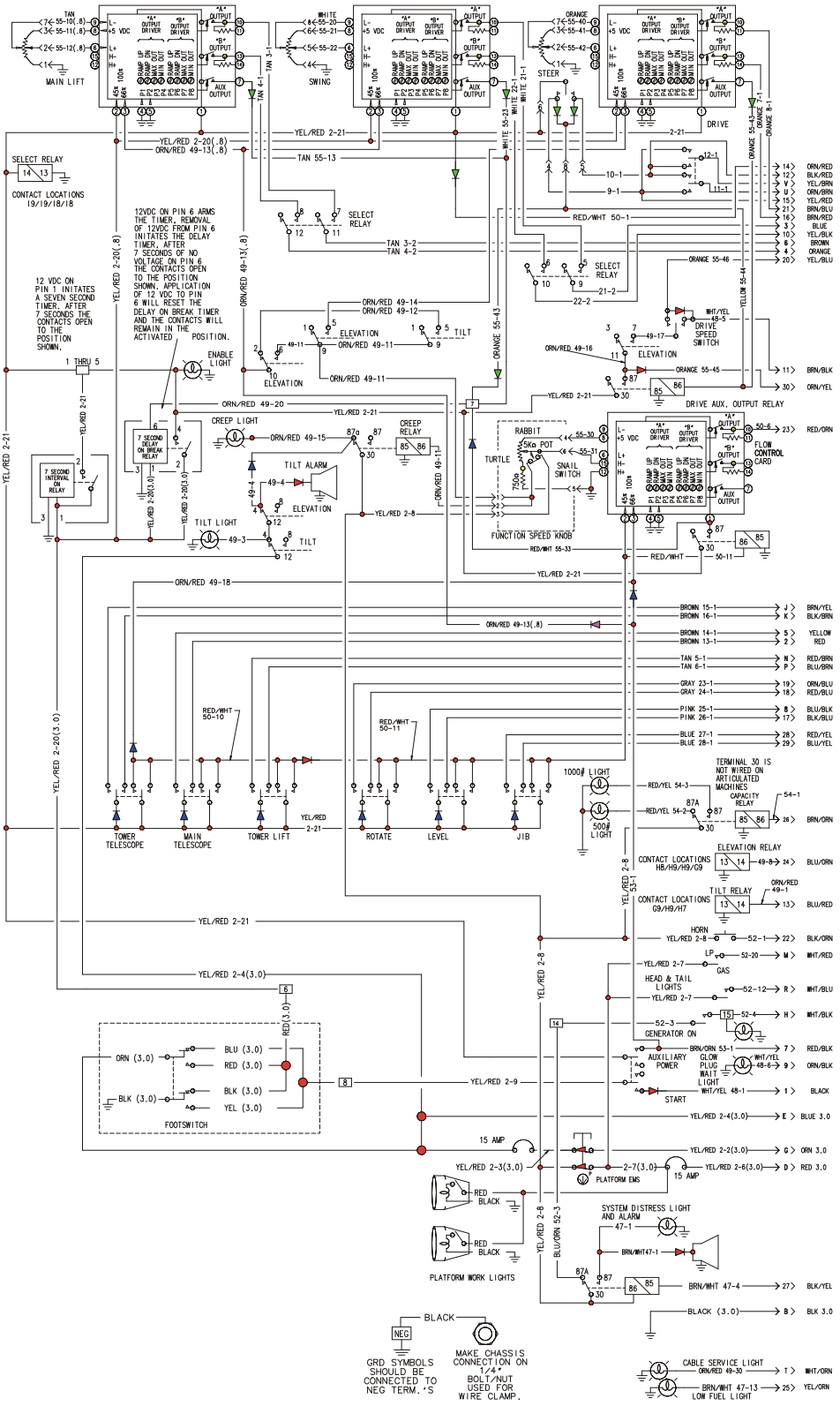

Figure 7-19. Electrical Schematic - Australian Models with Deutz Engine - Sheet 1

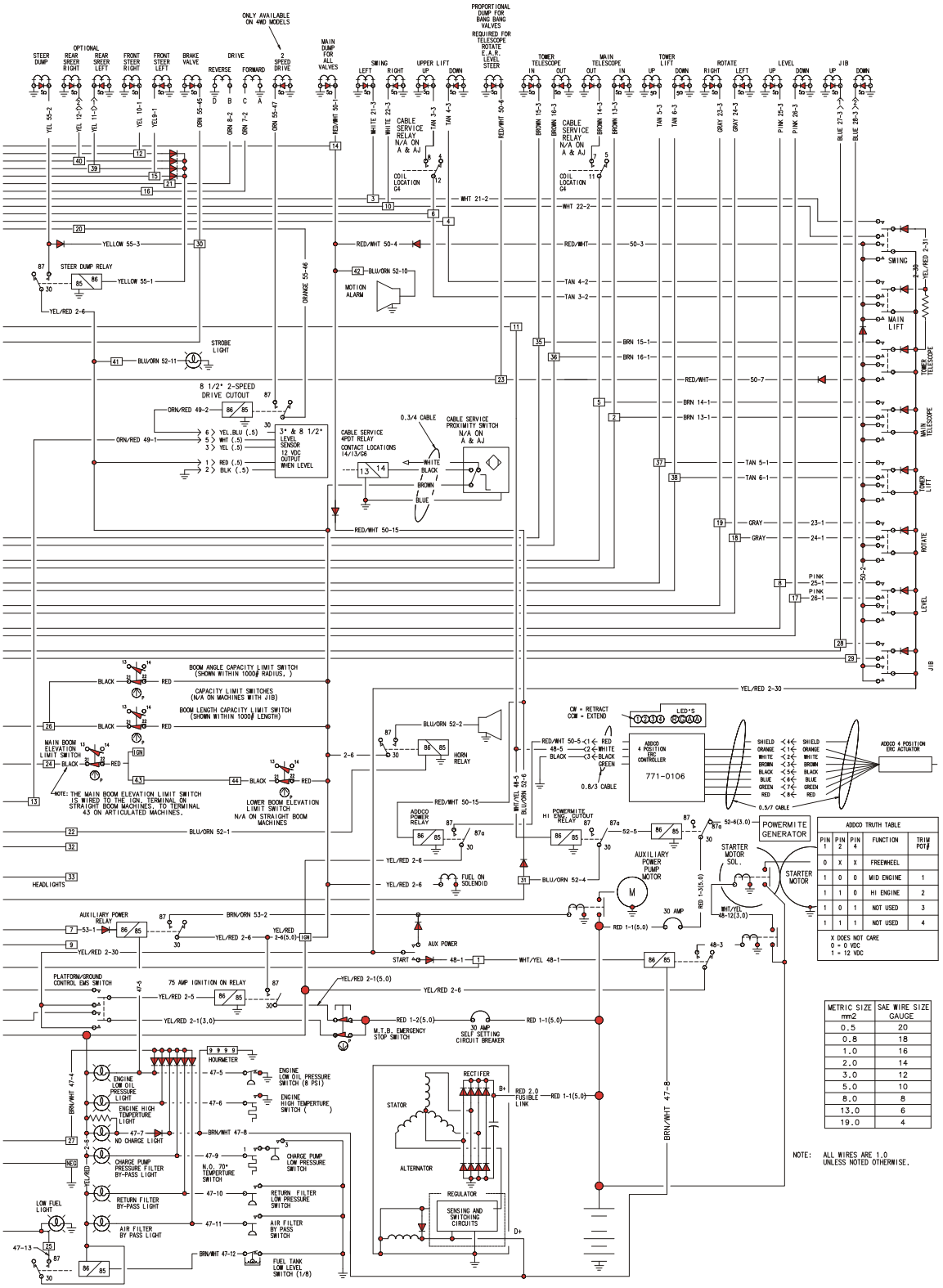

Figure 7-20. Electrical Schematic - Australian Models with Deutz Engine - Sheet 2

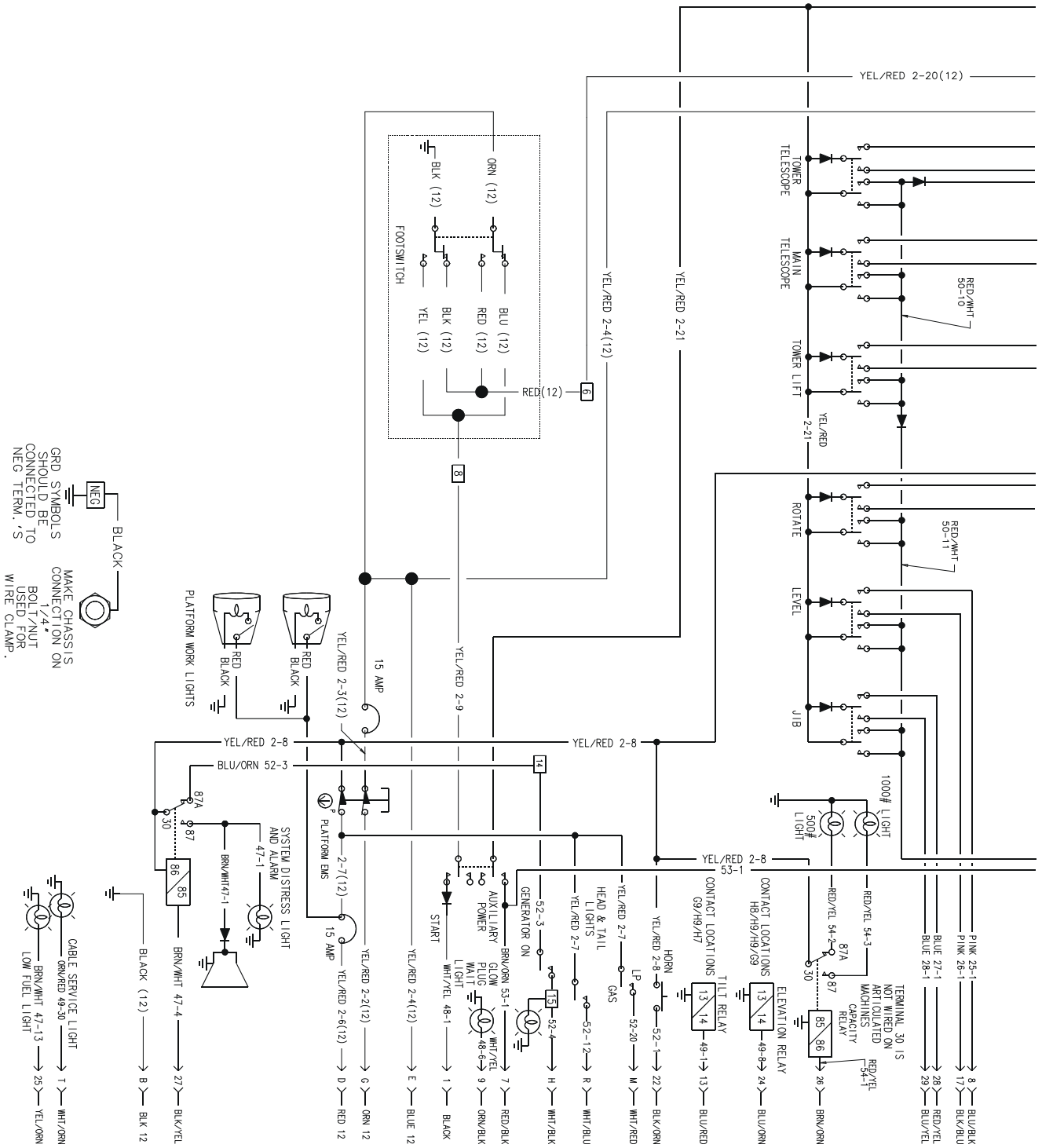

Figure 7-21. Electrical Schematic - Isuzu Engine - Sheet 1 of 4

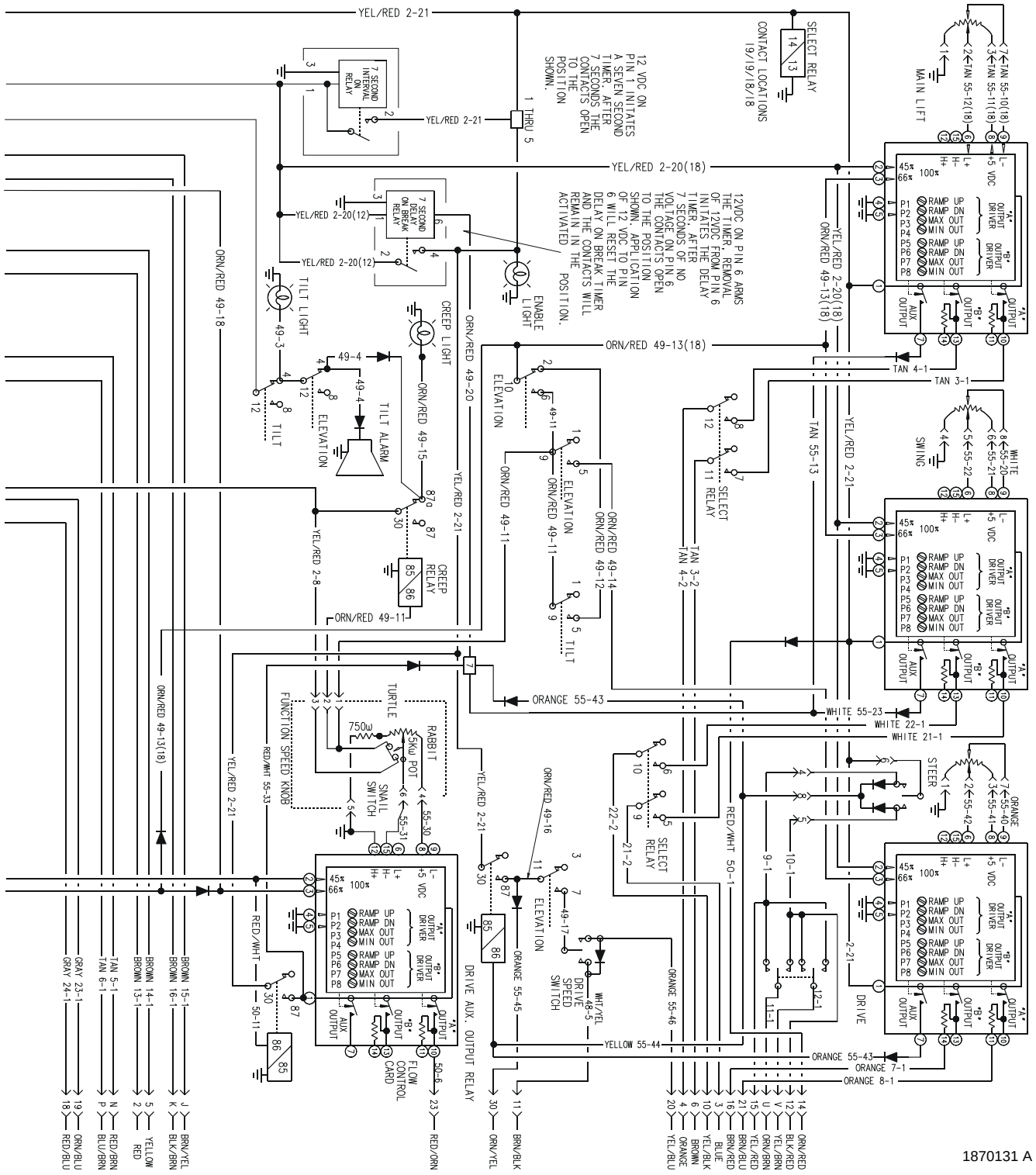

Figure 7-22. Electrical Schematic - Isuzu Engine - Sheet 2 of 4

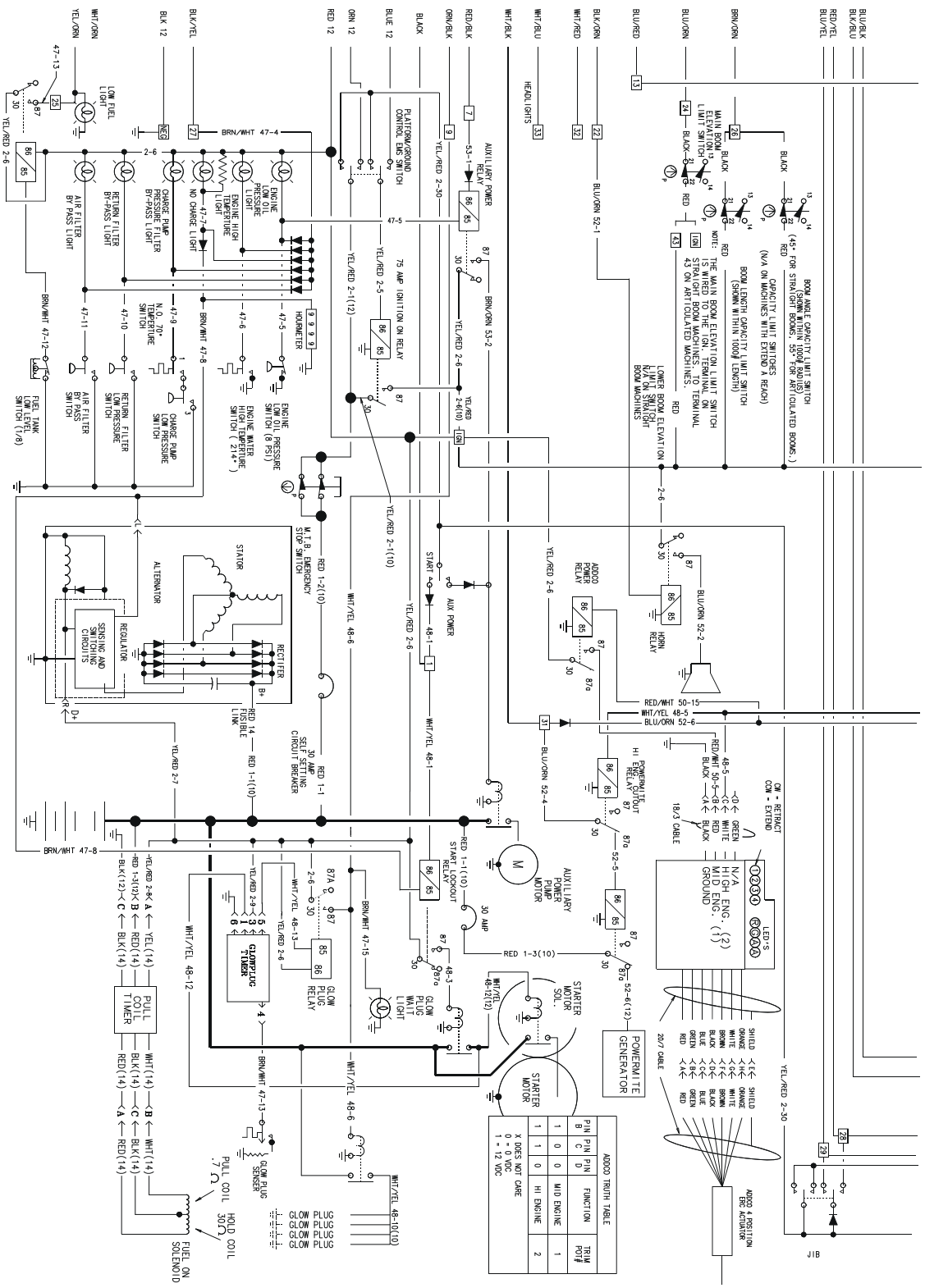

Figure 7-23. Electrical Schematic - Isuzu Engine - Sheet 3 of 4

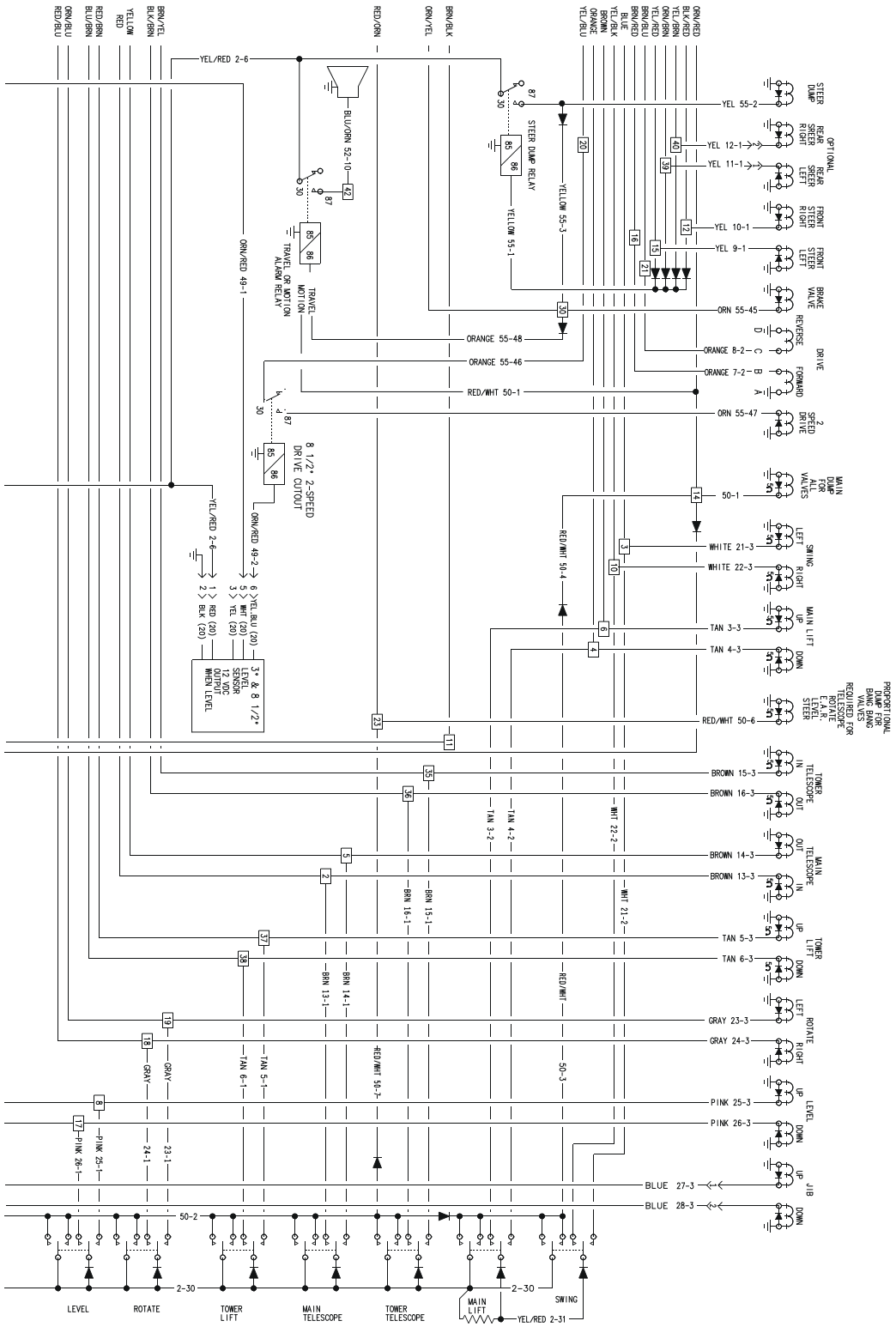

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Figure 7-24. Electrical Schematic - Isuzu Engine - Sheet 4 of 4

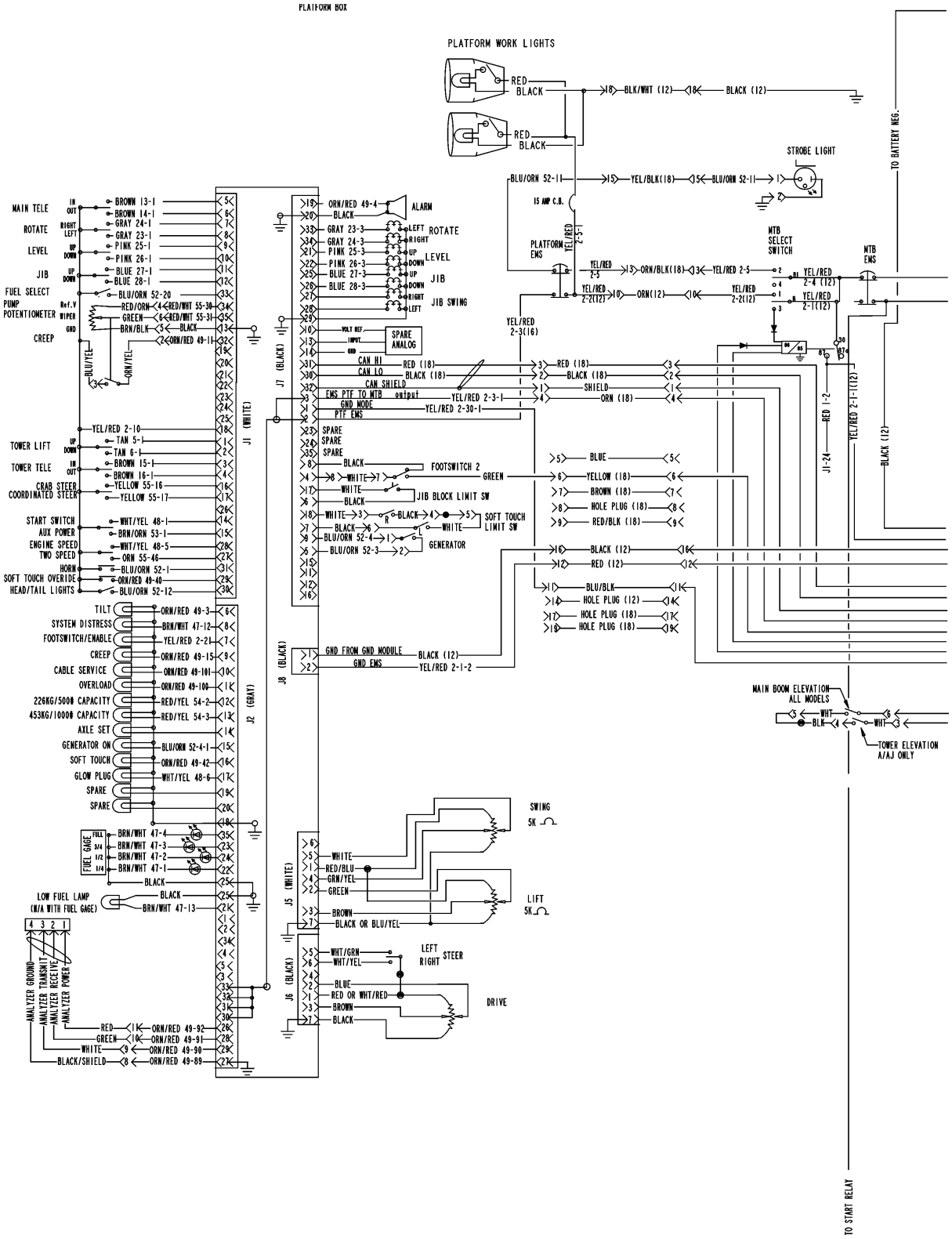


Figure 7-25. Electrical Schematic - ADE - Sheet 1 of 4

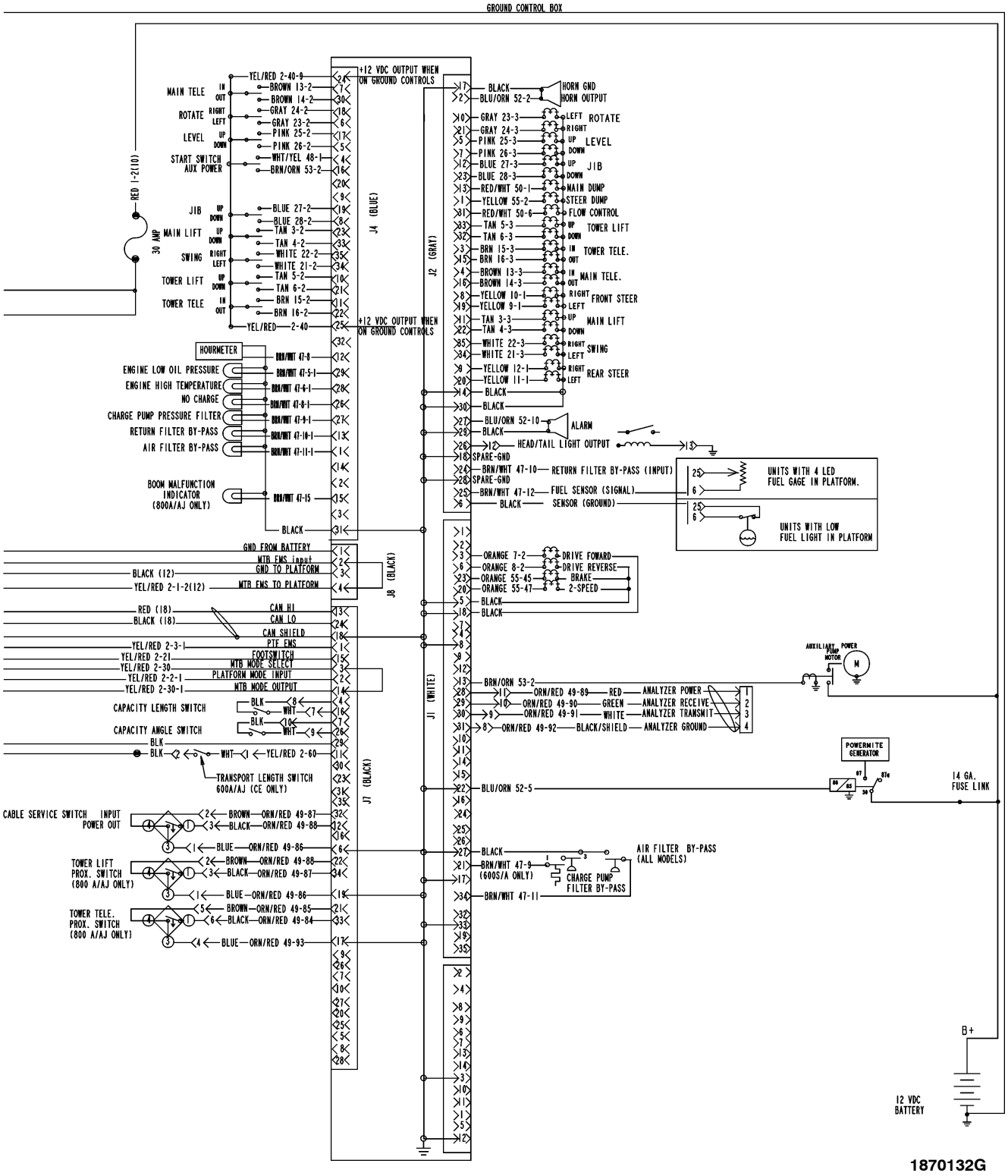


Figure 7-26. Electrical Schematic - ADE - Sheet 2 of 4

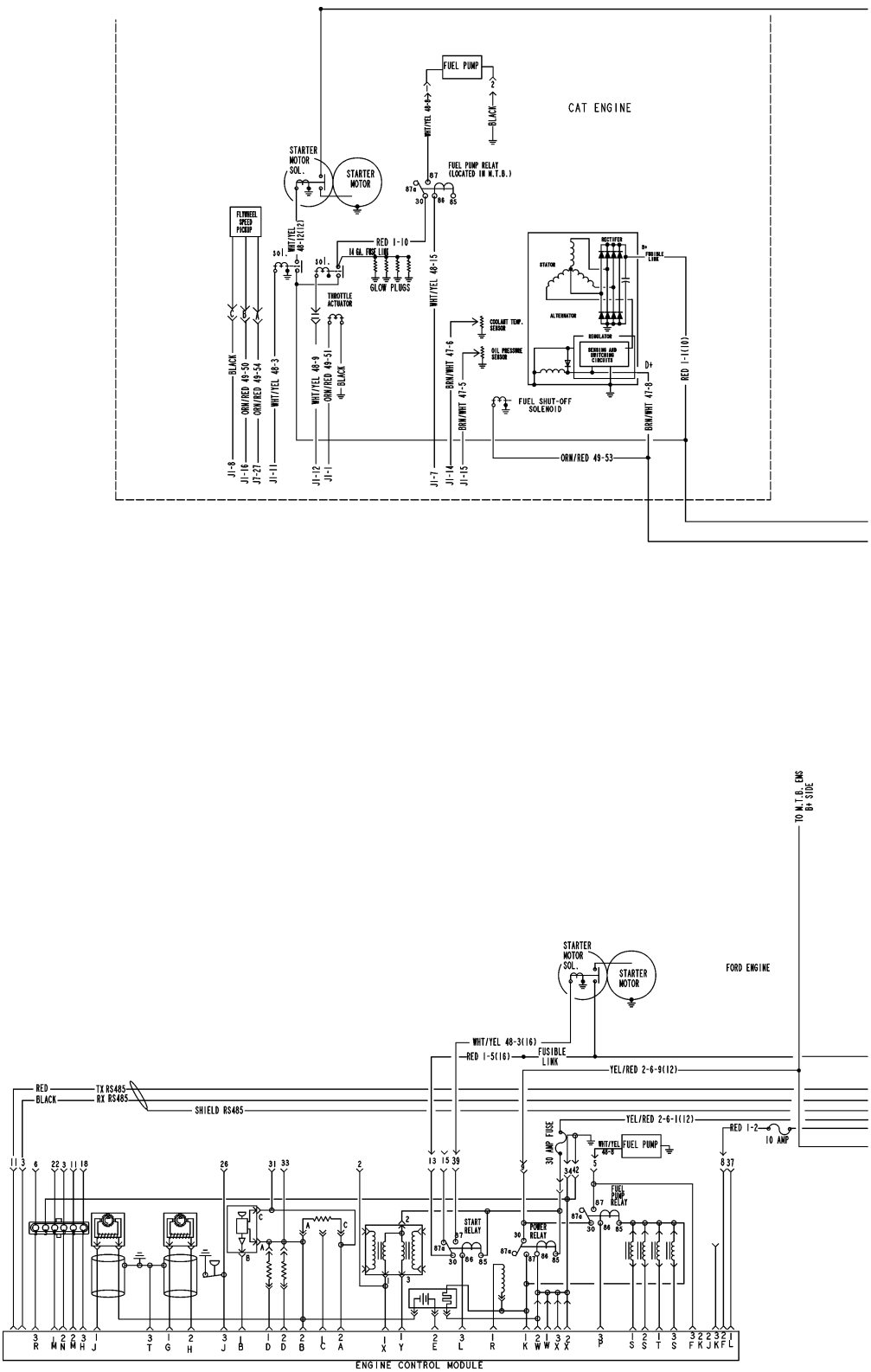


Figure 7-27. Electrical Schematic - ADE - Sheet 3 of 4

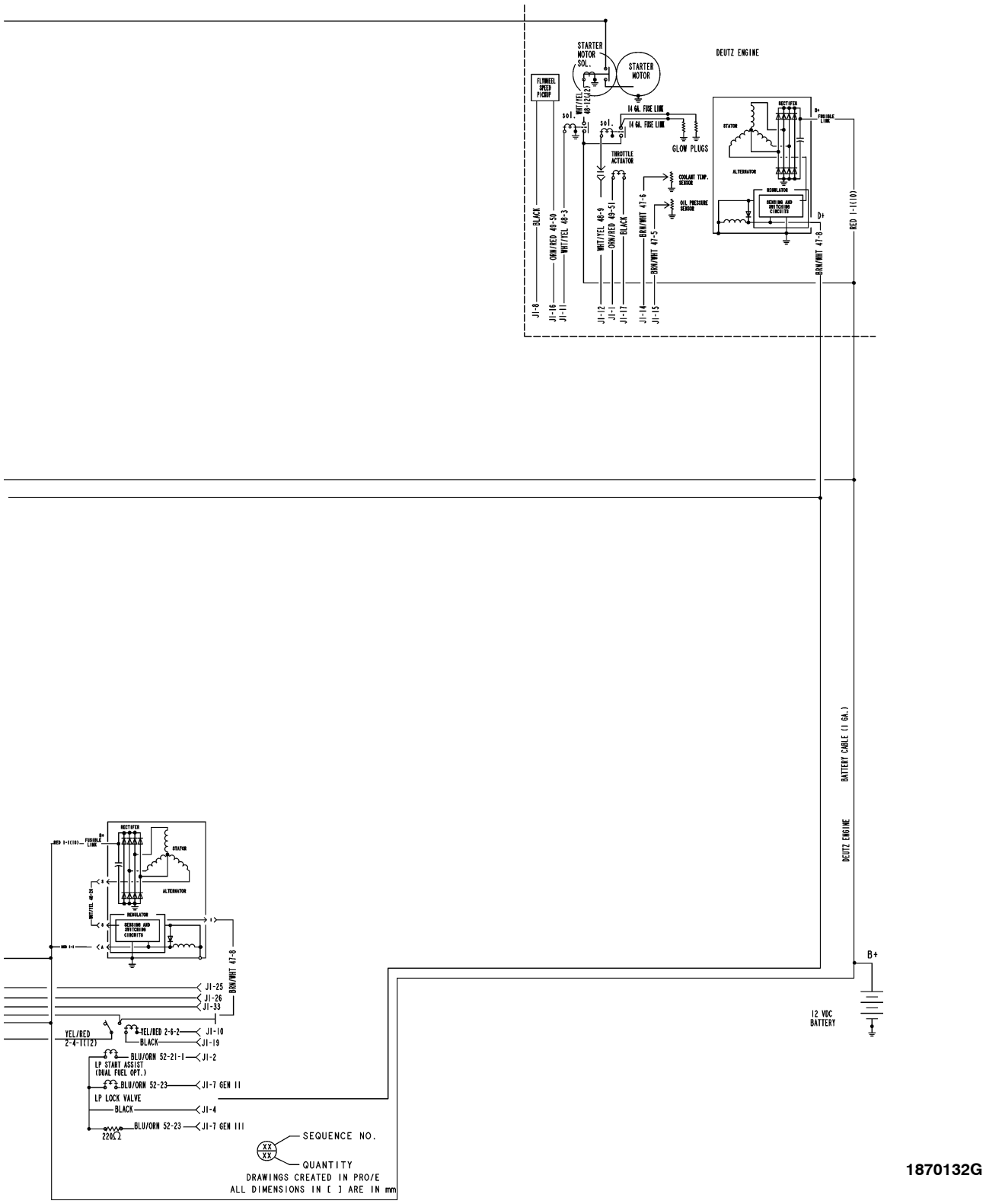


Figure 7-28. Electrical Schematic - ADE - Sheet 4 of 4

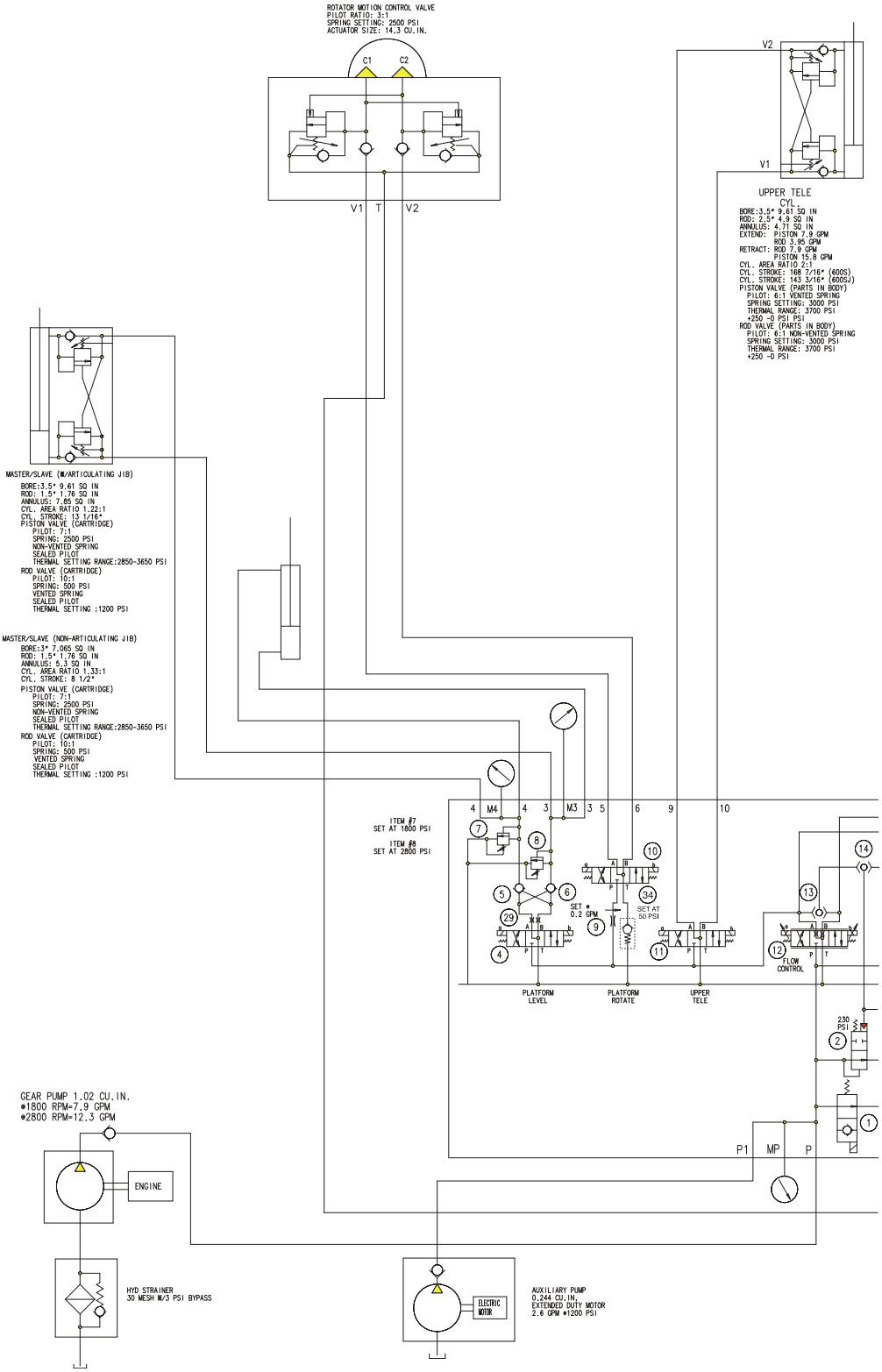


Figure 7-29. Hydraulic Schematic - S Models, Prior to S/N 75606 - Sheet 1

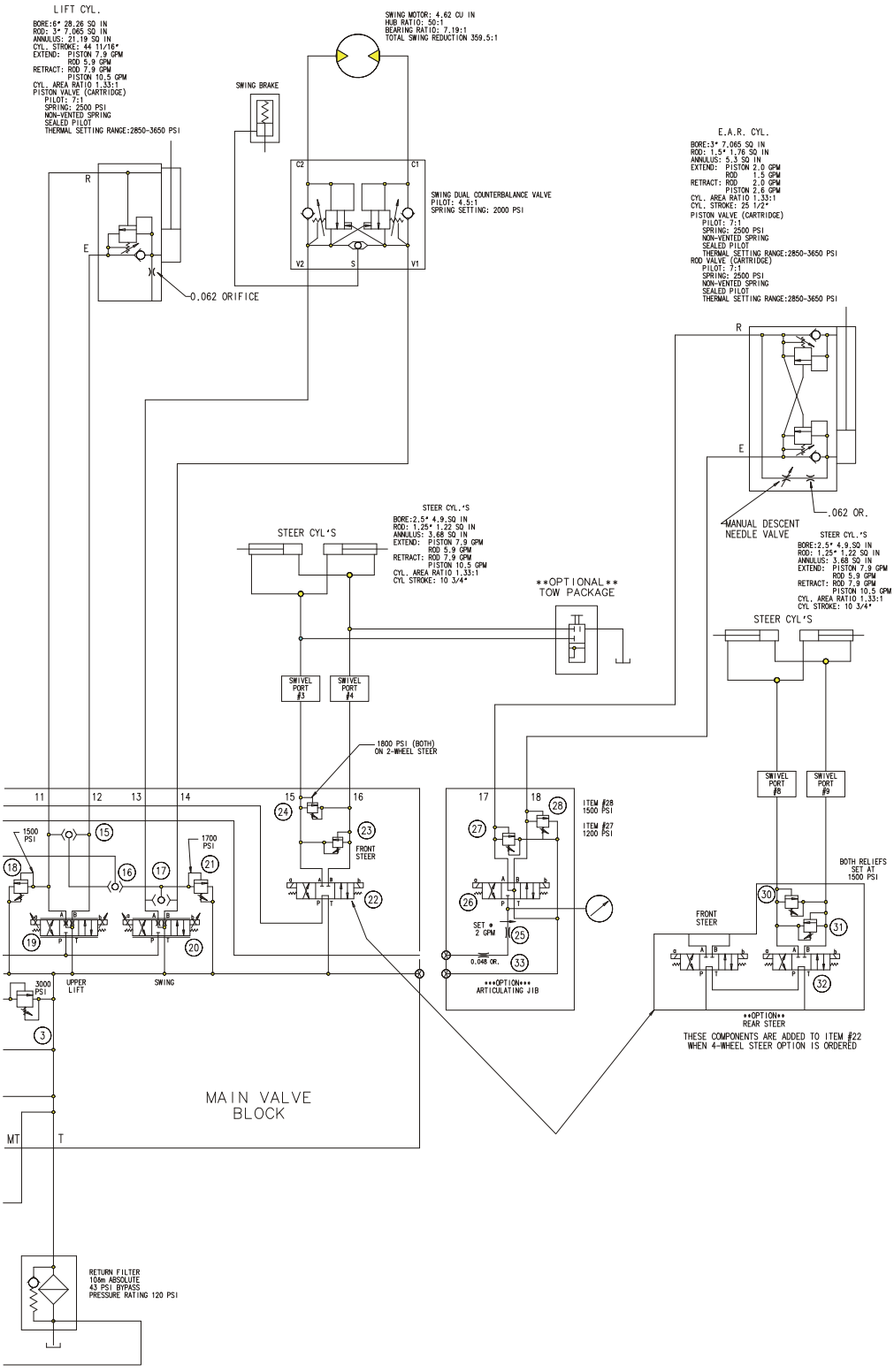


Figure 7-30. Hydraulic Schematic - S Models, Prior to S/N 75606 - Sheet 2

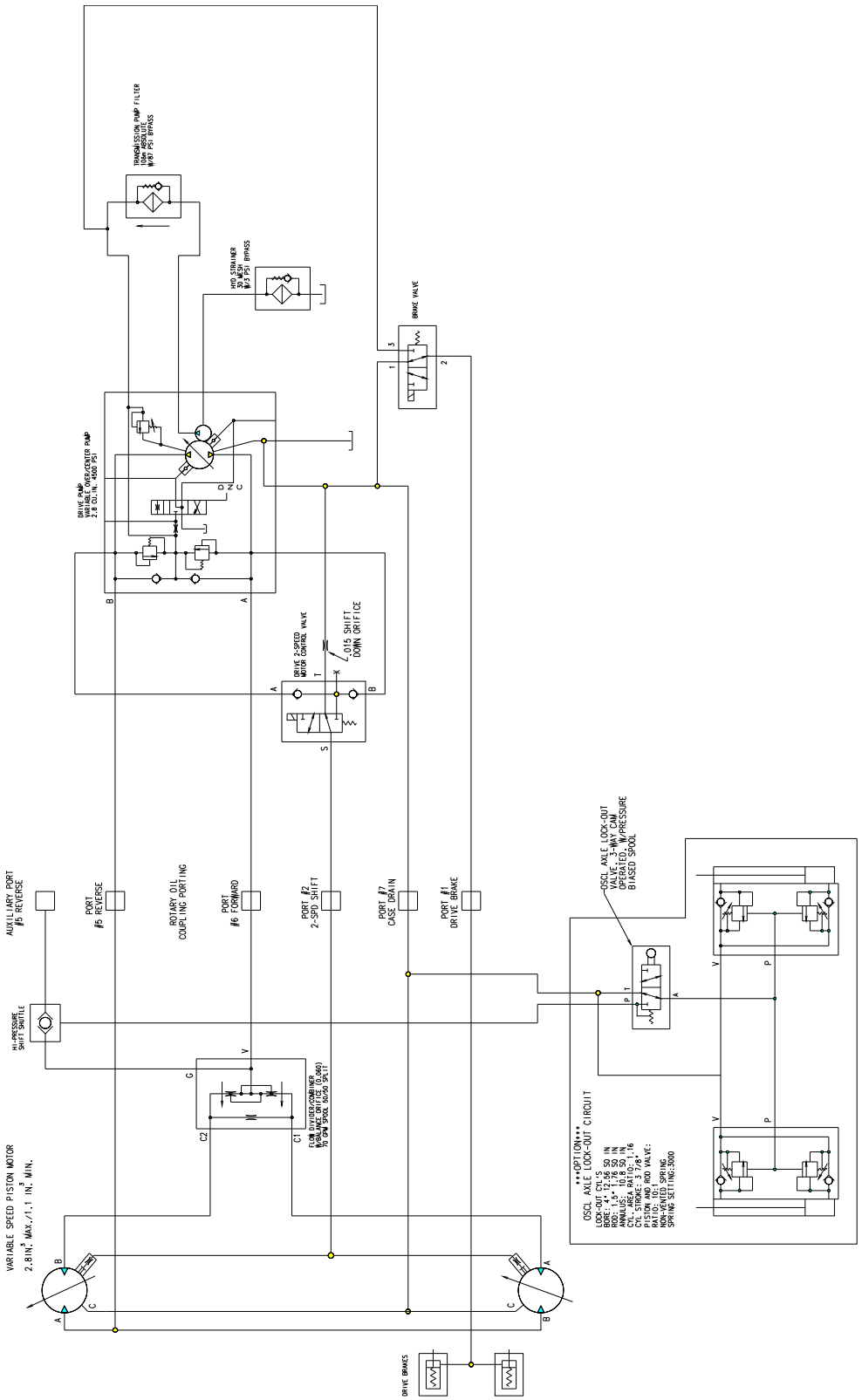


Figure 7-31. Hydraulic Schematic - S Models, Prior to S/N 75606 - Sheet 3

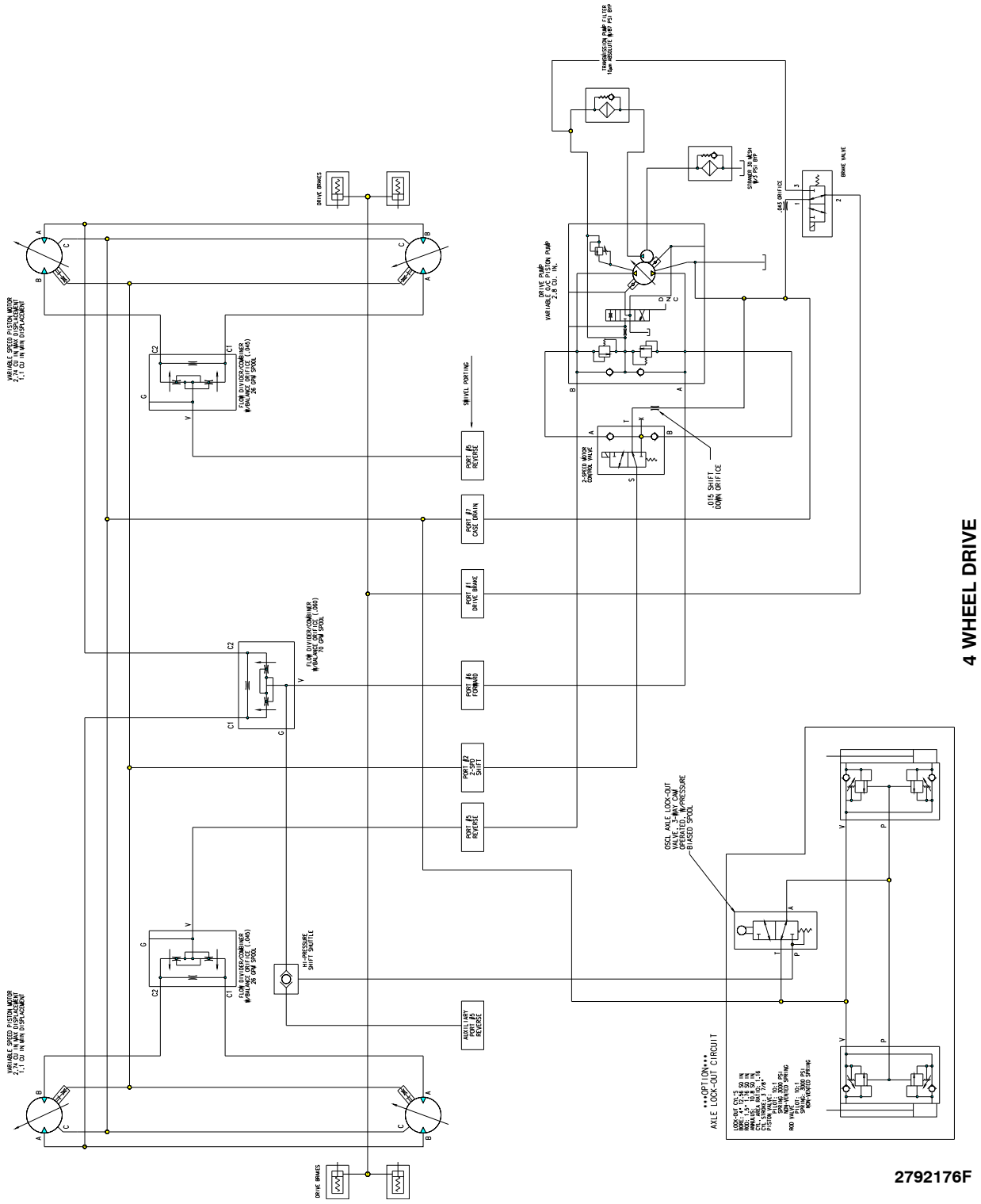


Figure 7-32. Hydraulic Schematic - S Models, Prior to S/N 75606 - Sheet 4

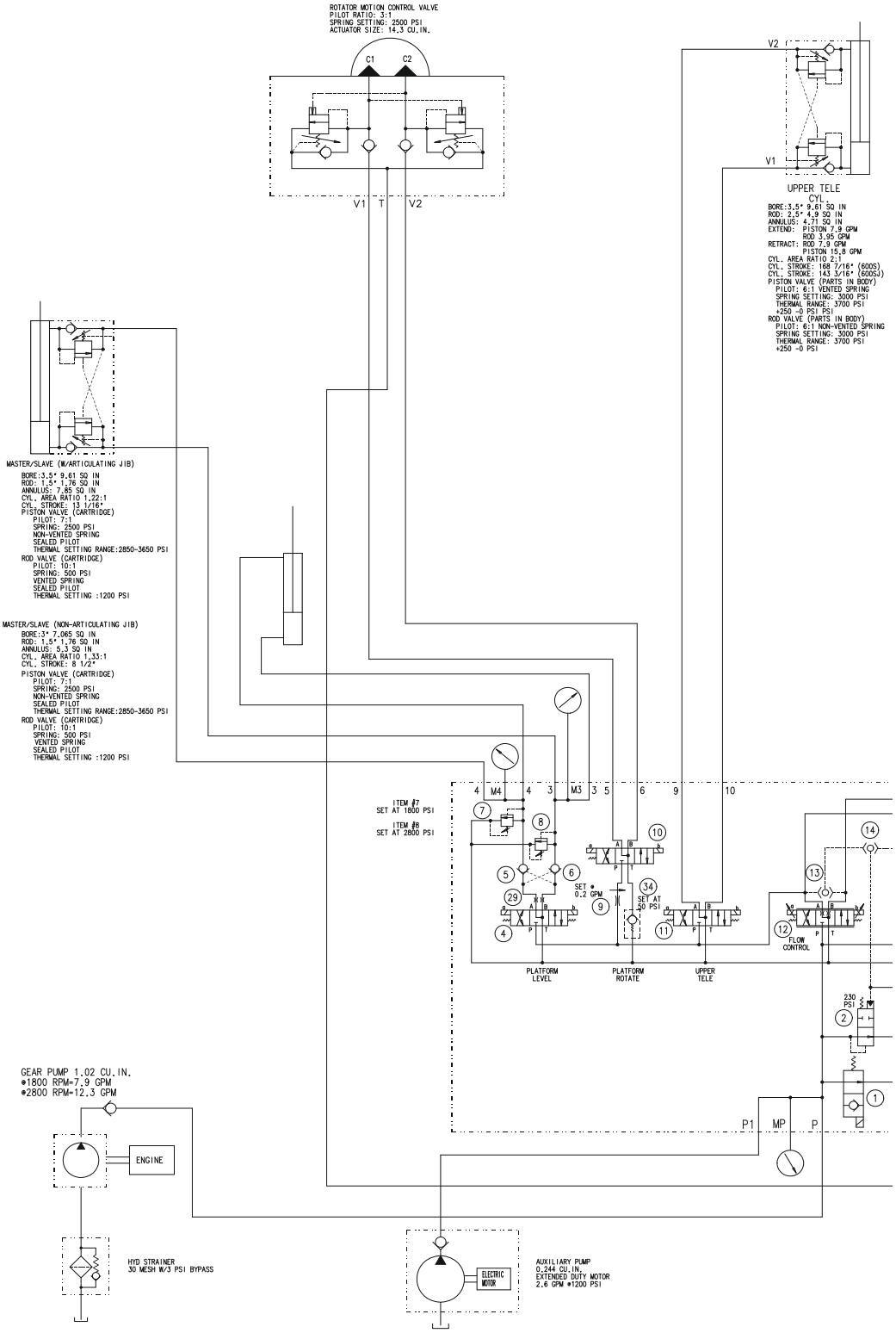
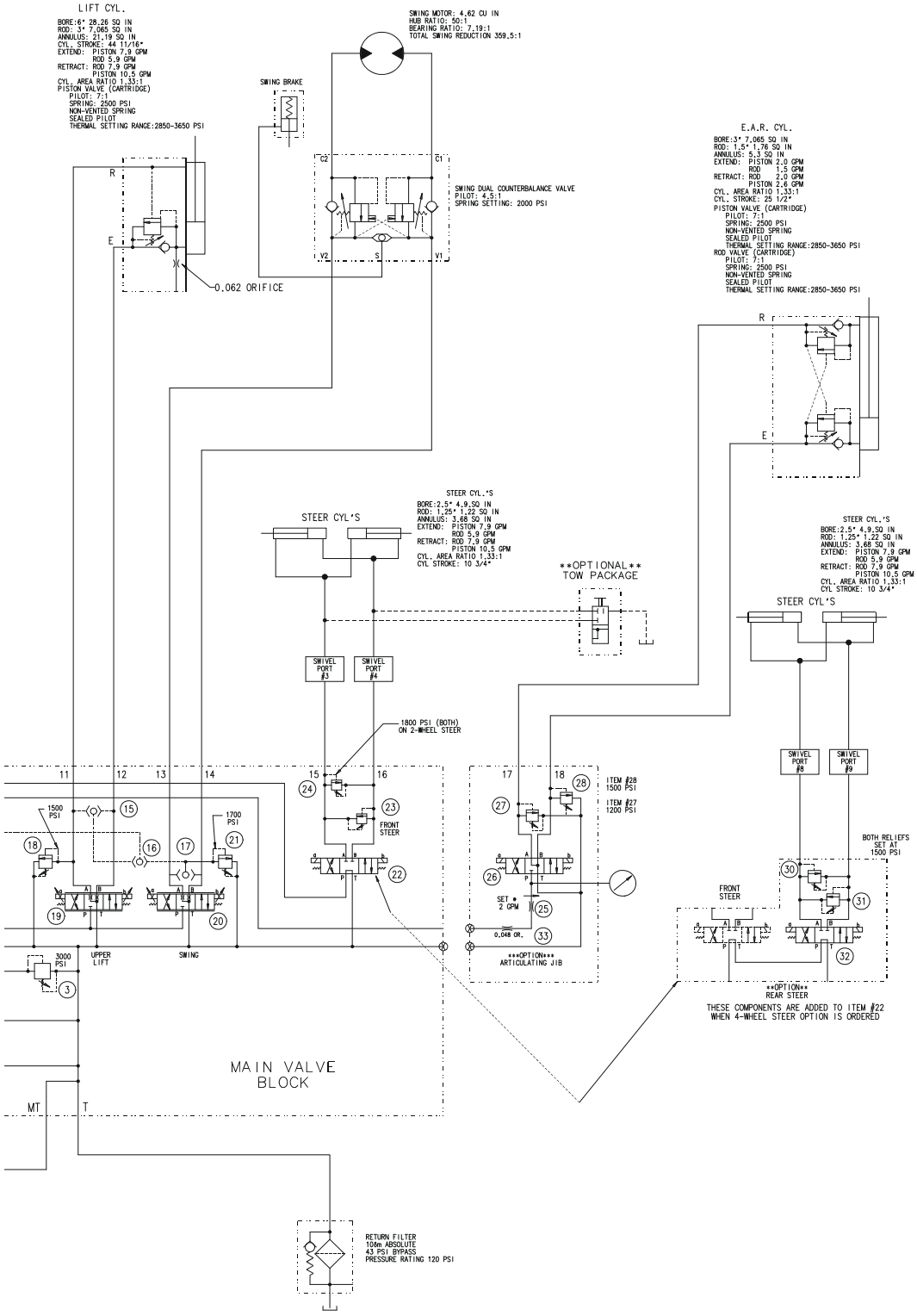


Figure 7-33. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 1 of 6



2792605 D

Figure 7-34. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 2 of 6

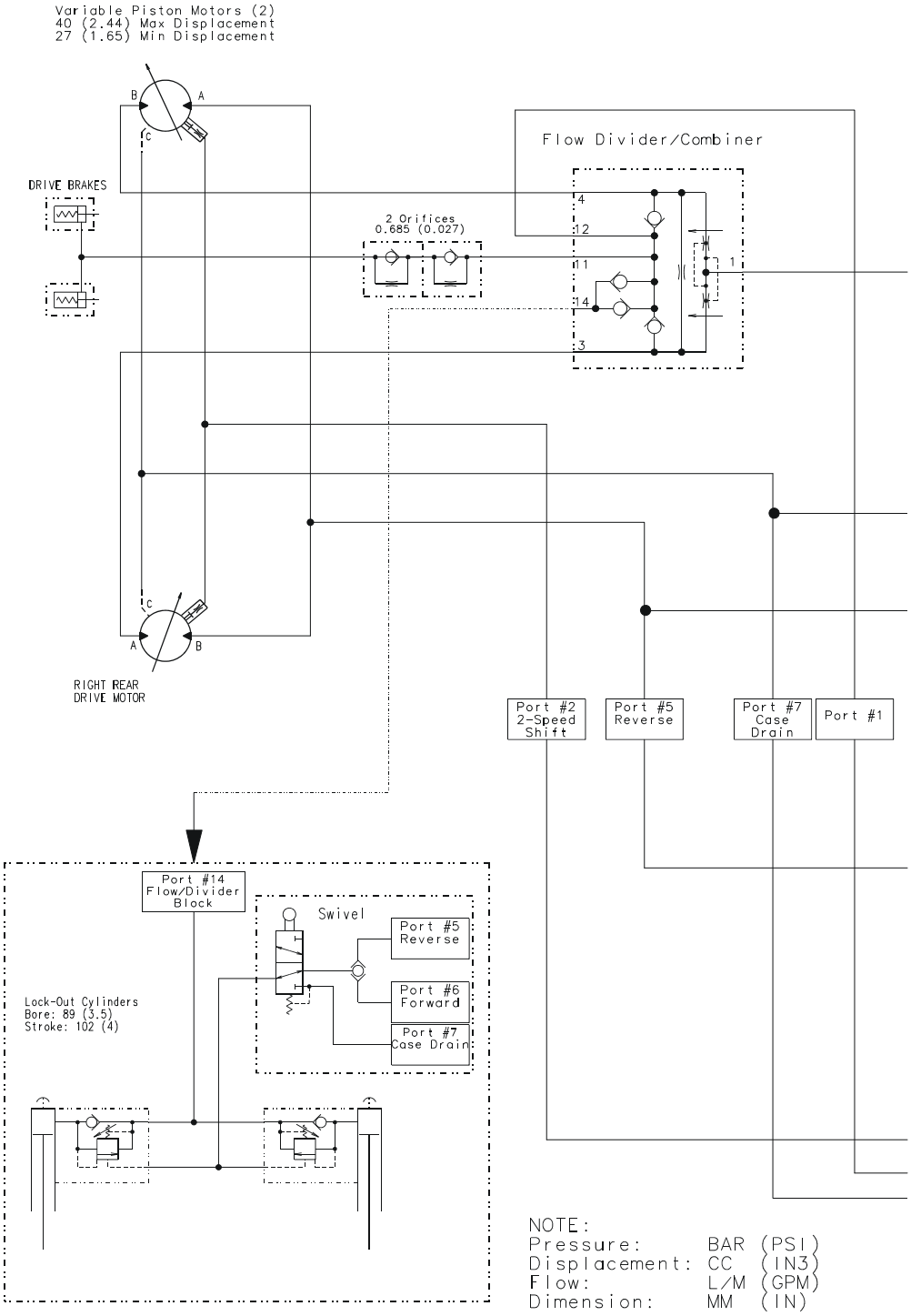


Figure 7-35. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 3 of 6

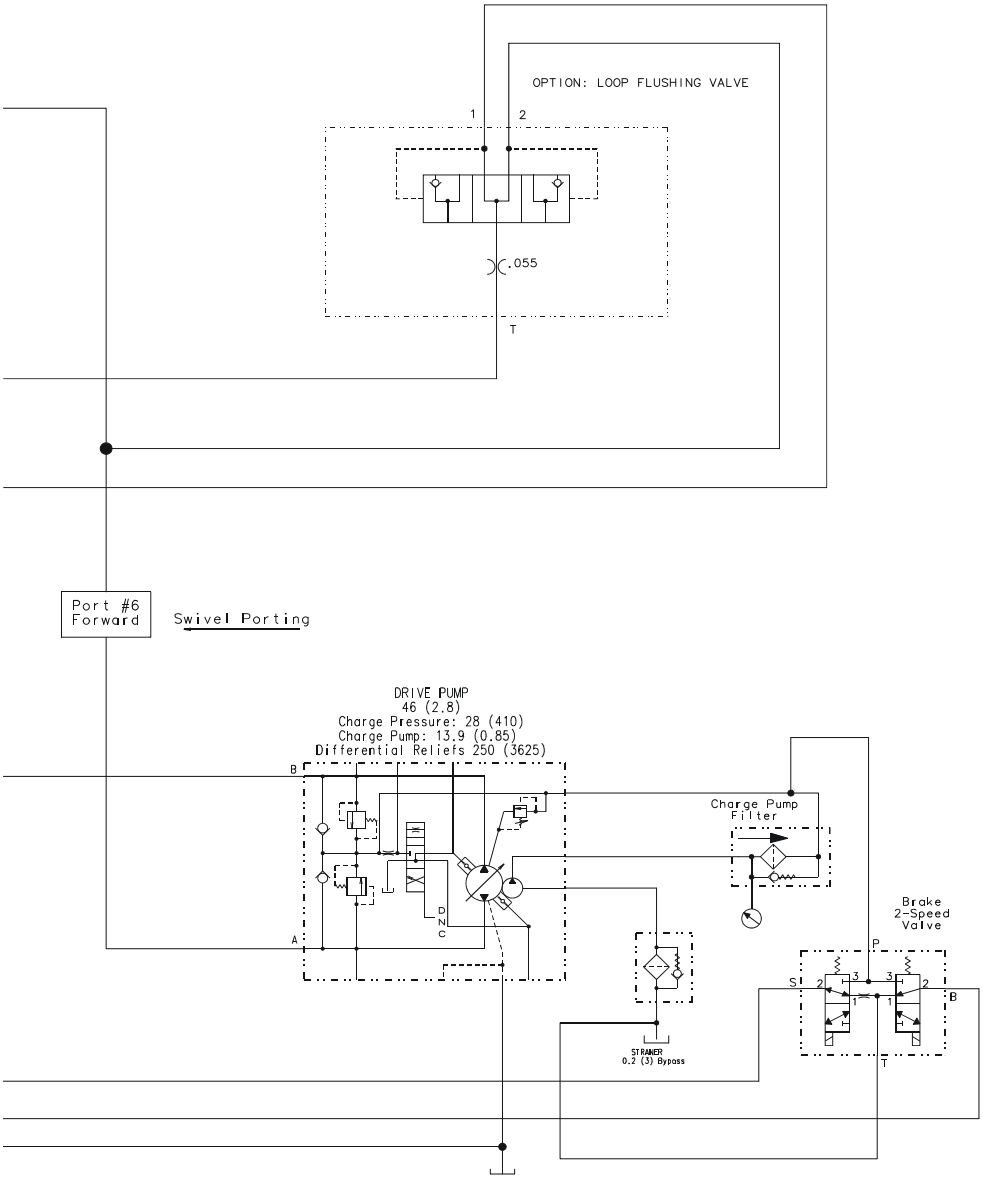


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Figure 7-36. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 4 of 6

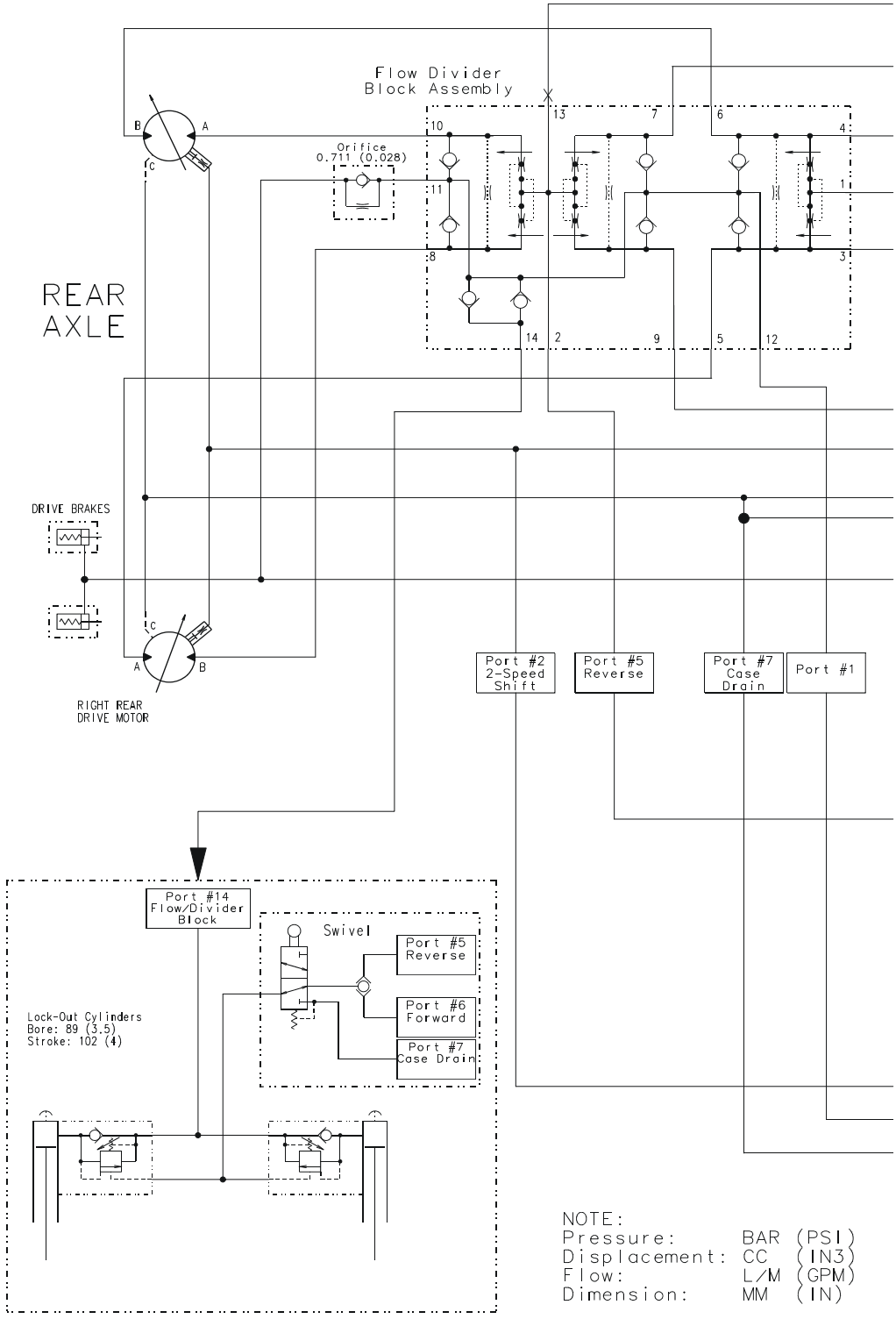

Figure 7-37. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 5 of 6

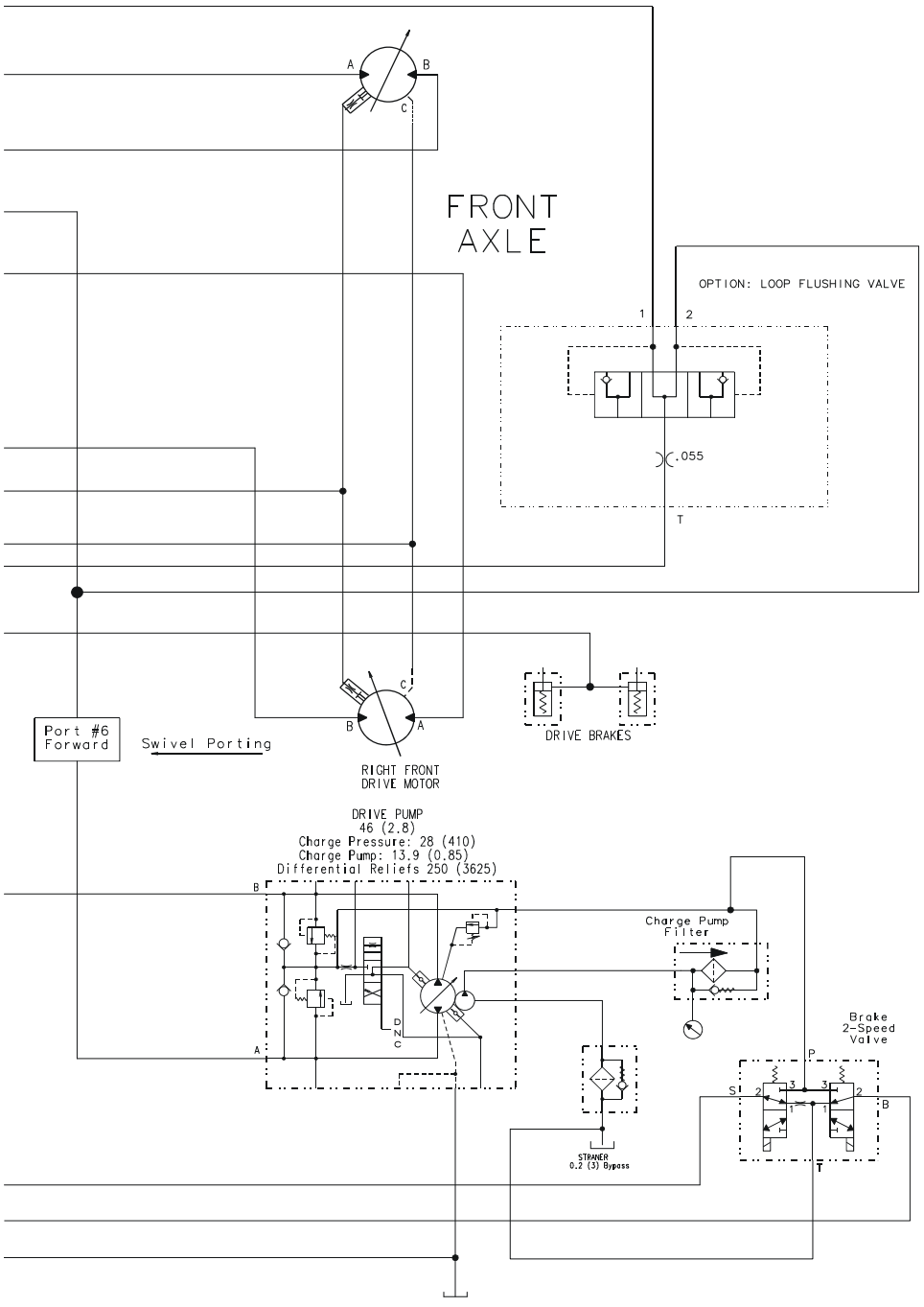

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Figure 7-38. Hydraulic Schematic - S Models, S/N 75606 to Present - Sheet 6 of 6

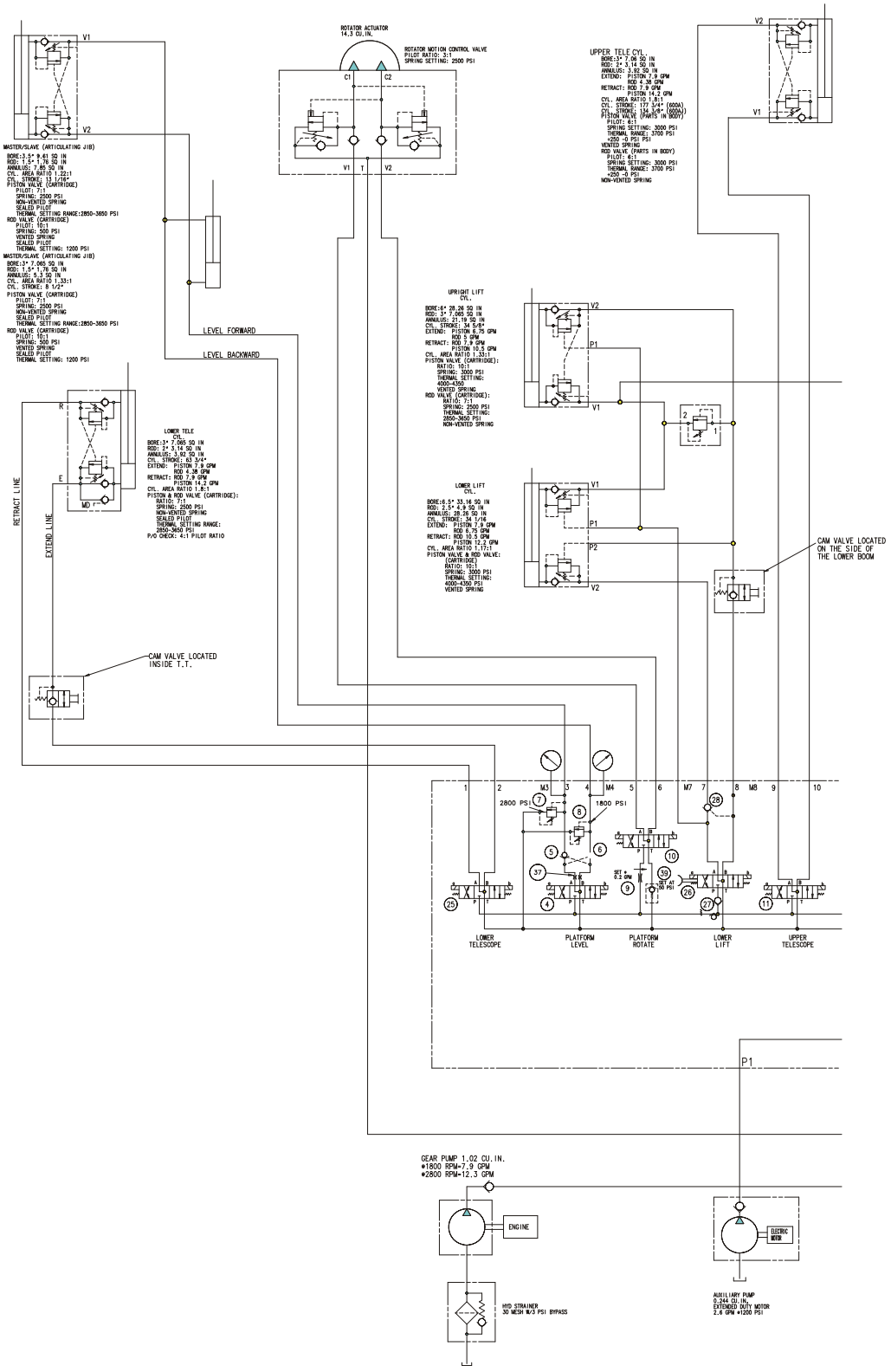


Figure 7-39. Hydraulic Schematic - A Models - Sheet 1

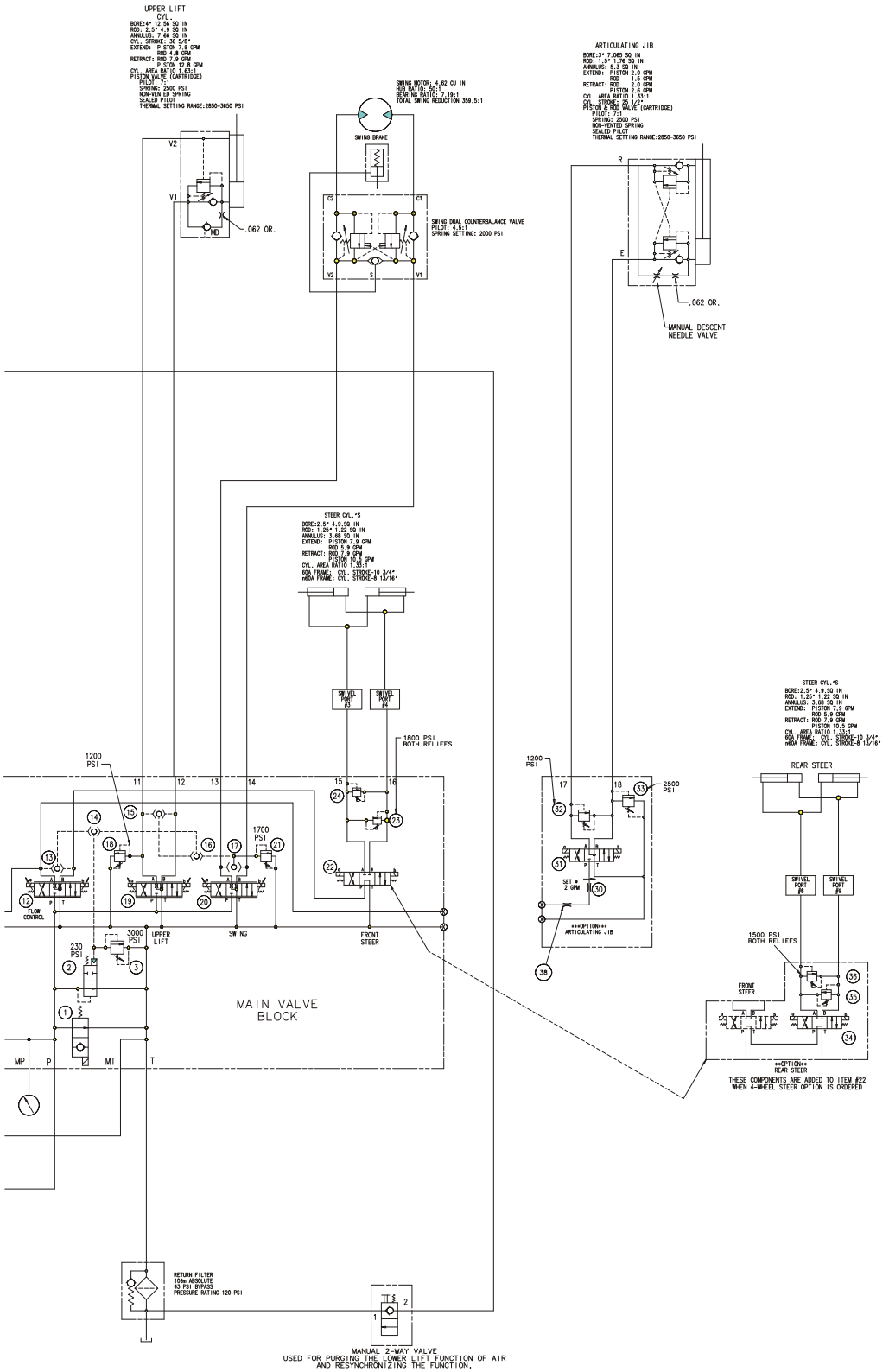
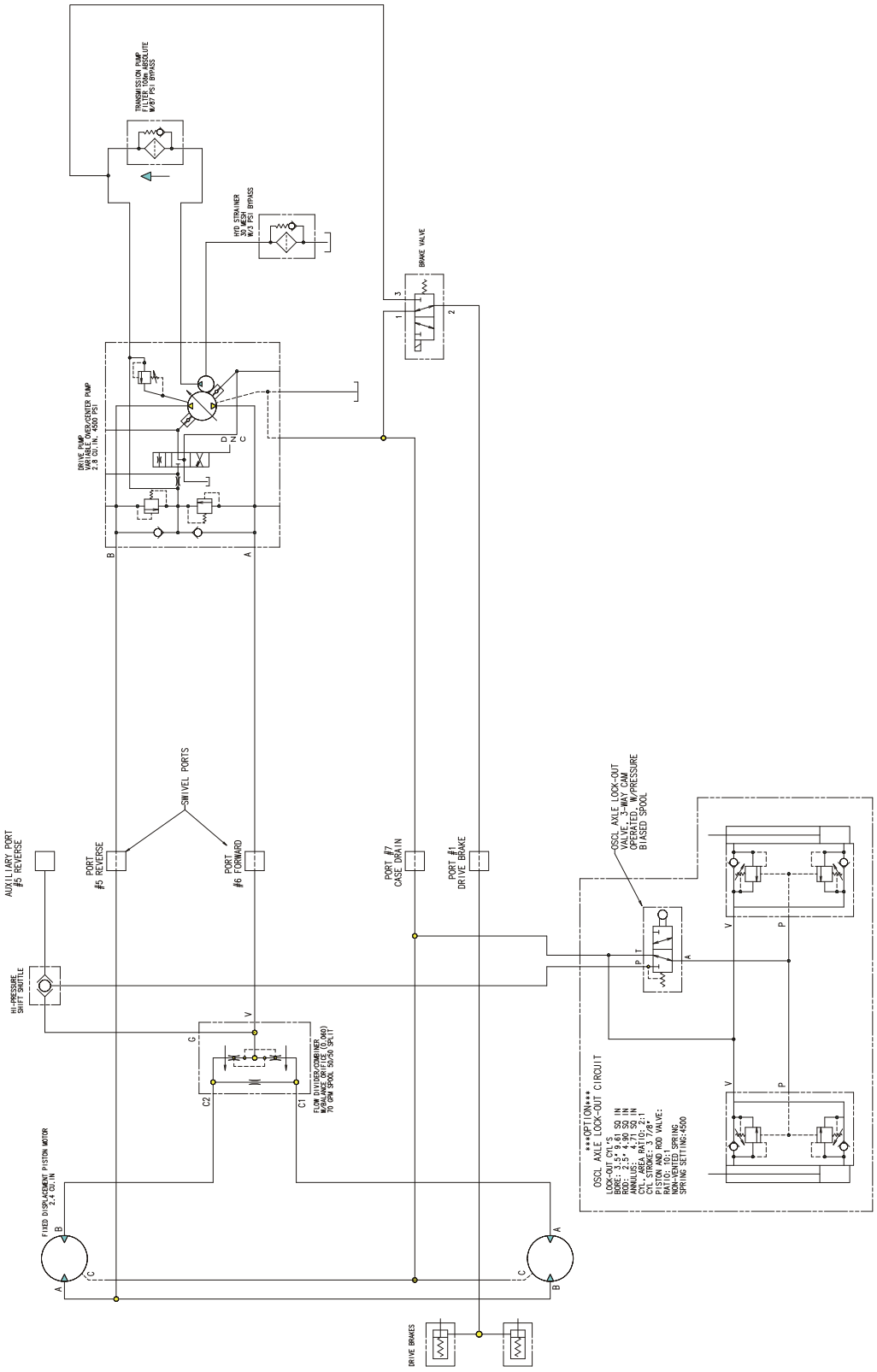


Figure 7-40. Hydraulic Schematic - A Models - Sheet 2



2 WHEEL DRIVE

Figure 7-41. Hydraulic Schematic - A Models - Sheet 3

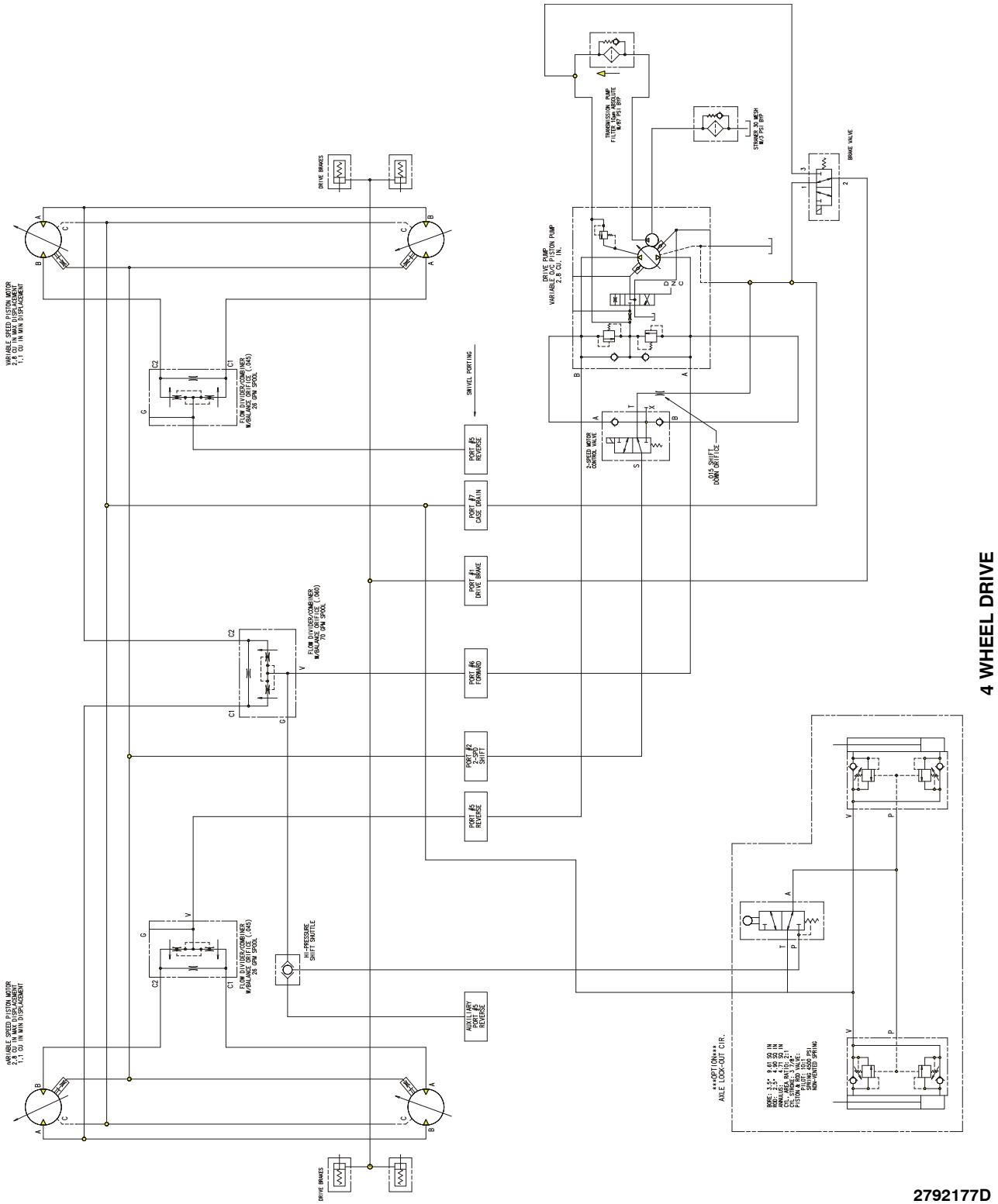


Figure 7-42. Hydraulic Schematic - A Models - Sheet 4

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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.

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