Service and Maintenance Manual

Model
80HX
80HX+6
80HXER

3120271
November 19, 2003

ANSI

CALIFORNIAN PROPOSITION 65

BATTERY WARNING

Battery posts, terminals and related accessories contain lead and lead compounds, chemical known to the State of California to cause cancer and reproductive harm.

WASH HANDS AFTER HANDLING!

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.

- 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

March, 1986	- Original Issue
February, 1997	- Revised
March 1, 1999	- Revised
September 7, 2000	- Revised
May 21, 2003	- Revised
November 19, 2003	- Revised

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Fuel Tank - 26 U.S. Gallons (98 L).

Hydraulic Oil Tank - 55 U.S. Gallons (208 L).

Hydraulic System (Including Tank) - Approx. 66 U.S. Gallons (250 L).

Torque Hub, Drive - 44 oz. (1.3 L).

Torque Hub, Swing - 17 oz. (0.5 L).

NOTE: *Torque Hubs should be one-half full of lubricant. (EPGL-90)*

Engine Crankcase (Ford LSG423) w/Filter - 5 quarts (4.73 L).

Engine Crankcase (Deutz F3L912) w/Filter - 9.5 quarts (9 L).

Engine Crankcase (Wisconsin V465D) w/Filter - 7 quarts (6.6 L).

Engine Crankcase (Cummins 4B 3.9C) - 11.5 quarts (10.9 L).

Tolerance on all engine rpm settings is plus or minus 10%.

1.2 COMPONENT DATA

Engine - Ford LSG423

Oil Capacity - 5 quarts (4.7 L) w/Filter, 4 quarts (3.8 L) w/o Filter.

Cooling System - 16 quarts (15 L).

Low RPM - 1000, no load

Mid RPM - 1800, no load.

High RPM - 3000, no load.

Alternator - 40 Amp, belt drive.

Battery - 1000 cold cranking Amps, 210 minutes reserve capacity, 12 VDC.

Horsepower - 63 @ 2800 RPM, no load.

Engine - Deutz F4L912

Oil Capacity - 9.5 quarts (8.99 L) w/Filter, 8.5 quarts (8.04 L) w/o Filter.

Low RPM 1800.

Mid RPM N/A

High RPM 2400.

Alternator - 60 Amp, belt drive.

Battery - 85 Amp hour, 550 CCA, 12 VDC.

Horsepower - 70 @ 2400 RPM, no load.

Engine - Wisconsin V465D

Oil Capacity - 7 quarts (6.62 L) w/Filter, 6 quarts (5.68 L) w/o Filter.

Low RPM 1800, no load.

High RPM 2400, no load.

Alternator - 37 Amp, belt drive.

Battery - 1000 cold cranking Amps, 210 minutes reserve capacity, 12 VDC.

Horsepower - 60 @ 2400 RPM, no load.

Engine - Cummins 4B 3.9C

Oil Capacity - 11.5 quarts (10.9 L).

Cooling System - 7.4 quarts (7.0 L)

Battery - 1000 cold cranking Amps, 210 minutes reserve capacity, 12 VDC.

Horsepower - 76 @ 2500 RPM, no load.

Engine - Ford LRG-423

Oil Capacity - 5 quarts (4.7 L).

Low RPM 1000

Mid RPM 1800

High RPM 3000

Horsepower - 66.

Engine - Ford LRG-425

Oil Capacity - 4.5 quarts (4.25 L).

Low RPM 1000

Mid RPM 1800

High RPM 3000

Horsepower - 75

Drive System

Pneumatic Tires - 15 x 19.5 NHS, 12 ply rating, 65 PSI. (4.5 Bar).

Foam-Filled Tires - 15 x 22.5 or 385/65R22.5

Air Pressure:
Firestone Tires - 95 PSI (6.5 Bar)
Goodyear Tires - 65 PSI (4.5 Bar)
Denman Tires - 70 PSI (4.8 Bar).

Drive Motor Displacement Machines Built Prior to Jan. 1992

Cessna - 5.04 in.3/rev. (4WD Same)

Vickers - 2.5/.98 in.3/rev.
(4WD Same)

2 Speed Cessna - 2.48/1.103/rev.

Gear Reducer - Vickers Drive Motors only - 3.6:1.

Drive Motor Displacement Machines Built from Jan. 1992 to Present

Rexroth - 2.8 in.3/rev.
(4WD Same)

Drive Hub Ratios

2WD with Racine proportional valves built prior to February 1988 - 42.5:1.

2WD with Racine proportional valves built February 1988 to present - 43:1.

2WD with Racine or Vickers proportional valves built prior to October 1989 - 30.04:1.

2WD/2WS with fixed or oscillating front axle built May 1988 to present - 24:1.

2WD/4WS with oscillating front axle built May 1988 to present - 24:1.

4WD built May 1988 to present - 24:1.

2WD/4WS with fixed front axle/Vickers proportional valves - 73:1.

4WD with Vickers Proportional valves - 30.04:1.

Steer System

Toe-in, adjust for 1/4 in. (6.35 mm) overall.

Swing System

Swing Motor - Displacement - 4.5 cu. in/Rev.

Swing Hub - Ratio - 69.50:1.

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

Hydraulic Pump

Deutz and Wisconsin engines with Single Speed Drive Motors (with Racine Valves).

First Section to Proportional Valve-Drive, Lift, Swing - 24 GPM (91 LPM).

Second Section to High Drive - 24 GPM (91 LPM).

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 9.5 GPM (36 LPM).

Clockwise Rotation.

Wisconsin Engines with 2 Speed Drive Motors and Deutz Engines with Single Speed Drive Motors (with Racine Valves).

First Section to Proportional Valve-Drive, Lift, Swing - 19 GPM (72 LPM).

Second Section to High Drive - 19 GPM (72 LPM).

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 9.5 GPM (36 LPM).

Clockwise Rotation.

Deutz Engines with 2 Speed Drive Motors (with Racine Valves).

First Section to Proportional Valve-Drive, Lift, Swing - 19 GPM (72 LPM).

Second Section to High Drive - 14.5 GPM (55 LPM).

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 9.5 GPM (36 LPM).

Clockwise Rotation.

Machines Built Prior to Mid 1987 (with Vickers Valves).

First Section to Proportional Valve-Drive, Lift, Swing - 14.5 GPM (55 LPM).

Second Section to High Drive - 9.5 GPM (36 LPM).

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 9.5 GPM (36 LPM).

Clockwise Rotation.

Machines Built Mid 1987 to Present (with Vickers Valves).

First Section to Proportional Valve-Drive, Lift, Swing - 15 GPM (57 LPM).

Second Section to High Drive - 9 GPM (34 LPM).

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 9 GPM (34 LPM).

Clockwise Rotation.

Auxiliary Power Pump

Two section, 3.75 GPM (14.19 lpm) each section, 12 VDC motor, clockwise rotation.

Hydraulic Filter - Tank

Return - Bypass Type.

10 Microns Nominal.

Hydraulic Filter - Inline (Racine Valve Only)

Return - Non-Bypass Type.

10 Microns Nominal.

1.3 PERFORMANCE DATA

Travel Speed

3.5 MPH (5.6 KM/HR).

Gradeability

25%.

Turning Radius (Outside)

24 ft. (7.3 m) with axles extended.

Boom Speed (Telescope)

Extend 71-133 Seconds

Retract 44-72 Seconds.

Boom Speed (Lift)

Up - 65-100 Seconds

Down - 55-100 Seconds.

Swing Speed 360°

Swing Speed 360° - 110-200 Seconds.

Boom Elevation

-16° to +75°

Machine Weight

80HX - approx. 31,800 LBS. (14,424 KG.)

80HX+6 - approx. 36,900 LBS. (16,738 KG.)

Machine Stowed Height

9.5 ft. (2.9 M)

Machine Stowed Length

80HX - 33.5 ft. (10.2 M)

80HX+6 - 36.7 ft. (11.2 M)

Machine Width

With axles retracted - 8 ft. (2.4 m)

With axles extended - 10 ft. (3 m)

Maximum Tire Load

80HX - 15500 lbs. (7037 kg) @103 psi (7.1 Bar)

80HX + 6 - 18295 (8299 kg) @107 psi (7.4 Bar)

Wheelbase

10 ft. (3 m)

1.4 TORQUE REQUIREMENTS

Table 1-1. Torque Requirements

Description	Torque		Interval Hours
	Ft. Lbs.	Nm	
Turntable (prior to April, 1986) 5/8" Bolts - Wet 5/8" Bolts - Dry 7/8" Bolts - Wet 7/8" Bolts - Dry	- 170 220 460 600	- 235 304 636 830	50/600*
Turntable (April, 1986 to Present) Wet Dry	- 170 220	- 235 304	50/600*
Wheel Lugs Wet Dry	- 220 300	- 304 415	100
Drive Hub Wet Dry	- 110 150	- 149 207	200/ 500**
Swing Hub Wet Dry	- 80 110	- 110 149	200/ 500**

* Check swing bearing bolts for security after first 50 hours of operation and every 600 hours thereafter.

**Retorque after first 200 hours of operation and every 500 hours thereafter.

NOTE: *See Procedure Section for tightening sequence of turntable bearing bolts.*

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

1.5 LUBRICATION

NOTE: *The lubrication intervals in the following paragraphs are equivalent to the following:*

150 hours = 3 months
300 hours = 6 months
600 hours = 1 year
1200 hours = 2 years

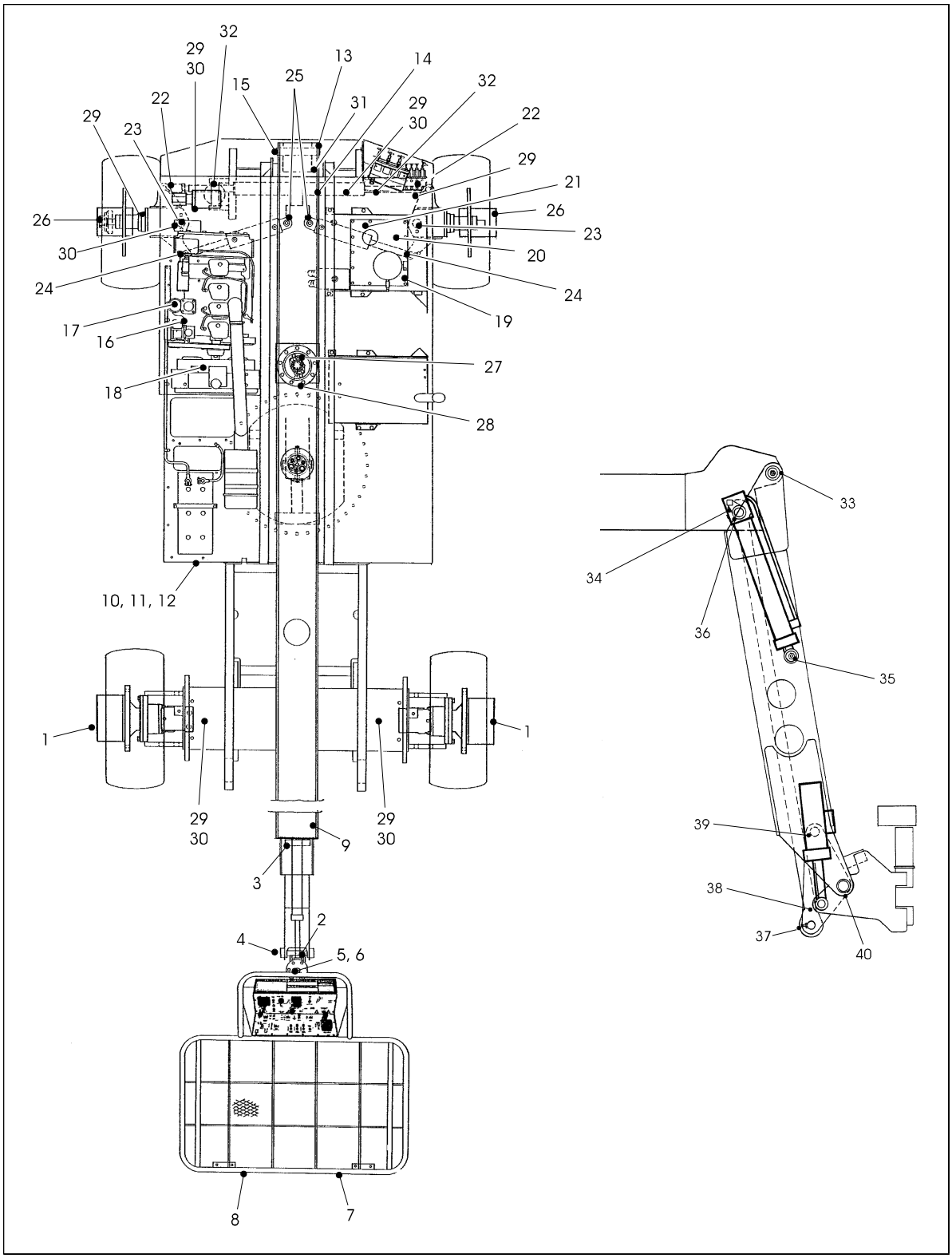


Figure 1-1. Lubrication Diagram

Table 1-2. Lubrication Chart

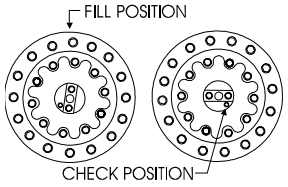
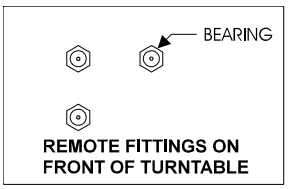
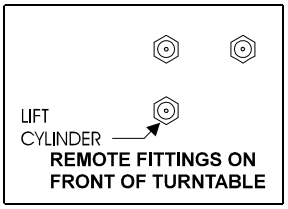
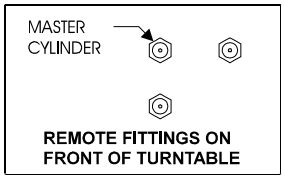
	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
1	Wheel Drive Hubs	Level/Fill Plug	2.75 pt. (1/2 full)	EPGL (SAE90)				X	Check level every 150 hours; change @ 1200 hours 
2	Slave Cylinder (Rod)	1 Grease Fitting	A/R	MPG		X			
3	Slave Cylinder (Barrel)	1 Grease Fitting	A/R	MPG		X			Gain access through boom fly section.
4	Platform Pivot	1 Grease Fitting	A/R	MPG		X			
5	Rotating Column (Optional)	2 Grease Fittings	A/R	MPG	X				
6	Rotary Worm Gear (Optional)	N/A	A/R	MPG		X			Brush on.
7	Platform Hinges	2 Grease Fittings	A/R	MPG		X			
8	Platform Latch	N/A	A/R	EO		X			
9	Boom Chain Extension Sheave	1 Grease Fitting	A/R	MPG	X				Align access holes in mid and fly boom.
10	Swing Bearing	2 Grease Fittings	A/R	MPG	X				Remote Access 
11	Lift Cylinder (Barrel End)	1 Grease Fitting	A/R	MPG	X				Remote Access 
12	Master Cylinder (Barrel End)	1 Grease Fitting	A/R	MPG	X				Remote Access 
13	Master Cylinder (Rod End)	1 Grease Fitting	A/R	MPG	X				

Table 1-2. Lubrication Chart

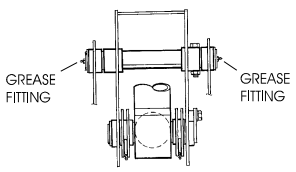
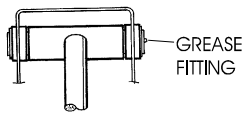
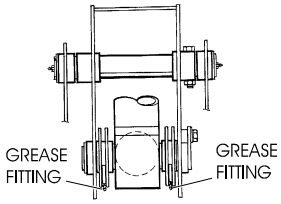
	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
14	Boom Chain Retract Sheave	1 Grease Fitting	A/R	MPG	X				
15	Boom Pivot Bushings	2 Grease Fittings	A/R	MoS_2	X				
16	Engine Crankcase	Fill Cap	Refer to Engine Manual	EO					Check daily. Change in accordance with engine manual.
17	Engine Oil Filter	N/A	N/A	N/A					Change in accordance with engine manual.
18	Engine Coolant	Radiator Cap	Refer to Engine Manual						Refer to engine manual for coolant specifications. Check daily with engine cold.
19	Hydraulic Oil	Fill Cap	56 gallons	HO				X	Check daily. Change every 1200 hours.
20	Hydraulic Oil Return Filters	N/A	N/A	N/A					Check filter gauges for element construction daily. Replace as necessary.
21	Hydraulic Reservoir Suction Filter	N/A	N/A	N/A			X		Replace filter element every 600 hours; clean mesh as necessary.
22	Tie Rod Ends	2 Grease Fittings	A/R	MPG	X				
23	King Pins	2 Grease Fittings	A/R	MPG	X				
24	Steer Cylinder (Rod End)	1 Grease Fitting	A/R	MPG	X				
25	Steer Cylinder (Barrel End)	1 Grease Fitting	A/R	MPG	X				
26	Wheel Bearings	N/A	A/R	MPG			X		Repack
27	Swing Drive Hub	Fill Plug	17 oz. (1/2 Full)	EPGL (SAE90)			X		Check oil level weekly; change every 600 hours
28	Swing Bearing and Pinion Gear Teeth	N/A	A/R	MPG			X		Apply by brush onto bearing and gear teeth
29	Axle Beam (Extendable Axles)	N/A	A/R	MPG		X			Apply by brush
30	Axle Lock Pin (Extendable Axles)	N/A	A/R	MPG	X				Apply by brush
31	Oscillating Axle Pivot	1 Grease Fitting	A/R	MPG	X				
32	Oscillation Cylinder	2 Grease Fittings	A/R	MPG	X				
33	Extend-A-Reach Pivot (If Equipped)	2 Grease Fittings	A/R	MPG	X				

Table 1-2. Lubrication Chart

	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	
34	Extend-A-Reach Lift Cylinder (Barrel End)	1 Grease Fitting	A/R	MPG	X				
35	Extend-A-Reach Lift Cylinder (Rod End)	1 Grease Fitting	A/R	MPG	X				
36	Extend-A-Reach - Boom End (If Equipped)	2 Grease Fittings	A/R	MPG	X				
37	Extend-A-Reach - Platform End (if Equipped)	1 Grease Fitting	A/R	MPG	X				
38	Extend-A-Reach - Slave Cylinder Rod End (If Equipped)	1 Grease Fittings	A/R	MPG	X				
39	Extend-A-Reach Link - Slave Cylinder Pivot Point (If Equipped)	1 Grease Fitting	A/R	MPG	X				
40	Extend-A-Reach Link - Slave Cylinder Pivot Point (If Equipped)	1 Grease Fitting	A/R	MPG	X				

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

Ford Engines

Single Viscosity Oils (SF, SF-SE, SF-CC, SF-CD).

When Outside Temp is Consistently	Use SAE Viscosity Number
-10° F - +60° F.	*10W
+10° F - + 90° F.	20W-20
Above +32° F.	30
Above + 50° F.	40

Multi-Viscosity Oils (SF, SF-SE, SF-CC, SF-CD).

When Outside Temp is Consistently	Use SAE Viscosity Number
Below +10° F.	*5W-20
Below +60° F.	5W-30
-10° F - +90° F.	10W-30
Above -10° F.	10W-40 or 10W-50
Above +20° F.	20W-40 or 20W-50

* Not recommended for severe service - including high RPM operation.

Deutz F4L912 Engine

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

When Outside Temp is Consistently	Use SAE Viscosity Number
-20° F - +25° F.	*10W
+15° F - + 50° F.	20W-20
+40° F - + 85° F.	30
Above 75° F.	40

Multi-Viscosity Oils (CD-SE, CD-SF).

When Outside Temp is Consistently	Use SAE Viscosity Number
-40° F - +75° F.	*5W-20 (Synthetic)
-5° F - +70° F.	10W-30
-5° F - +85° F.	10W-40
+15° F - +75° F.	15W-30
Above +15° F.	15W-40

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

Wisconsin V465D Engine

Single Viscosity Oils (MS, SD, SE).

When Outside Temp is Consistently	Use SAE Viscosity Number
+15° F - 0° F.	*10W
+40° F - + 15° F.	20-20W
+120° F - + 40° F.	30

Multi-Viscosity Oils (MS, SD, SE).

When Outside Temp is Consistently	Use SAE Viscosity Number
Below Zero.	*5W-20

NOTE: *Crankcase oil should meet one of the following API classification grades: SE/CC, SE/CD, SF/CC, SF/CD.*

Cummins 4B 3.9C

Multiple Viscosity Oils (CE/SG).

When Outside Temp is Consistently	Use SAE Viscosity Number
+70° F - 40° F.	5W-30
+70° F - -10° F.	10W-30
+120° F - + 10° F.	15W-40

Table 1-3.Hydraulic Oil

Hydraulic System Operating Temperature Range	SAE Viscosity Grade
0° to +23° F(-18° to -5° C)	10W
0° to +210° F(-18° to +100° C)	10W-20, 10W-30
+50° to +210° F(+10° to +99° C)	20W-20

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

NOTE: *When temperatures remain consistently below 20 degrees F (-7 degrees C.), JLG Industries recommends the use of Mobil DTE11.*

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

Table 1-4. Mobil EAL 224 H Specs

Type	Biodegradable Vegetable Oil
ISO Viscosity Grade	32/46
Specific Gravity	.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min.	428°F (220°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 104° F (40° C)	37 cSt
at 212° F (100° C)	8.4 cSt
Viscosity Index	213
Operating Temp	0-180° F (-17 - -162°C)
Note: Must be stored above 32° F (14° C)	

Table 1-5. Mobil DTE 13M Specs

Type	Petroleum Base
ISO Viscosity Grade	32
Specific Gravity	.877
Pour Point, Max	-40°F (-40°C)
Flash Point, Min.	330°F (166°C)
Viscosity	
at 104° F (40° C)	33 cSt
at 212° F (100° C)	6.5 cSt
Viscosity Index	140

Lubrication Specifications

Table 1-6.Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees 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, SAE 10W-20, Viscosity Index 152.
EO	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

Refer to Lubrication Chart for specific lubrication procedures.

1.6 PRESSURE SETTINGS

NOTE: *All pressure are given in pounds per square inch (psi), with the metric equivalent, Bar, in parentheses.*

Prior to Mid 1987

Main Relief - 2900 psi (200 Bar).

Drive - 2900 psi (200 Bar).

Lift Up - 2900 psi (200 Bar).

Lift Down - 1100 psi (76 Bar).

Swing - 1200 psi (83 Bar).

Main Relief (Solenoid Valve) - 2500 psi (172 Bar).

Telescope In - 2500 psi (172 Bar).

Telescope Out - 1500 psi (103 Bar).

Rotate - 2500 psi (172 Bar)

Level - 1500 psi, 2500 psi Split Valve (103 Bar, 172 Bar Split Valve).

Steer - 1500 psi (103 Bar) without steering wheel

Steer - 2500 psi (with steering wheel)

80 HX

Proportional Relief - Standard 3200 psi (220 Bar); Prop. Tele 3850 psi (265 Bar).

Sequence (Load Sense) - 450 psi (31 Bar).

Pressure Reducing (Pilot Press) - 550 psi (38 Bar).

Drive - 3100 psi. (214 Bar); Prop. Tele. 3750 psi (259 Bar).

Lift Up - 3000 psi (207 Bar).

Lift Down - 1500 psi (103 Bar)

Swing - 1500 psi (103 Bar).

Telescope In - 3000 psi (207 Bar); Prop. Tele 3750 psi (259 Bar).

Tele Out - 1500 psi (103 Bar).

Solenoid Main Relief - 3100 psi (214 Bar).

2 Wheel Steer - 2000 psi (138 Bar); w/axle lift cyl. 2200 psi (152 Bar)

2 Wheel Steer w/4WD - 2000 psi (138 Bar); w/axle lift cyl. 2200 psi (152 Bar).

4 Wheel Steer - 2000 psi (138 Bar) w/axle lift cyl. 2200 psi (152 Bar).

Extend-A-Reach Up - 2500 psi (172 Bar).

Extend-A-Reach Down - 1100 psi (76 Bar).

80HX w/Hydraulic Controls

Proportional Relief - Standard 3200 psi (220 Bar); Prop. Tele 3850 psi (265 Bar).

Sequence (Load Sense) - 400 to 600 psi (28 to 41 Bar).

Pressure Reducing (Pilot Press) - 600 psi (41 Bar).

Hyd. Controls Back Pressure - Relief 125 psi (8.6 Bar); Press. Red. 80 to 120 psi (5.5 to 8.2 Bar)

Drive - 3100 psi. (214 Bar); Prop. Tele. 3750 psi (259 Bar).

Lift Up - 3000 psi (207 Bar).

Lift Down - 1500 psi (103 Bar)

Swing - 1500 psi (103 Bar).

Telescope In - 3000 psi (207 Bar); Prop. Tele 3750 psi (259 Bar).

Tele Out - 1500 psi (103 Bar).

Solenoid Main Relief - 3100 psi (214 Bar)

2 Wheel Steer - 2000 psi (138 Bar); w/axle lift cyl. 2200 psi (152 Bar)

2 Wheel Steer w/4WD - 2000 psi (138 Bar); w/axle lift cyl. 2200 psi (152 Bar).

4 Wheel Steer - 2000 psi (138 Bar); w/axle lift cyl. 2200 psi (152 Bar).

Extend-A-Reach Up - 2500 psi (172 Bar).

Extend-A-Reach Down - 1100 psi (76 Bar).

80HX w/Oscillating Axle

Proportional Relief - Standard 3200 psi (220 Bar); Prop. Tele 3850 psi (265 Bar).

Sequence (Load Sense) - 450 psi (31 Bar).

Pressure Reducing (Pilot Press) - 550 psi (38 Bar).

Drive - 3100 psi. (214 Bar); Prop. Tele. 3750 psi (259 Bar).

Lift Up - 3000 psi (207 Bar).

Lift Down - 1500 psi (103 Bar)

Swing - 1500 psi (103 Bar).

Telescope In - 3000 psi (207 Bar) Prop. Tele 3750 psi (259 Bar).

Tele Out - 1500 psi (103 Bar).

Solenoid Main Relief - 3100 psi (214 Bar)

2 Wheel Steer - 1500 psi (103 Bar)

2 Wheel Steer w/4WD - 1500 psi (103 Bar).

4 Wheel Steer; Axle Lift Cyl. - 2200 psi (152 Bar).

Extend-A-Reach Up - 2500 psi (172 Bar)

Extend-A-Reach Down - 1100 psi (76 Bar)

NOTE: *Refer to Section 2 for pressure setting procedures.*

1.7 MAJOR COMPONENTS WEIGHTS

Table 1-7. Major Component Weights

Component	Lbs.	KG.
Platform w/o Control Box	236	107
Boom (includes Lift Cylinder, Rotator, and Support)	4816	2184
Turntable Complete (includes Engine)	14972	6790
Frame Complete (includes Tires and Wheels)	9290	4213
Complete Machine - 2WD No Options	28605	12973
Complete Machine - 4WD No Options	29106	13200
Complete Machine (80HX+6) 2WD No Options	31856	14447

1.8 CYLINDER SPECIFICATIONS

Table 1-8. Cylinder Specifications

DESCRIPTION	BORE	STROKE	ROD DIA.
Master Level	2.50	15.25	1.25
Slave Level	2.50	15.21	1.25
Lift	8.00	30.75	3.50
Lockout (Oscillating Axle)	4.00	4.88	1.25
Lockout (4WD)	4.00	4.25	1.25
Telescope	3.50	257.9	2.50
Steer (2WD)	3.00	8.06	1.25
Steer (4WD)	3.00	9.81	1.50
Extend-A-Reach			
Lift	3.00	12.687	2.00
Slave	3.50	7.25	1.75

1.9 BOOM TAPE

American Standard

Red - 39 in. (99 cm).

Yellow - 34 in. (86.4 cm).

Blue - 193.9 in. (492.5 cm).

Canadian Standard

Red - 53 in. (134.6 cm).

Yellow - 42 in. (106.7 cm).

Blue - 171.8 in. (436.4 cm).

1.10 CRITICAL STABILITY WEIGHTS

Table 1-9. Critical Stability Weights

Component		Lb.s	KG.
Engines	Deutz F4L912	837	380
	Ford LRG 423	410	186
	Cummins 4B3.9	680	309
Tire & Wheels	15x19.5 Tire	130	59
	Wheel	72	33
	Foam Fill	320	145

1.11 SERIAL NUMBER LOCATION

A serial number plate is affixed to the left rear front of the turntable. If the serial number plate is damaged or missing, the machine serial number is stamped on the left side of the frame between front and rear wheels, below turntable bearing. In addition, the last five digits of the serial number are stamped on top of the fly, mid and base end of the boom and on the left side of the turntable.

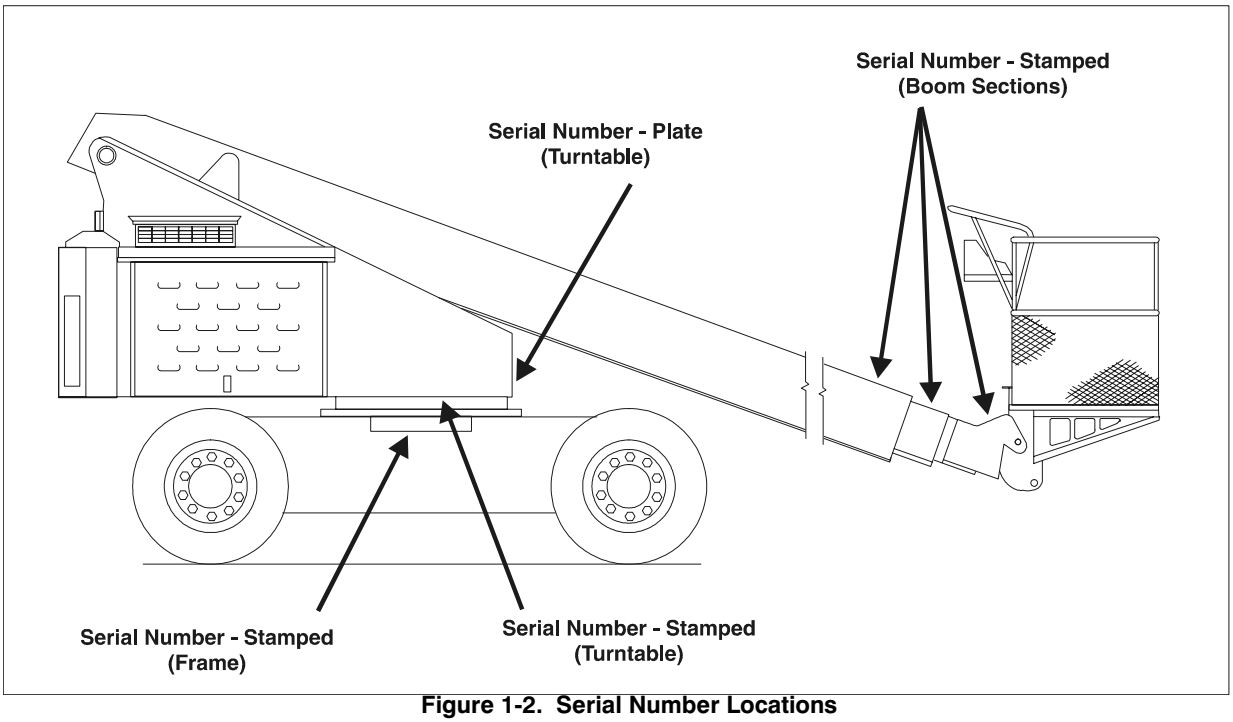


Figure 1-2. Serial Number Locations

				VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY										UNPLATED CAP SCREWS		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS					UNBRAKO 1960 SERIES SOCKET HEAD		
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE	
					DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH
		IN	SQ. IN.	LB.	IN-LB	IN-LB	IN-LB	IN-LB	LB.	IN-LB.	IN-LB	IN-LB	IN-LB	LB.	IN-LB	IN-LB
4	40	0.1120	0.00604	380	8	6	—	—	540	12	9	—	—	—	—	—
	48		0.00661	420	9	7	—	—	600	13	10	—	—	—	—	—
6	32	0.1380	0.00909	580	16	12	—	—	820	23	17	—	—	—	—	—
	40		0.01015	610	18	13	—	—	920	25	19	—	—	—	—	—
8	32	0.1640	0.01400	900	30	22	—	—	1260	41	31	—	—	—	—	—
	36		0.01474	940	31	23	—	—	1320	43	32	—	—	—	—	—
10	24	0.1900	0.01750	1120	43	32	—	—	1580	60	45	—	—	—	—	—
	32		0.02000	1285	49	36	—	—	1800	68	51	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	96	75	—	105	2860	144	108	—	160	3180	160	168
	28		0.0364	2320	120	86	—	135	3280	168	120	—	185	3640	168	178
		IN	SQ. IN.	LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB
5/16	18	0.3125	0.0524	3340	17	13	16	19	4720	25	18	22	30	5240	25	28
	24		0.0580	3700	19	14	17	21	5220	25	20	25	30	5800	27	30
3/8	16	0.3750	0.0775	4940	30	23	28	35	7000	45	35	40	50	7750	45	50
	24		0.0878	5600	35	25	32	40	7900	50	35	45	55	8780	50	55
7/16	14	0.4375	0.1063	6800	50	35	45	55	9550	70	55	63	80	10630	70	77
	20		0.1187	7550	55	40	50	60	10700	80	60	70	90	11870	75	82
1/2	13	0.5000	0.1419	9050	75	55	68	85	12750	110	80	96	120	14190	110	120
	20		0.1599	10700	90	65	80	100	14400	120	90	108	130	15990	115	127
9/16	12	0.5625	0.1820	11600	110	80	98	120	16400	150	110	139	165	18200	155	170
	18		0.2030	12950	120	90	109	135	18250	170	130	154	190	20300	165	182
5/8	11	0.6250	0.2260	14400	150	110	135	165	20350	220	170	180	240	22600	210	231
	18		0.2560	16300	170	130	153	190	23000	240	180	204	265	25600	220	242
3/4	10	0.7500	0.3340	21300	260	200	240	285	30100	380	280	301	420	33400	365	400
	16		0.3730	23800	300	220	268	330	33600	420	320	336	465	37300	400	440
7/8	9	0.8750	0.4620	29400	430	320	386	475	41600	600	460	485	660	46200	585	645
	14		0.5090	32400	470	350	425	520	45800	660	500	534	725	50900	635	700
1	8	1.0000	0.6060	38600	640	480	579	675	51500	900	680	687	990	60600	865	950
	12		0.6630	42200	700	530	633	735	59700	1000	740	796	1100	66300	915	1000
1-1/8	7	1.1250	0.7630	42300	800	600	714	840	68700	1280	960	1030	1400	76300	1240	1365
	12		0.8560	47500	880	660	802	925	77000	1440	1080	1155	1575	85600	1380	1520
1-1/4	7	1.2500	0.9690	53800	1120	840	1009	1175	87200	1820	1360	1453	2000	96900	1750	1925
	12		1.0730	59600	1240	920	1118	1300	96600	2000	1500	1610	2200	107300	1880	2070
1-3/8	6	1.3750	1.1550	64100	1460	1100	1322	1525	104000	2380	1780	1907	2625	115500	2320	2550
	12		1.3150	73000	1680	1260	1506	1750	118100	2720	2040	2165	3000	131500	2440	2685
1-1/2	6	1.5000	1.4050	78000	1940	1460	1755	2025	126500	3160	2360	2530	3475	140500	3040	3345
	12		1.5800	87700	2200	1640	1974	2300	142200	3560	2660	2844	3925	158000	3270	3600

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


SAE GRADE 5


SAE GRADE 8

Figure 1-3. Torque Chart - (In/Lb - Ft/Lb). (For ASTM Fasteners)

				VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY										UNPLATED CAP SCREWS		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS					UNBRAKO 1960 SERIES SOCKET HEAD		
					TORQUE					TORQUE					TORQUE	
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH
		IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m
4	40	0.1120	0.00604	380	.8	.8	—	—	540	1.4	1.0	—	—	—	—	—
	48		0.00661	420	1.0	.8	—	—	600	1.5	1.0	—	—	—	—	—
6	32	0.1380	0.00909	580	1.8	1.4	—	—	820	2.6	2.0	—	—	—	—	—
	40		0.01015	610	2.0	1.6	—	—	920	2.8	2.2	—	—	—	—	—
8	32	0.1640	0.01400	900	3.4	2.4	—	—	1260	4.6	3.4	—	—	—	—	—
	36		0.01474	940	3.4	2.6	—	—	1320	5	3.6	—	—	—	—	—
10	24	0.1900	0.01750	1120	5	3.6	—	—	1580	7	5	—	—	—	—	—
	32		0.02000	1285	6	4	—	—	1800	8	6	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	11	8	—	12	2860	16	12	—	18	3180	18	19
	28		0.0364	2320	14	10	—	15	3280	19	14	—	21	3640	19	20
		IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m
5/16	18	0.3125	0.0524	3340	23	18	22	26	4720	34	24	30	41	5240	34	38
	24		0.0580	3700	26	19	23	28	5220	34	27	34	41	5800	37	41
3/8	16	0.3750	0.0775	4940	41	31	38	47	7000	61	47	54	68	7750	61	68
	24		0.0878	5600	47	34	43	54	7900	68	47	61	75	8780	68	75
7/16	14	0.4375	0.1063	6800	68	47	61	75	9550	95	75	85	108	10630	95	104
	20		0.1187	7550	75	54	68	81	10700	108	81	95	122	11870	102	111
1/2	13	0.5000	0.1419	9050	102	75	92	115	12750	149	108	130	163	14190	149	163
	20		0.1599	10700	122	88	108	136	14400	163	122	146	183	15990	156	172
9/16	12	0.5625	0.1820	11600	149	108	133	163	16400	203	149	188	224	18200	210	230
	18		0.2030	12950	163	122	148	183	18250	230	176	209	258	20300	224	247
5/8	11	0.6250	0.2260	14400	203	149	183	224	20350	298	230	244	325	22600	285	313
	18		0.2560	16300	230	176	207	258	23000	325	244	277	359	25600	298	328
3/4	10	0.7500	0.3340	21300	353	271	325	386	30100	515	380	408	569	33400	495	542
	16		0.3730	23800	407	298	363	447	33600	569	434	456	630	37300	542	597
7/8	9	0.8750	0.4620	29400	583	434	523	644	41600	813	624	658	895	46200	793	874
	14		0.5090	32400	637	475	576	705	45800	895	678	724	983	50900	861	949
1	8	1.0000	0.6060	38600	868	651	785	915	51500	1220	922	931	1342	60600	1173	1288
	12		0.6630	42200	949	719	858	997	59700	1356	1003	1079	1491	66300	1241	1356
1-1/8	7	1.1250	0.7630	42300	1085	813	968	1139	68700	1735	1302	1396	1898	76300	1681	1851
	12		0.8560	47500	1193	895	1087	1254	77000	1952	1464	1566	2135	85600	1871	2061
1-1/4	7	1.2500	0.9690	53800	1518	1139	1368	1593	87200	2468	1844	1970	2712	96900	2373	2610
	12		1.0730	59600	1681	1247	1516	1763	96600	2712	2034	2183	2983	107300	2549	2807
1-3/8	6	1.3750	1.1550	64100	1979	1491	1792	2068	104000	3227	2413	2586	3559	115500	3145	3457
	12		1.3150	73000	2278	1708	2042	2373	118100	3688	2766	2935	4067	131500	3308	3640
1-1/2	6	1.5000	1.4050	78000	2630	1979	2379	2745	126500	4284	3200	3430	4711	140500	4122	4535
	12		1.5800	87700	2983	2224	2676	3118	142200	4827	3606	3856	5322	158000	4433	4881

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

SAE GRADE 5

SAE GRADE 8

Figure 1-4. Torque Chart (Metric Conversion) - (For ASTM Fasteners)

			VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY									
			CLASS 8.8 METRIC BOLTS & CLASS 8 METRIC NUTS					CLASS 10.9 METRIC BOLTS & CLASS 10 METRIC NUTS				
SIZE	PITCH	TENSILE STRESS AREA	CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE			
				DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271
		sq. mm	KN	N, m	N, m	N, m	N, m	KN	N, m	N, m	N, m	N, m
3	.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13	1.9	1.4	1.5	2.1
3.5	.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22	3.0	2.2	2.4	3.3
4	.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47	4.4	3.3	3.5	4.8
5	.8	14.2	6.18	6.2	4.6	5.6	6.8	8.85	8.9	6.6	7.1	9.7
6	1	20.1	8.74	11	7.9	9.4	12	12.5	15	11	12	17
7	1	28.9	12.6	18	13	16	19	18	25	19	20	28
8	1.25	36.6	15.9	25	19	23	28	22.8	37	27	29	40
10	1.5	58.0	25.2	50	38	45	55	36.1	72	54	58	79
12	1.75	84.3	36.7	88	66	79	97	52.5	126	95	101	139
14	2	115	50.0	140	105	126	154	71.6	200	150	160	220
16	2	157	68.3	219	164	197	241	97.8	313	235	250	344
18	2.5	192	83.5	301	226	271	331	119.5	430	323	344	473
20	2.5	245	106.5	426	320	383	469	152.5	610	458	488	671
22	2.5	303	132.0	581	436	523	639	189.0	832	624	665	915
24	3	353	153.5	737	553	663	811	220.0	1060	792	845	1170
27	3	459	199.5	1080	810	970	1130	286.0	1540	1160	1240	1690
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2100	1570	1680	2310
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2600	2140	2280	2860
36	4	817	355.0	2560	1920	2300	2690	509.0	3660	2750	2930	4020
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5860	4400	4690	6440

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

METRIC CLASS 8.8

METRIC CLASS 10.9

Figure 1-5. Torque Chart - (N, m) - (For Metric Class Fasteners).

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

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

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

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.
2. JLG recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

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

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

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils. 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 unless otherwise instructed (i.e. sheave pins).
   c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

Do NOT Do the Following When Welding on JLG Equipment

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

⚠ 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 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

The preventive maintenance and inspection checks are listed and defined in the following table. This table is divided into two basic parts, the “AREA” to be inspected, and the “INTERVAL” at which the inspection is to take place. Under the “AREA’ portion of the table, the various systems along with the components that make up that system are listed. The "INTERVAL" portion of the table is divided into five columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment, nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

JLG Industries requires that a complete annual inspection be performed in accordance with the “Annual Machine Inspection Report” form. Forms are supplied with each new machine and are also available from JLG Customer Service. Form must be completed and returned to JLG Industries.

IMPORTANT

JLG INDUSTRIES REQUIRES THAT A COMPLETE ANNUAL INSPECTION BE PERFORMED IN ACCORDANCE WITH THE “ANNUAL MACHINE INSPECTION REPORT” FORM.

The inspection and maintenance code numbers are as follows:

1. Check for proper and secure installation.
2. Check for visible damage and legibility.
3. Check for proper fluid level.
4. Check for any structural damage; cracked or broken welds; bent or warped surfaces.
5. Check for leakage.
6. Check for presence of excessive dirt or foreign material.
7. Check for proper operation and freedom of movement.
8. Check for excessive wear or damage.
9. Check for proper tightness and adjustment.
10. Drain, clean and refill.
11. Check for proper operation while engine is running.
12. Check for proper lubrication.
13. Check for evidence of scratches, nicks or rust and for straightness of rod.
14. Check for condition of element; replace as necessary.
15. Check for proper inflation.
16. Clean or replace suction screen.

***** Inspection and Maintenance Code 10 to be performed every two years.

** Axle Lockout Test to be performed quarterly.

Table 2-3.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	YEARLY
	BOOM						
1.	Platform	1,4					
2.	Platform Gate	1,4		12			
3.	Platform Rotator		5,11				
4.	Footswitch	1,11					
5.	Controllers	1,11					
6.	Switches	1,11					
7.	Placards and Decals	1,2					
8.	Control Tags	1,2					
9.	Valves	1,11	5,6				
10.	Carrier (Hoses and Cables)	1	4,8				
11.	Hydraulic Hoses	1	5				
12.	Capacity Indicator	2,7					
13.	Pins			8			
14.	Bushings			8			
15.	Wear Pads			8			
16.	Chains			8	12		
17.	Chain Adjusters			9			
18.	Cylinders		1,5,6,13				
19.	Sheaves		12				
20.	Drift Test*						

Table 2-3.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	YEARLY
	TURNTABLE						
1.	Engine Oil (see mfg. manual)	3	5				
2.	Battery	3	5				
3.	Radiator	3	5				
4.	Air Cleaner	1	14				
5.	Exhaust System	1		1,5			
6.	Spark Arrester	1		1,5	17		
7.	Engine Mount			1			
8.	Ground Controls	1,2,11					
9.	Main Hydraulic Pump	1	5				
10.	Auxiliary Power Pump	1	5				
11.	Valves	1,11	5				
12.	Hydraulic Filters	14	5				
13.	Hydraulic Hoses	1	5				
14.	Hydraulic Oil Tank**	3	5	4			
15.	Breather Hydraulic Tank		6,14				
16.	Fuel Tank	3,5		4			
17.	Cylinders		1,5,6,13	4			
18.	Hood Doors	1					
19.	Placards and Decals	1,2					
20.	Swing Bearing		1		9, 12		
21.	Swing Brake		1,5,6	8			
22.	Swing Hub				3,9		

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SECTION 3. CHASSIS & TURNTABLE

3.1 TORQUE HUB

(See Figure 3-1.)

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 and discard o-ring seal (22).
3. Lift carrier assembly and top thrust washer (39) from hub. Thrust washer may stick inside cover.
4. Pry ring gear (21) loose from hub and remove it. Remove o-ring seal (22) from hub counterbore and discard it.
5. Remove input gear (37) and thrustwashers (36,38) from input shaft assembly and remove input shaft assembly from hub.
6. Lift internal gear (12) and thrustwasher (39) from hub. Thrust washer may stick to bottom of carrier.
7. Remove retaining ring (9) from spindle (1) and lift hub from spindle.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

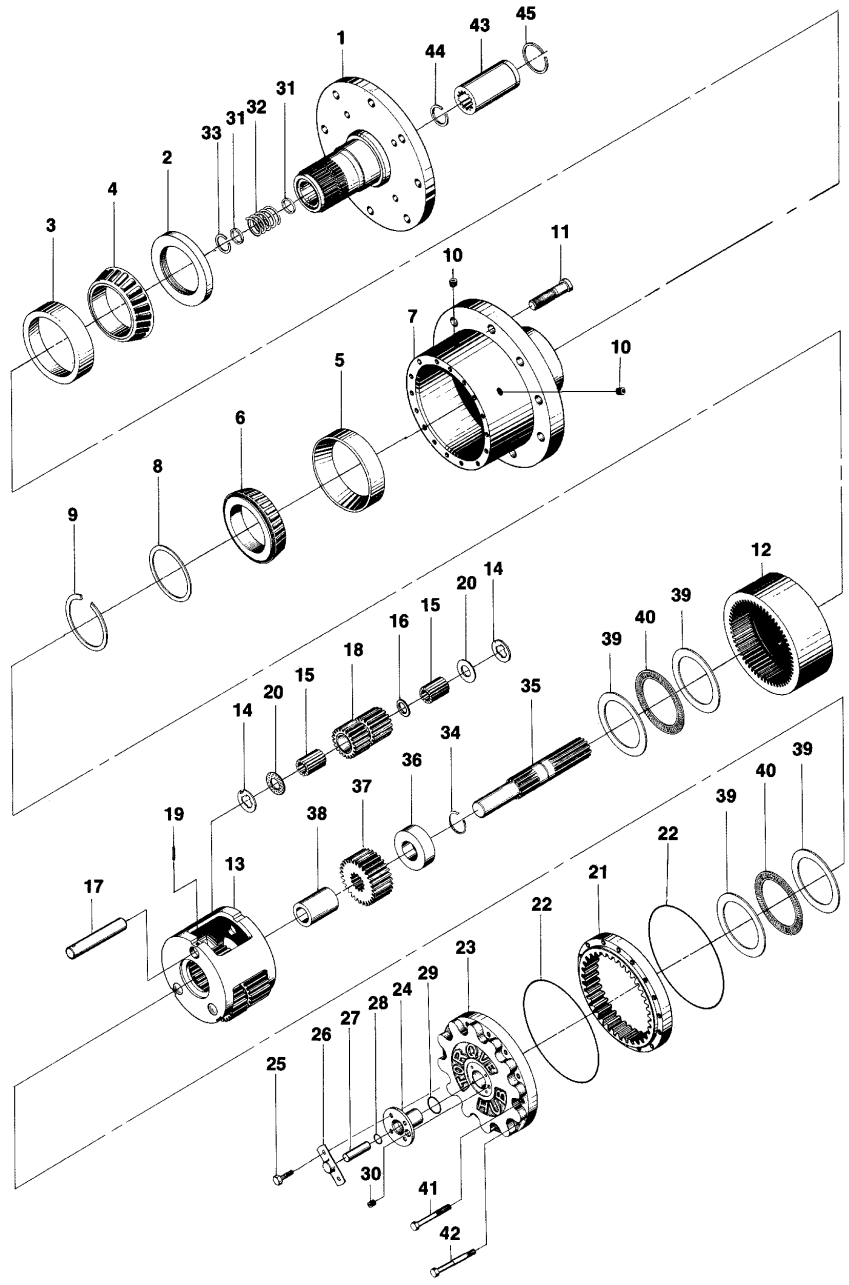
8. Remove inside bearing cone (6) and bearing shim 8.
9. If necessary, pry seal (2) out of hub using screwdriver or pry bar. With seal removed, outside bearing cone (4) can be removed.
10. If necessary, remove inner and outer bearing cones (3,5) using a suitable slide hammer puller.

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.



1. Spindle	10. Pipe Plug	19. Roll Pin	28. O-ring	37. Input Gear
2. Seal	11. Bolt	20. Thrustwasher	29. O-ring	38. Thrust Spacer
3. Bearing Cup	12. Internal Gear	21. Ring Gear	30. Pipe Plug	39. Thrustwasher
4. Bearing Cone	13. Carrier	22. O-ring	31. Washer	40. Thrust Bearing
5. Bearing Cup	14. Thrustwasher	23. Cover	32. Spring	41. Bolt
6. Bearing Cone	15. Needle Roller	24. Cover Cap	33. Retaining Ring	42. Shoulder Bolt
7. Hub	16. Spacer	25. Bolt	34. Retaining Ring	43. Coupling
8. Spacer	17. Pinion Shaft	26. Disconnect Cap	35. Input Shaft	44. Retaining Ring
9. Retaining Ring	18. Cluster Gear	27. Disconnect Rod	36. Thrust Spacer	45. Retaining Ring

Figure 3-1. Torque Hub Assembly

7. Inspect all threaded components for damage including stretching, thread deformation, or twisting.
8. Inspect seal mounting area in hub for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.
9. Inspect cover for cracks or other damage, and o-ring sealing area for burrs or sharp edges. Dress applicable surfaces or replace cover as necessary.

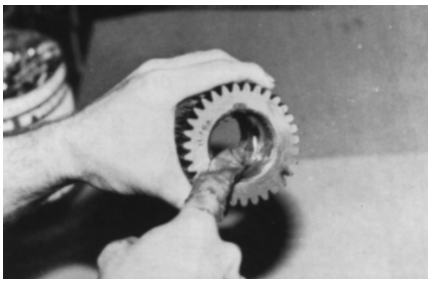
Repair

Cover Assembly.

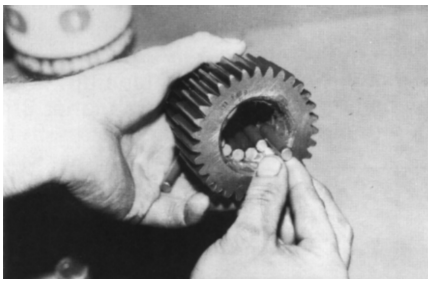
1. Remove two bolts (25) securing disconnect cap (26) to cover (23) and remove cap.
2. Remove two bolts (25) securing cover cap (24) to cover and remove cap.
3. Remove disconnect rod (27) from cap and remove o-rings (28,29) from cover cap. Discard o-rings.
4. If necessary, remove pipe plug (30) from cover.
5. Clean and inspect parts in accordance with step 2. Replace parts as necessary.
6. If removed, screw pipe into cover.
7. Slip o-ring (29) over cover cap and against face.
8. Place o-ring (28) into cover cap internal groove. Disconnect rod may be used to push o-ring into groove.
9. Place cover cap into cover with large hole located over pipe plug. Secure cover cap to cover with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 NM).
10. Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 NM).
11. Turn cover over and push disconnect rod into cover cap. Rod will be held in place by friction from o-ring.

Carrier Assembly.

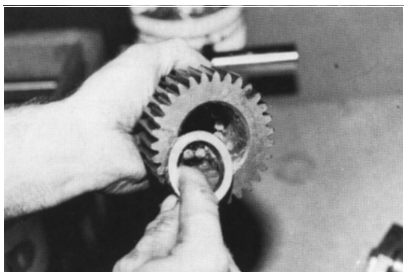
1. Drive anti-roll pin (19) into planet (17) using a suitable punch.
2. Using a suitable press, press planet shaft from carrier 13. After planet shaft is removed, drive anti-roll pin from shaft.
3. Remove cluster gear (18) and thrust washers (20,14) from carriers.
4. Remove sixteen needle rollers (15) from cluster gear bore.
5. Remove spacer (16) from cluster gear bore and remove second set of sixteen needle rollers (15).
6. Repeat steps 1 thru 5 for remaining two cluster gears.
7. Clean and inspect all parts in accordance with paragraph b. Replace parts as necessary.
8. Apply a coat of grease or petroleum jelly to cluster gear bore.



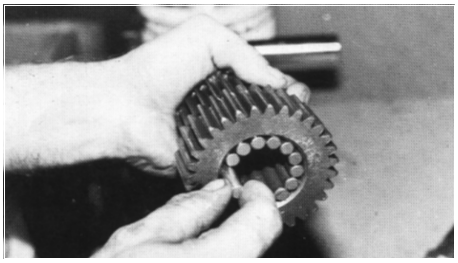
9. Place sixteen needle rollers into cluster gear bore.



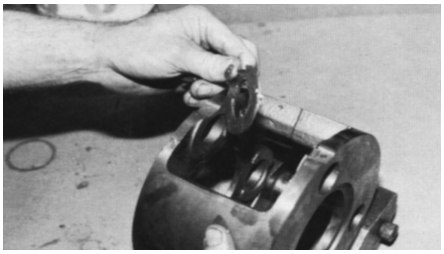
10. Place spacer into opposite side of cluster gear and against needle rollers.



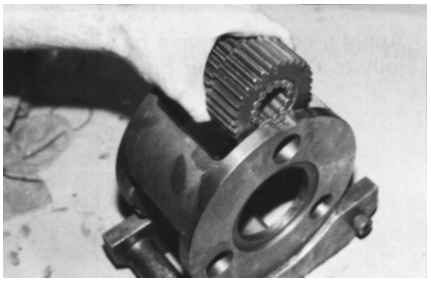
11. Place second set of sixteen needle rollers into cluster gear.



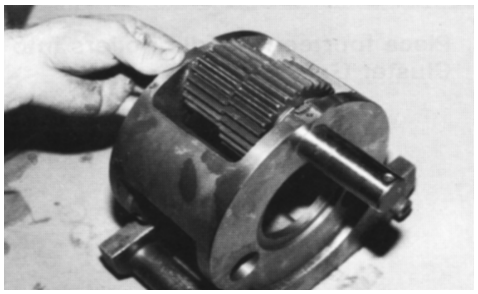
12. Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.



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



14. 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.



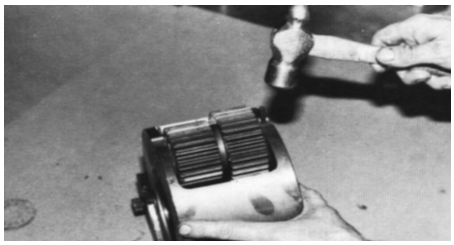
15. Drive anti-roll pin flush into carrier hole, locking planet shaft into place.
16. Repeat steps 8 thru 15 for remaining two cluster gears.

Input Shaft Assembly

⚠ CAUTION

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

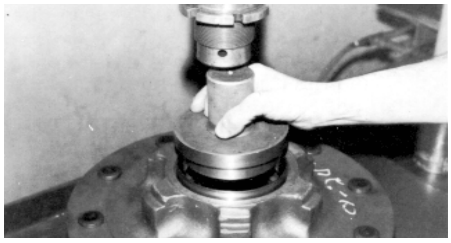
1. Carefully remove retaining ring (34) from input shaft (35) and discard retaining ring.
2. Remove two spacers (31) and spring (32) from input shaft.
3. Clean and inspect all parts as outlined under Cleaning and Inspection.



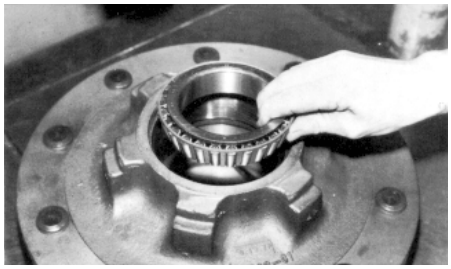
4. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.

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

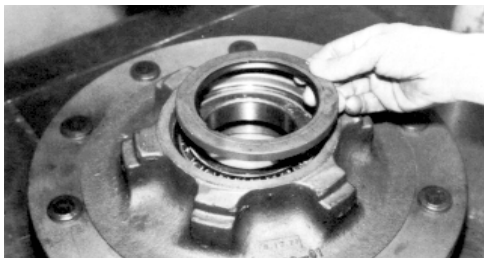
Assembly



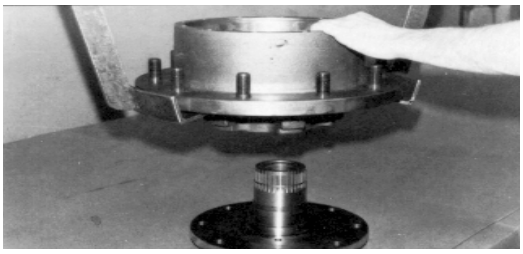
1. Using a suitable press, press new bearing cups (3,5), with large inside diameters facing out, into hub (7) counterbores.



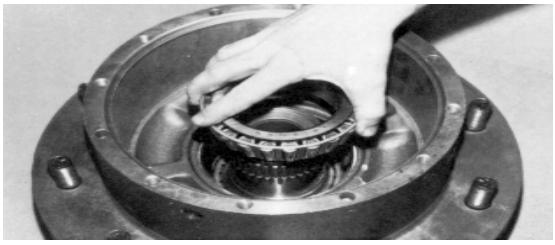
2. Place bearing cone (4) into bearing cup (3) in small end of hub.



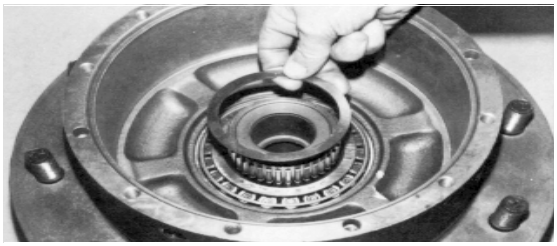
3. Press new seal (2) into hub counterbore with flat metal side facing in. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.



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



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

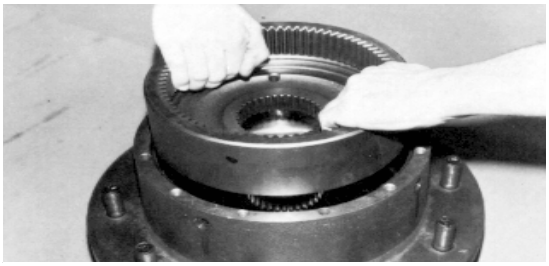


6. Place bearing shim (8) over end of spindle and against bearing cone.

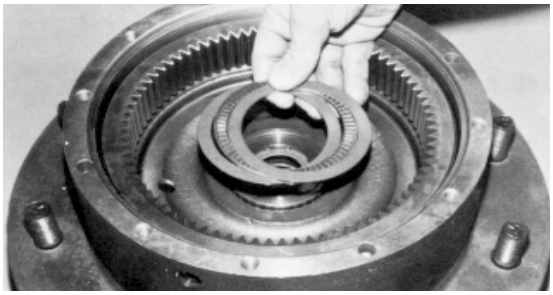
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

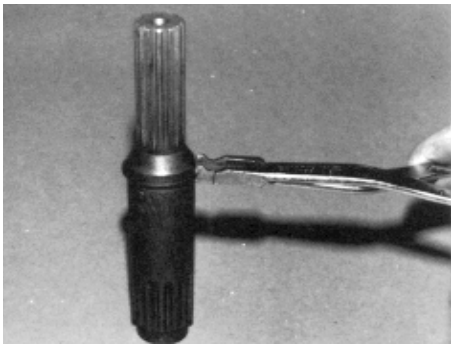
7. Install new retaining ring (9) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.



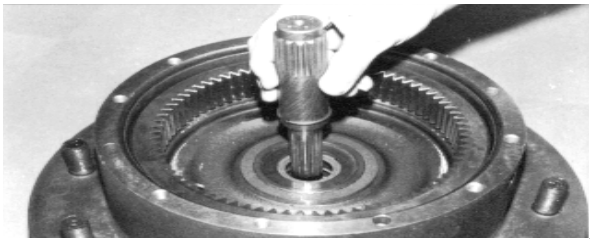
8. Place internal gear (12) onto end of spindle.



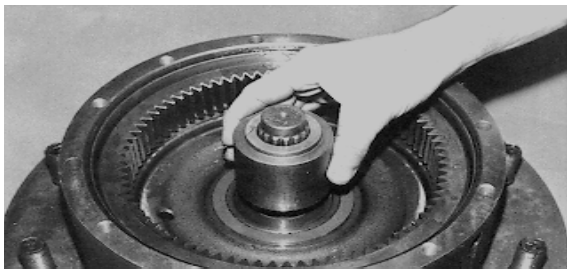
9. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.



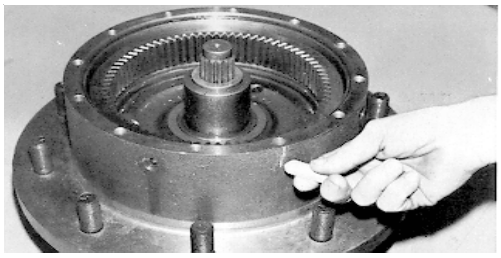
10. Install retaining ring (34) into input shaft retaining ring groove.



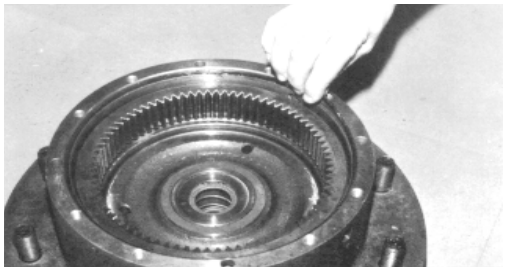
11. Place input shaft assembly into spindle bore with unsplined end facing out.



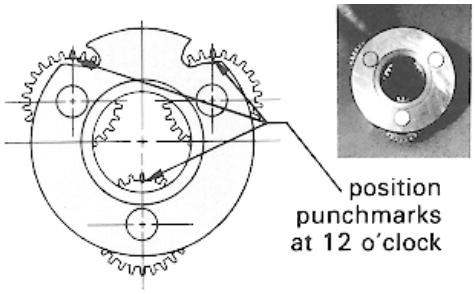
12. Place thrust spacer (36) over input shaft (35) with counterbore side facing spindle.



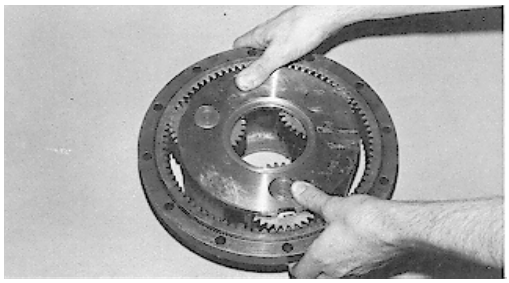
13. Locate the four counter-reamed holes in the face of the hub, mark them for later identification.



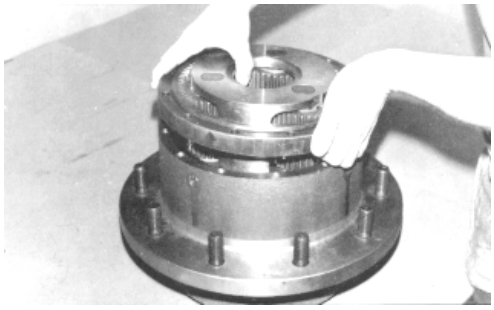
14. Place o-ring (22) into hub counterbore. Use petroleum or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.



15. Place carrier assembly on a flat surface with large gears up and positioned as shown above. 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.

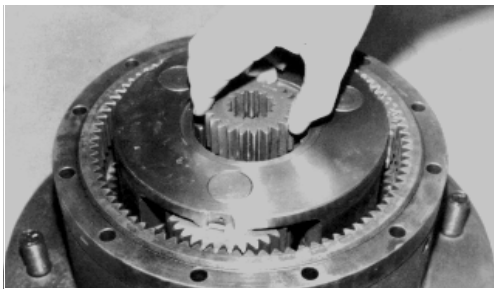


16. With shoulder side of ring gear (21) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation.

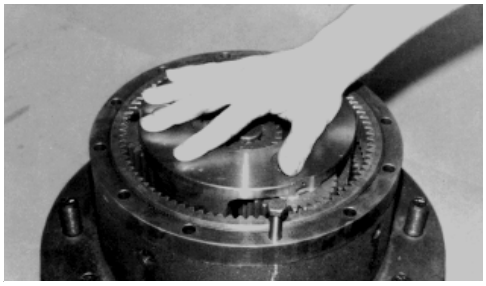


17. While holding ring gear, input gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked X over one of counterbored holes in hub.

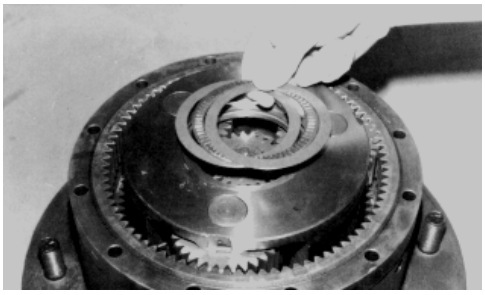
NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster timing.*



18. Install input gear (37) into carrier, meshing with small diameter cluster gears (18). Counterbore 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.

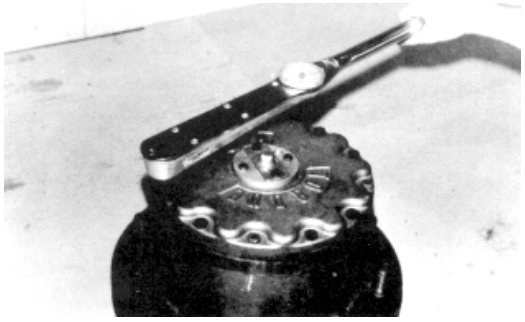


20. Install thrust washers and thrust bearing (39, 40) into carrier counterbore.

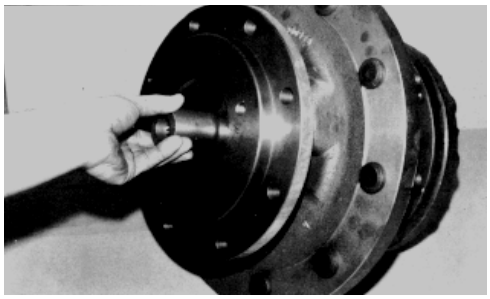
21. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place.

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 counterbored holes in hub marked in step (16). Torque shoulder bolts to 23-27 ft. lbs. (31-36 NM).



24. Install bolts (41) in remaining holes. Torque bolts to 23-27 ft. lbs. (31-36 NM).

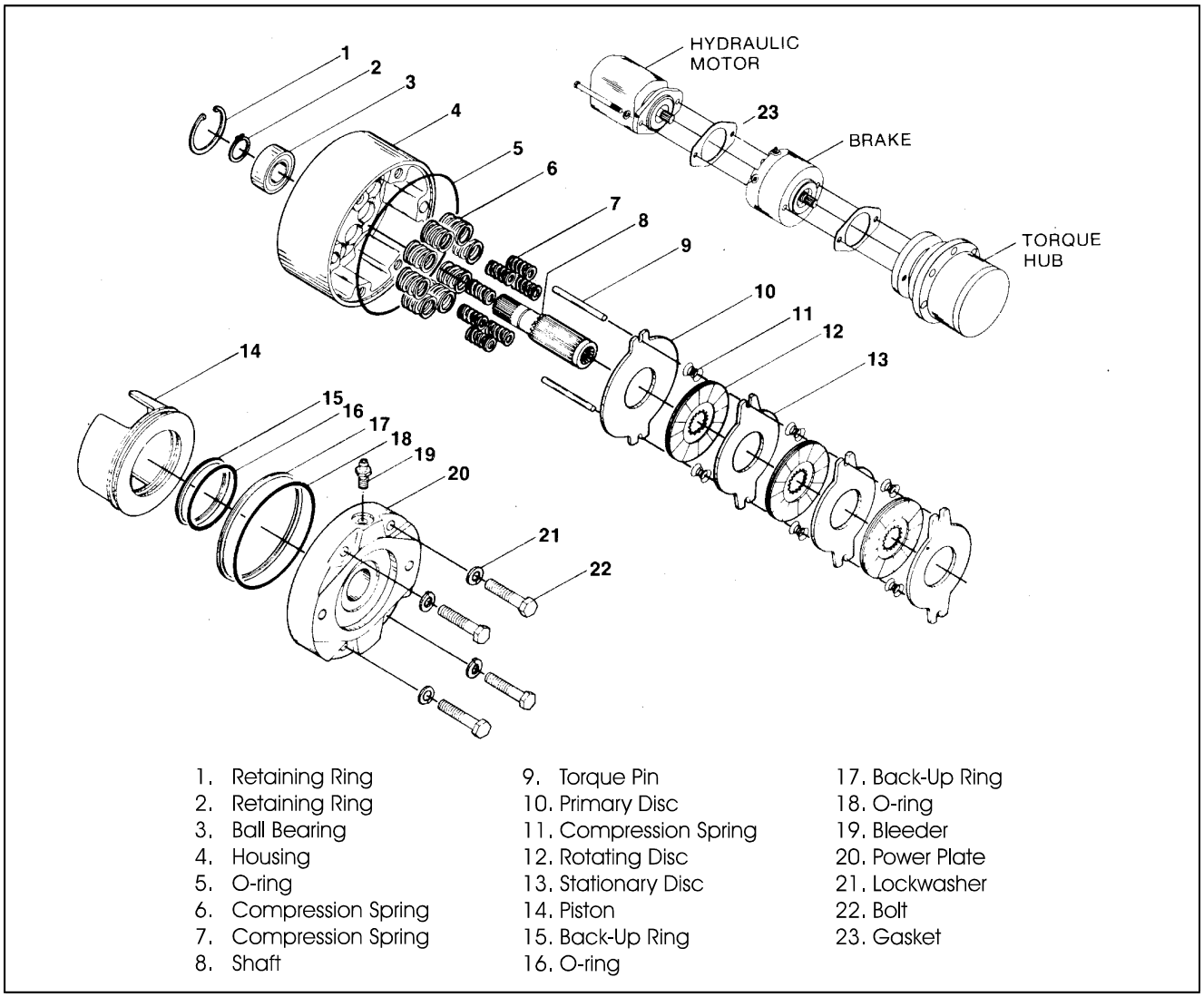


25. Place coupling (43) into spindle and onto input shaft.
26. Fill hub one-half full of EPGL 90 lubricant before operation.

3.2 DRIVE BRAKE, AUSCO - MACHINES BUILT PRIOR TO OCTOBER 1987

Disassembly

1. When shaft protruding downward, remove bolts (23) alternately and evenly to reduce spring tension.
2. Remove power plate (20), o-ring (5), stationary discs (13), springs (11), rotating discs (12), primary disc (10), pins (9), springs (6,7) and spring retainer (if so equipped).
3. Further disassembly is not recommended unless necessary for the replacement of specific parts.
4. If further disassembly is required, remove snap rings (1,2), then remove shaft (8) from bearing (3) by lightly tapping shaft with a plastic mallet.
5. Remove bearing from housing.
6. Remove piston (14) from the power plate (20) by introducing low pressure air (15 PSI) into hydraulic inlet. Make sure piston is directed away from operator. Remove o-rings (15,17) from the piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.
7. Bleeder (19) can be removed and inspected to assure spring loaded ball moves freely and is free of contamination.



1. Retaining Ring
2. Retaining Ring
3. Ball Bearing
4. Housing
5. O-ring
6. Compression Spring
7. Compression Spring
8. Shaft
9. Torque Pin
10. Primary Disc
11. Compression Spring
12. Rotating Disc
13. Stationary Disc
14. Piston
15. Back-Up Ring
16. O-ring
17. Back-Up Ring
18. O-ring
19. Bleeder
20. Power Plate
21. Lockwasher
22. Bolt
23. Gasket

Figure 3-2. Drive Brake, Ausco - Machines Built Prior to October 1987

Cleaning and 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, o-rings, cylinder of power plate and piston with clean hydraulic oil prior to assembly.*

1. Use the reverse of the disassembly procedure with the following notes and additions.
2. Worn o-rings and damaged or worn teflon back-up rings must be replaced prior to assembly.
3. If replacement of bleeder (19) is necessary, install 1/2 to 3/4 turns beyond finger tight.
4. Assemble piston (14) into power plate (20) using a shop press, being careful not to damage the o-rings or teflon back-up rings. Visually align the center of the cutouts in the piston with the torque pin (9) holes in the power plate.

5. Rotating discs (12) must be clean and dry, with no presence of oil on any lining material or mating surface or the stationary discs 13.
6. Install bolts (23). Tighten sequentially one turn at a time, until power plate (20) is properly seated. Torque to 50-60 ft. lbs. (68-81 NM).

3.3 DRIVE BRAKE, MICO - MACHINES BUILT PRIOR TO OCTOBER 1987

Disassembly

1. Remove end cover (4) from housing (25) by removing capscrews (1) and lockwashers 2.

⚠ WARNING

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 1500 POUNDS (681 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Tap cover with a soft mallet in order to dislodge bearing (7) from cover.
3. Remove o-ring (6), square ring (5), pipe plug (3) and bleeder screw (13) from end cover.
4. Remove piston (10) from end cover by inserting two 1/4-20 UNC bolts into threaded holes in piston. By turning and pulling, piston can be removed from bore.
5. Remove o-ring (8), back-up ring (9), o-ring (11) and back-up ring (12) from piston (24).
6. Remove separators (18) from housing (25).
7. Remove shaft assembly, consisting of shaft (14), discs (15,19), and friction discs (17), springs (16) and bearings (7,23), from housing by pressing or using a soft mallet on male end of shaft.
8. Remove springs (16) from between tabs of discs (15,19).
9. Remove bearings (7,23) from shaft using an appropriate bearing puller. The discs and friction discs will then slide off either end of shaft.
10. Remove dowel pins (22), springs (20,21) and oil seal (24) from housing (25).

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 re-used 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. Insert new oil seal (24), dowel pins (22) and springs (20,21) in housing (25).
2. Install new bearing (23) on male end of shaft (14) and press until it shoulders on shaft.
3. Insert shaft and bearing on housing (25) and press until bearing bottoms on shoulder in housing.
4. Position large diameter disc (19) in housing, with tabs guided by dowel pins (22), until disc rests on springs (20,21).

⚠ CAUTION

DISC (15,19) AND FRICTION DISCS (17) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.

5. Place friction disc (17) on shaft until it contacts bottom disc (19). Insert one spring (16) on each dowel pin (22).

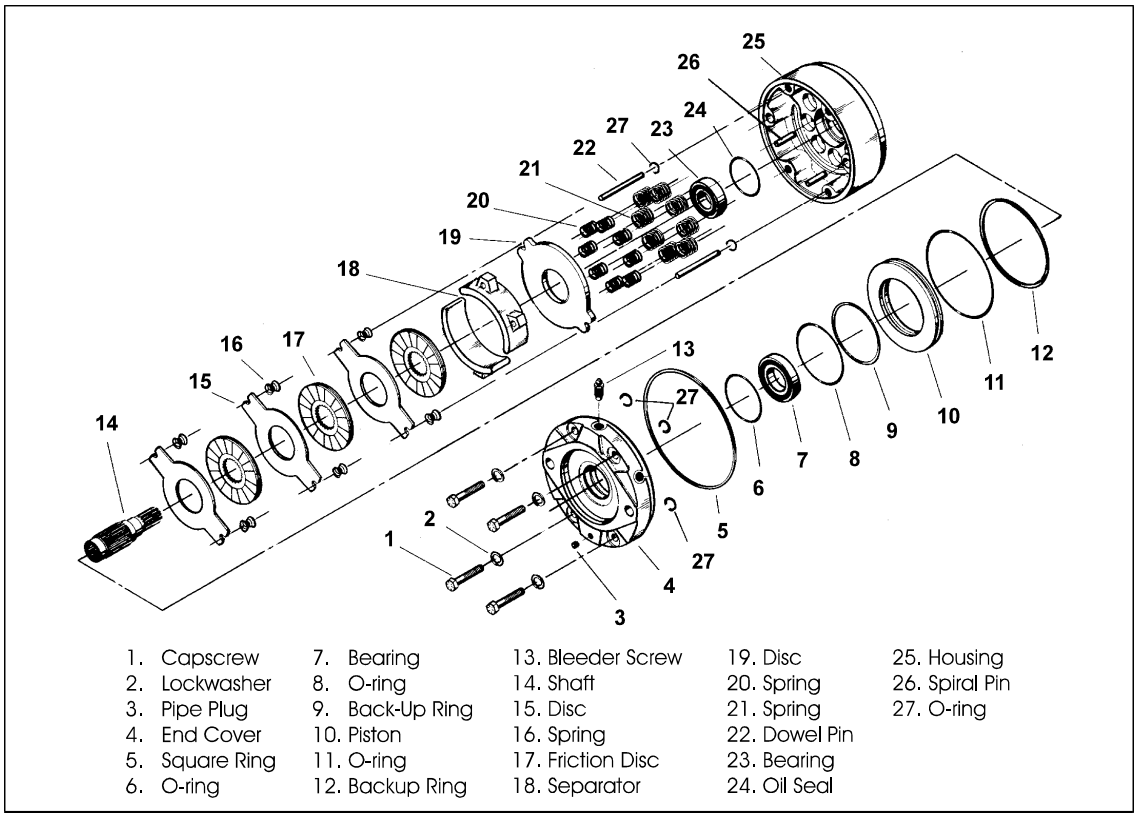


Figure 3-3. Drive Brake, Mico - Machines Built Prior to October 1987

6. Add additional discs (15), friction discs (17), and springs (16) as required to complete assembly. Alternate discs and friction discs during assembly.
7. Insert separators (18) over spiral pins in housing. When properly installed, separators will contact top of bottom disc.
8. Install o-ring (8), back-up ring (9), o-ring (11) and back-up ring (12) on piston 10. Insert piston into end cover (4), being careful not to shear o-rings or back-up rings. Inserting 1/4-20 UNC bolts in piston may simplify installation.
9. Install o-ring (6), bearing (7), square ring (5), pipe plug (3) and bleeder screw (13) in end cover.
10. Position end cover on housing, aligning dowel pins with holes in cover, and push end cover until top friction disc aligns with spline shaft.
11. Install capscrew (1) and lockwashers 2. Tighten evenly to draw end cover to housing and bearing onto shaft. Torque capscrews to 55 ft. lbs. (75 NM).

NOTE: *If available, a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening capscrews.*

12. To eliminate binding on bearings, press on inner ring of bearing (7) until it shoulders on shaft. Restrain opposite end of shaft to avoid excessive thrust loading of bearing (24).

⚠ CAUTION

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

Bleeding

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

3.4 DRIVE BRAKE, AUSCO - MACHINES BUILT PRIOR TO 1992

NOTE: *This drive brake was used on 80HX 2WD from October 1987 to January 1992, 80HX 4WD Prior to February 1991, and 80H 2WD and 4WD from October 1987 to January 1992.*

Disassembly

1. With shaft protruding downward, remove bolts (22) alternately and evenly to reduce spring tension.
2. Remove power plate (21) and gasket 2.
3. Bearing (18) is pressed onto shaft (7) and must be removed before removal of rotating discs (11) and stationary discs 12.
4. Further disassembly is not recommended unless necessary for the replacement of specific parts.
5. If further disassembly is required, remove shaft (7) and stack sub-assembly from housing (1) by lightly tapping or pressing on the small external spline end of the shaft and removing the shaft, bearings and stack from housing.
6. Remove bearing (18), stationary disc (12), rotating disc (11), springs (10) and primary disc 9.
7. Remove bearing (3) from shaft using care not to damage seal 4. Remove seal 4.
8. Remove springs (6) and spring retainer (5) from housing.
9. Remove piston (13) from power plate by introducing low pressure air (15 PSI) into hydraulic inlet. Direct piston away from operator.
10. Remove o-rings (15,17) and back-up rings (14,16) from piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.
11. Pressure relief valve (23) can be removed and inspected to assure spring loaded ball moves freely and is contamination free.

Cleaning and 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, o-rings, cylinder of the power plate and piston with clean hydraulic oil prior to assembly.*

1. Assemble piston (13) into power plate (21) using a shop press, being careful not to damage the o-rings or back-up rings. Visually align the center of the cut-outs in piston (13) with torque pin (8) holes in power plate (21). Avoid pushing the piston all the way to the bottom of the cylinder in the power plate. Try to keep the top surface of the piston flush to 1/8"(0.32 cm) below the machined surface of the power plate.
2. When pressing the bearing onto the shaft, press on the inner race of the bearing and support the shaft properly.
3. Rotating discs must be clean and dry. Worn or heavily scored rotating discs must be replaced.
4. Press bearings (3) into housing 1. Bearing must be seated against shoulder in housing.

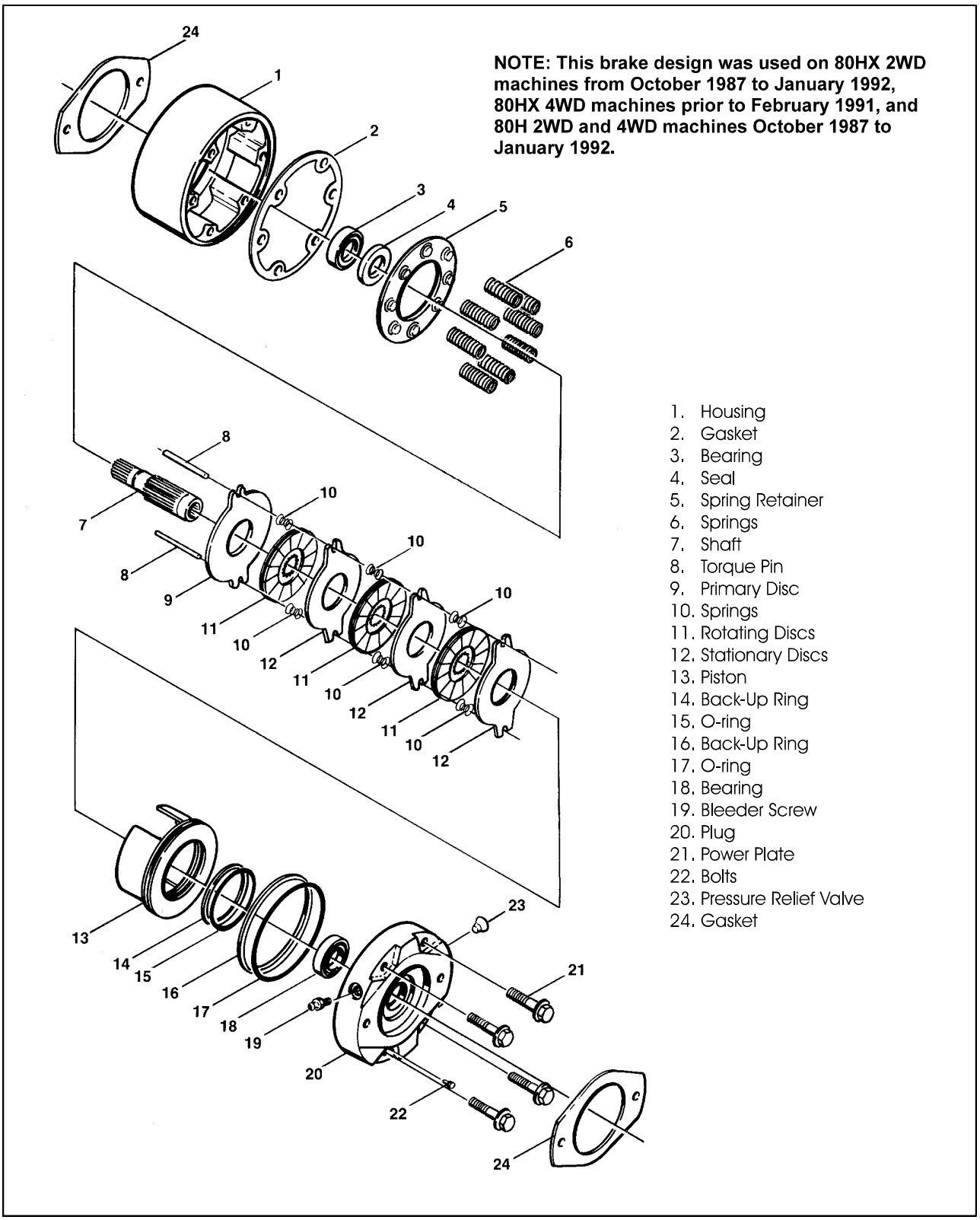


Figure 3-4. Drive Brake, Ausco - Machines Built Prior to 1992

5. Using a shop press install seal (4) by pressing evenly around O.D. of seal. Use care to avoid cocking.
6. Install shaft (7) into housing. Support the inner race of bearing (3) when pressing shaft into bearing.
7. Install gasket 2. Align properly. After installing all the remaining internal components of the brake, install bearing (18). Properly support the shaft when pressing the bearing onto shaft.
8. Install the power plate sub-assembly. Use a shop press to evenly lower plate into position. There should be no gap at the O.D. when the power plate is properly seated against housing. If a shop press is not available, use the assembly bolts (22). Tighten sequentially one turn at a time until the power plate is properly seated. Torque to 50-60 ft. lbs. (68-81 NM).
9. If replacement of pressure relief valve is necessary, install 1/2 to 3/4 turns beyond finger tight.
10. Bleed air from brake via bleeder screw.

3.5 DRIVE BRAKE, MICO - MACHINES BUILT FROM 1992 TO PRESENT

Disassembly

1. Remove end cover (13) from housing (7) by removing capscrews (12).

⚠ WARNING

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2000 POUNDS (907 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS.

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 (20), back-up ring (21), o-ring (18) and back-up ring (19) from piston (24).
5. Remove separators (10) from housing (7).
6. Remove stack assembly, consisting of shaft (4), return plate (8), and friction discs (22), from housing (7).
7. Remove dowel pins (17), springs (5,6) and spring guide (16) 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) and bearing (2) from shaft (4).
11. Press rotary oil seal (1) from housing (7).

Inspection

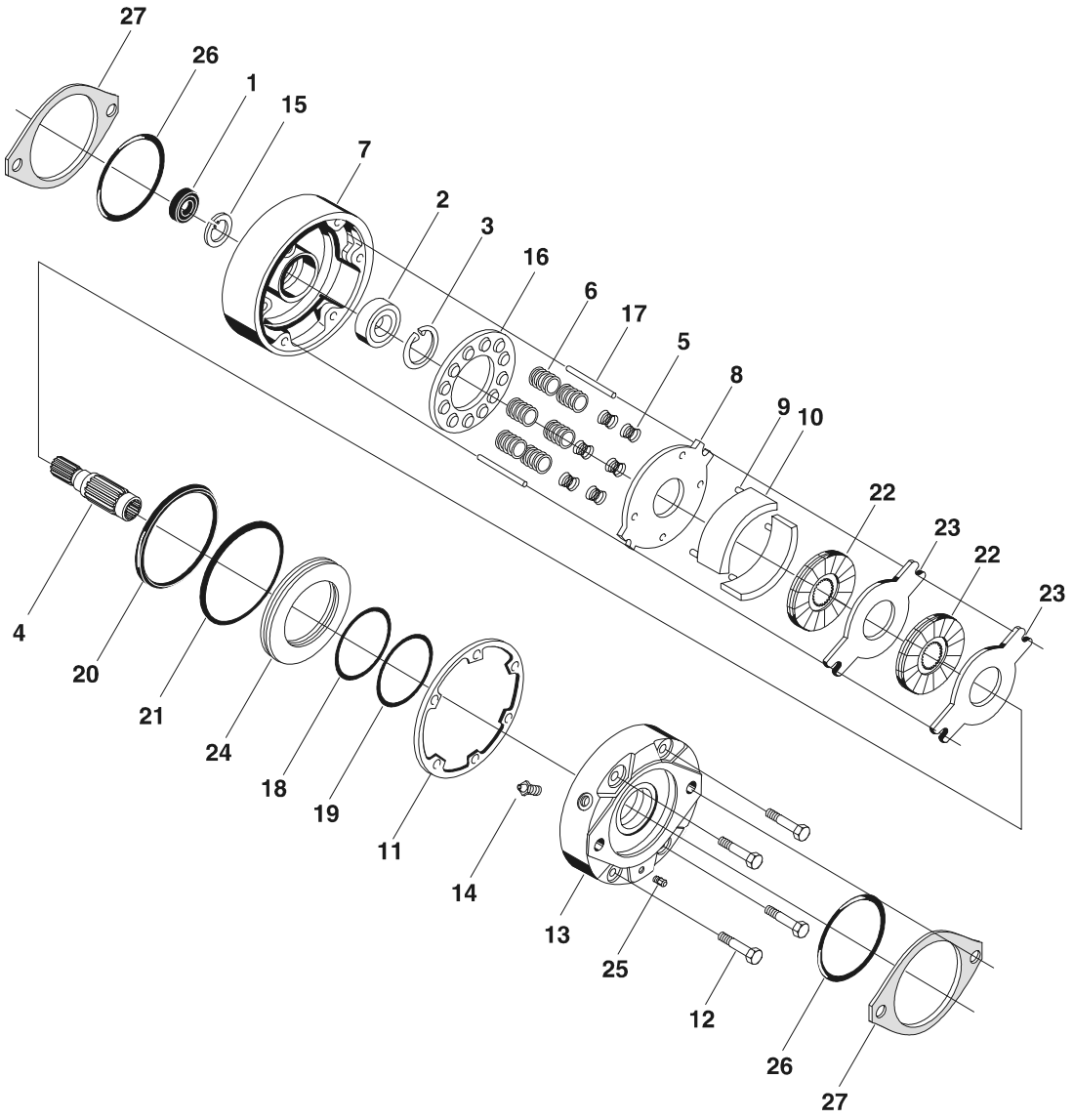
1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks, and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

NOTE: *Bearings may be re-used 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. Clean all parts thoroughly before assembly.
2. Press new rotary oil seal (1) into housing (7). Note direction of seal.
3. Install new bearing (2) and retaining ring (15) on shaft (4).
4. Insert shaft assembly and retaining ring (3) in housing (7).



1. Oil Seal
2. Bearing
3. Retaining Ring
4. Shaft
5. Inner Spring
6. Outer Spring
7. Housing
8. Return Plate
9. Pin
10. Separator
11. Case Seal
12. Washer Head Cap Screw
13. Cover
14. Bleeder Screw
15. Retainer Ring
16. Guide Spring
17. Dowel Pin
18. Back-Up Ring
19. O-Ring
20. Back-Up Ring
21. O-Ring
22. Disc (Rotor)
23. Friction Disc (Stator)
24. Piston
25. Pipe Plug
26. O-Ring
27. Gasket

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Figure 3-5. Drive Brake, Mico - Machines Built from 1992 to Present

5. Insert dowel pins (17), spring guide (16) and springs (5,6) in housing (7) as shown in Figure 3-6., Spring Loading.

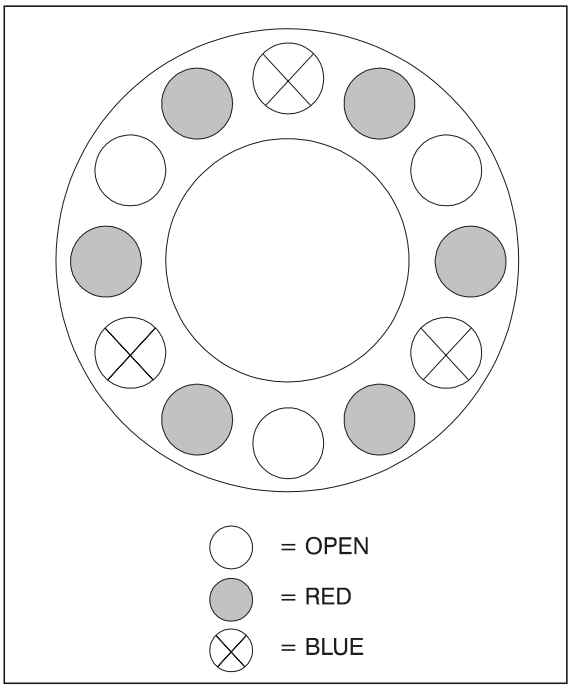


Figure 3-6. Spring Loading

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

⚠ CAUTION

STATORS (23) AND FRICTION DISCS (22) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.

7. Place a new friction disc (22) on shaft (4) until it contacts return plate (8).
8. Add additional new discs (23) and new friction discs (22) as required to complete assembly.
9. Insert separators (10) in holes of return plate (8).
10. Install new o-ring (19), new back-up ring (18), new o-ring (21) and new back-up ring (20) on piston (24). Note order of o-rings and back-up rings. Insert piston (24) into end cover (13) being careful not to shear o-rings or back-up rings.
11. Install new case seal (11) in housing (7) then install bleeder screw (14) in end cover (13).
12. Position end cover (13) on housing (7) aligning dowel pins (17) with holes in end cover.
13. Install capscrews (12) and tighten evenly to draw end cover (13) to housing (7). Torque capscrews to 55 ft. lbs. (75 NM).

NOTE: *If available a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening the capscrews.*

14. If hydrostatic bench testing is performed on the brake assembly, release pressure should not exceed 2000 psi (137 Bar) unless two additional bolts are used for supplemental clamping.

3.6 GOVERNOR CHECKS AND ADECO ADJUSTMENT, LRG423 & LRG425

Checks

(Refer to Figure 3-7.)

1. Check the governor drive belt tension. A belt in operation for 10 minutes or more should be set at 100 ft. lbs. (135 Nm).
2. Check the length of the spring spreader adjustment from the centerline of the eye to the centerline of the eye. This dimension should be 1 5/8 inch.
3. Manually move the governor throttle lever to the maximum high speed position. (The Adeco actuator must be disconnected to accomplish this.) The carburetor throttle lever should have 1/32 to 1/16 inch travel remaining to the stop. The governor high speed stop screw was removed at the factory.

NOTE: *All governor adjustments must be made with Adeco throttle actuator disconnected.*

Adjustments

See Figure 3-7. and Figure 3-8.

1. With the throttle rod and Adeco actuator disconnected from the governor, advance the governor arm to the high speed position. This should advance the governor throttle lever to the maximum wide open position. Verify the wide open position of the lever by checking the governor spring for tension. Reconnect the throttle rod.
2. From the ground control, start the engine. Allow the engine to come up to normal operating temperature. Advance the governor arm to the wide open position. Set the high engine speed at 3000 RPM (2500 RPM for machines with piston pump) by making adjustments at the throttle rod. Return the engine to low speed.
3. If the engine hunts or surges in the maximum speed no load condition, decrease engine speed until surging stops. Increase the speed slowly to 2925 RPM (2425 RPM for machines with piston pump). Slowly turn the governor surge screw clockwise until the no load engine speed increases to 3000 RPM (2500 RPM for machines with piston pump). Lock the surge screw in position. Shut off the engine.

NOTE: *Do not turn the surge screw in any further than necessary or governor performance will be affected.*

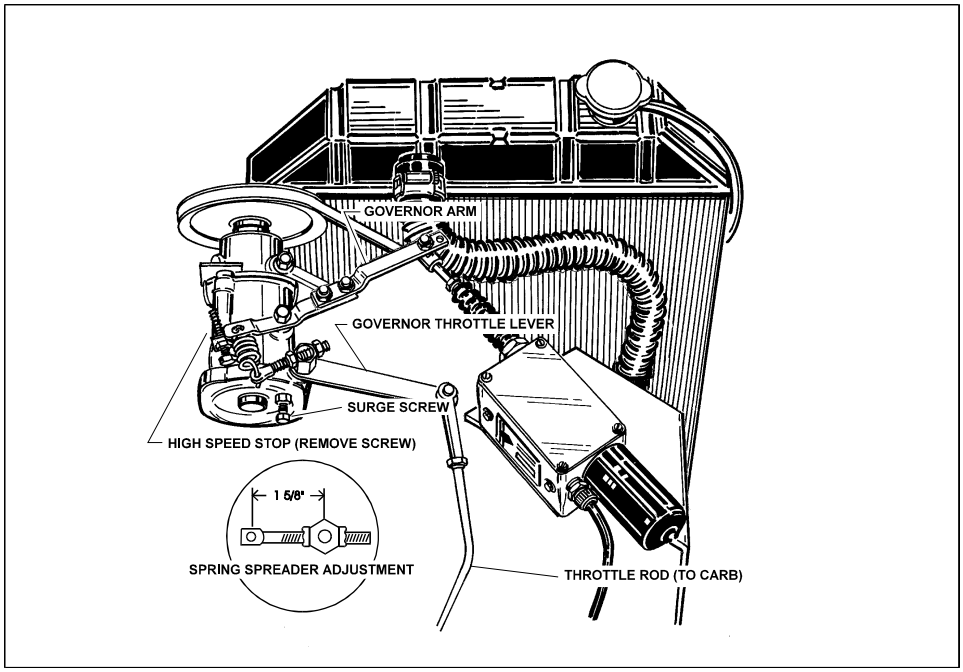


Figure 3-7. Governor Adjustment, LRG-423 & LRG-425 with Adeco

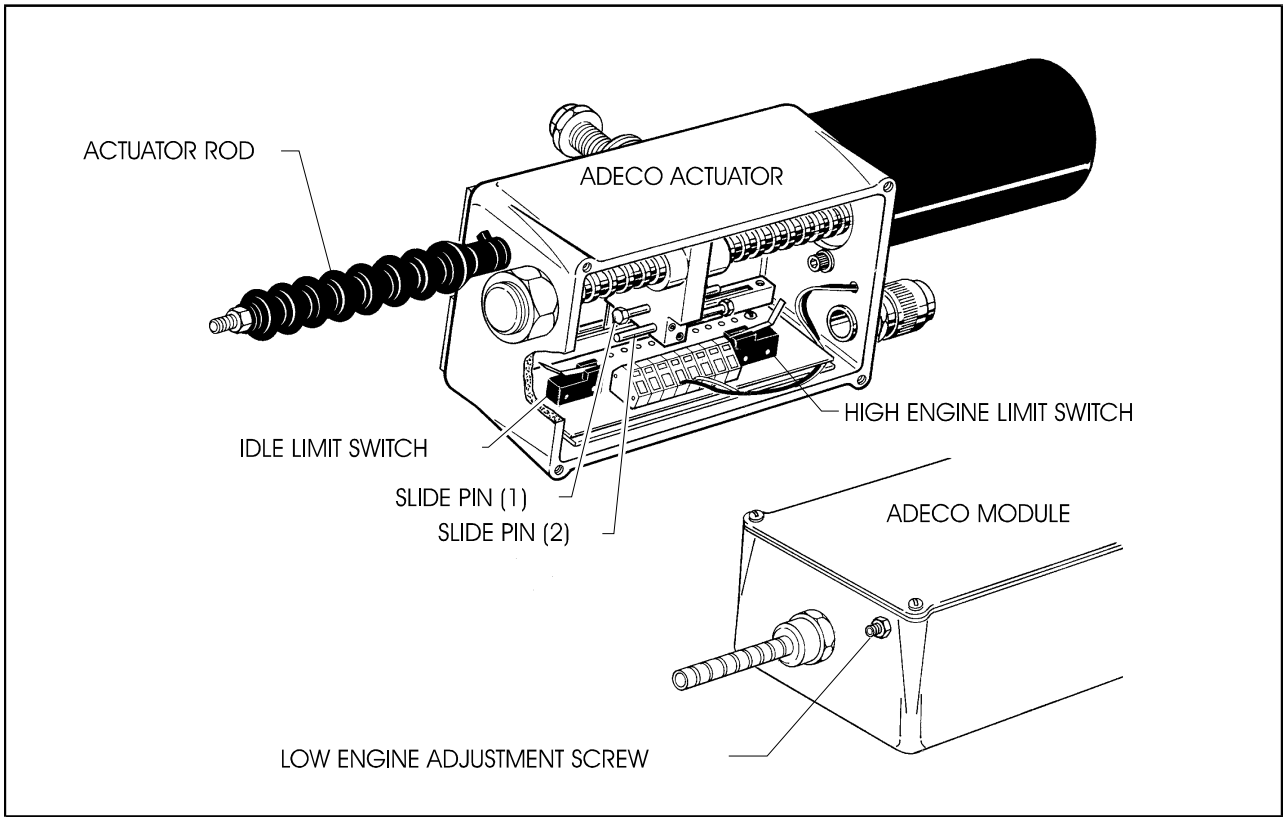


Figure 3-8. Adeco Adjustment, LRG-423 & LRG-425

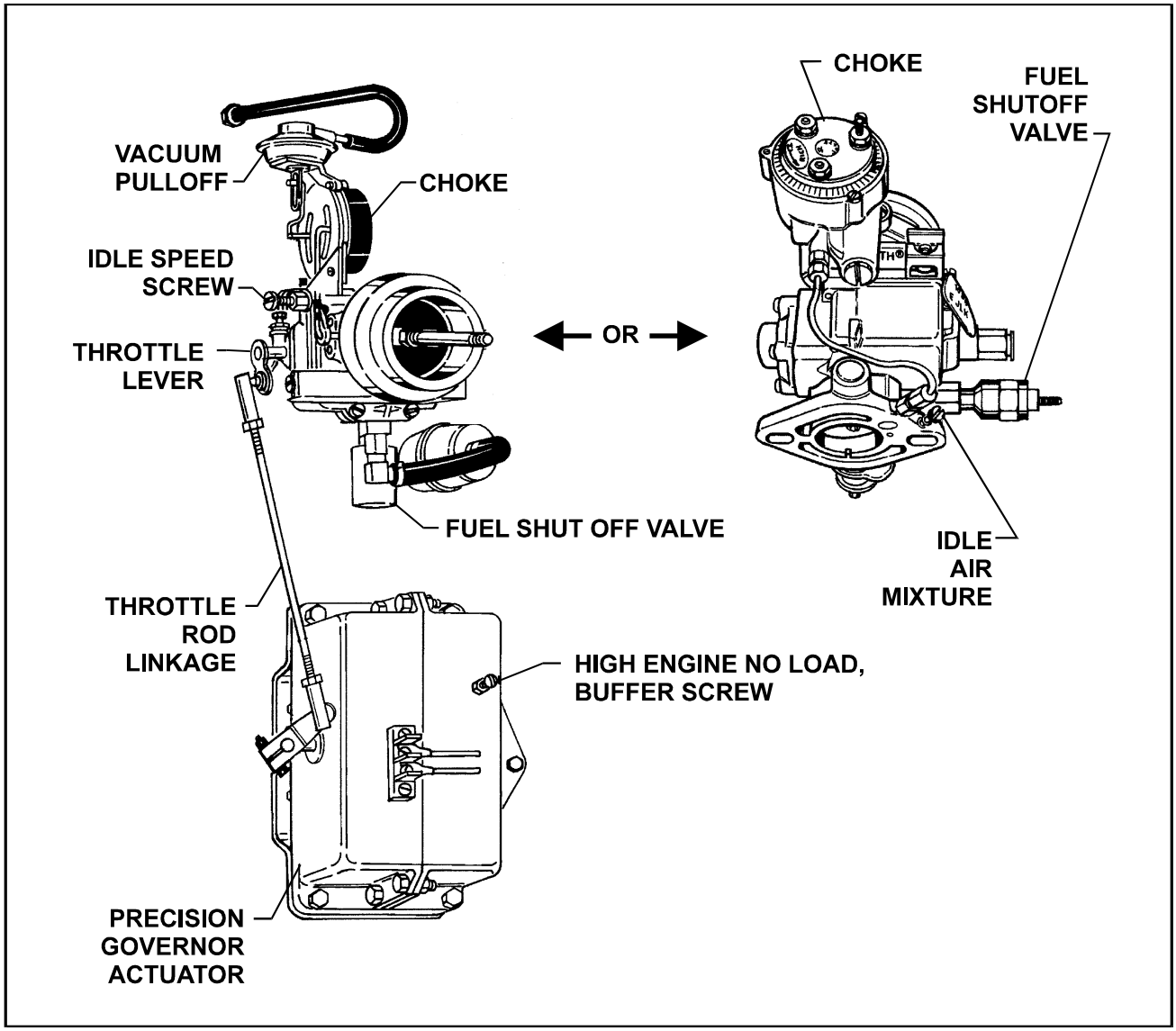
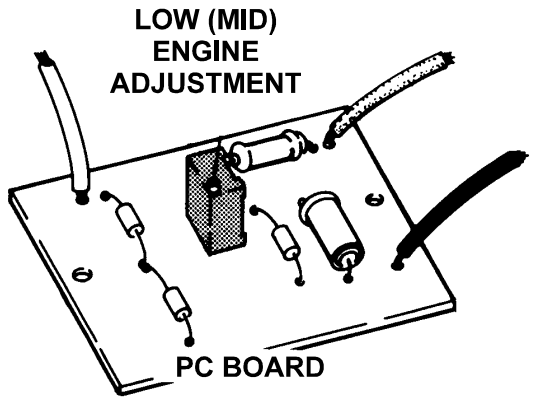


Figure 3-9. Precision Governor Adjustment - LRG-423 & LRG-425 (Sheet 1 of 2)



NOTE

All pots should be sealed with finger nail polish or its equivalent after all adjustments are completed.

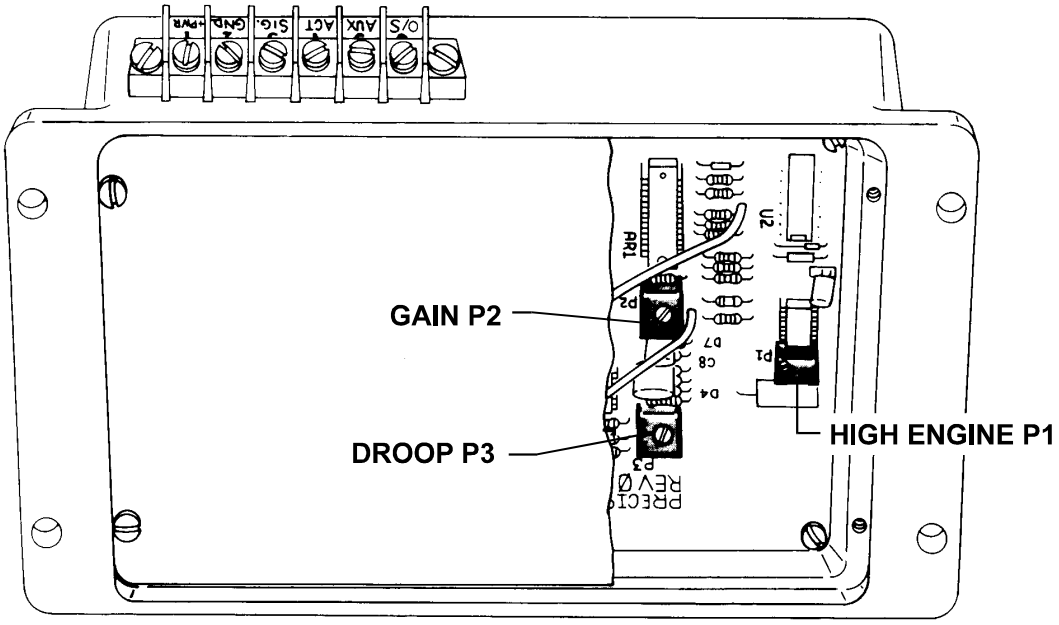


Figure 3-10. Precision Governor Adjustment - LRG-423 & LRG-425 (Sheet 2 of 2)

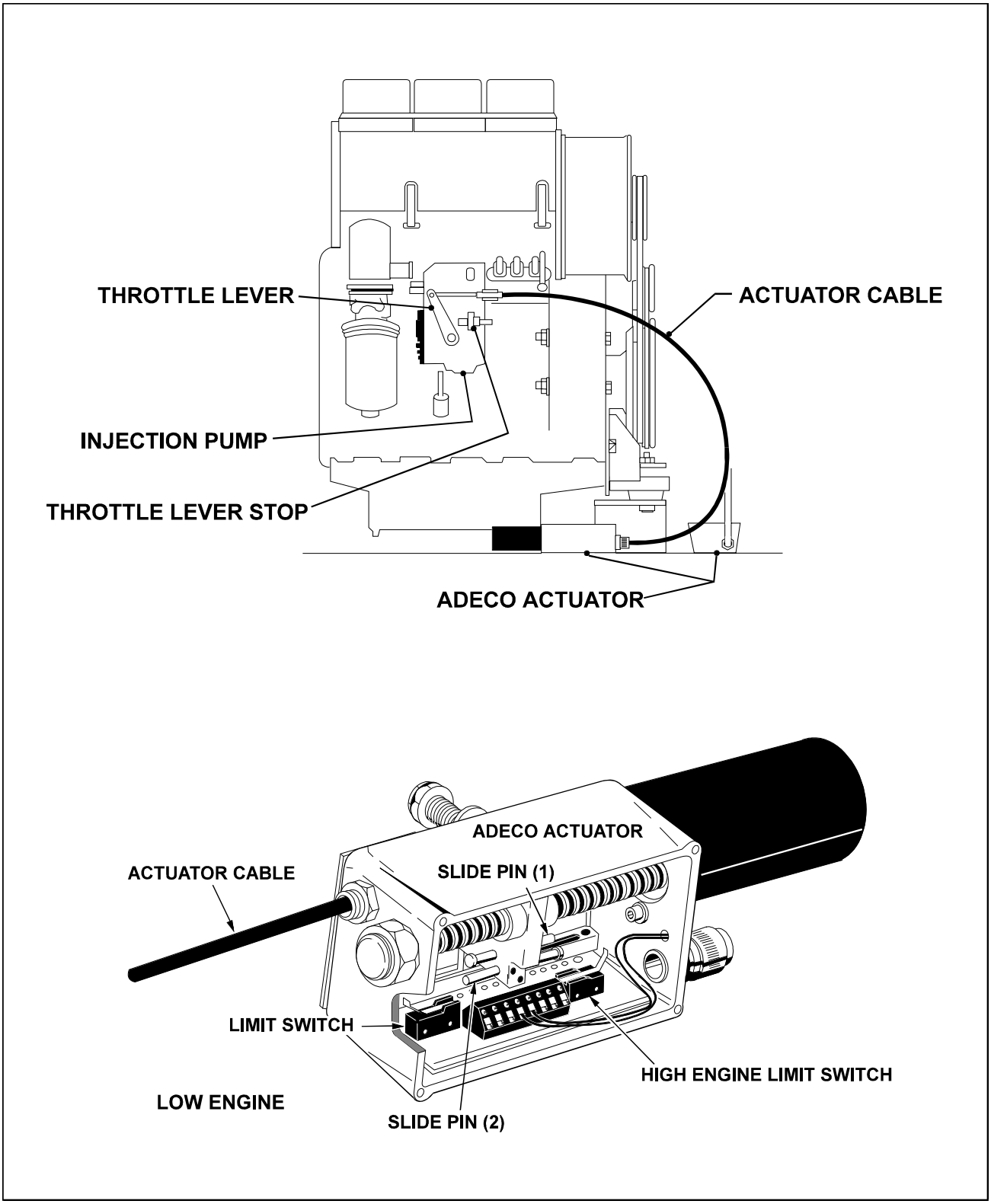


Figure 3-11. Adeco Actuator Adjustments - F4L912

1. From the basket (for idle) start the engine and allow it to come up to operating temperature. Set the idle speed at 1000 RPM using the idle adjustment screw on the carburetor. Shut off the engine.
2. Remove the cover on the Adeco actuator. With no function activated, the actuator should be fully extended. Hold the governor arm in the idle position. Adjust slide pin (1) to contact the idle limit switch at the output rod end of the actuator. Adjust the actuator rod until you can hook it up to the governor arm.
3. With the aid of an assistant, start the engine from the basket and allow it to come to operating temperature. Disconnect the proportional dump valve wire. Activate the footswitch. Turn the high engine switch on. Hold the drive controller in the full drive position. Adjust the slide pin (2) to contact high engine limit switch at 3000 RPM (2500 RPM for machines with piston pump). Shut off all switches and controllers. Reconnect proportional dump valve wire.
4. With the aid of an assistant, start the engine from the basket and allow it to come to operating temperature. Disconnect the bang-bang dump valve wire. Activate the footswitch. Operate a bang-bang function switch to increase RPM to low engine speed. Using a small screwdriver set low engine speed at 1800 RPM at the Adeco electronic module.

NOTE: *Early machines are at idle until a function is activated. Later machines are at idle only at the platform without the footswitch activated. Therefore when setting low engine speed on later machines it will not be necessary to disconnect the bang-bang dump valve wire or operate a bang-bang function. Just activate the footswitch to get low engine speed.*

3.7 THROTTLE CHECKS AND PRECISION GOVERNOR ADJUSTMENTS, LSG-423 & LRG-425

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

Checks

1. Check that the anti-dieseling solenoid is operating. If the solenoid is operating, an audible click at the carburetor should be heard when the ignition is switched on.
2. Check the throttle linkage for smooth operation by rotating the throttle lever by hand to the full throttle position then slowly back to the idle position, feeling closely for sticking or binding. To accomplish this the throttle rod must first be disconnected.

Carburetor and Governor Adjustment

1. With the aid of an assistant, start the engine at the platform console and allow it to come up to operating temperature with air cleaner installed. Adjust the carburetor idle screw until the engine idles at 1000 RPM. Shut down the engine.

NOTE: *Steps 2 and 3 are preliminary settings.*

2. On the controller (in ground control box) turn the "high engine." (P1) adjusting screw 25-30 turns CCW, then 10 turns CW.
3. On the controller (in ground control box) turn the "gain" (P2) adjusting screw CCW to the stop, then CW until the screw slot is vertical (approximately 1/4 turn).
4. On the controller (in ground control box) turn the "droop" (P3) adjusting screw CCW to the stop, then CW until the screw slot is vertical (approximately 1/4 turn). No further adjustment should be necessary to "droop" (P3).
5. With the aid of an assistant at the platform console, start the engine and allow it to come up to operating temperature. Then have the assistant depress the footswitch and place the engine speed switch to HIGH ENGINE.

6. If engine surging occurs at this point, turn the “gain” (P2) adjusting screw CCW until surging ceases. Turn the “high engine” (P1) adjusting screw until the engine runs at 3000 RPM (2500 RPM for machines with piston pump). Turning the screw CW increases RPM. Turning the screw CCW decreases RPM.
7. While the assistant continues to depress the footswitch, have the assistant place the engine speed switch to LOW ENGINE. Turn the “low (mid) engine” adjusting screw until the engine runs at 1800 RPM. Turning the screw CW increases RPM. Turning the screw CCW decreases RPM. Shut down the engine. Seal all trim pots when finished with finger nail polish or an equivalent sealer.

NOTE: *If the engine surges under no load, on HIGH ENGINE and you cannot get enough response from adjusting “gain” (P2), try adjusting the surge screw on the actuator. Loosen the surge screw locknut. Disconnect the throttle linkage. Turn the surge screw CW until linkage arm moves. Manually stroke the linkage fully and allow it to return slowly until it stops. Try to move the linkage towards the return position. If the linkage moves, turn the surge screw CCW 1/2 turn. Again stroke the linkage and allow it to return slowly until it stops. Try to move the linkage towards the return position. If the linkage moves, turn the surge screw CCW 1/2 turn. Repeat this procedure until the linkage does not move after stroking. Do not turn any more. This will set the buffer spring tension properly. Reconnect the throttle linkage.*

8. With the engine speed switch set to LOW ENGINE, when the footswitch is depressed the engine should immediately respond. If response time lags, turn the “gain” (P2) adjusting screw CW to improve response time. Turn the adjusting screw in small increments only until response time is correct. Turning the adjusting screw too far CW can cause surging (see step 7 above).

3.8 E331 PRECISION GOVERNOR AND ADJUSTMENTS - FORD ENGINES

General

These instructions presume no electrical test equipment other than a multimeter for making the electrical measurements called for on the following pages. If no suitable meter is available, an inexpensive but adequate meter, part number 22-188 is available from any local Radio Shack store.

Many "governor problems" are due to installation problems, particularly in first time applications. Careful attention to the directions provided will result in a successful installation made in the least amount of time.

Quick-start Installations

If you are experienced in installing and adjusting Electric Governor, follow these steps. Otherwise refer to the more detailed instructions starting with "Mounting-Actuator".

1. Mount Actuator rigidly to engine location which will permit a short, straight linkage to the carburetor or fuel valve. Avoid very hot areas.
2. Mount controller in a dry, fairly cool location. Accessibility for adjusting is required
3. Wire per appropriate included schematic, using #16 wire.
4. Set up fuel linkage. This is critical, so review the section titled "LINKAGE".
5. Hold linkage for safety, and start the engine.
6. Adjust engine speed to desired valve using High Engine pot. (See E-331 Electronics - Adjustment Locations.)

Mounting-Actuator

The Actuator may be mounted in any attitude - there is no preferred orientation

With no power applied, the actuator is spring loaded to the minimum fuel position. The Actuator output shaft rotates toward the maximum fuel position against this spring through electrical power from the controller. This rotation is CW (clockwise) on one side of the Actuator, and CCW (counterclockwise) on the other. If necessary, reverse the Actuator on its mounting plate so that the desired direction of rotation is on the desired side to match the fuel system direction of travel.

Before selecting the mounting location, consider the linkage that will be required to connect the Actuator output arm to the butterfly or fuel valve. Read the following section on linkages before deciding on a mounting location.

1. Mount Actuator rigidly to the engine location witch will permit a short, straight linkage to the carburetor or fuel valve. Avoid very hot areas.

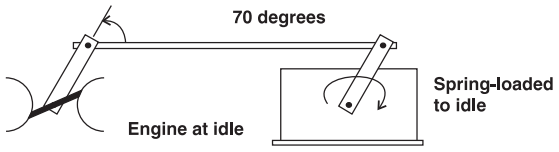
Linkage

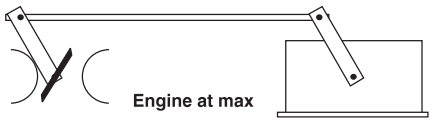
1/4 -28 threaded rod and low friction rod-end bearings are recommended for linkage materials.

Keep the linkage as short and as straight as possible.

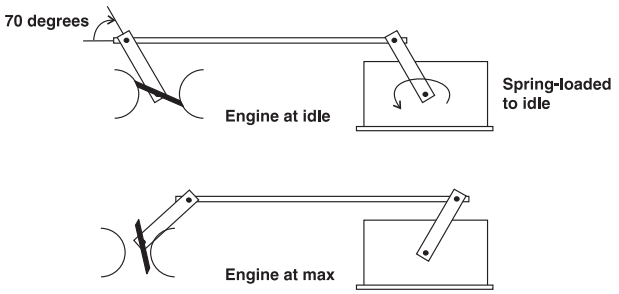
The linkage must not rub against the engine, brackets, hoses, etc. The linkage must be free of friction and lost motion or "slop"

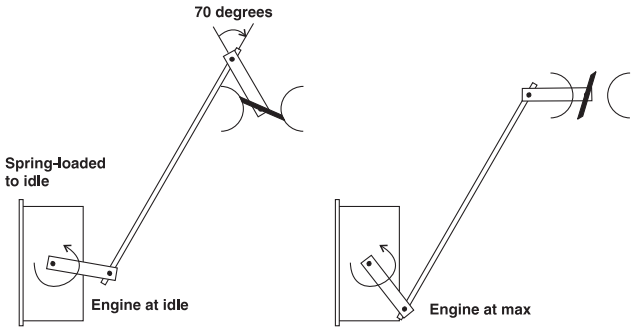
The following sketch indicates the proper linkage geometry for most installations.





Note that the angle between the carburetor arm and the rod is 70 degrees with the engine at idle.This is very desirable! Note also that the Actuator arm travels equally on either side of a 90 degree angle with the rod. This angular arrangement will give the proper mechanical gain for good stability and performance. It may be necessary to rotate the carburetor arm relative to the butterfly to achieve this. This can usually be done, and is usually worth the effort! Below are some workable installations, with good linkages. Remember, the Actuator can be turned 180 degrees on its mounting to "reverse" the spring-loaded direction. Also the Actuator can be Mounted in any attitude.





The needed travel of the carburetor determines how far out the Actuator arm the rod is to be attached. Inmost cases, The carburetor should be moved from closed to above 10 degrees from full open as the Actuator is moved min. to max. THEN ALTER THE LENGTH OF THE ROD SLIGHTLY (PERHAPS 0.030”), SO THAT THE ACTUATOR IS JUST OFF ITS INTERNAL STOP, AND IS PULLING THE BUTTER-FLY AGAINST ITS STOP. This insures that the carburetor can fully close to idle on load dumps, minimizing over speeds.

Examine the system for springs, such as carburetor return springs. These should be removed. Some automotive carburetors (as opposed to industrial carburetors) contain internal springs for accelerator pumps, etc. These may make good governing difficult, or even impossible. For this and other reasons, industrial carburetors are preferred.

Move the linkage slowly through its travel, and look for any binding or unexplained forces. Correct any before going further.

Many “governing” problems are really caused by binding of the butterfly and its shaft in the carburetor. This is caused by loading due to vacuum under the butterfly and atmospheric pressure above when the engine is running. These forces cannot be felt when the engine is not running. Therefore, start the engine while carefully controlling the speed by hand, and feel for binding or air load forces. Needle bearings on the butterfly shaft are available on many industrial carburetors to deal with this problem. Any tendency on the butterfly stick must be corrected.

Mounting-Controller

Select a reasonably cool, dry, and vibration free location.

The rear cover will probably need to be removed during set-up in order to make adjustments for speed setting and gain. You may wish to defer final installation until this is done.

After completing these adjustments, replace cover. Mount so that water cannot pool on this cover. Always mount the controller with the strain relief down. This will prevent water from entering thru the cable, also place the vent hole in the bottom of the controller down.

Wiring

See wiring diagram for details of hook-up.

Use #16 wire minimum.

Keep all wiring to the Governor as short as is practical.

Go directly from the controller ground terminal (B of the 8 pin connector) by dedicated wire, to the battery “minus” terminal. If this cannot be done, for some reason, go by dedicated wire to a very good engine ground.

A properly functioning engine electrical system will supply 13.5 - 14.8 VDC when the engine is running. If wiring size is adequate, with good connections and proper grounds, you will get this reading between the wires terminals A & B of the 8 pin connector when the Governor is controlling engine speed. Verify this. Improper hook-up can damage electronics. Re-check wiring before applying power.

Power Distribution

8 Pin Connector

Pin:

a. 12 VDC from the make before break oil pressure switch. This switch provides power to pin A when the ignition is on and the engine is running (no oil pressure), or when the engine is off when the engines running (has oil pressure).

b. Ground.

c. Tach signal from the engine ignition system.

d. Tach signal from the engine ignition system.

e. Control signal to operate the Actuator.

f. Control signal to operate the Actuator.

g. Removes ground from the start lock out relay when the engine is running above the start lock out set point. A 20 turn pot is provided to adjust this set point. (usually around 500 RPM)

h. Removes ground from the overspeed relay if this point is exceeded. A 20 turn pot is provided to adjust this set point.(usually around 5000 RPM)

4 Pin Connector

Pin:

a. Input from the elevation limit switches to allow high engine to operate.

b. Input from the high engine switch.

c. Input for mid engine from one of the following: The engine low coolant temperature switch, platform footswitch, or a ground control directional switch.

d. Provides ground to lockout start when the engine RPMS exceed the set point.

Check-Out and Initial Start-Up Procedures

Before proceeding, familiarize yourself with the locations of the various adjustment pots.

Adjustments

High engine
Mid engine
Start lockout
Over speed lockout
Factory adjust Gain

High Engine:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the high engine pot is 25 turns, each turn will change engine speed by about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However the governor will not function when the pot is past full travel. If you suspect that you may have over-adjusted the high engine pot, or have lost track of where you are, turn the pot 25 to 30 turns out (CCW), then turn in (CW) 10 turns. This will get you back into the range you should be in. Make the high engine adjustment first, then gain, then reset high engine.

Gain:
This adjustment is made by turning the plastic screw clockwise (CW to increase governor sensitivity, counterclockwise (CCW) to decrease sensitivity. The adjustment range of the Factory pot is about 3/4 of a turn, AND OVERTURNING WILL BREAK THE INTERNAL STOPS, making further adjustments impossible. Too much gain will cause instability and the engine will pulsate, Not enough gain will make the engine slow to respond to load requirements, and at first appears to be a good setting when operating directional functions other than drive. The engine will accelerate right up to the set RPMS and stop at that point.The problem with this type of gain setting is that when a large load is applied (usually thru drive) and then suddenly unloaded, the engine will be slow to respond in decreasing RPMS. This will cause the engine to over rev and then at times, will activate the over speed cutout and shut the engine off. The ideal gain setting will provide a compromise between quick response and good stability. This will usually show up as 1 to 3 engine pulsation's before leveling out at the set RPMS when going from idle to high engine.

Mid engine:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the Mid engine pot is about 25 turns, each turn will change engine speed by about 100 to 200 RPMS. THE pot is protected by an slip clutch at each end and will not be harmed by moderate over adjustment. However, the governor will not function when the pot is past full travel. If you suspect that you have over adjusted the Mid engine pot, or have lost track of where you are, turn the pot 25 turns out (CCW), then turn in (CW), 15 turns. This will get you back into the range you should be in. Make all adjustments before setting the mid engine.

Start lockout:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed and counterclockwise (CCW) to decrease speed. The adjustment range of the Start lockout pot is about 25 turns, each turn will change engine speed by about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However, the governor will not function when the pot is past full travel. If you suspect that you may have over-adjusted the Start lockout pot, or have lost track of where you are, turn the pot to 25 to 30 turns in (CW), Then turn out (CCW) 8 1/2 turns. This will get you back into the range you should be in. Start lockout should normally not have to be adjusted. Normally startout should occur at around 500 RPM. If while cranking the engine seems to stop momentarily then reengages the starter, turn the adjustment in (CW) 1/4 to 1/2 turn at a time until the engine will crank with out locking out start. If the starter engages while the engine is running, check the idle RPMS before adjusting the governor. On the 800 series, this should be 1000 RPMS. Do not set the RPMS above 1100 RPMS as this will cause engine shut down problems that will be similar to dieseling.

Over speed:
This adjustment is made by turning the 1/8" brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the Over speed pot is about 25 turns, each turn will change engine speed about 100 to 200 RPMS. This pot is protected by a slip clutch at each end and will not be harmed by moderate over-adjustment. However the governor will not function when the pot is past full travel. If you suspect that you have over-adjusted the Over speed pot, or have lost track of where you are, turn the pot 25 turns in (CW), then turn out (CCW) 5 1/2 turns. This will get you back into the range you should be in. Over speed should normally not have to be adjusted. When adjusting Over speed make sure other adjustments have been made correct.

Factory:
This adjustment is made by turning the plastic screw clockwise (CW) to increase governor sensitivity, counterclockwise (CCW) to decrease sensitivity. The adjustment range of the Factory range of the pot is about 3/4 of a turn, AND OVERTURNING WILL BREAK THE INTERNAL STOPS, making further adjustments impossible. The Factory setting normally will not have to be adjusted.

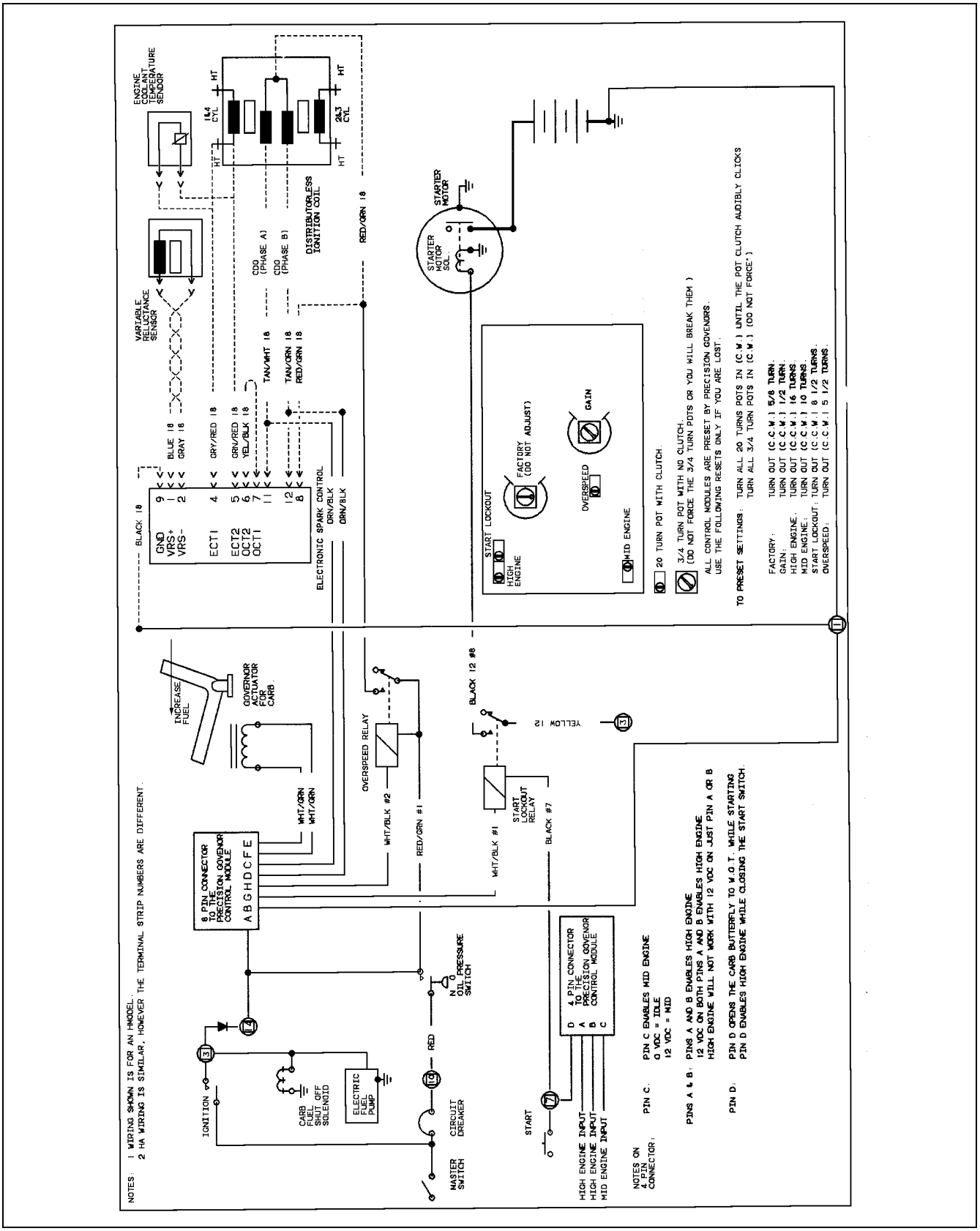
NOTE: *These settings are factory set, Start Lockout, Factory Adjust and Overspeed. They are conformally coated by P.G. and should not need to be reset.*

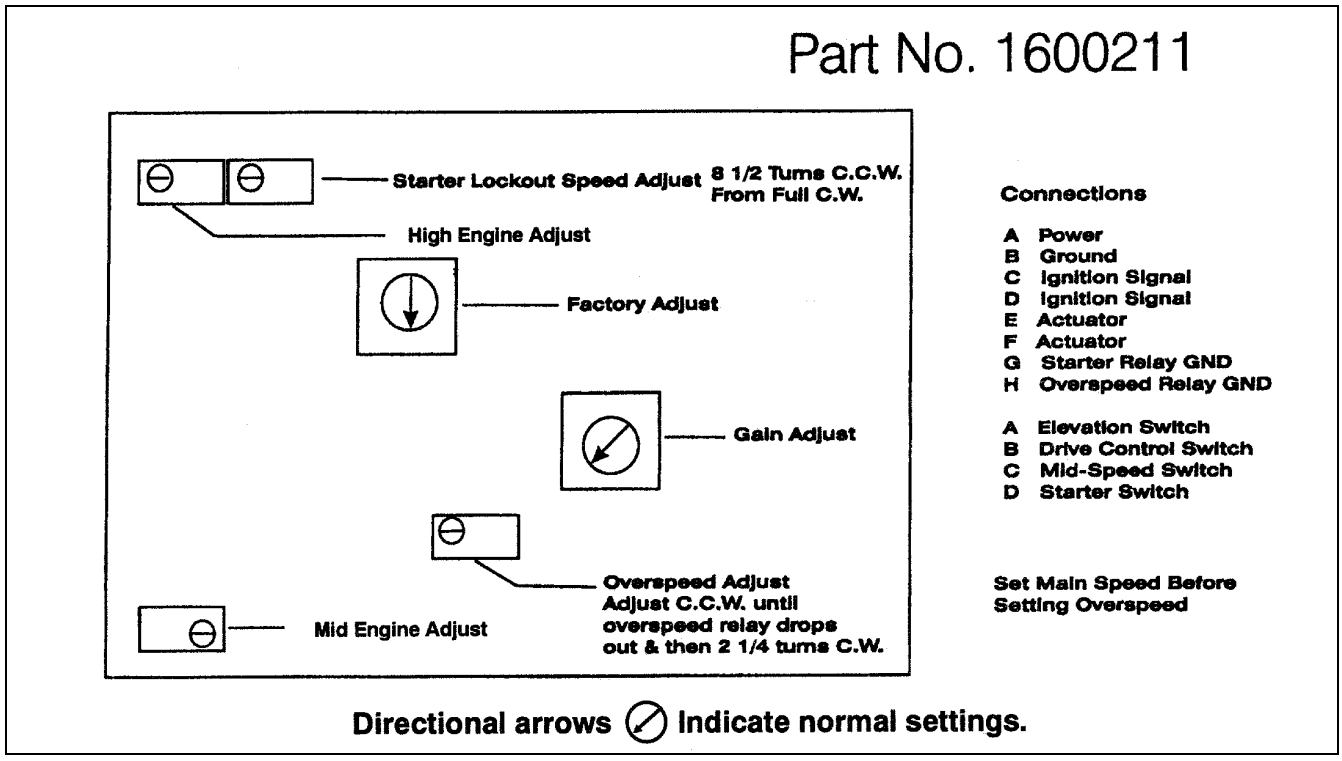
Assuming that the Actuator and Controller are mounted, the wiring is run and checked, and that the linkage is properly installed, proceed as follows:

1. Turn ignition switch on. Do not start engine. Actuator should kick toward max. fuel once, and then immediately return to min. fuel. If not, see Troubleshooting.
2. Use multimeter to check battery voltage at battery terminals, and record. Now check voltage at the machine connection points for terminals A & B of the 8 pin connector on the E-331 (A is +, B is -). Voltage reading should be the same as at battery. If not, shut down, and correct wiring.
3. Hold the linkage back by hand, so as to control engine speed manually. Start engine, set vehicle controls to obtain High Engine speed, gradually release the linkage, and adjust the speed-set as needed to set the speed as desired. If engine speed surges, reduce Gain a little, as required (CCW).
4. Re-check voltage between terminal A & B as in step 2. Voltage reading should be between 13.5 - 14.6 VDC.
5. Carefully adjust Gain. You are looking for the best compromise between quick response and good stability. Make very small adjustments, then load and unload engine, or pull linkage back slightly and release. Usually, a good set-up is one that makes 1 to 3 small bounces and then steadies down after a large change. Too much Gain shows up as a rapid (once per second) instability, most commonly at light loads. Too little Gain shows up in large overshoots on start-up or large load changes, and generally sluggish operation.
6. Make final adjustment to the High Engine Pot.
7. Set machine controls to obtain the mid-engine speed. Adjust the mid-engine pot as needed to obtain the speed desired.
8. The start lockout adjustment is factory set. If necessary, he starter lockout pot may be adjusted to obtain dropout of the starter as the engine attains running speed. Normally this is around 500 RPM.
9. The overspeed adjustment is factory set. If necessary, it may be readjusted to shut off ignition power at a different engine speed by means of the overspeed adjustment pot. The overspeed is simply to shut down an over revving engine.

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

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


NOTES: 1 WIRING SHOWN IS FOR AN HMODEL.
2 HA WIRING IS SIMILAR, HOWEVER THE TERMINAL STRIP NUMBERS ARE DIFFERENT.
ENGINE COOLANT TEMPERATURE SENSOR
VARIABLE RELUCTANCE SENSOR
DISTRIBUTORLESS IGNITION COIL
1&4 CYL
2&3 CYL
HT
CDO (PHASE A)
CDO (PHASE B)
BLACK 18
GND
VRS+
VRS-
ECT1
ECT2
OCT2
OCT1
BLUE 18
GRAY 18
GRY/RED 18
GRN/RED 18
YEL/BLK 18
TAN/WHT 18
TAN/GRN 18
RED/GRN 18
ELECTRONIC SPARK CONTROL
BRN/BLK
STARTER MOTOR
STARTER MOTOR SOL.
START LOCKOUT
HIGH ENGINE
FACTORY (DO NOT ADJUST)
OVERSPEED
GAIN
MID ENGINE
20 TURN POT WITH CLUTCH.
3/4 TURN POT WITH NO CLUTCH. (DO NOT FORCE THE 3/4 TURN POTS OR YOU WILL BREAK THEM)
ALL CONTROL MODULES ARE PRESET BY PRECISION GOVENORS. USE THE FOLLOWING RESETS ONLY IF YOU ARE LOST.
TO PRESET SETTINGS: TURN ALL 20 TURNS POTS IN (C.W.) UNTIL THE POT CLUTCH AUDIBLY CLICKS
TURN ALL 3/4 TURN POTS IN (C.W.) (DO NOT FORCE)
FACTORY: TURN OUT (C.C.W.) 5/8 TURN.
GAIN: TURN OUT (C.C.W.) 1/2 TURN.
HIGH ENGINE: TURN OUT (C.C.W.) 16 TURNS
MID ENGINE: TURN OUT (C.C.W.) 10 TURNS.
START LOCKOUT: TURN OUT (C.C.W.) 8 1/2 TURNS.
OVERSPEED: TURN OUT (C.C.W.) 5 1/2 TURNS.
INCREASE FUEL
GOVERNOR ACTUATOR FOR CARB.
WHT/GRN
WHT/GRN
OVERSPEED RELAY
WHT/BLK #2
RED/GRN #1
BLACK #8
YELLOW 12
WHT/BLK #1
START LOCKOUT RELAY
BLACK #7
8 PIN CONNECTOR TO THE PRECISION GOVENOR CONTROL MODULE
A B G H D C F E
4 PIN CONNECTOR TO THE PRECISION GOVENOR CONTROL MODULE
D
A
B
C
OIL PRESSURE SWITCH
RED
IGNITION
CARB FUEL SHUT OFF SOLENOID
ELECTRIC FUEL PUMP
CIRCUIT BREAKER
MASTER SWITCH
START
HIGH ENGINE INPUT
HIGH ENGINE INPUT
MID ENGINE INPUT
NOTES ON 4 PIN CONNECTOR:
PIN C. PIN C ENABLES MID ENGINE
0 VDC = IDLE
12 VDC = MID
PINS A & B: PINS A AND B ENABLES HIGH ENGINE
12 VDC ON BOTH PINS A AND B ENABLES HIGH ENGINE
HIGH ENGINE WILL NOT WORK WITH 12 VDC ON JUST PIN A OR B
PIN D: PIN D OPENS THE CARB BUTTERFLY TO W.O.T. WHILE STARTING
PIN D ENABLES HIGH ENGINE WHILE CLOSING THE START SWITCH.



Troubleshooting

We will discuss Troubleshooting in two general categories:

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

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

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

- Governor won't work.

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

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

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

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

(2.) Incorrect Linkage - Re-check linkage as discussed on page 40 and 41. Freedom of movement and lack of play are important.

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

(4.) No speed signal to Controller.

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

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

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

This kind of trouble usually falls into three main categories:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

a. Gain adjustment is to far CCW.

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

Automatic Choke Adjustment Procedure

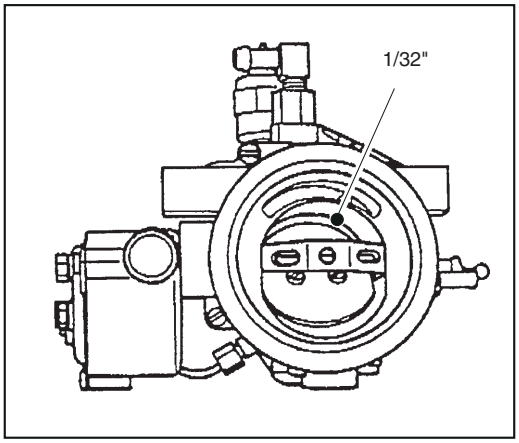
(For all JLG 1.IL and 2.3L Ford carbureted engines)

1. At 70°F the choke plate should be open 1/3” (not touching the choke bore).
2. If the ambient temperature is not 7o°F, an additional adjustment is required:
   a. Loosen the three cover plate screws.
   b. Adjust the cover to open the choke plate 1/32”.
   c. Readjust for ambient temperature by rotating the cover one (1) mark per 5°F from 70°. Rotate CCW (lean) if warmer than 70°, CW (rich) if colder than 70°.
   (If actual temperature is 80°, set at 1/32” and rotate two (2) marks CCW (lean) direction.)

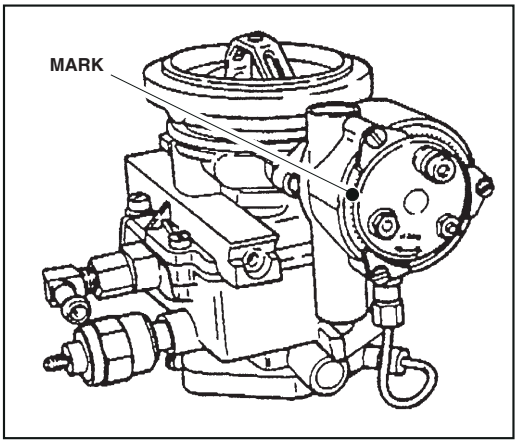
Tighten the three cover plate screws and check for free rotation (no sticking or binding) of the choke shaft.

3.9 AUTOMATIC CHOKE ADJUSTMENT - FORD ENGINE

1. At 70°F the choke plate should be open 1/32" (not touching the choke bore).
2. If the ambient temperature is not 70°F, an additional adjustment is required.
   a. Loosen the three cover plate screws.
   b. Adjust the cover to open the choke plate 1/32".



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



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

3.10 COLD WEATHER STARTING DIFFICULTY

Machines equipped with carbureted Ford LRG-425 engines in weather conditions of 15 to 20° F (-9.5 to -6.5 C) or colder may encounter difficulty in starting.

After 10 unsuccessful attempts of starting the engine follow the troubleshooting procedures below to locate the cause of the starting difficulty.

Most Cold weather starting issues fall into the following categories which will be addressed separately:

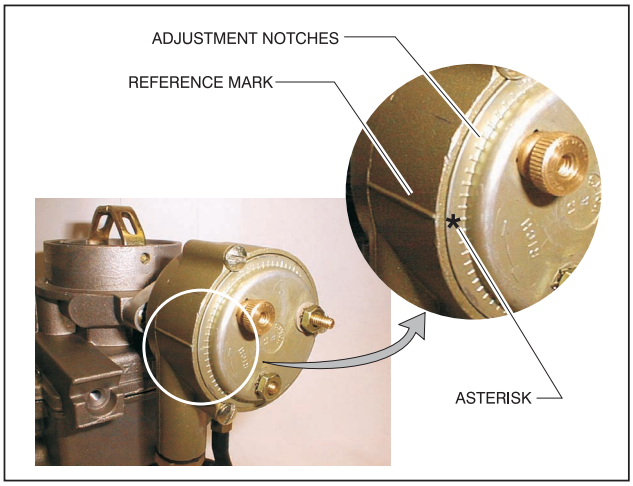
- Carburetor
- Ignition
- Fuel

1. **Engine Receiving Fuel** - After cranking the engine for a period of time, there may be white smoke noticed coming out of the exhaust tube. This is an indication that the engine is in a "flooded" condition. If the engine is flooded and will not start, follow the procedures under Checking the Carburetor. If after following those procedures the engine still does not start, continue with Checking the Ignition.
2. **Engine Not Receiving Fuel** - If after cranking the engine for a period of time, and there is no white smoke coming out of the exhaust tube, follow the procedures under Checking the Fuel.

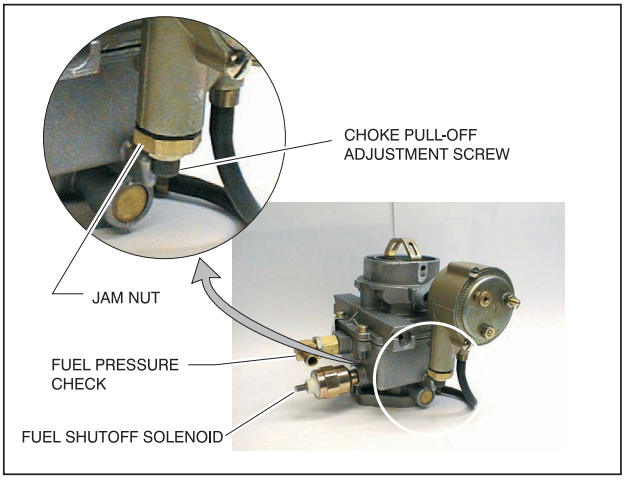
Checking the Carburetor

After cranking the engine for a period of time there may be white smoke noticed coming out of the exhaust tube. This is an indication the engine is receiving fuel and is in a “flooded” condition.

NOTE: *Make sure the choke is adjusted using the asterisk (*). There is also a zero (0) stamped on the choke. The zero (0) is used for assembly purposes and is not to be used as an adjustment reference.*



1. Check the choke for ambient temperature setting. The default ambient temperature setting is 70° F (21° C), which aligns the asterisk (*) on the choke face with the reference mark on the side of the choke housing. The choke should be set at one notch “clockwise” past the (*) asterisk for every 5 degrees below 70° F (one notch “clockwise” past the (*) asterisk for every 2.8 degrees below 21° C). This adjustment will "richen" the fuel mixture.
2. Check if the choke “butterfly” is stuck by manually opening and closing by hand.
3. Check the choke pull-off (butterfly stop) screw for proper adjustment as follows:



   a. Loosen jam nut
   b. Screw the adjustment screw all the way in, then back out 1/2 turn.
   c. Tighten jam nut.

Try to start the engine.

NOTE: *If EMS switch is pulled on for an extended period of time, i.e. 1 to 2 minutes, without attempting to start the engine, the choke will start to open due to electrical heating.*

Checking the Ignition

If the engine tries to start but spits and sputters:

1. Check the Oil Pressure Switch:
   - **a.** Check for voltage from N.C. (normally closed) terminal to common ground while cranking the engine. (what should the voltage be?)
   - **b.** Jump all three posts at the oil pressure switch, then see if the engine will start.
   - **c.** If the engine starts after jumping the posts, replace oil pressure switch (JLG p/n: 4360405)
2. Check the Spark Plugs for presence of spark. If there is no spark at the plugs during cranking:
   - **a.** Overspeed relay not activating.
   - **b.** Check the ignition module red/green wire for 12 volts.
   - **c.** Check the white/black wire coming from the 8-pin connector (pin-H) that runs to the overspeed relay on terminal 85 for proper ground.
3. Ignition module may have failed.
   - **a.** Ignition module series: AA, AB and FA prior to date code-1889 may need replaced. (refer to: Ford Technical Bulletin # FF-91-99)
   - **b.** Check the vacuum advance tube attached to the ignition module for secure connection.

Try to start the engine.

Checking the Fuel

The engine may not be getting fuel to the carburetor

1. Check the fuel shutoff solenoid
   - **a.** Must have 12 volt while cranking the engine.
2. Check the electric fuel pump
   - **a.** Must have 12 volts or be able to hear the pump running while cranking the engine.
   - **b.** Check fuel pressure, must have a minimum of 2-4lbs.
3. Check Fuel Filter:

NOTE: *Some JLG machines have a fuel return line between the fuel pump and carburetor, if this return line is pinched and the fuel pressure increases this indicates a clogged fuel filter.*

4. Check the fuel pump supply line for any obstruction.

Try to start the engine.

NOTE: *JLG Industries Inc. recommends the use of engine block heaters and or cold weather packages for machines intended for use in 0° F (-18° C) or colder conditions. Refer to the JLG Parts Manual for specify options for your machine.*

(Machines equipped with non-hydrostatic gear pump or non-proportional drive systems, i.e. H models, 60HA should consider having block heaters and or cold weather packages installed for use in 20° F (-6.5° C) and colder conditions.

3.11 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE

(See Figure 3-11.)

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

1. Disconnect the actuator cable from the throttle lever. With the aid of an assistant, start the engine and allow it to come up to operating temperature. Adjust the throttle lever stop until engine runs at 1800 RPM. Shut down the engine. Reattach the actuator cable to throttle lever making sure that low engine setting remains the same. If necessary, adjust slide pin to contact low engine limit switch at 1800 RPM. Shut down engine.
2. With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect proportional dump valve wire. Activate footswitch. Turn on HIGH ENGINE switch. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 2400 RPM. Shut off all switches and controllers. Reconnect proportional dump valve wire.

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

NOTE: *Early machines are at idle until a function is activated. Later machines are at idle only at platform without footswitch activated. Therefore when setting low engine speed on later machines it will not be necessary to disconnect bang-bang dump valve wire or operate a bang-bang function. Just activate footswitch to get low engine.*

3.12 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.*

Check the frame to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated on Figure 3-12., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
3. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
4. Swing the turntable 90 degrees, and check some selected bolts at the new position.
5. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.

Check the turntable to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated on Figure 3-12., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
3. Lower the boom to horizontal and fully extend the boom.
4. At the position indicated on Figure 3-12., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

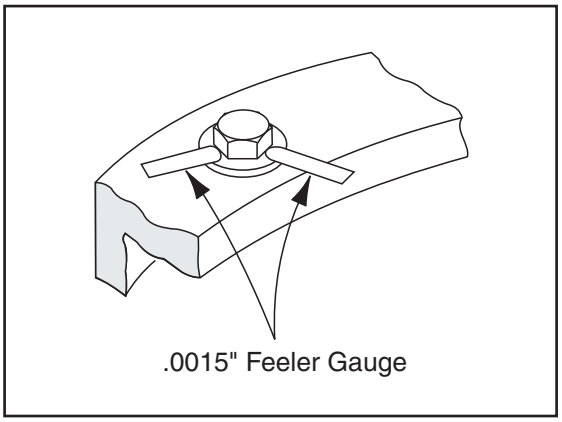


Figure 3-12. Swing Bearing Bolt Feeler Gauge Check

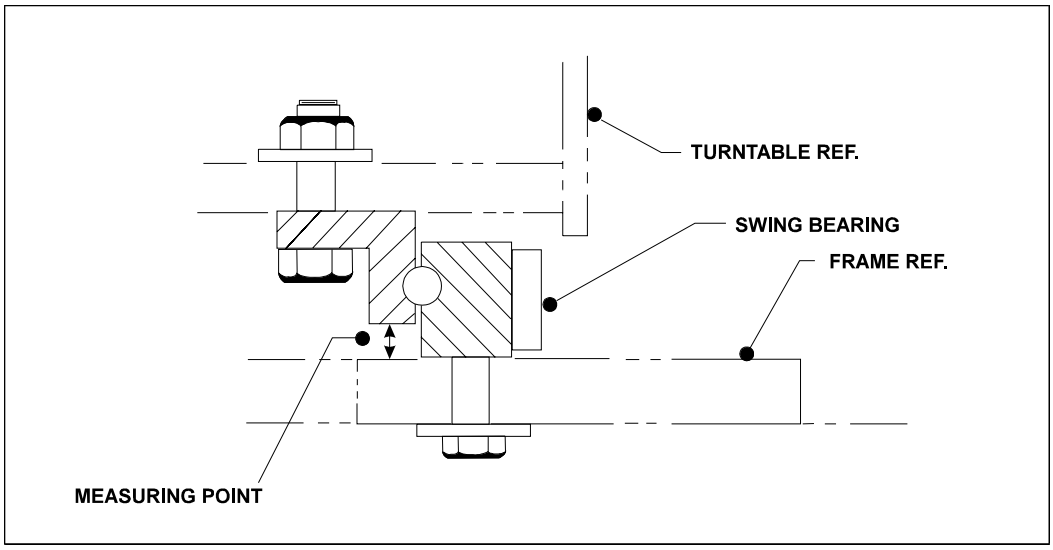


Figure 3-13. Swing Bearing Tolerance Measuring Point

Wear Tolerance

1. From the underside of the machine, at rear center, with the boom fully elevated and fully retracted (See Figure 3-14.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 3-14.)
2. At the same point, with the boom at horizontal and fully extended (See Figure 3-14.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 3-13.)
3. If a difference greater than 0.057" (1.45 mm) is found, the swing bearing should be replaced.
4. If a difference less than 0.057" (1.45 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

⚠ WARNING

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.

Replacement and Devcon Application Procedures on Machines Built Prior to Mid 1991

Removal.

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

⚠ WARNING

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

2. Attach an adequate support sling to the boom and draw all slack from the sling. Prop or block the boom if feasible.
3. From the underside of the machine frame, remove the bolts and lockwashers which attach the retaining yoke of the rotary coupling to the coupling housing.

IMPORTANT

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

4. Tag and disconnect the hydraulic lines from the fittings on the top and sides of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.

5. Attach suitable overhead lifting equipment to the base of the turntable weldment.
6. 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, nuts and washers which attach the turntable to the bearing inner race. Discard the nuts and bolts.
7. 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.
8. Carefully place the turntable on a suitably supported trestle.
9. 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, move the bearing to a clean, suitably supported work area.

Installation.

NOTE: *Steps 1 thru 13 apply only to machines built prior to mid 1991.*

NOTE: *Manufacturing tolerances of frames and turntables are inspected prior to the factory installation of swing bearings to determine the need for use of Devcon filler. When servicing machine swing bearing, apply Devcon filler only to those machines having Devcon previously applied at the factory. If a new turntable or frame is being installed, contact the manufacturer for procedures to determine the need for Devcon application.*

1. Use suitable standard tools and equipment to carefully remove any hardened epoxy residue from the bearing mounting area of the frame and turntable.
2. Apply a layer of Devcon (or equivalent) filler approximately 0.125 inches (0.318 cm) thick on the bearing mounting plate on the frame.
3. Use suitable lifting equipment to carefully lower the swing bearing into position on the frame. Ensure that the scribed line of the outer race of the bearing aligns with the scribed mark 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 centerline of the frame.
4. Ensure that all frame and bearing attachment holes are aligned, and install four diametrically opposed bolts or clamps to secure the bearing to the frame. Tighten the bolts or clamps evenly in a diametrically opposed pattern to a torque of 20 ft. lbs. (3 kgm).
5. Allow Devcon filler to cure at room temperature (approximately 70 degrees F., 21 degrees C.) for 10 to 16 hours.
6. After the appropriate interval, release the clamps or remove the bolts. Use a suitable lifting device to carefully remove the bearing from the frame.
7. Carefully remove any excess filler from the frame mounting area, from the bearing attachment holes, and from between the gear teeth.

⚠ WARNING

ENSURE THE TURNTABLE IS ADEQUATELY SUPPORTED WHILE APPLYING DEVCON AND WHILE INSTALLING THE BEARING. EXTREME CARE MUST BE TAKEN DURING THE FOLLOWING STEPS TO AVOID SERIOUS OR FATAL INJURY TO PERSONNEL.

8. Apply a layer of Devcon (or equivalent) filler approximately 0.125 inches (0.318 cm) thick to the underside of the bearing mounting area of the turntable base plate.

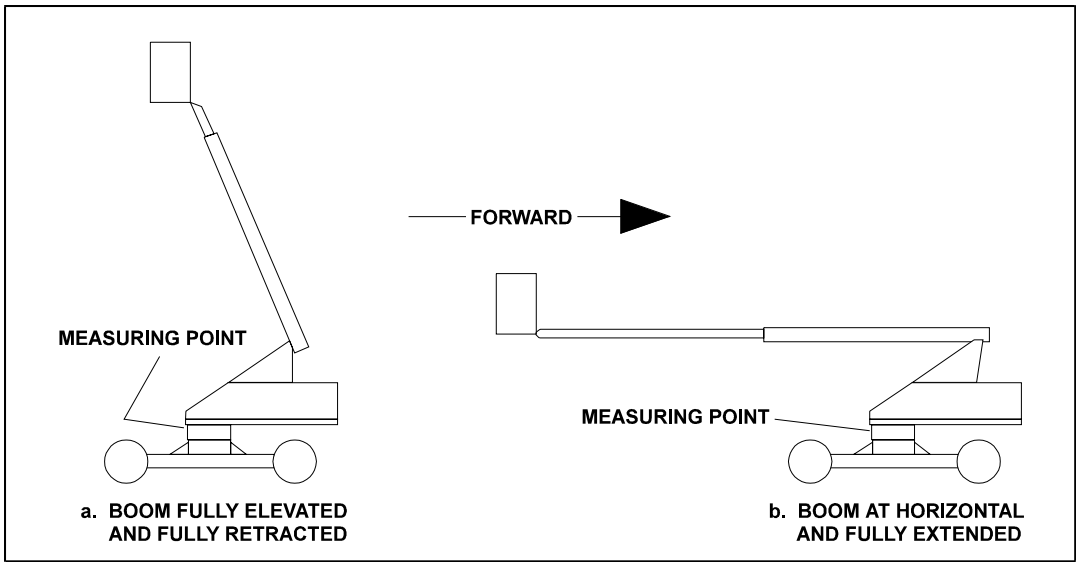


Figure 3-14. Swing Bearing Tolerance Boom Placement

9. Use suitable hydraulic jacks to carefully raise the swing bearing to the underside of the turntable mounting plate. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable (if a new swing bearing is used, ensure that the filler plug fitting is 90 degrees from the fore and aft centerline of the turntable).
10. Ensure that all turntable and bearing attachment holes are aligned, and install four diametrically opposed clamps or bolts and nuts to secure the bearing to the turntable. Tighten the nuts and bolts or clamp evenly in a diametrical pattern to a torque of 20 ft. lbs. (3 kgm).
11. Allow Devcon filler to cure at room temperature (approximately 70 degrees F., [21 degrees C]) for 10 to 16 hours.
12. After the appropriate time interval, place a suitable hydraulic jack under the bearing and release the clamps or remove the nuts and bolts, use the hydraulic jack to carefully remove the bearing from the turntable.
13. Carefully remove excess filler from the turntable mounting area, from the bearing attachment holes and from between gear teeth.
14. Position the bearing on the machine frame in the same position as noted in step 3 above.

⚠ WARNING

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED BEARING NUTS AND BOLTS BE DISCARDED AND REPLACED WITH NEW NUTS AND 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.

15. Spray a light coat of Safety Solvent 13 to the new bearing bolts. Then 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.

16. Following the Torque Sequence diagram shown in Figure 3-15., and torque the bolts. Refer to Swing Bearing Torque Values in this section.
17. Remove the lifting equipment from the bearing.

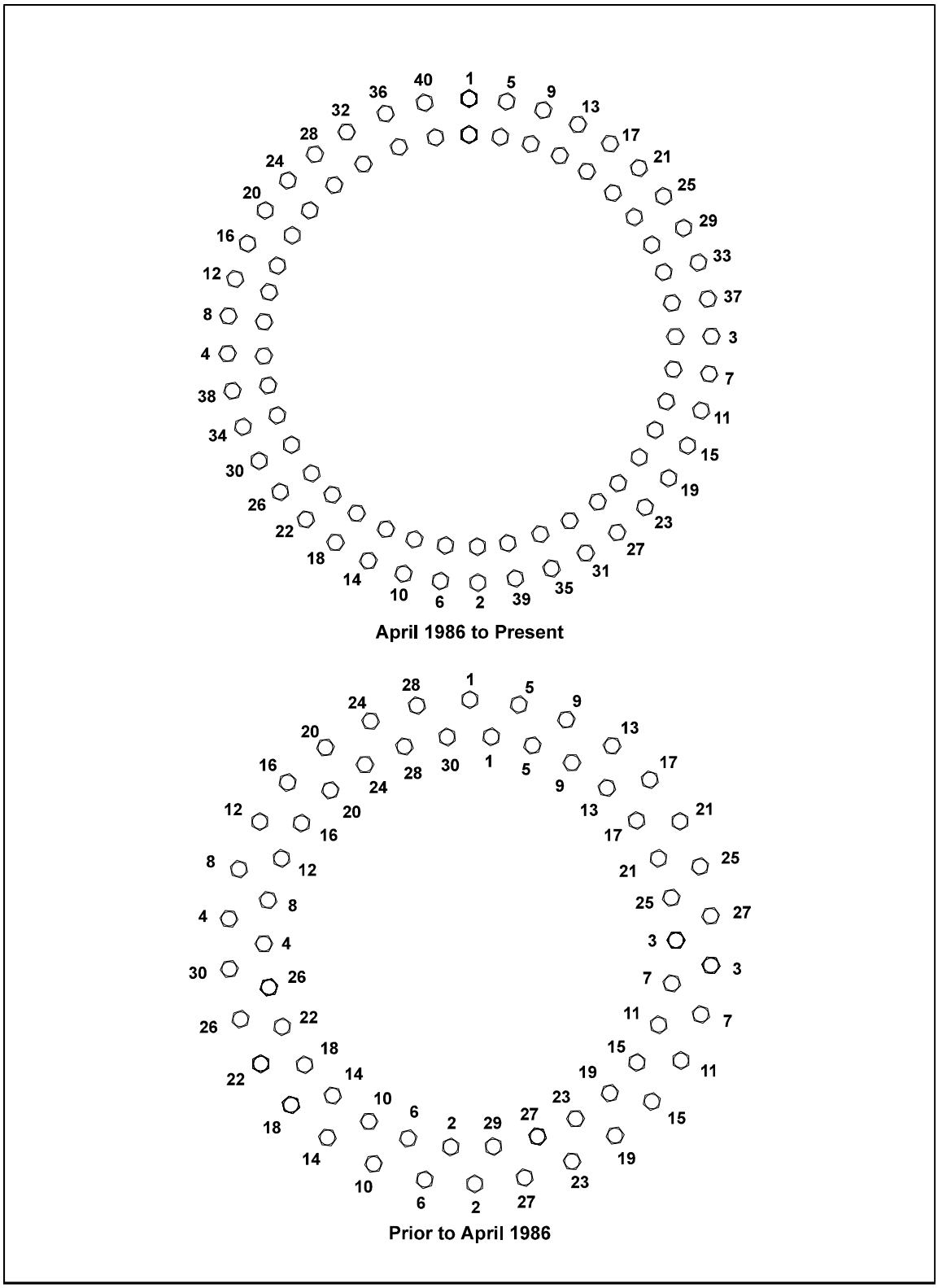


Figure 3-15. Swing Bearing Torquing Sequence

18. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.
19. Carefully lower the turntable onto the swing bearing, ensuring that the turntable and bearing align as noted in step 9 above.

⚠ 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.

20. Spray a light coat of Safety Solvent 13 to the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts, washers and nuts through the turntable and inner race of the bearing.
21. Following the Torque Sequence diagram shown in Figure 3-15., torque the bolts to the values listed under Swing Bearing Torque Values.
22. Remove the lifting equipment.
23. Install the rotary coupling retaining yoke, apply a light coating of Loctite Sealant #TL277-41 to the attaching bolts and secure the yoke to the rotary coupling with the bolts and lockwasher.
24. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.
25. At the ground control station, use the boom lift control to lower the boom to the stowed position.
26. Using all applicable safety precautions, activate the hydraulic system and functionally check the swing system for proper and safe operation.

Swing Bearing Torque Values

Prior to April, 1986.

1. **Outer Race**

   5/8" Bolts - 170 ft. lbs. (235 NM) wet, 220 ft. lbs. (304 NM) dry.
   7/8" Bolts - 460 ft. lbs. (636 NM) wet, 600 ft. lbs. (830 NM) dry.

2. **Inner Race**

   5/8" Bolts - 170 ft. lbs. (235 NM) wet, 220 ft. lbs. (304 NM) dry.
   7/8" Bolts - 460 ft. lbs. (636 NM) wet, 600 ft. lbs. (830 NM) dry.

3. Swing Bearing Torquing Sequence, see Figure 2-21.

April, 1986 to Present.

1. Outer Race - 170 ft. lbs. (235 NM) wet, 220 ft. lbs. (304 NM) dry.
2. Inner Race - 170 ft. lbs. (235 NM) wet, 220 ft. lbs. (304 NM) dry.
3. Swing Bearing Torquing Sequence, see Figure 2-21.

⚠ WARNING

RETORQUE THE INNER AND OUTER SWING BEARING BOLTS AFTER FIRST 200 HOURS OF OPERATION, AND EVERY 500 HOURS THEREAFTER.

3.13 OSCILLATING AXLE BLEEDING PROCEDURE

Lockout Cylinder Bleeding (Without Holding Valves)

1. Make a hydraulic hose using approximately 6 feet of 1/4 in. wire braid hose with quick connect fitting on one end and a 1/4 in. JIC female fitting on the other.
2. Swing the boom over the front of the machine and engage the turntable lock. Using ground control raise the boom out of the way.
3. Remove the cover between frame slabs through which the cam valve wheel protrudes.
4. Remove cap from fitting on cam valve and connect your hose (see 1 above) at this point.
5. Attach the other end of the hose to the quick connect on the swing brake.
6. Using a floor jack (or overhead crane) raise one front wheel approximately 6 inches (15.2 cm) off the ground.
7. Use a bar as a lever to press down on the cam valve plunger which will allow the axle to fully oscillate against the stop.
8. With the aid of an assistant, start the engine from ground control.

⚠ WARNING

ENSURE TURNTABLE LOCK IS ENGAGED.

9. While your assistant activates swing from ground control, depress plunger on cam valve and open both bleeders on the lockout cylinder of the elevated wheel purging any air.
10. Remove the jack from the elevated wheel and, using the bar, again press down on the cam valve plunger, allowing the axle to center.
11. Next raise the other front wheel as you did in step 6 and repeat steps 7 thru 10.
12. Shut down the engine, remove the hose, and replace the cap on the cam valve fitting. Install frame cover over cam valve and disengage turntable lock.
13. The boom can now be returned to its normal position.

Lockout Cylinder Bleeding (With Holding Valves)

⚠ CAUTION

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

MAKING SURE MACHINE IS ON A LEVEL SURFACE AND REAR WHEELS ARE BLOCKED, DISENGAGE DRIVE HUBS. OPTIONAL 4WD ALL HUBS MUST BE DISENGAGED.

1. Making sure machine is on a level surface and rear wheels are blocked, disengage drive hubs. Optional 4WD all hubs must be disengaged.
2. Make up an adapter with an air regulator, remove filler cap on hydraulic tank and install regulator.
3. Attach air supply to the regulator and set regulator to 2 - 5 psi (0.14-0.34 Bar).

⚠ CAUTION

DO NOT EXCEED 5 PSI (0.34 BAR) INTO HYDRAULIC TANK. MORE THAN 5 PSI (0.34 BAR) WILL CAUSE DAMAGE TO THE HYDRAULIC TANK.

4. Activate machine hydraulic system from platform control station.
5. Place LOW ENGINE, HIGH DRIVE SPEED and HIGH WHEEL MOTOR SPEED control switches to their respective HIGH positions.
6. Depress footswitch and activate DRIVE CONTROLLER to “FORWARD” position.
7. Using a suitable lifting equipment lift front of machine and place a 6 in. (15.2 cm) high block under right front wheel.
8. Lower machine so both of the lockout cylinders are oscillated; one extended, the other retracted.
9. Use suitable containers to retain any residual hydraulic fluid, place containers under each lockout cylinder.
10. With DRIVE CONTROLLER activated and engine at idle, open all four bleeder screws (two on each lockout cylinder), one at a time, then close bleeder screws when all air is dissipated (bled).
11. Using a suitable lifting equipment lift front of machine and remove the 6 in. (15.2 cm) high block.
12. Transfer the 6 in. (15.2 cm) high block to the left front wheel and repeat steps 2 thru 7, substituting the word “right” for “left” in step 5.
13. Perform oscillating axle lockout test.

3.14 OSCILLATING AXLE LOCKOUT TEST

⚠ CAUTION

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

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

1. Place a 6 in. (15.2 cm) high block with ascension ramp in front of left front wheel.
2. From platform control station, activate machine hydraulic system.
3. Place HIGH ENGINE, DRIVE SPEED and WHEEL MOTOR SPEED 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). After boom reaches stowed position, activate DRIVE and lockout cylinders should release and allow wheel to rest on ground.
9. Place the 6 in. (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). After boom reaches stowed position, activate DRIVE and lockout cylinders should release and allow wheel to rest on ground.
15. If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

3.15 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.
3. 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.
3. Remove chocks from wheels as required.

3.16 SPARK ARRESTOR MUFFLERS

The multiple discs on these mufflers will require frequent cleaning if used with oily or sooty exhaust (diesel), or on malfunctioning engines (as evidenced by visible exhaust.

3.17 FOOTSWITCH ADJUSTMENT

Adjust so that functions will operate when pedal is at center of travel. If switch operates within last 1/4 in. (6.35 mm) of travel, top or bottom, it should be adjusted.

3.18 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) prior to assembly.

3.19 DUAL FUEL SYSTEM

⚠ CAUTION

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

Changing from gasoline to LP-Gas

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

⚠ CAUTION

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

3. While the engine is operating, place the three position LP/Gasoline switch at the ground control station to the center “off” position. Allow the engine to operate, without load, until the engine begins to “stumble” from lack of gasoline.
4. As the engine begins to “stumble” place the switch to the “LPG” position, allowing the LP fuel to be sent to the fuel regulator.

Changing from LP Gas to Gasoline

1. With engine operating on LP under no load condition, throw the “LP/Gasoline” switch at the ground control station across to the “Gasoline” position.
2. If engine “stumbles” because of lack of gasoline, place the switch to the “LPG” position until engine regains smoothness, then return the switch to the “Gasoline” position. Repeat as necessary until engine runs smoothly on gasoline.
3. Close the hand valve on the LP gas supply tank by turning clockwise.

SECTION 4. BOOM & PLATFORM

4.1 BOOM MAINTENANCE

Removal

1. Remove the platform from the boom assembly.
2. Remove the slave leveling cylinder from the boom assembly.

NOTE: *The boom assembly weighs approximately 4800 lbs. (2200 kg).*

3. Using suitable lifting equipment, adequately support the boom weight along the entire length of the retracted boom.

⚠ CAUTION

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

4. Tag and disconnect the hydraulic lines that run along the side of the boom.
5. Remove the hardware attaching the upper lift cylinder attach pin to the boom.
6. Using a slide hammer or similar tool, and taking care not to damage the pin, remove the pin from the boom.
7. Using all applicable safety precautions, and only if necessary, operate the crane and fully retract the lift cylinder.
8. Shut down all machine systems.
9. Tag and disconnect all wiring to the ground control box.
10. Loosen and remove the hardware securing the boom pivot pin.
11. Ensuring that the boom is adequately supported and using a suitable slide hammer, carefully remove the pivot pin from the boom and turntable structure. Ensure the boom and turntable structure are not damaged.
12. Carefully lift the boom assembly clear of the turntable and lower to the ground or suitably supported work surface.

Disassembly

⚠ CAUTION

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

1. Remove all hydraulic lines, electrical cables, carrier tube, and power track from the right side of the boom assembly.
2. Remove control console from the platform.
3. Remove the platform from the fly boom assembly.
4. Remove the carrier tube and power track from the right side of the boom assembly.
5. Remove and disassemble the extension chain attachment and adjustment assembly (mounted at aft of boom base section) as follows:
   a. Remove the jam nut and nut which secures the chain attachment clevis bolt to the chain adjustment block.
   b. Remove the bolts and washers which secure the extension chain attachment assembly to the base boom section; remove the chain attachment assembly from the base boom section mounting point.
   c. Remove the cotter pins from the clevis pins. Remove the clevis pins and washers from the chain attachment clevis bolt; remove the chain attachment clevis from the chain.
6. Remove and disassemble the retraction chain attachment and adjustment assembly as follows:
   a. Remove the nuts and washers from the chain attachment shield, and remove the shield from the boom base section.
   b. Remove the jam nut and nut from the threaded end of the tension-adjusting clevis bolt. Remove the entire tension-adjusting assembly from the boom-mounted bracket.
   c. Remove the cotter pins from the clevis pins which secure the retraction chains to the clevis bolt assembly.
   d. Remove the cotter pins, nuts and bolts securing the chain attach blocks to the clevis bolt assembly. Remove the attach blocks.
   e. Separate the top and bottom clevis bolt assembly plates. Remove the clevis bolt from the bottom plate.

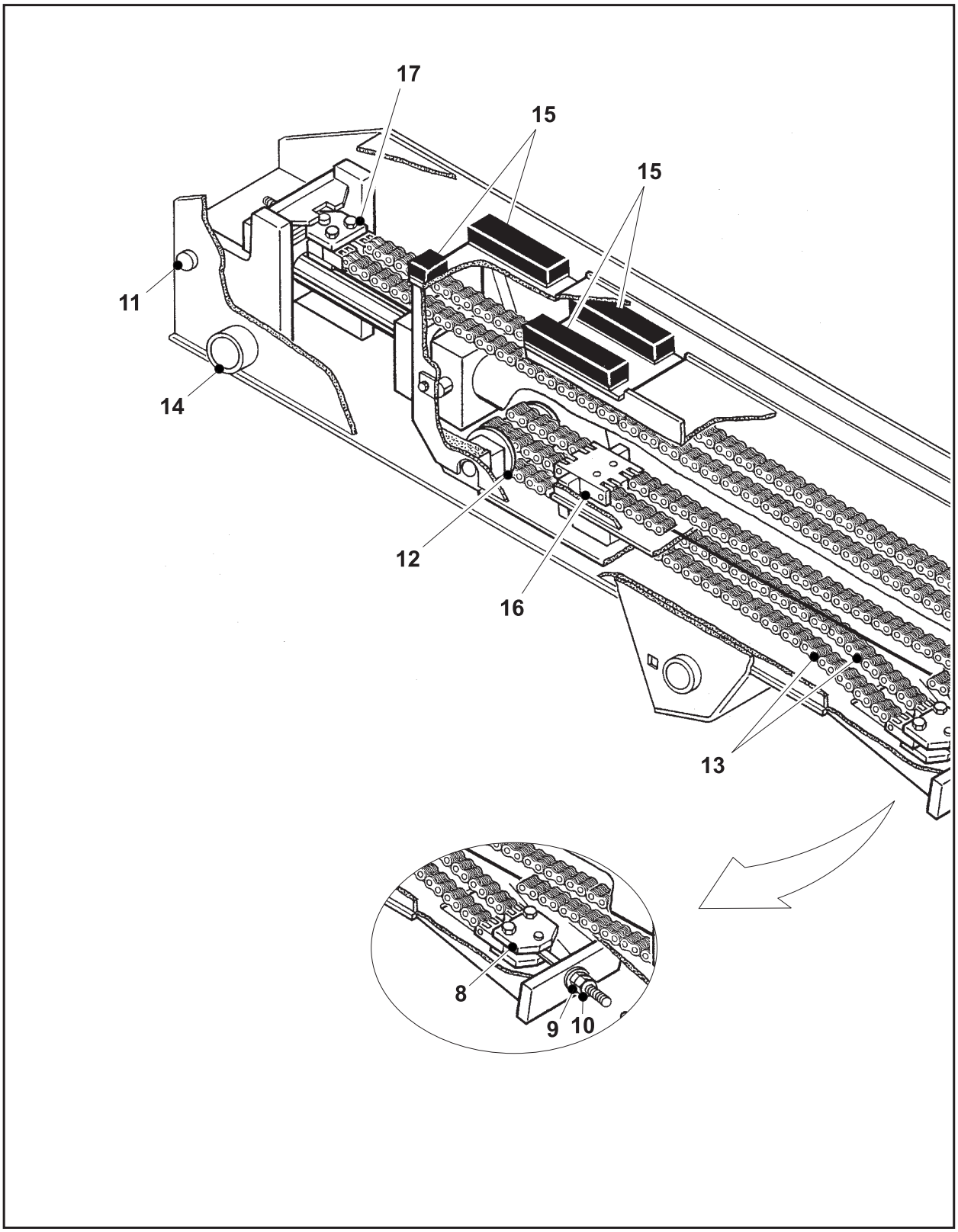


Figure 4-1. Boom Assembly (Sheet 1 of 2)

1. Boom Base
2. Mid Boom
3. Fly Boom
4. Extend Chain
5. Telescope Cylinder
6. Telescope Cylinder Sheave Assembly
7. Telescope Sheave Pin
8. Chain Adjuster (Retract)
9. Adjustment Nut
10. Jam Nut
11. Eccentric Bushing
12. Retract Chain Sheave
13. Retract Chain
14. Boom Pivot Point
15. Upper Rear Wear Pads
16. Chain Attach Block
17. Chain Adjuster (Extend)

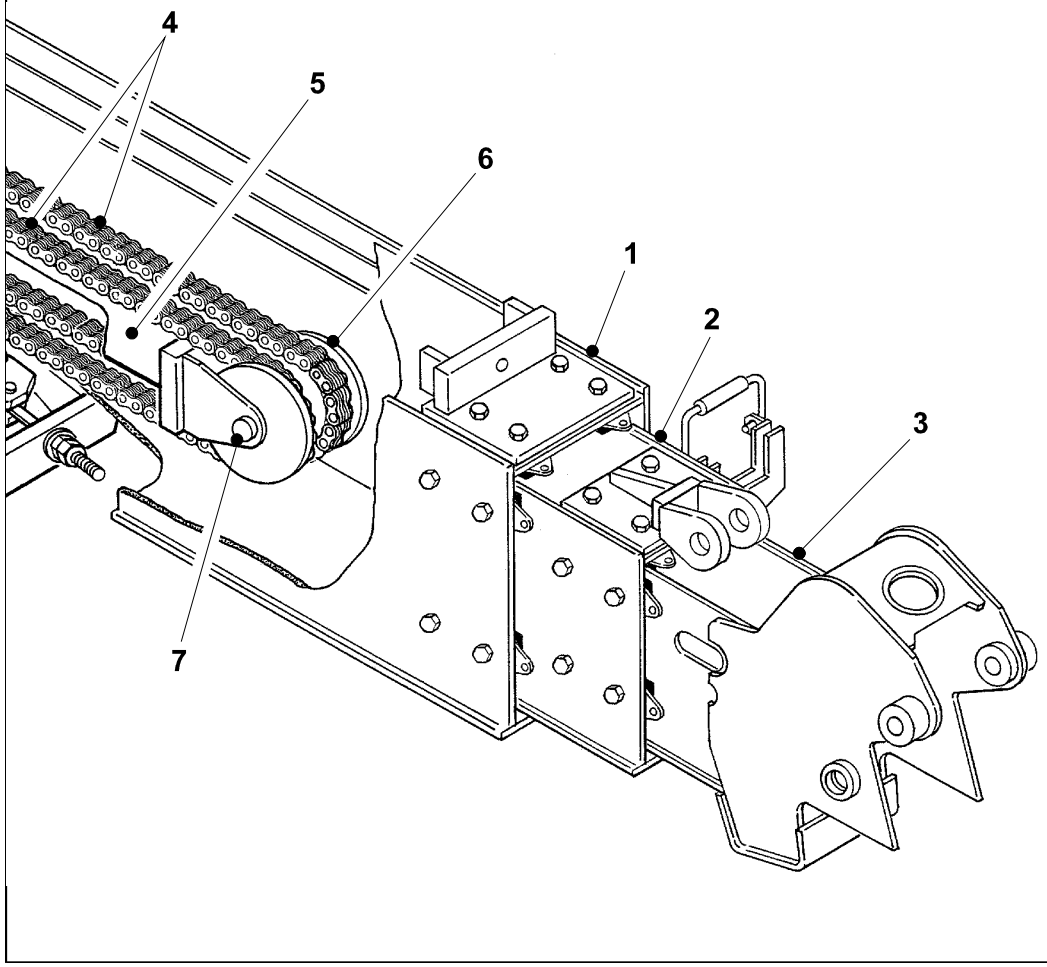


Figure 4-2. Boom Assembly (Sheet 2 of 2)

7. Remove the snap rings from the pin which attaches the telescope cylinder rod end to the boom base section; use a brass drift to remove the pin.

NOTE: *Note and record the number and thickness of any wear pad shims during wear pad removal.*

8. Remove bolts which secure the wear pads to the inner forward surfaces of the boom base section. Remove the wear pads from the top, sides and bottom of the boom base section.
9. Using suitable lifting equipment, carefully slide the assembled mid and fly sections from the base section. Place the mid and fly sections on a suitable trestle.
10. Remove the setscrew which secures the sheave pin at the aft end of the mid section. Use a suitable brass drift to remove the pin. Remove the sheave assembly.
11. Remove the bolts, washers and bar from the trunnion pins which secure the cylinder base to the boom mid section; use a suitable slide hammer to remove the pins.

⚠ 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 FROM THE BOOM AS DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

12. Pull the cylinder partially from the rear of the boom mid section; secure the cylinder with a suitable sling and lifting device at approximately the center of gravity.
13. Carefully remove the telescope cylinder and sheave assembly. Place the cylinder on a suitable trestle.
14. Remove the bolts and washers from the sheave pin; remove the pin and the sheave assembly.

NOTE: *Note and record the number and thickness of any wear pad shims during wear pad removal.*

15. Remove the bolts which secure the wear pads to the inner surfaces of the boom mid section; remove the wear pads from the top, sides and bottom of the mid section.
16. Remove the bolts and lockwashers which secure the chain block weldment to the aft end of the fly section. Remove the cotter pins from the clevis pins which secure the extension chain and retraction chains to the block; remove the clevis pin, washers and chains from the block.
17. Using suitable lifting equipment, remove the fly section from the mid section; place the fly section on a suitable trestle.
18. Remove the bolts which secure the wear pads to the aft ends of the fly and mid sections; remove the wear pads from the boom sections.

Inspection

1. Inspect all sheaves (extend chains, retract chains and telescope cylinder) for excessive groove wear, burrs or other damage. Replace the sheaves as necessary.
2. Inspect the extend chain and retract chain sheave bearings for wear, scoring, or other damage, and for ovality. Replace the bearings as necessary, ensuring they are installed flush with the sheave surface.
3. Inspect the extend chain and retract chain sheave pins for scoring, tapering, ovality and evidence of correct lubrication. Replace the pins as necessary.
4. Inspect the telescope cylinder sheave pin for tapering, scoring, ovality and evidence of correct lubrication. Replace the pin as necessary.
5. Inspect the boom pivot pin for wear, scoring or other damage, and for tapering or ovality. Replace the pin as necessary.
6. Inspect the upper lift cylinder attach pin for tapering, ovality, scoring, wear, or other damage. Ensure the pin surfaces are protected prior to installation. Replace pin as necessary.
7. Inspect telescope cylinder trunnion attach pin for tapering, ovality, scoring, wear, or other damage. Replace pin as necessary.
8. Inspect the extend chain attach clevis pins for wear, scoring, or other damage. Replace the pins as necessary.
9. Inspect the telescope cylinder rod attach pin for scoring, wear, or other damage. Replace the pin as necessary.
10. Inspect the inner diameter of the boom pivot bushing for scoring, distortion, wear, or other damage. Replace the bushing as necessary.
11. Inspect all wear pads for excessive wear or damage. Replace the pads when worn to within 1/8 inch (3.2 mm) of insert.
12. Inspect extend and retract chains and chain attach components for cracks, stretching, distortion, or other damage. Replace components as necessary.
13. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.

14. Inspect structural units of the 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 the same number and thickness of shims as were removed during disassembly.*

1. Measure the inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Install side wear pads to the aft end of the fly section; shim evenly to the measurements of the inside of the mid section.
3. Install the side wear pads to the aft end of the mid section; shim evenly to the measurement of the inside of the base section.
4. Shim the insides of the boom sections for a total of 1/16 inch (.062) clearance (if the action is centered, there will be 1/32 clearance on each side).
5. Slide the fly section into the mid section a distance of approximately one foot; take the measurement of the inside of the mid section top wear pad clearance and fabricate shim packs.
6. Remove the fly section from the mid section and install two top wear pads and a shim pack. Shim the top of the fly section for a total of 1/16 inch (.062) clearance.
7. Slide the mid section into the base section a distance of approximately one foot; take the measurement of the top wear pad clearance and fabricate shim packs.
8. Remove the mid section from the base section and install two top wear pads and a shim pack. Shim the top of the mid section for a total of 1/16 inch (.062) clearance.
9. Attach the extension chain to the appropriate clevised attachment point of the chain block weldment by installing the clevis pin and washer through the attach holes; secure the clevis pin with a new cotter pin. Place the chain block weldment in position at the aft end of the fly section; secure the weldment by installing the bolts and washers.

⚠ CAUTION

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

10. Slide the fly section into the mid section. Shim the boom, if necessary, for a total of 1/16 inch (.062) clearance.
11. Install wear pads into the forward portion of the mid section. Shim the boom, if necessary, for a total of 2/10 inch (.20) clearance.
12. Align the attach points of the retraction chains with those of the chain attachment block, located at the aft end of the fly section. Install the clevis pins and washers through the attaching holes of the chains and block; secure the clevis pins by installing new cotter pins.
13. Properly position the retraction chain sheave assemblies at the aft end of the mid section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pin and secure by installing the setscrews. Position the retraction chains onto the sheaves.
14. Align the telescope cylinder base-to-sheave attachment points. Install the sheave pin through the cylinder base and sheave assembly; secure the pin with bolt and washer.
15. 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 AS DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

16. Position the free end of the extension chain around and over the sheave. Slowly slide the cylinder into the boom while maintaining tension on the chain. (This will keep the chain properly seated in the sheave groove throughout installation).
17. Align the cylinder base-end attachment holes with the boom mid section attachment holes; install the trunnion pins and secure the pins by installing bars, washers and bolts.
18. Slide the mid section into the base section. Allow the retraction chains to trail between the bottom surfaces of boom sections. Ensure that no twists exist in the chains. Shim the top of the mid section for a total of 1/16 inch (.062) clearance.
19. Install wear pads into the forward portion of the base section. Shim the boom, if necessary, for a total of 2/10 inch (.20) clearance.
20. Assemble the extension chain attachment and adjustment assembly (mounted at aft of boom base section) as follows:
    a. Align the attaching holes of the chain attachment clevis bolt with those of the extension

chain end; install the clevis pin through the attaching holes. Install the washer and cotter pin which secures the clevis pin through the chain attachment assembly.

21. Align the cylinder rod-end attachment point with those of the boom base section. If necessary, use an auxiliary hydraulic power source to extend and retract the cylinder rod for alignment. Install the cross pin through the base boom section and cylinder rod. Install the snap rings onto the cross pin.
22. Align the chain attachment assembly holes with the threaded mounting holes at the aft end of the boom by installing the bolts and washers.
23. Insert the threaded end of the chain attachment clevis bolt through the large hole of the chain attachment weldment. Loosely install the jam nut and nut onto the threaded end of clevis bolt.
24. Assemble and install the retraction chain attachment and adjustment assembly as follows:
    a. Place the clevis bolt on the bottom plate and place the top plate onto the clevis assembly. Secure the clevis bolt with clevis pins, washers and new cotter pins.
    b. Insert chain attach blocks between the clevis plates ensuring the attachment points are properly aligned. Secure the block in position with bolts, nuts and new cotter pins.
    c. Align the retraction chains with the clevis attach blocks; secure the chains with clevis pins, washers and new cotter pins.
    d. Position the bolt end of the extension-adjustment clevis into the boom mounted bracket. Secure the chain-adjusting assembly by installing the jam nut and nut.
    e. Position the chain adjustment shield over the chain adjustment assembly; secure the shield by installing the bolts and washers.
25. Adjust the retract and extend chains to the proper torque. (See adjusting procedures of Section 4.2).
26. Install the hydraulic hoses, electrical cables, and the harnessing power track components as follows:
    a. Properly position the fly section carrier tube with carrier tube bracket installed at the side of the boom. Align the attachment holes the forward end of the carrier tube with those of the fly section mounting plate. Secure the carrier tube by installing the bolts, washers, lock washers and nuts. Align the support bracket with attachment holes in the mid boom and secure with bolts and washers.
    b. Properly position the assembled hoses, electrical cable, and the harnessing power track onto the base section carrier tube. Carefully feed the proper hose and cable ends through the fly section carrier tube and into the hole in the boom fly section. Properly align the power track end with the attachment point of the fly section carrier tube; install the bolts, washers, lock washers and nuts which secure the power track to the carrier tube.
    c. Carefully feed the remaining hose and cable ends aft through the base section carrier tube. Properly align the remaining power track end with the attachment point of the base section carrier tube; install the bolts, washers, lockwashers and nuts which secure the power track to carrier tube.
    d. Ensure all hoses and cables are properly routed through the carrier tube and power track. Tighten or install all clamping or securing apparatus to the hoses or cables, as necessary.

Installation

1. Using suitable lifting equipment, position the assembled boom on turntable so that boom pivot holes in both boom and turntable are aligned.
2. Insert boom pivot pin, ensuring that locating slots in pin are aligned with setscrew locating holes in pin bushings.
3. If necessary, gently tap the pin into position with a soft headed mallet. Secure the pin with setscrews.
4. Connect all wiring to the ground control box.
5. Using all applicable safety precautions, operate lifting equipment in order to position the boom lift cylinder so the holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin.
6. If necessary, gently tap the pin into position with a soft headed mallet, ensuring the pin plate holes are aligned with the attach holes in the boom structure. Install the pin attaching bolts, washers and lockwashers.
7. Shut down all machine systems.
8. Connect the hydraulic lines running alongside of boom.
9. Using all applicable safety precautions, operate the machine systems and raise and extend the boom fully, noting the performance of the extension cycle. If chattering is apparent, the extend chain system requires adjustment.
10. Retract and lower the boom, noting the performance of the retraction cycle. If chattering is apparent, the retract chain system requires adjustment.
11. Shut down all machine systems.
12. Adjust the extend and retract chain systems as required and secure the adjustment locknuts.

13. As necessary, lubricate all points requiring lubrication.

4.2 BOOM CHAINS

(See Figure 4-3.)

Adjusting Procedures

⚠ WARNING

ENSURE THE MACHINE IS ON A FIRM AND LEVEL SURFACE.

1. Fully retract the boom in the horizontal position (± 5°) with no load in the platform.
2. Extend the platform approximately 3 ft. (1 meter).
3. Torque the boom retract chain adjuster to 50 ft. lbs. (69 NM), then torque the boom extend chain adjuster to 50 ft. lbs. (69 NM).
4. Retract the platform approximately 1 ft. (0.3 m).
5. Check the boom extend chain adjusters (50 ft. lbs. {69 NM} required).
6. Retract the platform approximately 1 ft. (0.3 m) once again.
7. Recheck the extend chain adjusters (50 ft. lbs. {69 NM} required).
8. Extend the platform approximately 1 ft. (0.3 m). Check for proper operation of boom.
9. Recheck the retract chain adjuster torque. (50 ft. lbs. {69 NM} required).
10. Fully extend and retract the boom and check for proper operation.

JLG Industries, Inc. requires a complete boom disassembly, per instructions outlined in Section 4.1, Boom Maintenance, every two years. All boom chains and related components (i.e., sheaves, pins, sprockets, wear pads, etc.) must also be inspected and replaced (as necessary) during this disassembly.

An immediate disassembly of the boom assembly and inspection of the boom chains and related components is required if any of the following conditions occur:

1. After the machine is exposed to hostile environments or conditions (i.e. extreme cold, dust, sand, blasting grit, salt, chemicals, etc.), which could adversely affect boom operation.
2. Erratic boom operation or unusual noise exists. See the Troubleshooting section in this Service Manual.
3. Chain adjustment is required more often than specified in the Preventive Maintenance and Inspection Schedule in this Service Manual or links need to be removed (chain shortened) to make the proper adjustment.
4. The machine is idle for an extended period (6 months or longer.)
5. The boom is overloaded or sustained a shock load.

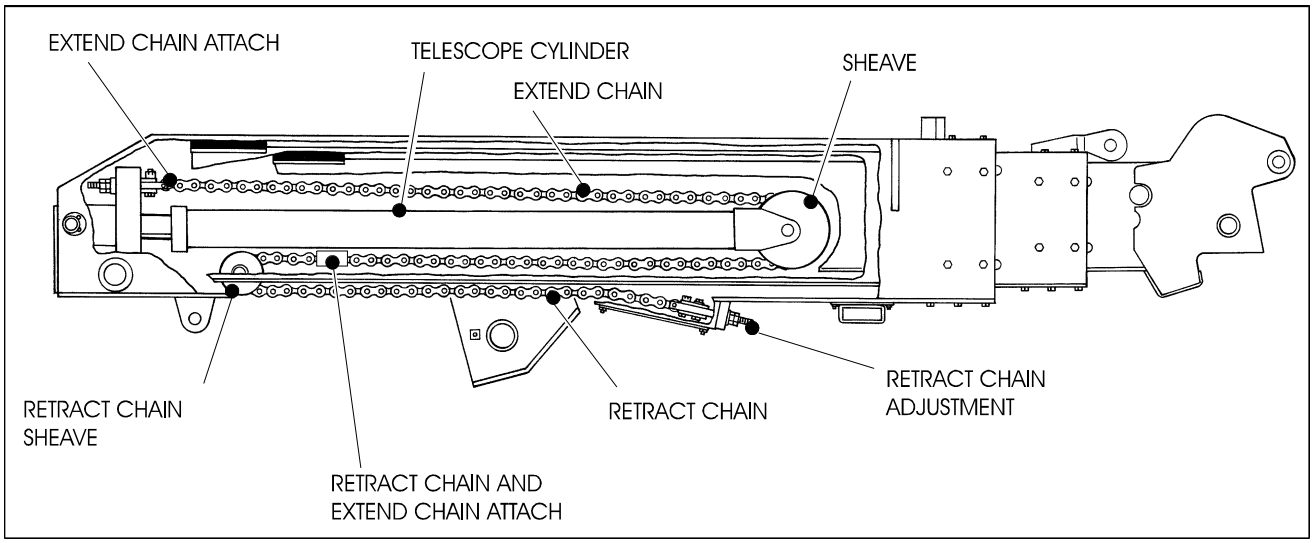


Figure 4-3. Typical Boom Assembly

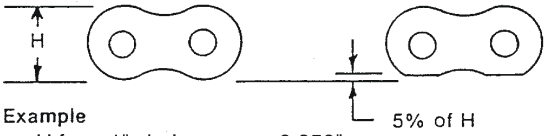
⚠ WARNING

FAILURE TO DISASSEMBLE THE BOOM ASSEMBLY AND PROPERLY INSPECT AND/OR REPLACE THE BOOM CHAINS AND RELATED COMPONENTS (I.E., SHEAVES, PINS, SPROCKETS, WEAR PADS, ETC.) COULD RESULT IN THE DAMAGE AND/OR BREAKAGE OF THE BOOM CHAINS AND/OR RELATED COMPONENTS. DAMAGE AND/OR BREAKAGE OF THESE ITEMS COULD RESULT IN UNCONTROLLED EXTENSION OR RETRACTION OF THE BOOM ASSEMBLY AND COULD CAUSE SERIOUS INJURY OR DEATH TO PERSONNEL OPERATING THE JLG BOOM LIFT.

Inspection Procedures

Inspect boom chains for the following condition:

6. **Wear:** Always inspect that segment of chain that operates over a sheave. As the chain flexes over the extend/retract sheaves, joints and plate edges very gradually wear. Chain "stretch" can be measured using a manufacturers wear scale or steel tape. When chains have elongated 3% they must be removed and replaced. Refer to Table 2-1 for proper chain specifications and allowable stretch tolerances. Peening and wear of chain plate edges are caused by sliding over a chain worn contact face of a sheave, or unusually heavy loads. All of the above require replacement of the chain and correction of the cause. Chain side wear, noticeable when pin heads and outside plates show a definite wear pattern, is caused by misalignment of the sheave/chain anchors and must be corrected promptly. Do not repair chains; if a section of chain is damaged, replace the entire chain set.



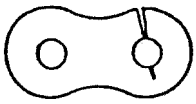
Example
H for a 1" chain = 0.950"
Maximum wear = 5% of 0.950" = 0.047"
Minimum plate depth = 0.950" - 0.047" = 0.903"

7. **Lubrication:** One of the most important but often overlooked factors is adequate lubrication. In addition to reducing internal friction, maintaining a film of oil on all chain surfaces will inhibit rusting and corrosion. This is important as corrosion of highly stressed, hardened steel chain components can cause a major reduction in the load capacity of leaf chain and result in link plate cracking.

NOTE: *The need for lubrication can be determined by the presence of rust on the exposed portions of chain.*

8. **Rust and Corrosion:** Rust and corrosion will cause a major reduction in the load carrying capacity of the chain, because these are primary reasons for side plate cracking. The initial lubrication at the factory is applied in a hot dip tank to assure full penetration into the joint. Do not steam clean or degrease this lubricant on chains. A grade of SAE 30 or 40 weight, non detergent motor oil should be used as a supplemental lubricant and a film of this oil should be constantly maintained on the surfaces and internal joints. At time of chain installation, factory lube must be supplemented by a maintenance program to provide a film of oil on the chains at all times. If chains are corroded, they must be inspected, especially the outside plates, for cracks in-line with the pins. If cracks are found, replace the chain; if no cracks are discovered, lubricate the chains by dipping in heated oil, and reinstall on the machine. Keep chains lubricated.

9. **Fatigue Cracks:** Fatigue is a phenomenon that affects most metals, and is the most common cause of chain plate failures. Fatigue cracks are found through the link holes, perpendicular (90 degrees) from the pin in-line position. Inspect chains carefully after long time use and heavy loading for this type of crack. If any cracks are discovered, replace all chains, as seemingly sound plates are on the verge of cracking. Fatigue and ultimate strength failures on JLG Lifts are incurred as a result of severe abuse as design specs are well within the rated lifting capacity of these chains.

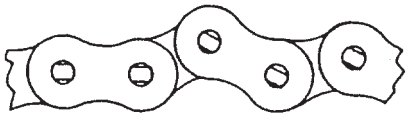


10. **Tight Joints:** All joints in the roller chain should flex freely. On roller chain, tight joints are usually caused by rust/corrosion, or the inside plates "walking" off the bushing. Limber up rusty/corroded chains (after inspecting care fully) with a heavy application of oil (preferably a hot oil dip). Tap inside "walking" plates inward; if "walking" persists, replace the chain. This type of problem is accelerated by poor lubrication maintenance practice, and most tight joint chains have been operated with little or no lubrication. Tight joints on leaf chain are generally caused by:

11. Bent pins or plates.
12. Rusty joints.
13. Peened plate edges.

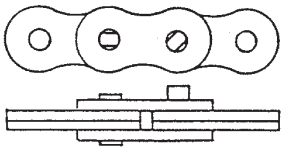
Oil rusty chains, and replace chains with bent or peened chain components. Keep chains lubricated.

TIGHT JOINTS



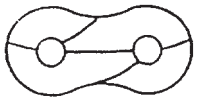
14. **Protruding or Turned Pins:** Chains operating with inadequate lube generate tremendous friction between the pin and plates (pin and bushing on roller chain). In extreme cases, this frictional torque can actually turn the pins in the outside press-fit plates. Inspect for turned pins, which can be easily spotted as the “V” flats on the pin heads are no longer in line. Replace all chains showing evidence of turned or protruding pins. Keep chains lubricated.
15. **Stress Corrosion Cracking:** The outside link plates, which are heavily press-fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (aperture) but tend to extend in an arc-like path, often parallel to the rolling grain of the material.

ABNORMAL PROTRUSION OR TURNED PINS



Also, more then one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere. Stress corrosion is an environmentally assisted failure. Two conditions must be present; corrosive agent and static stress.

ARC-LIKE CRACKED PLATES (STRESS CORROSION)



In the chain, static stress is present at the aperture due to the press fit pin. No cycle motion is required and the plates can crack during idle periods. The reactions of many chemical agents (such as battery acid fumes) with hardened metals liberate hydrogen which attacks and weakens the metal grain structure.

16. **Chain Anchors, Sheaves and Pins:** An inspection of the chain must include a close examination of chain anchors, sheaves and pins. Check chain anchors for wear breakage and misalignment. Anchors with worn or broken fingers should be replaced. They should also be adjusted to eliminate twisting the chain for an even load distribution.

Sheaves should be inspected for worn flanges, which would indicate misalignment, and wear on the outside diameter of the sheave. A worn sheave can mean several problems, as follows:

1. Chains too tight.
2. Sheave bearings/pin bad.
3. Bent/misaligned chains.

Table 4-1. Chain Stretch Tolerance

CHAIN SIZE	PIN TO PIN MEASUREMENT	ALLOWABLE STRETCH 14 IN. SPAN
0.50 in. (1.27 cm) pitch	14 in. (36 cm) or 28 pitches	0.42 in. (1.07 cm)
1.00 in. (2.54 cm) pitch	14 in. (36 cm) or 14 pitches	0.42 in. (1.07 cm)
1.75 in. (4.45 cm) pitch	14 in. (36 cm) or 8 pitches	0.42 in. (1.07 cm)
2.00 in. (5.08 cm) pitch	14 in. (36 cm) or 7 pitches	0.42 in. (1.07 cm)

4.3 WEAR PADS

1. Shim up wear pads within 1/16 in. (1.59 mm) tolerance between wear pad and adjacent surface.
2. Replace wear pads when worn within 1/8 in. (3.18 mm) of threaded insert.

4.4 TELESCOPE CYLINDER ECCENTRIC BUSHING

IMPORTANT

RELOCATE ALTERNATE SETSCREW HOLE ONLY WHEN REPLACING ECCENTRIC BUSHING.

When replacing the eccentric bushings, drill 5/16" dia. x 3/4" deep, tap 3/8-16NC x 9/16" deep for a new setscrew (bushing to boom) either above or below original holes. Allow enough room between the holes for strength while staying on the thick side of the bushing. (See Figure 4-4.)

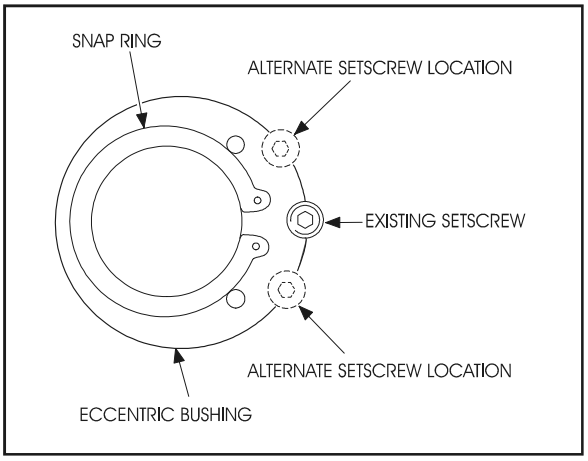


Figure 4-4. Telescope Cylinder Eccentric Bushing

4.5 HORIZONTAL HIGH SPEED CUTOUT SWITCH ADJUSTMENT PROCEDURE

Adjust the switch to trip when the boom reaches 0 degrees +0 degrees /-3 degrees.

4.6 CONTROLLERS

PQ

Refer to separate publication (3120351) for complete troubleshooting, wiring and replacement parts.

OEM

Refer to separate publication (3120344) for description troubleshooting, wiring and replacement parts.

VICKERS (All Hydraulic)

Refer to separate publication (3120335) for complete troubleshooting, wiring and replacement parts.

4.7 CAPACITY INDICATOR

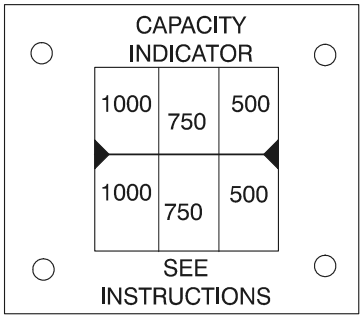
The capacity indicator is a mechanical gage that indicates the allowable maximum weight in the platform in reference to the angle of the boom.

⚠ WARNING

THE CABLE ADJUSTMENT AND DECAL REPLACEMENT ARE CRITICAL TO INSURE AN ACCURATE READING OF THE CAPACITY INDICATOR.

Capacity Indicator Cable Adjustment

1. Position main boom top plate and platform to be parallel to the floor.
2. Adjust the cable to locate the dial in the capacity indicator box so that the indicator line and calibration arrows on the nameplate are aligned.



Capacity Indicator Boom Tape Replacement

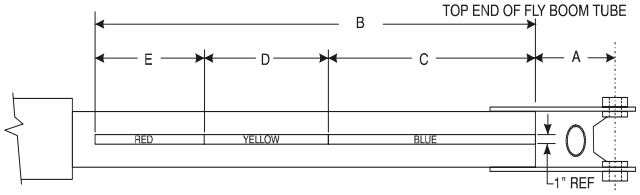
Replacement of boom tape is required when tape is illegible or missing.

⚠ WARNING

THE LOCATION DIMENSIONS AND COLORS ARE CRITICAL FOR AN ACCURATE READING OF THE CAPACITY INDICATOR GAGE.

Installation Procedure

1. Clean and dry fly boom top surface before installing the tape.
2. Install tape on center of fly boom to dimensions shown in table.



BOOM TAPE CHART					
DESCRIPTION	DIM. "A"	DIM."B"	DIM. "C"	DIM."D"	DIM. "E"
Standard	12-1/4"	266-7/8"	193-7/8"	34"	39"
CSA App.	12-1/4"	266-7/8"	171-7/8"	42"	53"

Figure 4-5. Boom Tape Replacement

Capacity Indicator Dial Decal Replacement

Dial decal is required to be replaced when illegible or missing.

⚠ WARNING

DECAL LOCATION DIMENSIONS ARE CRITICAL FOR ACCURATE READING OF CAPACITY INDICATOR.

Indicator Decal Installation

1. Clean and dry wheel surface before installing decal.
2. Locate bottom of dial decal 1/16" from 1/8" dia. hole on face of gage wheel.

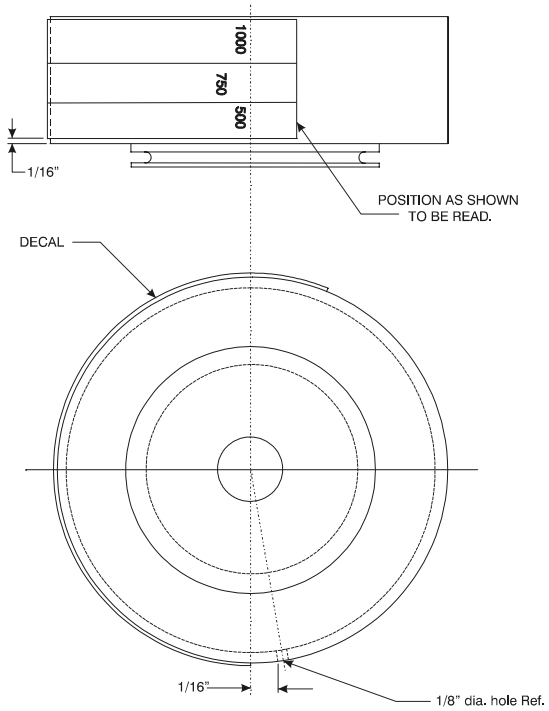


Figure 4-6. Capacity Indicator Dial

4.8 BASKET ROTATOR BRAKE

Torque belleville washers (4160026) to 140 ft. lbs. (190 NM).

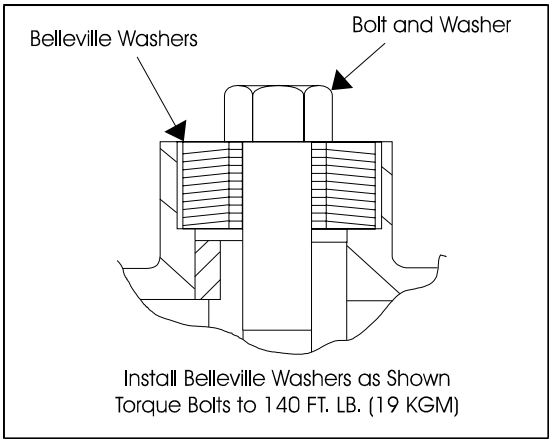


Figure 4-7. Belleville Washers

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SECTION 5. HYDRAULICS

5.1 CYLINDERS - THEORY OF OPERATION

Double Acting Cylinders

Cylinders are of the double-acting type. Systems incorporating double-acting cylinders are as follows: Lift, Telescope, Platform Leveling, Steer and 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.

5.2 VALVES - THEORY OF OPERATION

Holding Valves

Holding Valves are used in the Lift, Telescope, Slave Level and lockout 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.

Solenoid Control Valves (Bang-Bang)

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.

Proportional Control Valve - Vickers

(See Figure 5-1.)

CMX series valves provide a power output matching that required by the load. A small line connected to a load-sensing port feeds load pressure back to the pump. The pump senses the difference between the load and pump outlet pressures, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valves meter-in spool, with the effect that pump flow is determined by the degree of spool opening, independent of load pressure. Return lines are connected together simplifying routing of return flow and to help reduce cavitation. Load sensing lines connect through shuttle valves to feed the highest load signal back to the pump. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard. The load drop check prevents any drop of a suspended load before upward movement.

Main Relief Valves

Main relief valves are installed at various points with 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.

Relief Valves

Crossover relief valves are used in circuits where the actuator requires an operating pressure lower than that supplied to the system. When the circuit is activated and the required pressure at the actuator is developed, the crossover relief diverts excess pump flow to the reservoir, individual, integral reliefs are provided for each side of the circuits.

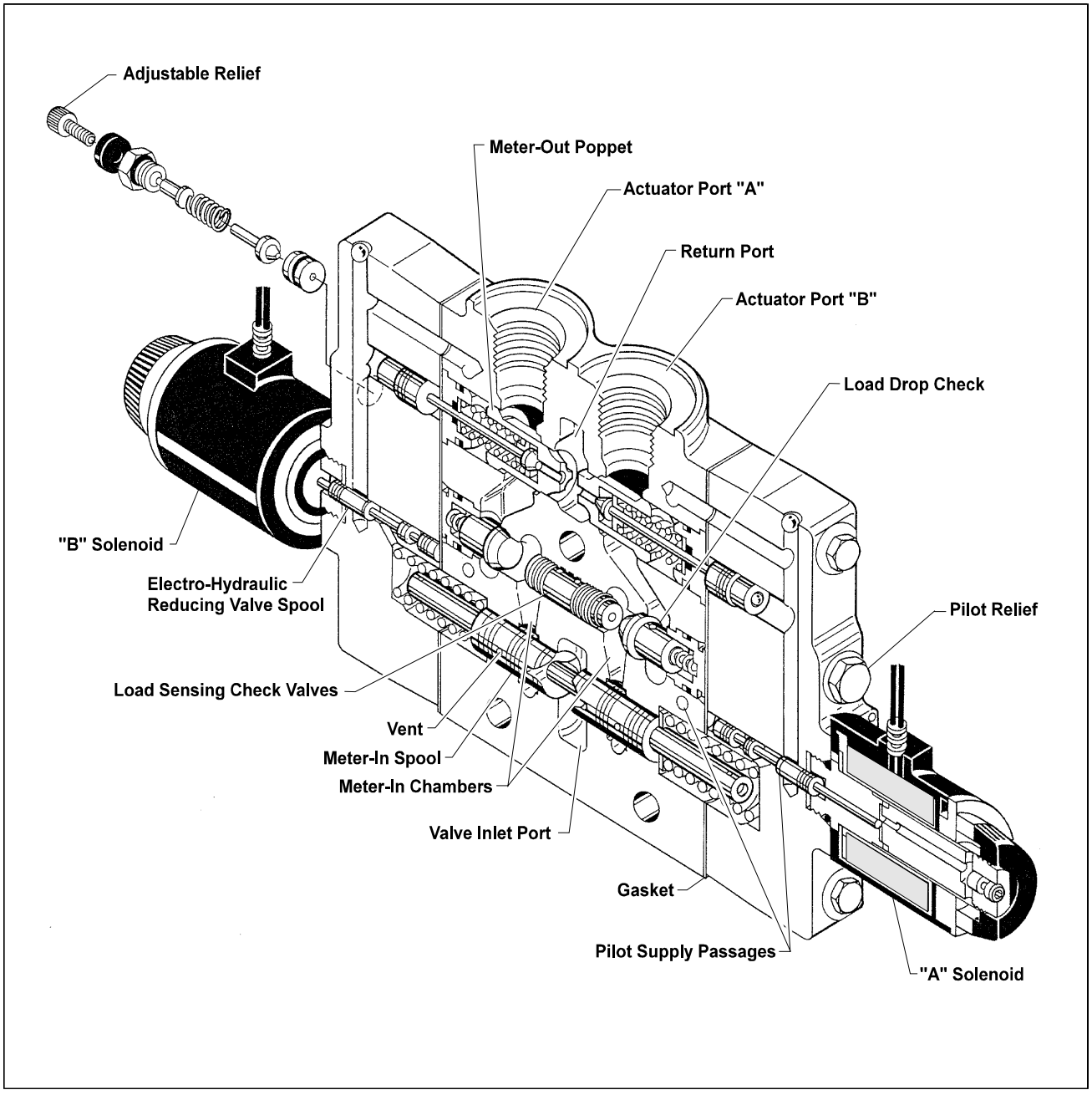


Figure 5-1. Proportional Control Valve

5.3 CYLINDER CHECKING PROCEDURE

NOTE: *Cylinder checks must be performed any time a cylinder component is replaced or when improper system operation is suspected.*

Cylinders Without Counterbalance Valves

(Steer Cylinder and Master Cylinder)

1. Using all applicable safety precautions, activate the engine and fully extend the cylinder to be checked. Shut down the engine.
2. Carefully disconnect the hydraulic hose from the retract port of the cylinder. 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 retract port.
3. Activate the engine and extend the cylinder.
4. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect the hose to the port and retract the cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repairs must be made.
5. With the cylinder fully retracted, shut down the engine and carefully disconnect the hydraulic hose from the cylinder extend port.
6. Activate the engine and retract the cylinder. Check the extend port for leakage.
7. If the extend port leakage is less than 6-8 drops per minute, carefully reconnect the hose to the extend port, then activate the 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

(Lift Cylinder, Telescope Cylinder and Extend- A-Reach Lift Cylinder)

⚠ CAUTION

OPERATE ALL FUNCTIONS FROM THE GROUND CONTROLS.

1. Using all applicable safety precautions, activate the hydraulic system.

⚠ WARNING

WHEN WORKING ON THE LIFT CYLINDER, RAISE THE BOOM TO HORIZONTAL AND PLACE A BOOM PROP APPROXIMATELY 1 INCH (2.50 CM) BELOW THE BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE PROP IN PLACE. REFER TO FIGURE 5-2.

2. After completing the above, shut down the hydraulic system and allow the machine to sit for 10-15 minutes. Turn the IGNITION SWITCH to ON, move the control switch or lever for the applicable cylinder in each direction, then turn the IGNITION SWITCH to OFF. This is done to relieve pressure in the hydraulic lines. Carefully remove the hydraulic hoses from the 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 not be any further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the following cylinder repairs must be made. If the retract port is leaking, the piston seals are defective and must be replaced. If the extend port is leaking, the counterbalance valve is defective and must be replaced.
4. If no repairs are necessary or when repairs have been made, carefully reconnect the hydraulic hoses to the appropriate ports.
5. If used, remove the boom prop from beneath the boom, activate the hydraulic system and run the cylinder through one complete cycle to check for leaks.

Cylinders With Dual Counterbalance Valves

(Platform Slave Level Cylinder, Lockout Cylinder and Extend-A-Reach Level Cylinder)

⚠ CAUTION

OPERATE ALL FUNCTIONS FROM THE GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate the hydraulic system.
2. When working on the platform slave level cylinder, stroke the platform slave level cylinder forward until the platform sits at a 45° angle.
3. Shut down the hydraulic system and allow the machine to sit for 10-15 minutes. If the machine is equipped with bang-bang or proportional control valves, turn the IGNITION SWITCH to ON, move the control switch or lever for the applicable cylinder in each direction, then turn the IGNITION SWITCH to OFF. If the machine is equipped with hydraulic control valves, move the control lever for the applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove the hydraulic hoses from the appropriate cylinder port block.
4. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should not be any 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.
5. To check the piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge there should not be any 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.
6. If no repairs are necessary or when repairs have been made, replace the counterbalance valve and carefully connect the hydraulic hoses to the cylinder port block.
7. If used, remove the lifting device from the upright or remove the prop from below the boom, activate the hydraulic system and run the cylinder through one complete cycle to check for leaks.

5.4 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.*

NOTE: *See Figure 5-3., Figure 5-4., Figure 5-5., and Figure 5-6. for the breakdown of typical hydraulic cylinders used on this machine.*

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 THE CYLINDER TO THE END OF THE STROKE. RETRACT THE 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.

⚠ WARNING

ON CYLINDERS WITH DOUBLE HOLDING VALVES, BEFORE REMOVING HOLDING VALVES, CRACK THE BLEEDERS TO RELEASE PRESSURE.

3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard the o-rings.

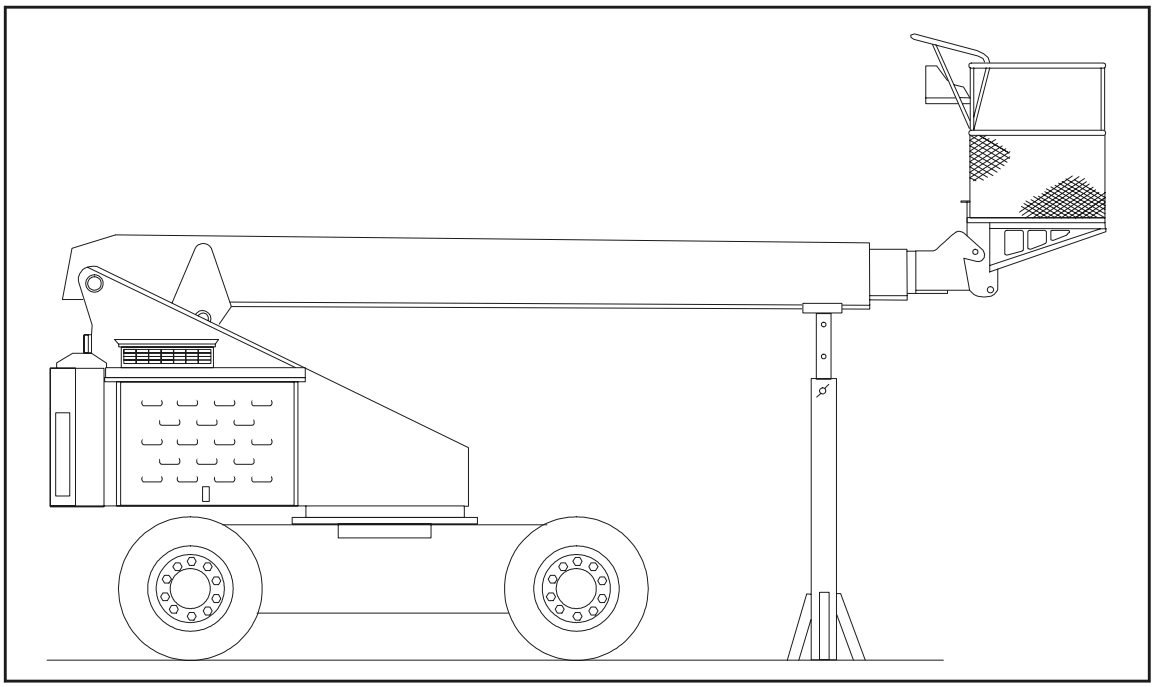


Figure 5-2. Boom Positioning and Support - Cylinder Repair

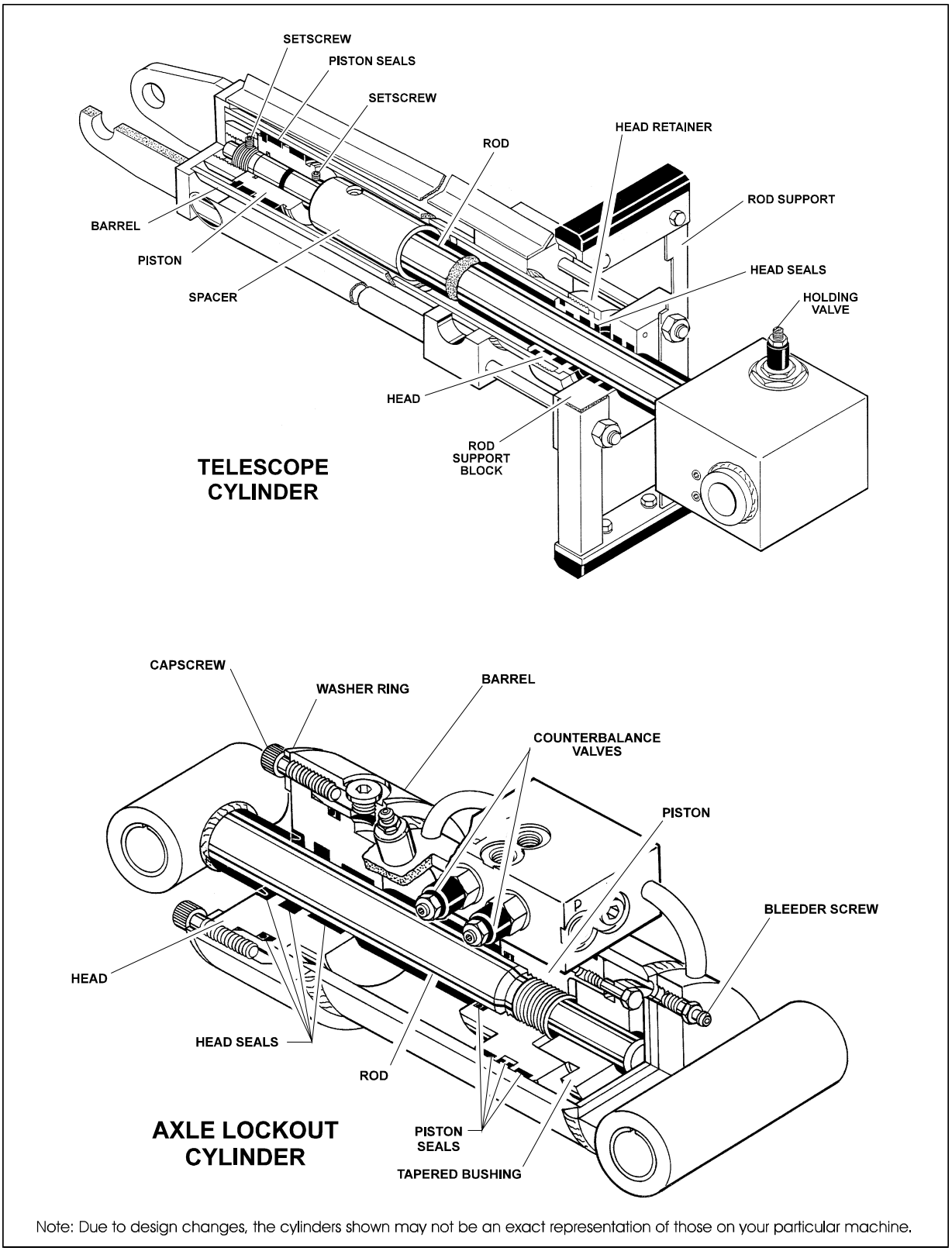


Figure 5-3. Typical Hydraulic Cylinders (Sheet 1 of 4)

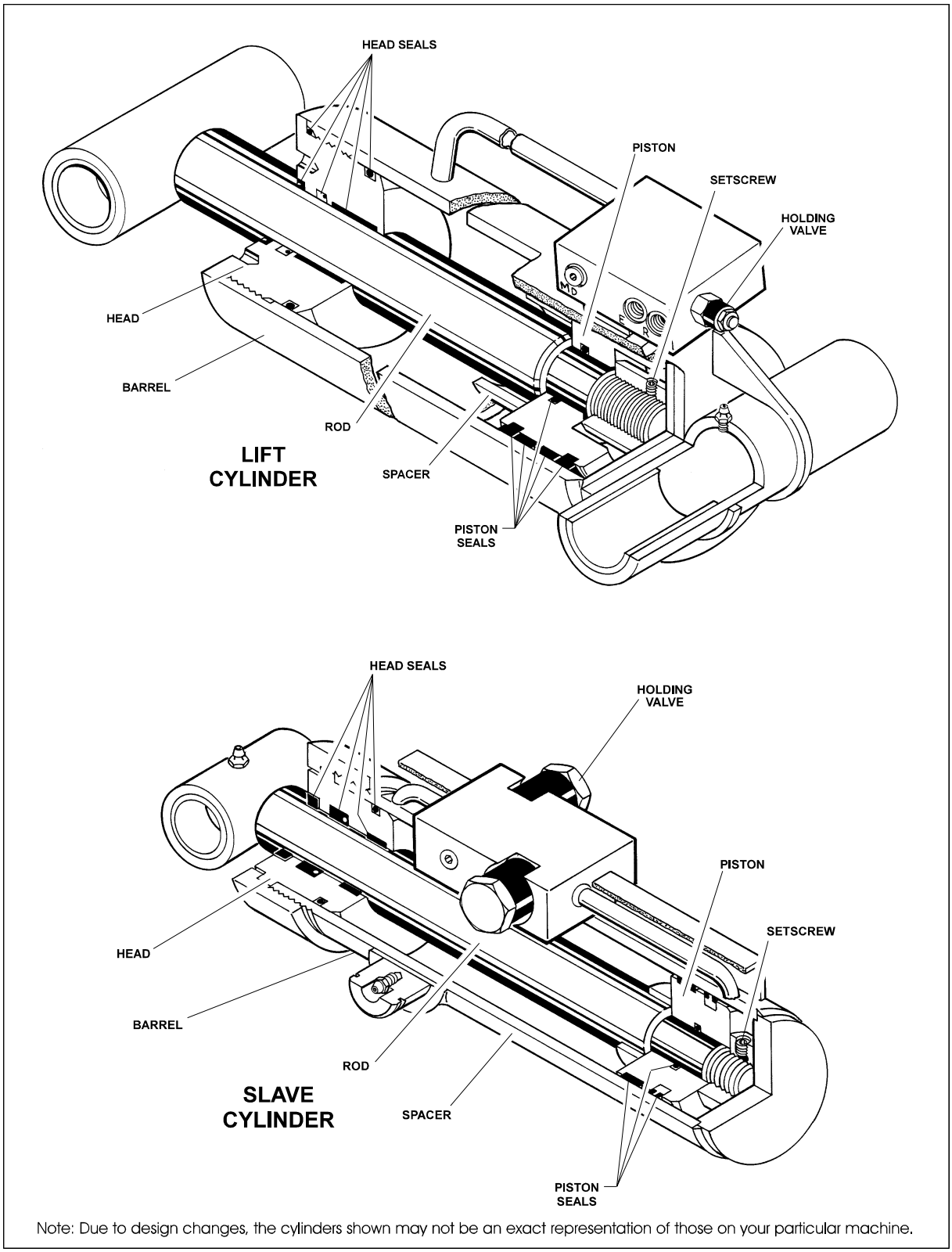


Figure 5-4. Typical Hydraulic Cylinders (Sheet 2 of 4)

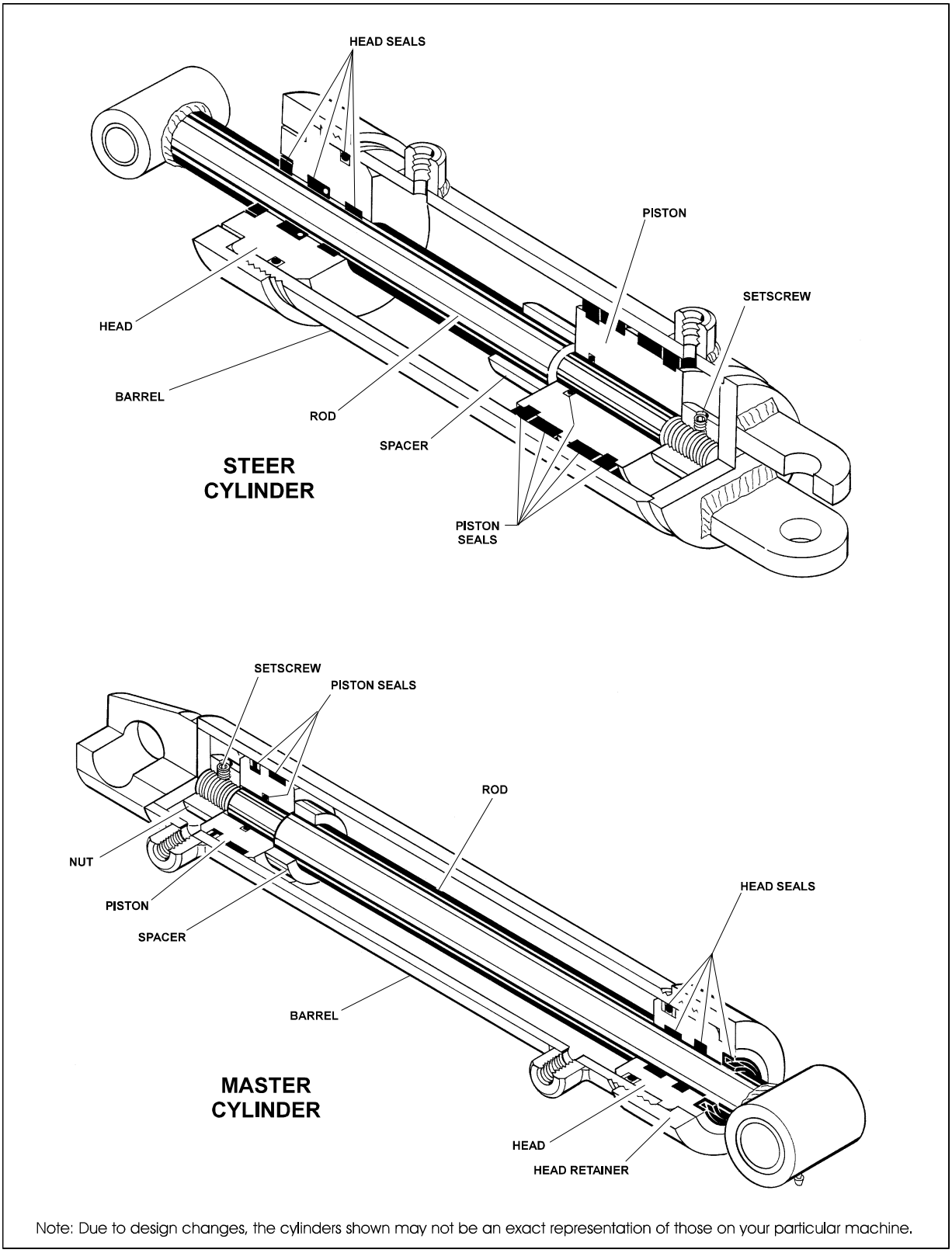


Figure 5-5. Typical Hydraulic Cylinders (Sheet 3 of 4)

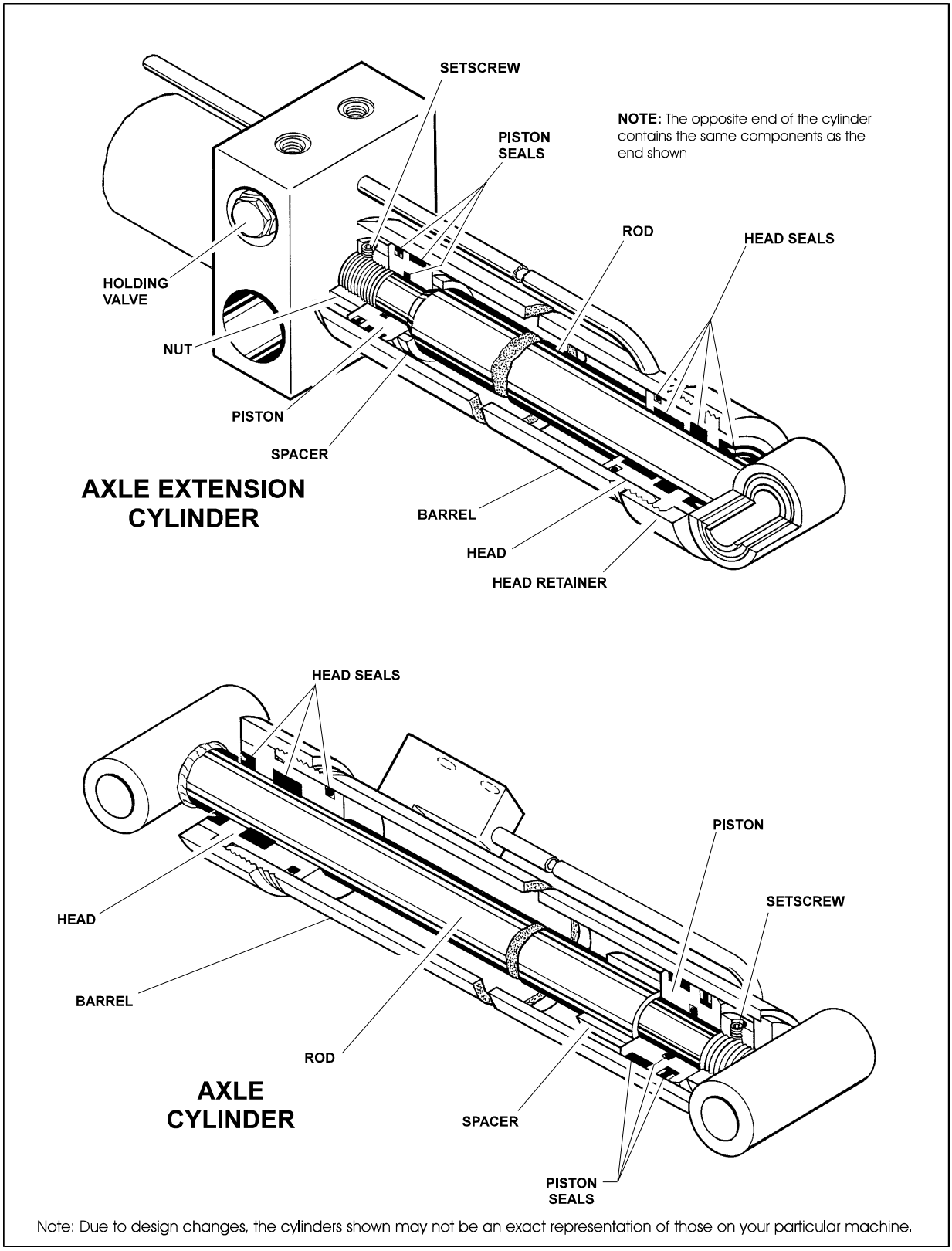


Figure 5-6. Typical Hydraulic Cylinders (Sheet 4 of 4)

NOTE: *Step 4 applies only to the Telescope Cylinder.*

4. Remove the nuts which attach each cylinder rod support block pull rod and withdraw the rods from the forward end of the telescope cylinder.
5. Place the cylinder barrel into a suitable holding fixture. Tap around the outside of the cylinder head retainer with a suitable hammer to shatter the loctite seal.

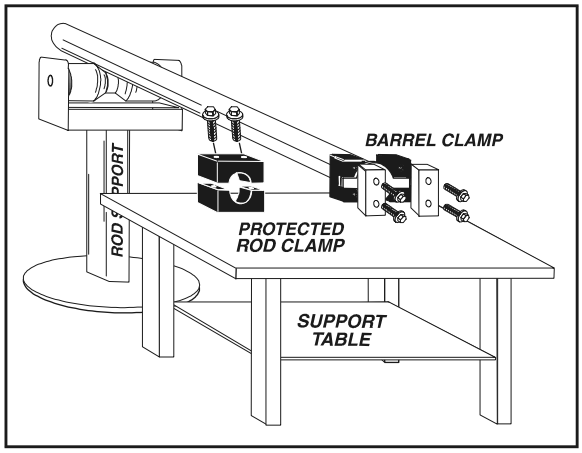


Figure 5-7. Cylinder Barrel Support

6. Using a suitable spanner wrench, loosen the cylinder head retainer, if applicable, and/or cylinder head gland, and remove from cylinder barrel.
7. 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.

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

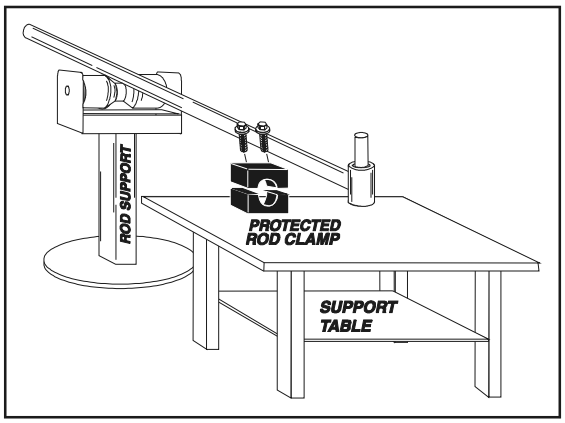


Figure 5-8. Cylinder Rod Support

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. Remove the setscrew(s), if applicable, and nut which attach the piston to the rod, and remove the piston. Discard self-locking set screws.
11. Remove the piston rings.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove the setscrew, if applicable, piston spacer, and wear ring, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer, 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 the rod with Scotch Brite or an equivalent. Replace the rod if necessary.
3. Inspect the threaded portion of the rod for excessive damage. Dress the threads as necessary.
4. Inspect the inner surface of the cylinder barrel tube for scoring or other damage. Check the inside diameter for tapering or ovality. Replace if necessary.
5. Inspect the threaded portion of barrel for damage. Dress the threads as necessary.
6. Inspect the piston surface for damage and scoring and for distortion. Dress the piston surface or replace the piston as necessary.
7. Inspect the seal and o-ring grooves in the piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect the cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect the seal and o-ring grooves in the cylinder head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. If applicable, inspect the cylinder head retainer or end cap for surface or thread damage. Repair or replace as necessary.
11. Inspect the cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
12. If applicable, inspect the thread ring for scoring or other damage. Dress the threads or applicable surfaces as necessary.
13. If applicable, inspect the seal grooves in the thread ring for burrs and sharp edges. Dress applicable surfaces as necessary.
14. If applicable, inspect the rod and barrel bushings for signs of correct lubrication and excessive wear. Replace as necessary.
15. Inspect the travel limiting collar or spacer for burrs and sharp edges. If necessary, dress the inside diameter surface with Scotch Brite or equivalent.
16. If applicable, inspect the port block fittings and holding valve. Replace as necessary.
17. On the telescope cylinder only, inspect the cylinder rod support block and wear ring inside diameter for scoring or other damage. Repair or replace as necessary.
18. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
19. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

NOTE: *Steps 20 thru 23 apply to the Telescope Cylinder only.*

20. Inspect the chain sheave bushings for scoring, tapering, ovality and for excessive wear and evidence of correct lubrication. Replace the bushing as necessary.
21. Inspect the sheave chain groove for damage. Replace the sheave assembly as necessary.
22. Inspect the sheave attach pin for scoring or other damage and for evidence of correct lubrication. Dress the pin surface with Scotch Brite or equivalent or replace the pin as necessary.
23. Inspect the sheave pin lubrication drilling and fitting for blockage or the presence of dirt or other foreign material. Repair 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.

IMPORTANT

WHEN INSTALLING 'POLY-PAK' PISTON SEALS, ENSURE THE SEALS ARE INSTALLED PROPERLY. REFER TO FIGURE 2-3 FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

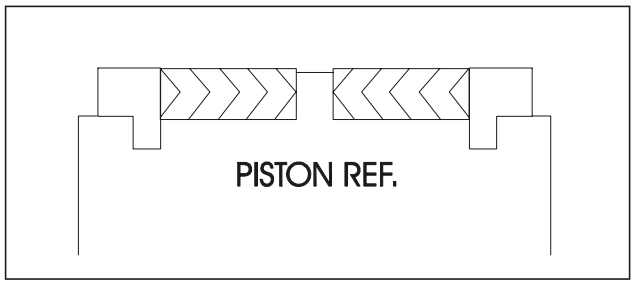


Figure 5-9. Poly-Pak Seal Installation

1. For the telescope cylinder only, support the cylinder rod and install the assembled rod support on the rod shaft. Push the support along the rod to the port block end.
2. Place a new wiper seal and rod seal into the applicable cylinder head gland grooves.
3. 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.
4. Carefully slide the piston spacer on the rod. If applicable, align the oil holes in the rod and the spacer. Secure the spacer, if applicable.
5. If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.
6. Carefully place the piston on the cylinder rod, ensuring that the o-ring and back-up rings are not damaged or dislodged.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Push the piston onto the rod until it abuts the spacer end and install the attaching nut.

⚠ WARNING

WHEN REBUILDING THE LIFT, SLAVE LEVEL, TELESCOPE, STEER, AND EXTEND-A-REACH SLAVE AND LIFT CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT, THEN TIGHTEN BOTH SECURELY. (SEE TABLE 5-1 FOR TORQUE SPECIFICATIONS).

NOTE: *These cylinders use self-locking knurled cup point setscrews which should be discarded and replaced whenever they are removed.*

After torquing the piston nut spot drill cylinder rod for setscrews.

9. If applicable, install the setscrew(s) which secure the piston attaching nut to the diameter groove. (See Table 5-1 for Torque Specifications).
10. Remove the cylinder rod from the holding fixture.
11. Place new o-rings and seals in the applicable outside diameter grooves of both the piston and the cylinder head.
12. Position the cylinder barrel in a suitable holding fixture.

⚠ WARNING

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.

13. 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.
14. Place the support rods in the tubes provided on the barrel assembly. The rods will bottom out on the attached stops. Thread the rods through the rod support block and, using loctite, tighten the rod nuts down on the support.

⚠ WARNING

THE SUPPORT RODS MUST BE INSTALLED SO THAT THEY BOTTOM OUT SIMULTANEOUSLY ON THE STOPS.

15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder or, if applicable, until the cylinder threads engage the threads of the barrel.

16. If applicable, secure the cylinder head gland using a suitable spanner type wrench in the holes provided.
17. If applicable, secure the cylinder head retainer using a suitable spanner type wrench in the holes provided.
18. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
19. If applicable, install the cartridge-type holding valve and fittings in the rod port block using new o-rings as applicable. (See Table 5-2, Holding Valve Torque Specification).

⚠ 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, FORKLIFT, OR OTHER MEANS TO SUPPORT THE OVERHANGING WEIGHT OF THE EXTENDING ROD.

NOTE: *Steps 20 thru 23 apply to the Boom Telescope Cylinders.*

20. Elevate the barrel end of the cylinder to a work bench or other suitable device.
21. Plug the retract port and supply hydraulic power to the extend port.
22. Open the bleeder port plug (TP) venting all trapped air to atmosphere. Retighten the bleeder port plug. Disconnect the hydraulic power source and remove plug from retract port.
23. An alternative to steps (20) through (23) is to position the barrel horizontally in a suitable holding device, attach a hydraulic power source to both extend and retract ports, while supporting the cylinder rod, cycle the cylinder a minimum of 5 times with the bleeder port unplugged venting all trapped air to atmosphere. A suitable hose may be attached to the bleeder port with the end in a container suitable to contain the hydraulic fluid. After all air is vented remove all attached hoses, and install the bleeder port plug. Also plug the extend and retract ports until cylinder is installed in boom.

Table 5-1. Cylinder Piston Nut Torque Specifications

Description	Nut Torque Value (Wet)	Setscrew Torque Value (Dry)
Lift Cylinder	600 ft.lbs. (814 Nm)	40 in.lbs. (5 Nm)
Slave Cylinder	80 ft.lbs. (109 Nm)	100 in.lbs. (12 Nm)
Master Cylinder	80 ft.lbs. (109 Nm)	100 in.lbs. (12 Nm)
Steer Cylinder	80 ft.lbs. (109 Nm)	100 in.lbs. (12 Nm)
Steer Cylinder (Oscillating Axle)	275-330 ft.lbs. (380-456 Nm)	N/A
Lockout Cylinder	N/A	N/A
Telescope Cylinder	600 ft.lbs. (814 Nm)	100 in.lbs. (12 Nm)
Axle Extension Cyl.	50 ft.lbs. (7 Nm)	100 in.lbs. (12 Nm)
Axle Extension Cyl. (Oscillating Axle)	100 ft.lbs. (138 Nm)	100 in.lbs. (12 Nm)
Axle Lift Cylinder	400 ft.lbs. (553 Nm)	100 in.lbs. (12 Nm)
Tie-Rod Cylinder (Oscillating Axle)	150-180 ft.lbs. (210-250 Nm)	N/A
Extend-A-Reach		
Lift Cylinder	200 ft.lbs. (271 Nm)	100 in.lbs. (12 Nm)
Slave Cylinder	200 ft.lbs. (271 Nm)	100 in.lbs. (12 Nm)

NOTE: *After torquing piston nut spot drill cylinder rod for setscrews.*

Table 5-2.Holding Valve Torque Specification

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)

5.5 CYLINDER REMOVAL AND INSTALLATION

Telescope Cylinder Removal

1. Be sure the boom is fully retracted and in a horizontal position.
2. Shut down the engine. Support the boom basket end with a prop. (See Figure 5-2.)
3. Remove the boom end-cover.

⚠ CAUTION

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

4. Tag and disconnect the hydraulic lines to the telescope cylinder. Use a suitable container to catch any residual hydraulic fluid. Cap all hydraulic lines and ports.
5. Remove the two snap rings that retain the telescope cylinder pin to the base boom.
6. Using a suitable brass drift, carefully drive the telescope cylinder pin from the base boom.
7. Remove the telescope cylinder trunnion pin covers from each side of the base boom.
8. Remove the capscrews securing the trunnion pins from each side of the boom.
9. Using a suitable slide hammer, remove the trunnion pins attaching the telescope cylinder to the mid boom.
10. Attach a suitable sling to the telescope cylinder. Support the cylinder with an overhead crane or other suitable lifting device.
11. Remove the two (2) extension chain adjusting nuts from the eyebolt through the chain adjust assembly.
12. Remove the four (4) bolts and lock washers attaching the chain attach block to the base boom section and remove the block.
13. Using the lifting equipment, raise the telescope cylinder enough to obtain adequate clearance for removal of the telescope cylinder rod support bracket.
14. Remove the cylinder rod support bracket.
15. Attach a suitable lifting device to the extension chain adjusting eyebolt above the cylinder rod.

NOTE: *The extension chain will come out of the boom twice as far as the telescope cylinder.*

16. Using both lifting devices, carefully pull the cylinder from the boom assembly.
17. As the cylinder is removed from the boom, lay the extension chain on top of the base boom.
18. Using another lifting device, support the sheave wheel end of the cylinder and remove the cylinder from the boom assembly.
19. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

Telescope Cylinder Installation

1. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.
2. Using another lifting device, support the sheave wheel, or rod end, of the cylinder and install the cylinder into the boom assembly.
3. Slide the cylinder into boom, sliding the extension chain in place as the cylinder is moving in.
4. Attach a suitable lifting device to the extension chain adjusting eyebolt.
5. Attach the cylinder rod support bracket to the rod support block on the telescope cylinder.
6. Install the chain adjust block with four (4) lockwasher and bolts to the base boom section.
7. Install the two (2) extension chain adjusting nuts that attach the eyebolt to the chain adjust block.
8. Remove the lifting device from the telescope cylinder.
9. Using a suitable brass drift install the trunnion pins attaching the telescope cylinder to the mid boom section.
10. Install the capscrews securing the trunnion pins to each side of the boom. Note that loctite 242 is required on the capscrew threads.

11. Install the trunnion pin covers on each side of boom.
12. Carefully install the telescope cylinder barrel attach pin into the base boom.
13. Install the snap rings that retain the telescope cylinder pin to the base boom.
14. Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
15. Install the boom end cover.
16. Activate hydraulic system.
17. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
18. Cycle (extend/retract) boom several times, then torque boom chains to 40 ft. lbs. (2.76 Bar). See Boom Chains in Section 4, Boom & Platform for correct torquing procedure.
19. Check fluid level of hydraulic tank and adjust as necessary.

Boom Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the engine and place the boom in a horizontal position. Shut down the engine and prop the boom. (See Figure 5-2.)
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 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 upright.
6. Remove the cylinder from the boom and place in a suitable work area.

Boom Lift Cylinder Installation

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

5.6 TELESCOPE CYLINDER ECCENTRIC BUSHING

IMPORTANT

RELOCATE ALTERNATE SETSCREW HOLE ONLY WHEN REPLACING ECCENTRIC BUSHING.

When replacing the eccentric bushings, drill 5/16" dia. x 3/4" deep, tap 3/8-16NC x 9/16" deep for a new setscrew (bushing to boom) either above or below original holes. Allow enough room between the holes for strength while staying on the thick side of the bushing. (See Figure 5-10.)

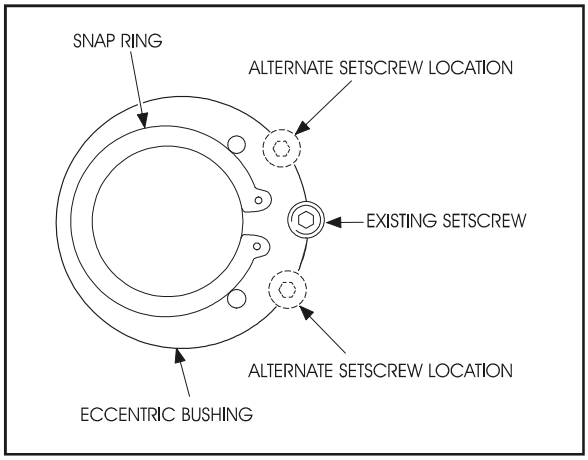


Figure 5-10. Telescope Cylinder Eccentric Bushing

5.7 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) prior to assembly.

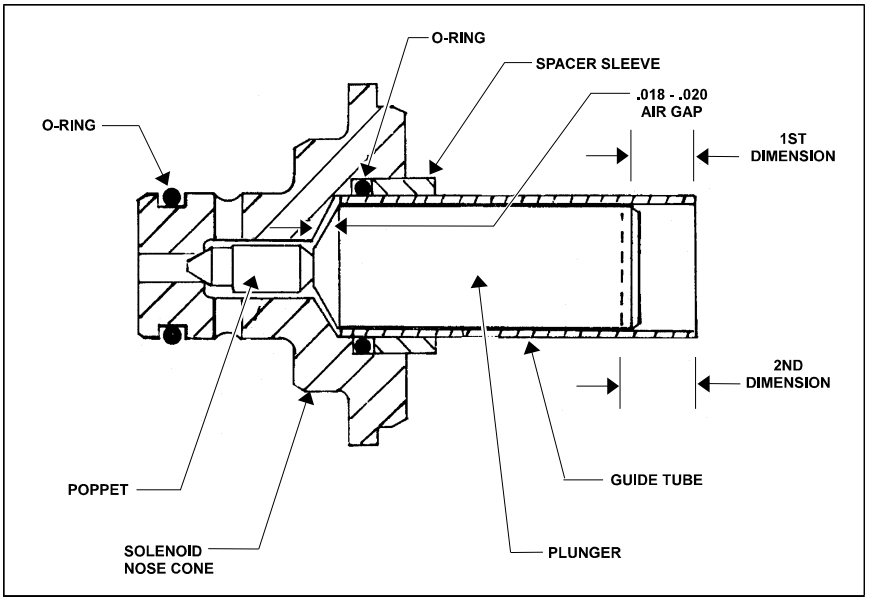


Figure 5-11. Racine Proportional Air Gap Adjustment, Machines Built Prior to Mid 1987

5.8 RACINE PROPORTIONAL AIR GAP ADJUSTMENT

NOTE: *The assembly in Figure 5-11. includes select fit parts in order to maintain a proper air gap. These parts must remain as an assembly or if disassembled, controlled to ensure that these component parts are not intermixed with similar parts.*

In the event that parts do become exchanged or you suspect the air gap to be incorrect (Too much air gap will result in loss of auxiliary power operation and less than full spool shift; too little air will result in erratic operation.), it may be checked and adjusted using the procedure below.
All parts must be clean and properly assembled before making these checks.

1. With all parts assembled as shown in Figure 5-11., use a depth mike or other measuring instrument to determine the distance from the end of the guide tube to the exposed end of the plunger. Record this dimension.
2. Remove the plunger and poppet. With the poppet removed, install the plunger and check the distance from the end of the guide tube to the exposed end of the plunger.
3. Subtract the first dimension from the second dimension, this will be the amount of air gap.
4. The correct air gap is 0.018"- 0.020" with 0.018" preferred. If the air gap is excessive, it may be reduced by using a brass drift and hammer. Lightly tap the

   end of the plunger with all parts assembled. Recheck the air gap.
5. If the air gap is less than recommended, replace the nose cone assembly.

5.9 PRESSURE SETTING PROCEDURES

1. Racine Proportional Valve Pressure Setting, Machines Built Prior To Mid 1987 are shown in Figure 5-12. and Figure 5-13.
2. Vickers Proportional Valve Pressure Setting, Machines Built Prior To 1989 With Accessory Valve are shown in Figure 5-14., Figure 5-15., Figure 5-16., and Figure 5-17.
3. Solenoid Valve Pressure Settings Machines Built Prior To May 1992 With Steer Wheel are shown in Figure 5-18.
4. Pressure And Flow Settings Machines Built Prior To May 1992 With Steering Wheel are shown in Figure 5-19.
5. Vickers Proportional Valve Pressure Setting, Machines Built To Present are shown in Figure 5-20., Figure 5-21., Figure 5-22., and Figure 5-23.
6. Vickers All Hydraulic Pressure Setting are shown in Figure 5-24., Figure 5-25., Figure 5-26., and Figure 5-27.
7. Solenoid Valve Pressure Settings Machines Built To Present are shown in Figure 5-28.
8. Solenoid Valve Pressure Settings 4 W/S are shown in Figure 5-29.
9. Extend - A - Reach Valve Pressure and Speed Settings are shown in Figure 5-30.

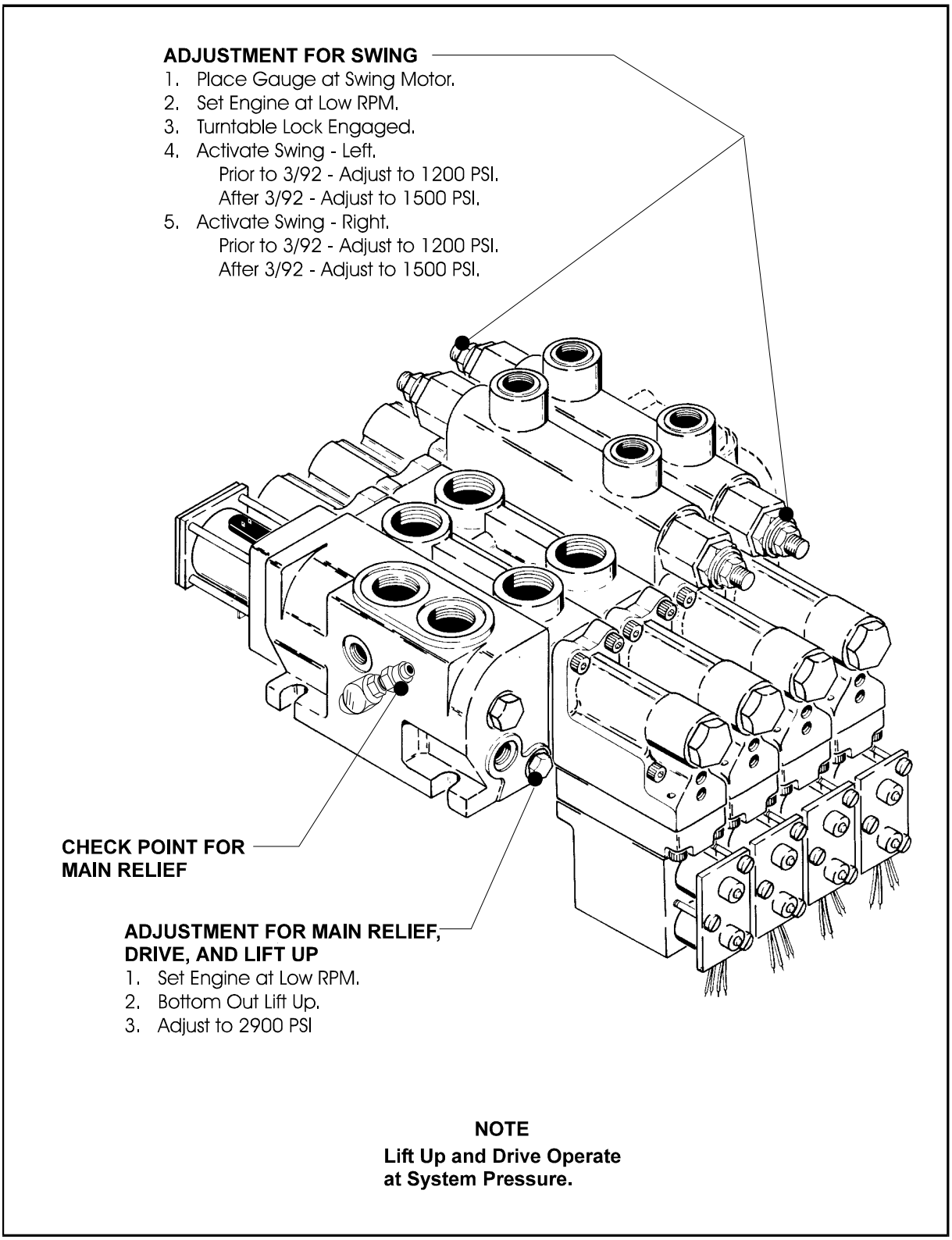


Figure 5-12. Racine Proportional Valve Pressure Setting - Prior to Mid 1987 (Sheet 1 of 2)

ADJUSTMENTS FOR PILOT PRESSURE

1. Set Engine at Low RPM.
2. Connect 12V jumper wire to dump valve solenoid.
3. Pressure gauge should read between 250-400 PSI.
4. Shut down system, remove cap plug and shim up spring to increase pressure, shorten spring to decrease pressure.
5. Install cap plug and repeat steps 1 thru 3.

NOTE

The pilot pressure is factory set and normally should not require adjusting. Adjust only if you notice poor or sluggish response to proportional functions or loss of auxiliary power.

IMPORTANT

Take pilot pressure reading before attempting to make adjustment. Do not adjust if pilot pressure is between 250-400 psi.

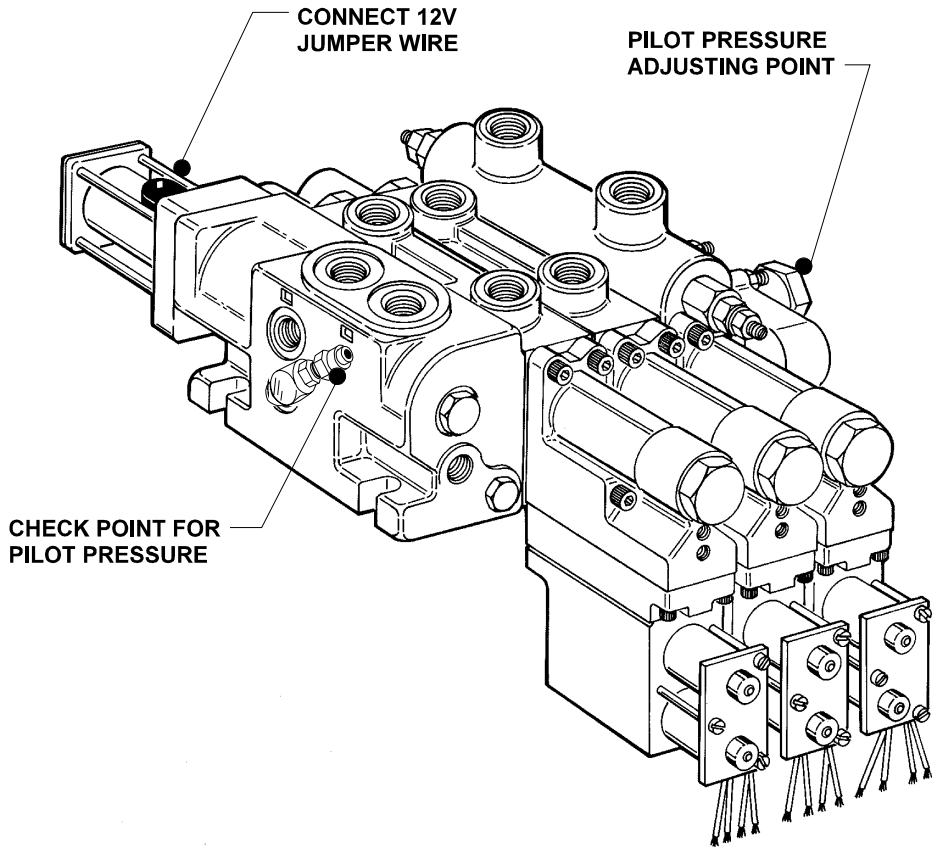
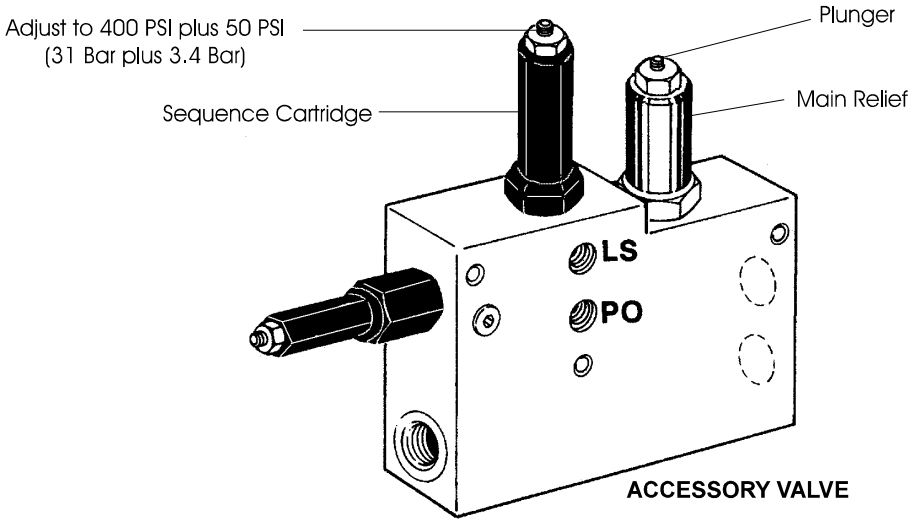


Figure 5-13. Racine Proportional Valve Pressure Setting - Prior to Mid 1987 (Sheet 2 of 2)

TO BE PERFORMED IN SEQUENCE, STEP 1, STEP 2, ETC.



Step 1

To Set Sequence Pressure:

1. **Plug pressure gauge into quick-disconnect on Vickers Valve.**
2. **Loosen nut at main relief and depress plunger.**
3. **Monitor pressure gauge while making adjustments at sequence cartridge to 400 PSI plus 50 PSI (28 Bar plus 3.4 Bar).**
4. **Release plunger and tighten nut at main relief.**
5. **Remove pressure gauge.**

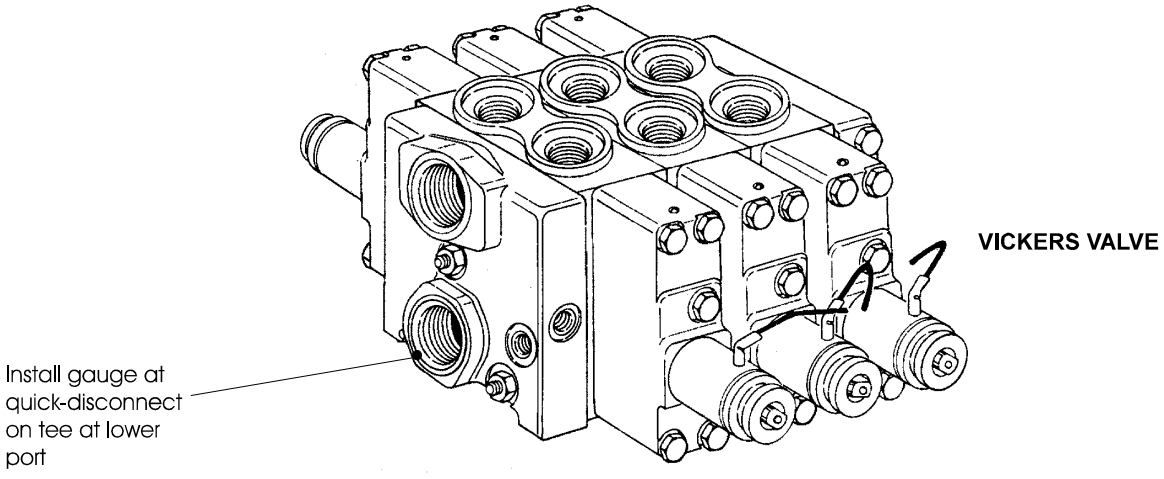
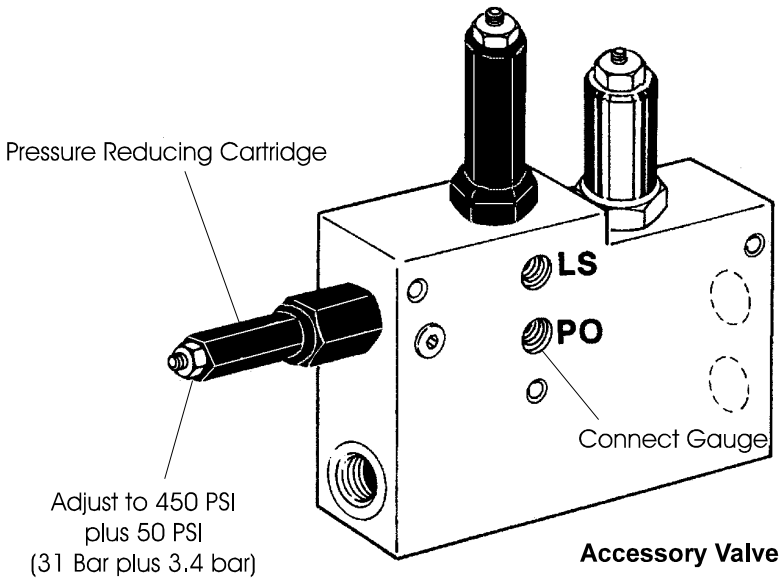


Figure 5-14. Vickers Proportional Valve Pressure Setting - Prior to 1989 with Accessory Valve (Sheet 1 of 4)

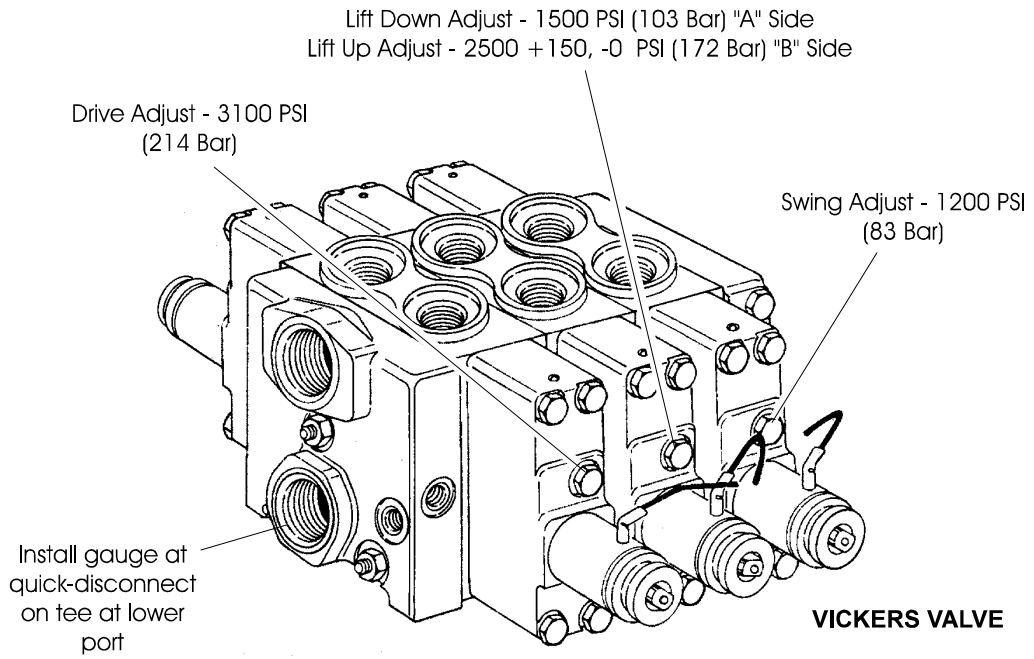


Step 2

To Set Pilot Pressure:

1. **Plug pressure gauge into quick-disconnect on Accessory Valve.**
2. **Activate Lift Down**
3. **While monitoring pressure gauge, adjust reducing cartridge to 450 PSI plus 50 PSI (31 Bar plus 3.4 Bar)**
4. **Remove pressure gauge.**

Figure 5-15. Vickers Proportional Valve Pressure Setting - Prior to 1989 with Accessory Valve (Sheet 2 of 4)



NOTE: All Pressure Plus or Minus 150 PSI (10 Bar), Except Where Noted

Step 3

Swing Adjust - Right and Left - Monitor gauge at quick dicconnect on relief valve. Lock Turntable and activate Swing Right. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Swing Left.

Lift Adjust - Lift Down - Monitor gauge at quick disconnect on relief valve. Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease pressure.

Lift Up - Bottom out Lift Up, add shims to increase pressure, remove shims to decrease pressure.

Drive Adjust - Disconnect and cap brake line at counterbalance valve, also plug port in valve. Have assistant activate Drive Forward. Monitor gauge at quick disconnect on relief valve. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Drive Reverse.

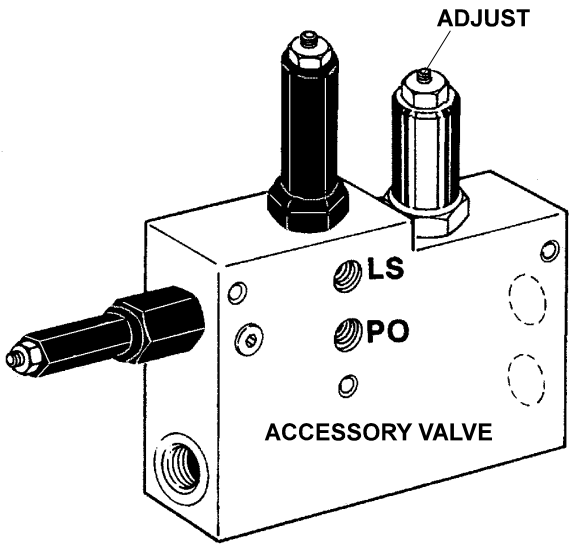
Figure 5-16. Vickers Proportional Valve Pressure Setting - Prior to 1989 with Accessory Valve (Sheet 3 of 4)

STEP 4

To Set Main Relief (Proportional Functions).

Note: This adjustment to be made after all proportional functions are set.

Disconnect and cap hoses to drive motor, also plug ports on drive section of proportional valve. Back out adjustment 2 turns (counterclockwise). Have assistant activate drive. Slowly turn adjustment in (clockwise) and watch pressure gauge. Continue turning until gauge stops moving (approximately 3000 PSI [207 Bar]). Turn adjustment in an additional 1/2 turn, this will result in approximately 200 PSI (14 Bar) higher than Drive relief setting.



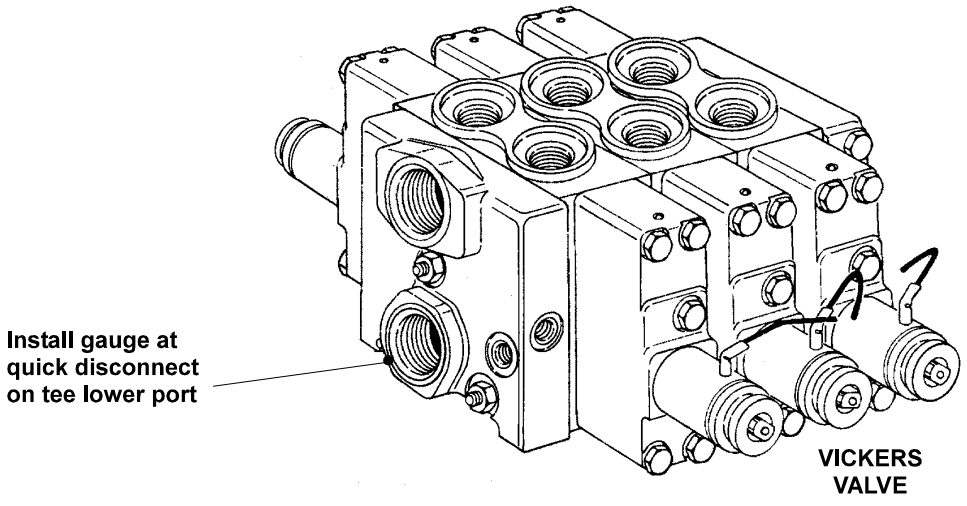


Figure 5-17. Vickers Proportional Valve Pressure Setting - Prior to 1989 with Accessory Valve (Sheet 4 of 4)

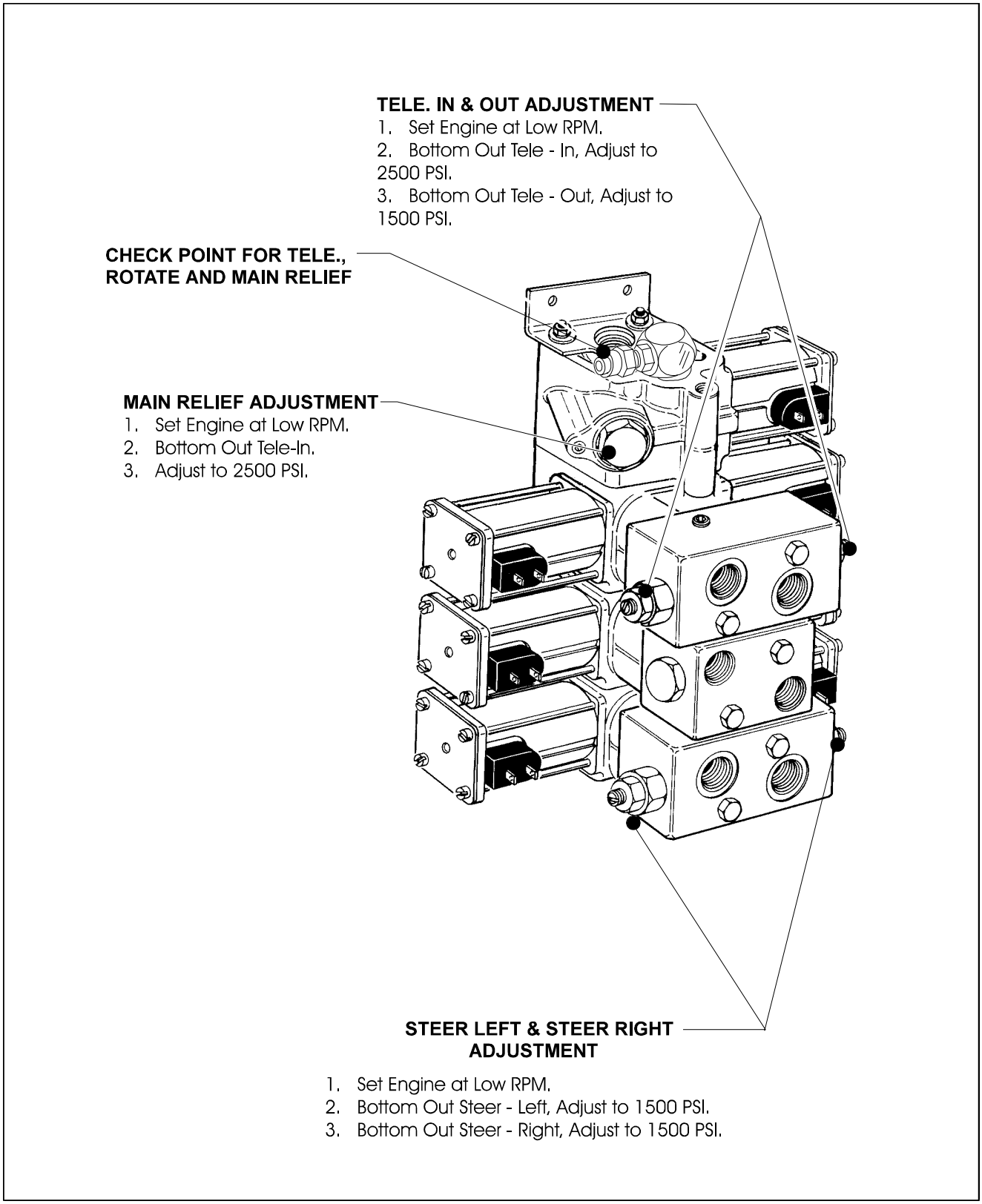
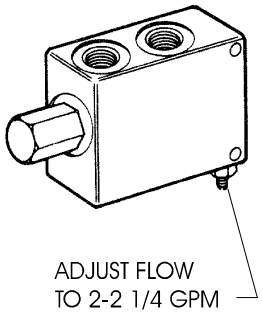
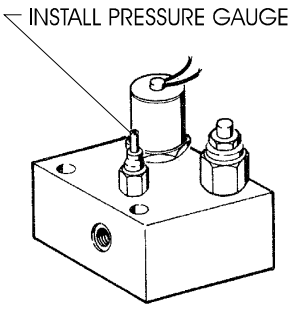


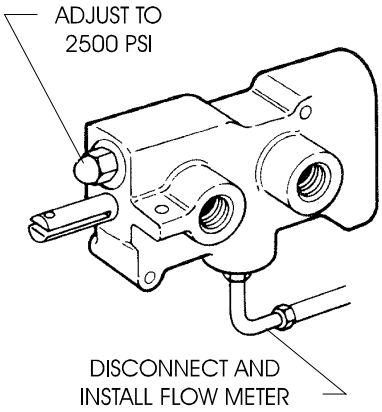
Figure 5-18. Solenoid Valve Pressure Settings - Prior to Mid 1992 with Steering Wheel



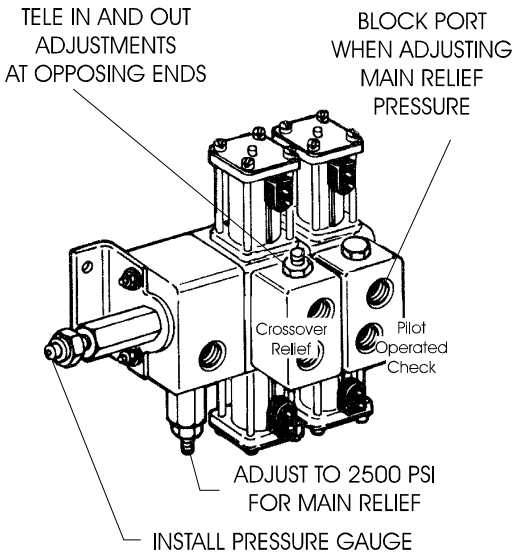
PRIORITY FLOW CONTROL VALVE



DUMP VALVE



ROTATOR VALVE



2 STACK VALVE

ROTATE AND STEERING

1. **TO SET FLOW.** Install a flow gauge inline at rotator valve. With the aid of an assistant, make adjustments at the priority flow control alve for 2 to 2 1/4 G.P.M.
2. **TO SET PRESSURE.** Install pressure gauge at quick disconnect on dump valve. With the aid of an assistant, make adjustments at rotator valve to 2500 PSI. Set with engine at low RPM and bottom out rotate left or right.

TELESCOPE AND MAIN RELIEF

1. **TO SET MAIN RELIEF PRESSURE.** Install pressure gauge at quick connect on 2 stack valve. Disconnect level hose, plug hose and block port on valve. Make adjustments at 2 stack to 2500 PSI, with engine at low RPM, activate level function.
2. **TO SET TELESCOPE PRESSURE.** With a pressure gauge at the quick disconnect, and the engine at low RPM, bottom out tele-in and adjust to 2500 PSI. Then bottom out tele-out and adjust to 1500 PSI.

Figure 5-19. Pressure and Flow Settings - Machines Prior to Mid 1992 with Steering Wheel

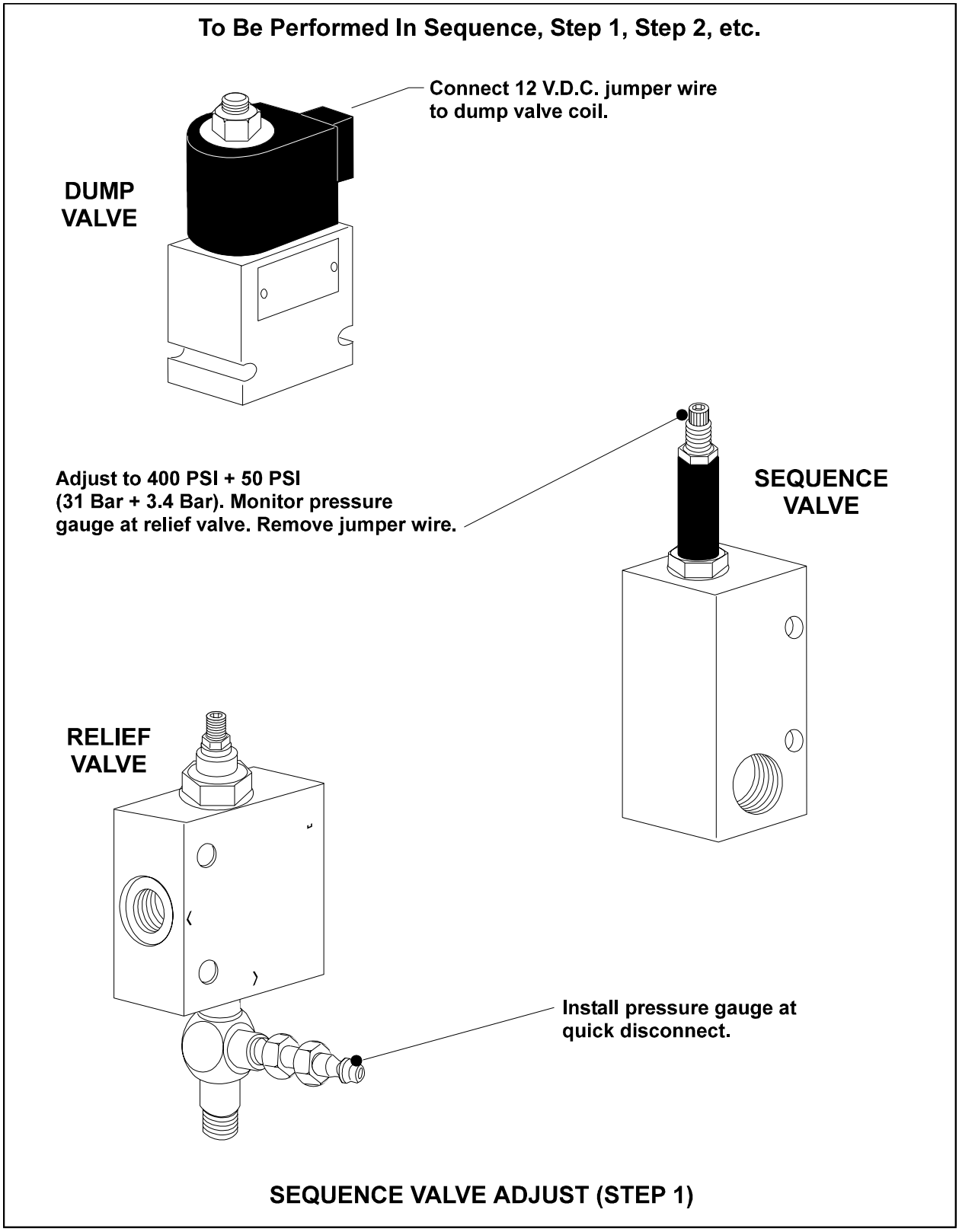


Figure 5-20. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 1 of 4)

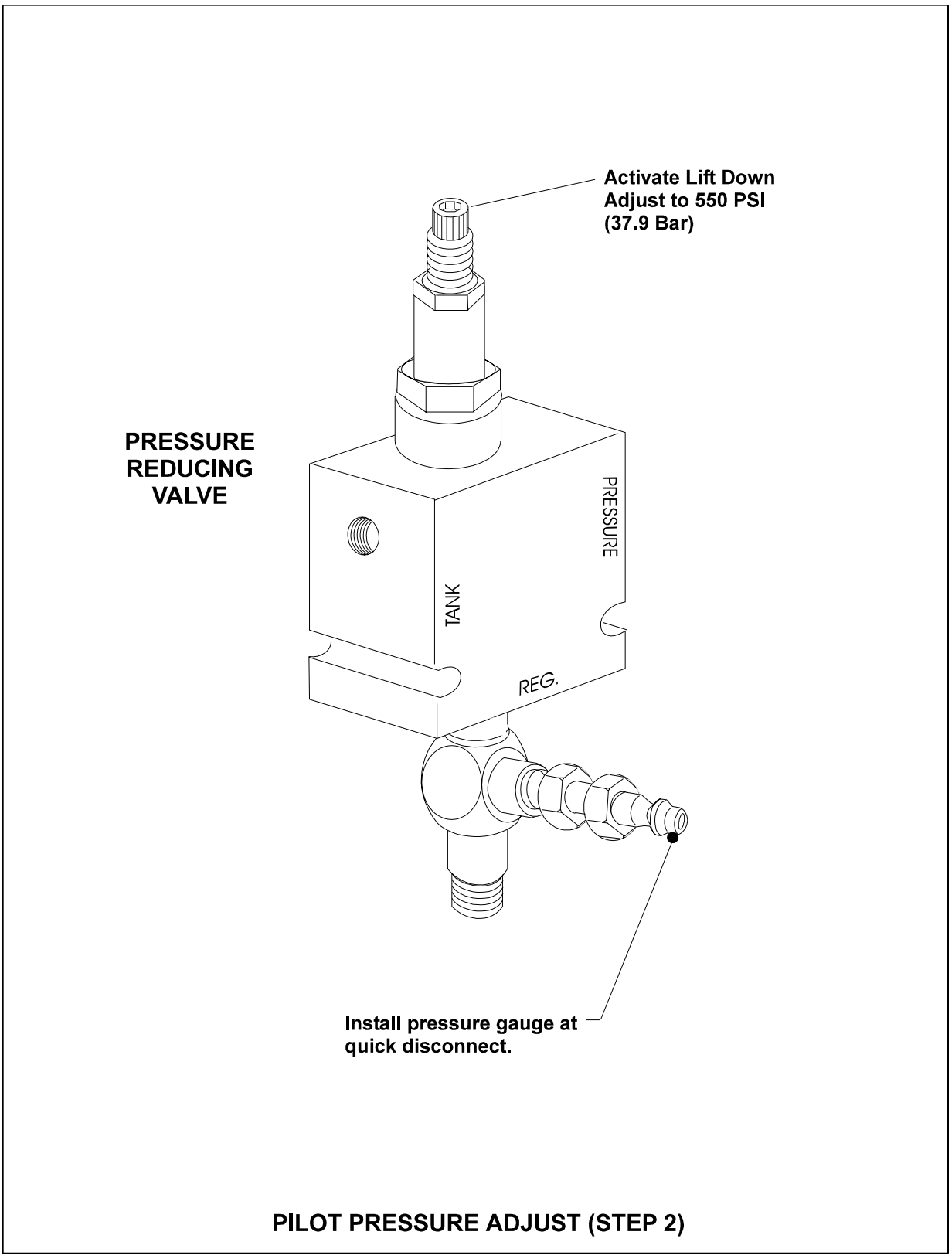
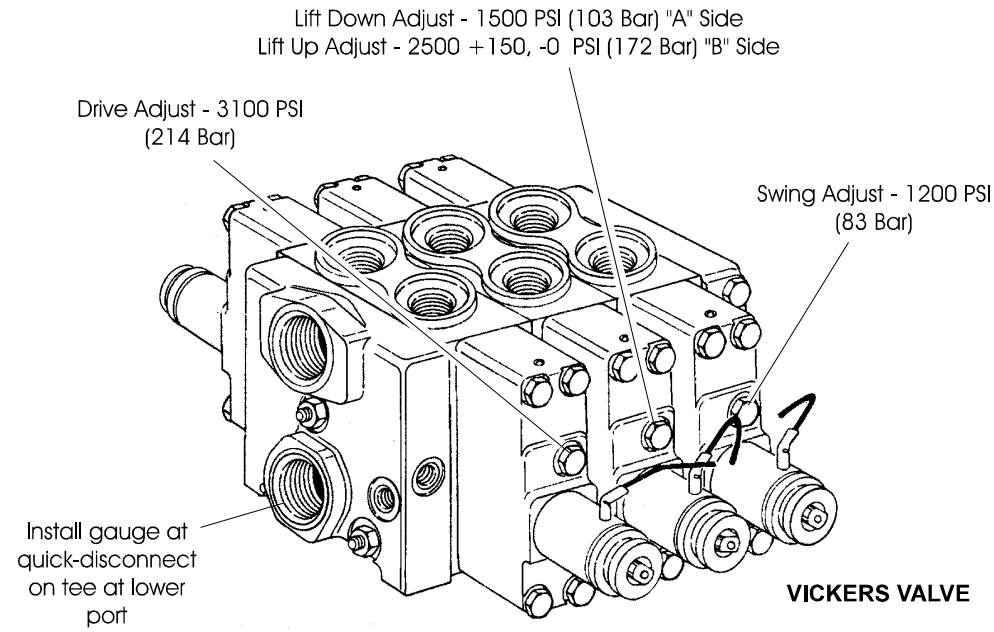


Figure 5-21. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 2 of 4)



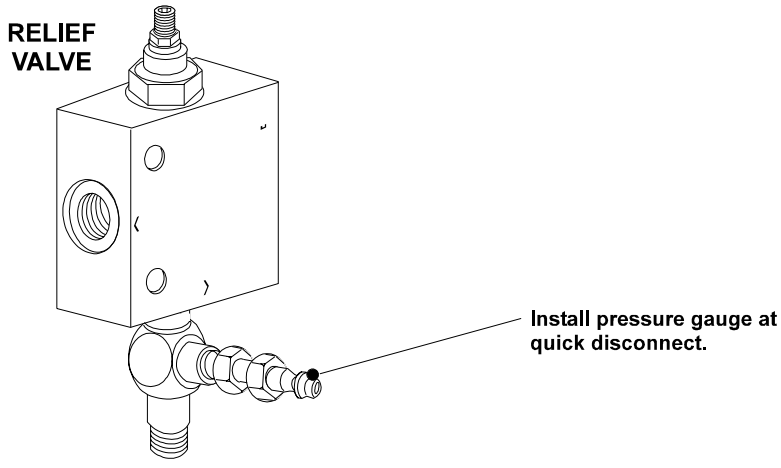
NOTE: All Pressure Plus or Minus 150 PSI (10 Bar), Except Where Noted

Swing Adjust - Right and Left - Monitor gauge at quick dicconnect on relief valve. Lock Turntable and activate Swing Right. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Swing Left.

Lift Adjust - Lift Down - Monitor gauge at quick disconnect on relief valve. Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease pressure.

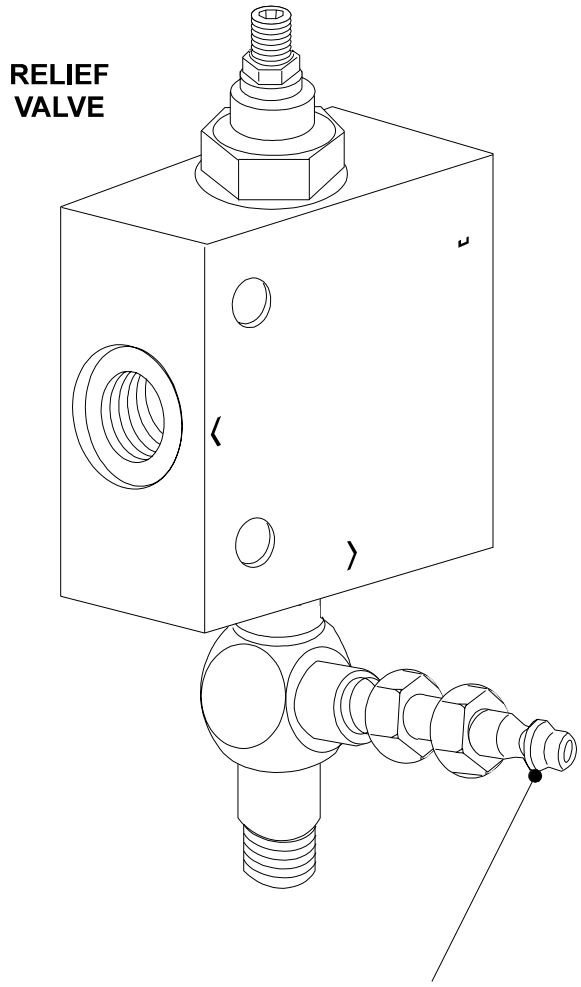
Lift Up - Bottom out Lift Up, add shims to increase pressure, remove shims to decrease pressure.

Drive Adjust - Disconnect and cap brake line at counterbalance valve, also plug port in valve. Have assistant activate Drive Forward. Monitor gauge at quick disconnect on relief valve. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Drive Reverse.



PROPORTIONAL VALVE ADJUST (STEP 3)

Figure 5-22. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 3 of 4)

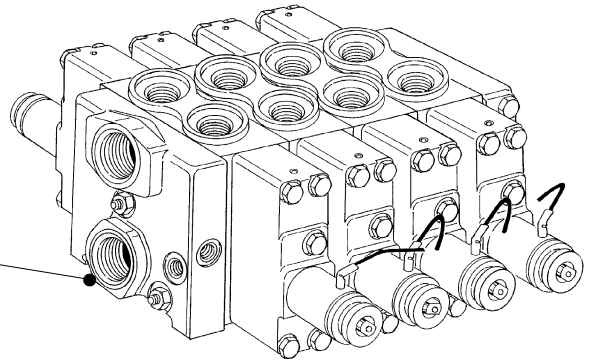


NOTE: This adjustment to be made after all proportional functions are set.

Disconnect and cap hose to brake line at counterbalance valve also plug port in valve. Back out adjustment 2 turns (counterclockwise). Have assistant activate drive. Slowly turn adjustment in (clockwise) and watch pressure gauge. Continue turning until gauge stops moving (approximately 3000 PSI [207 Bar]). Turn adjustment in an additional 1/2 turn. This will result in approximately 200 PSI (14 Bar) higher than Drive relief setting.

MAIN RELIEF ADJUST (PROPORTIONAL FUNCTIONS) (STEP 4)

Figure 5-23. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 4 of 4)



VICKERS CONTROL VALVE ASSEMBLY

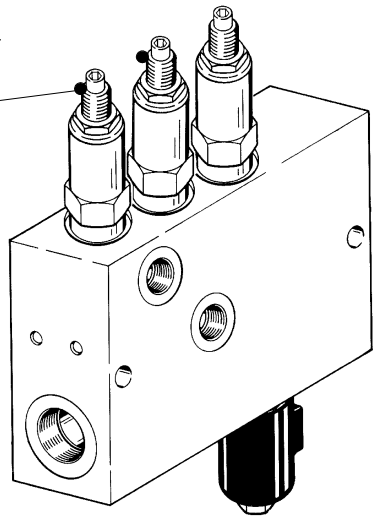
Install pressure gauge at quick disconnect

Step 1 Setting Sequence Pressure:

1. Plug pressure gauge into quick-disconnect on Vickers Valve.
2. Loosen nut at main relief and depress plunger.
3. Monitor pressure gauge while making adjustments at sequence cartridge to 400 PSI plus 50 PSI (28 Bar plus 3.4 Bar).
4. Release plunger and tighten nut at main relief.
5. Remove pressure gauge.

Adjust Pressure Reducing Cartridge to 600 PSI (41 Bar)

Adjust Sequence Cartridge 400 to 600 PSI (28 to 41 Bar)



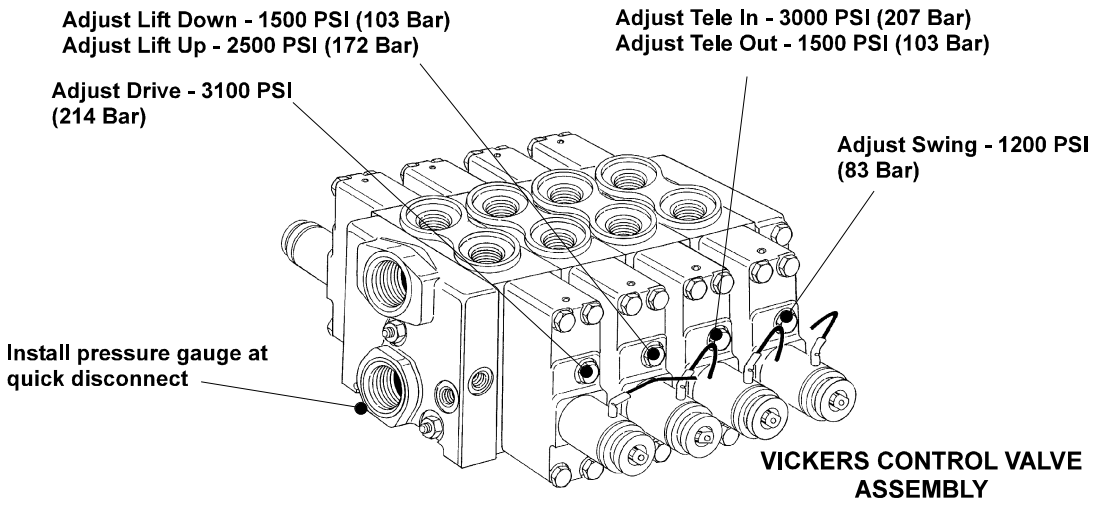
ACCESSORY VALVE ASSEMBLY

Note: On all hydraulic system, dump is activated when switched to Ground Control.

Step 2 Setting Pilot Pressure:

1. Plug pressure gauge into quick-disconnect on Accessory Valve.
2. Activate Lift Down
3. While monitoring pressure gauge, adjust reducing cartridge to 450 PSI plus 50 PSI (31 Bar plus 3.4 Bar)
4. Remove pressure gauge.

Figure 5-24. Pressure Setting - All Hydraulic Machines (Sheet 1 of 4)



STEP 3 Setting Drive, Swing, Lift, and Telescope Adjustments:

⚠ CAUTION

AFTER BRAKE LINES ARE DISCONNECTED AND PRIOR TO MAKING ADJUSTMENTS, ACTIVATE DRIVE WITH NO PERSONNEL IN VICINITY OF TRAVEL PATH TO ENSURE BRAKES ARE HOLDING SECURELY.

DRIVE ADJUST

1. Disconnect and cap brake line at counter-balance valve also plug port in valve.
2. Have assistant activate Drive Forward.
3. Monitor gauge. Add shims to increase pressure, remove shims to decrease.
4. Same procedure applies to Drive Reverse. Make note of pressures. Leave brake line capped, until all adjustments are complete.

SWING ADJUST RIGHT AND LEFT

1. Lock turntable. Monitor gauge at quick disconnect.
2. Add shims to increase pressure, remove shims to decrease.
3. Activate Swing Right.
4. Same procedure applies to Swing Left.

LIFT ADJUST - LIFT DOWN

1. Bottom out Lift Down.
2. Monitor gauge at quick disconnect.
3. Add shims to increase pressure, remove shims to decrease.

LIFT ADJUST - LIFT UP

1. Bottom out Lift Up.
2. Monitor gauge at quick disconnect.
3. Add shims to increase pressure, remove shims to decrease.

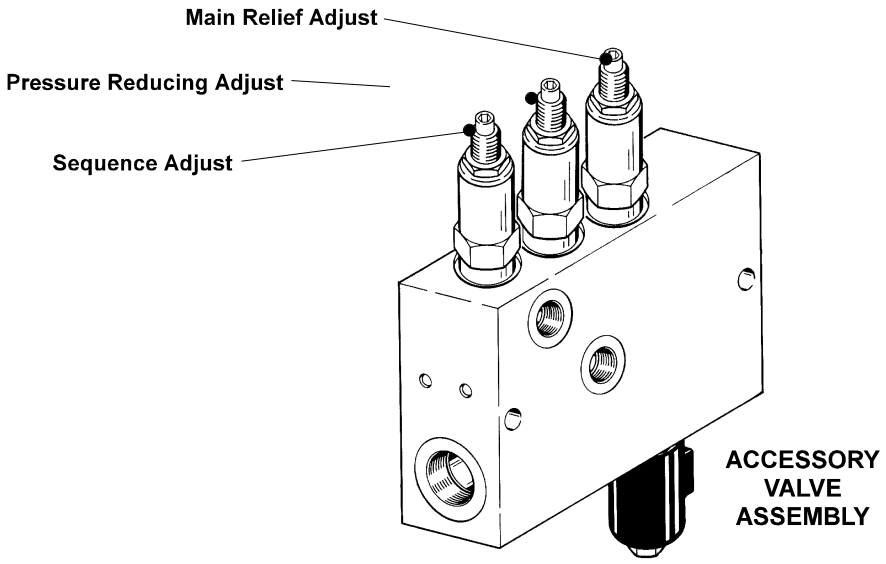
TELE ADJUST - TELE IN

1. Bottom out Tele In.
2. Monitor gauge at quick disconnect.
3. Add shims to increase pressure, remove shims to decrease.

TELE ADJUST - TELE OUT

1. Bottom out Tele Out.
2. Monitor gauge at quick disconnect.
3. Add shims to increase pressure, remove shims to decrease.

Figure 5-25. Pressure Setting - All Hydraulic Machines (Sheet 2 of 4)



Step 4 Setting Main Relief (Proportional Functions):

Note: This adjustment to be made after all proportional functions are set.

1. **Disconnect and cap hoses to brakes and cap port at counterbalance valve.**
2. **Back out adjustment 2 turns (counterclockwise).**
3. **Have assistant activate drive.**
4. **Slowly turn adjustment in (clockwise) and watch pressure gauge. Continue turning until gauge stops moving (approximately 3000 PSI [207 Bar]).**
5. **Turn adjustment in an additional 1/2 turn, this will result in approximately 200 PSI (14 Bar) higher than the highest Drive relief setting.**

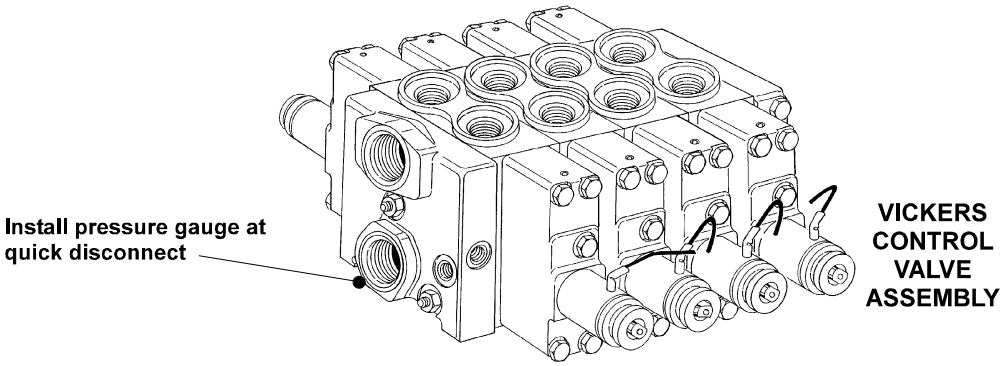
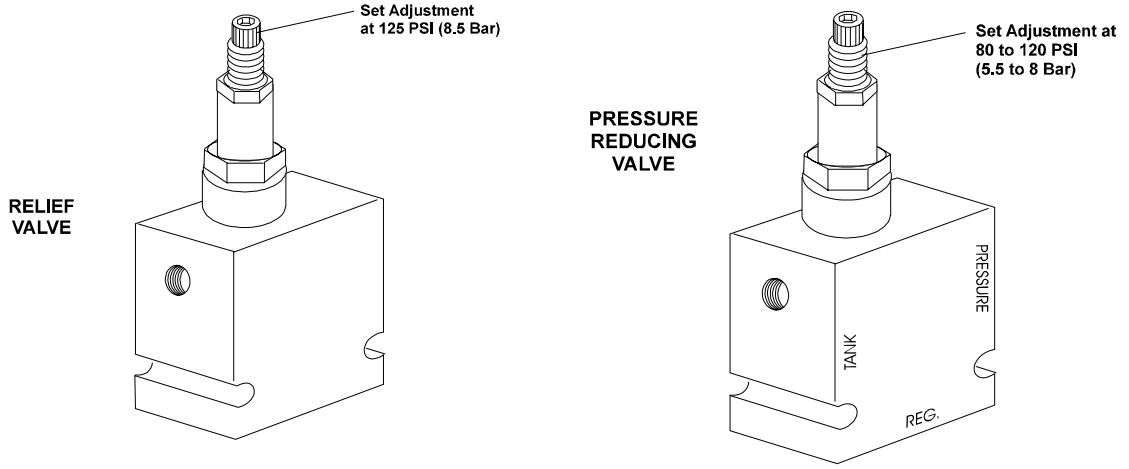
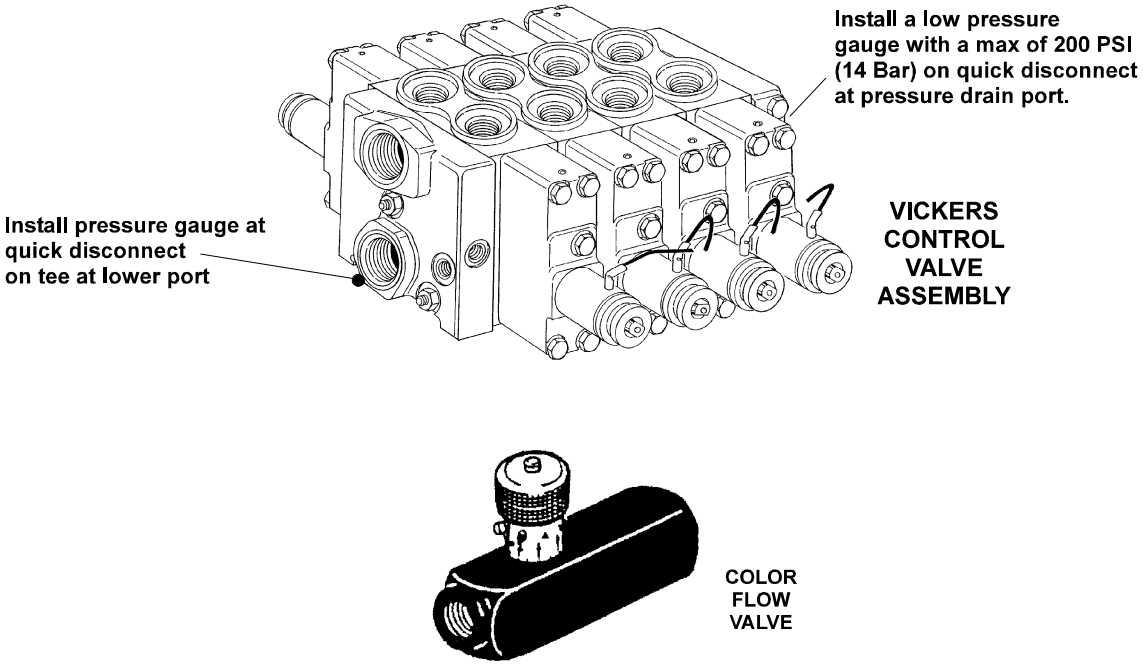


Figure 5-26. Pressure Setting - All Hydraulic Machines (Sheet 3 of 4)



Step 5 Setting Relief and Pressure Reducing Valves(Proportional Functions):

1. **Plug a low pressure gauge into quick disconnect on Vickers Valve Pressure drain port at end cap.**
2. **Adjust relief all the way in "temporary".**
3. **Set pressure reducing valve to 150 PSI (10 Bar) temporary.**
4. **Reset relief valve pressure to 140 PSI (9.6 Bar) and lock.)**
5. **Reset pressure reducing valve 80 to 120 PSI (5.5 to 8 Bar) and lock.**
6. **Remove pressure gauge.**



Step 6. Setting Flow Control Valves:

1. **Adjust out - for faster response to control. Adjust in - for slower response to control.**

Figure 5-27. Pressure Setting - All Hydraulic Machines (Sheet 4 of 4)

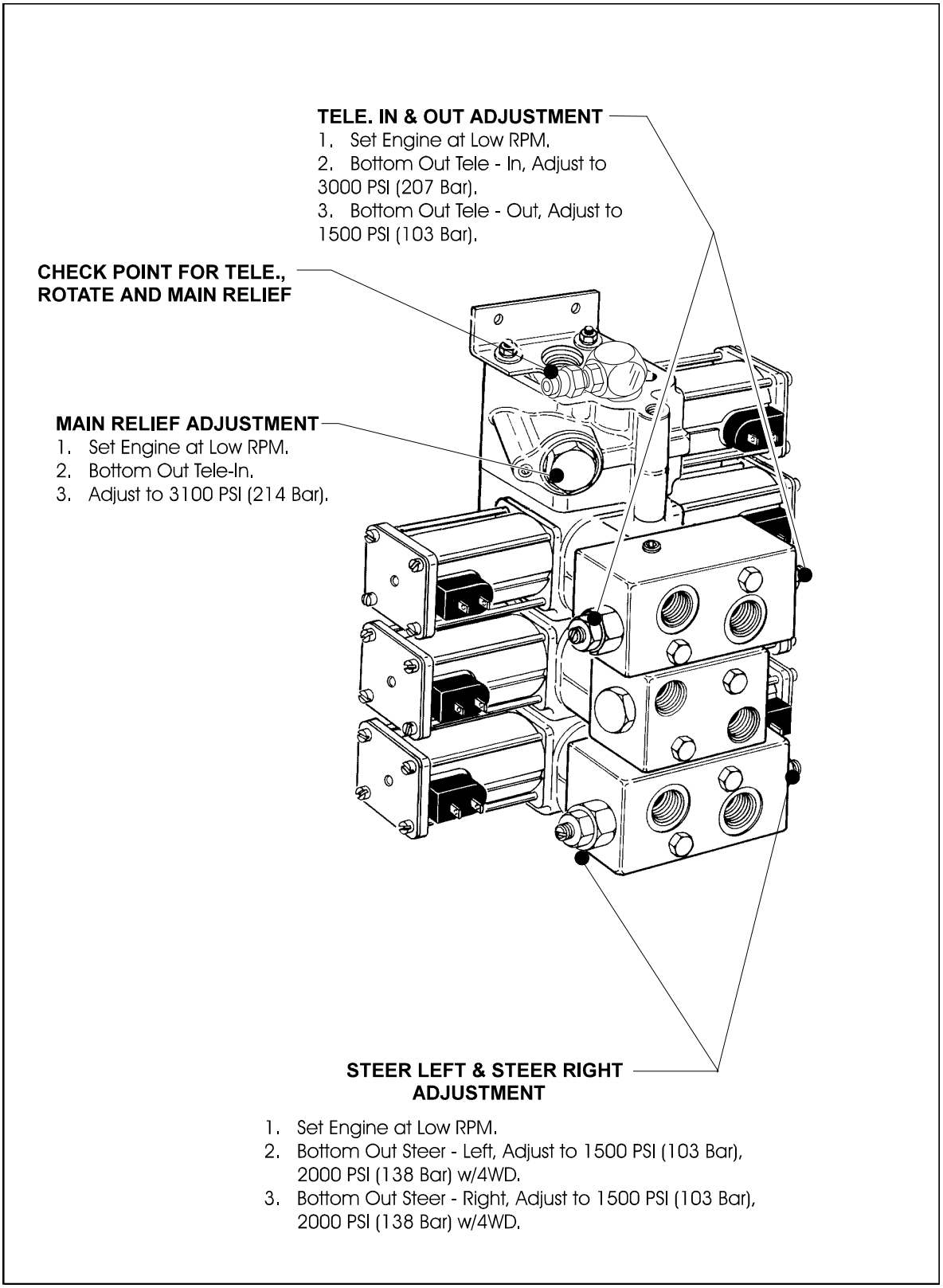


Figure 5-28. Solenoid Valve Pressure Settings - Machines Built to Present

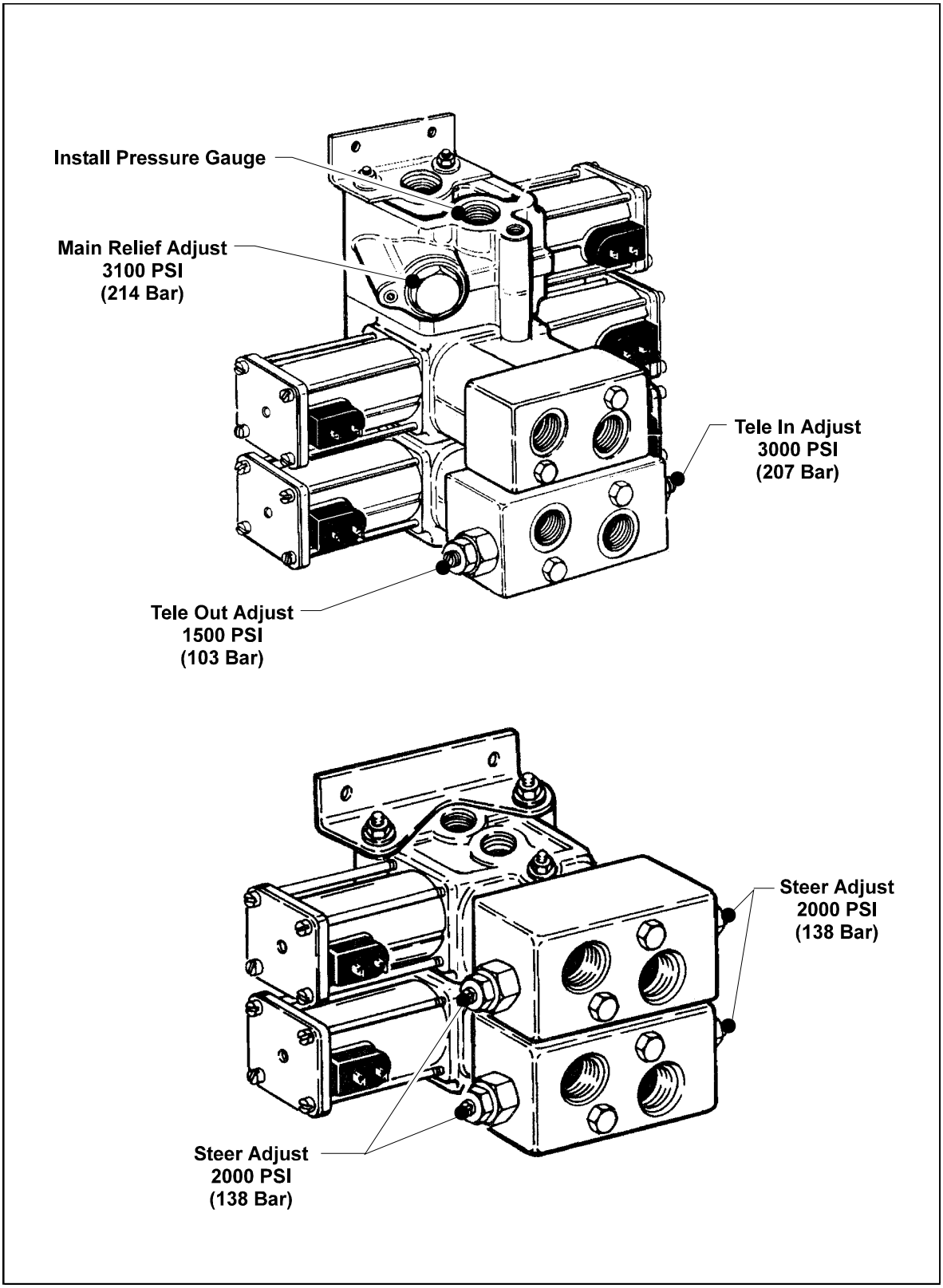


Figure 5-29. Solenoid Valve Pressure Settings - 4 Wheel Steer

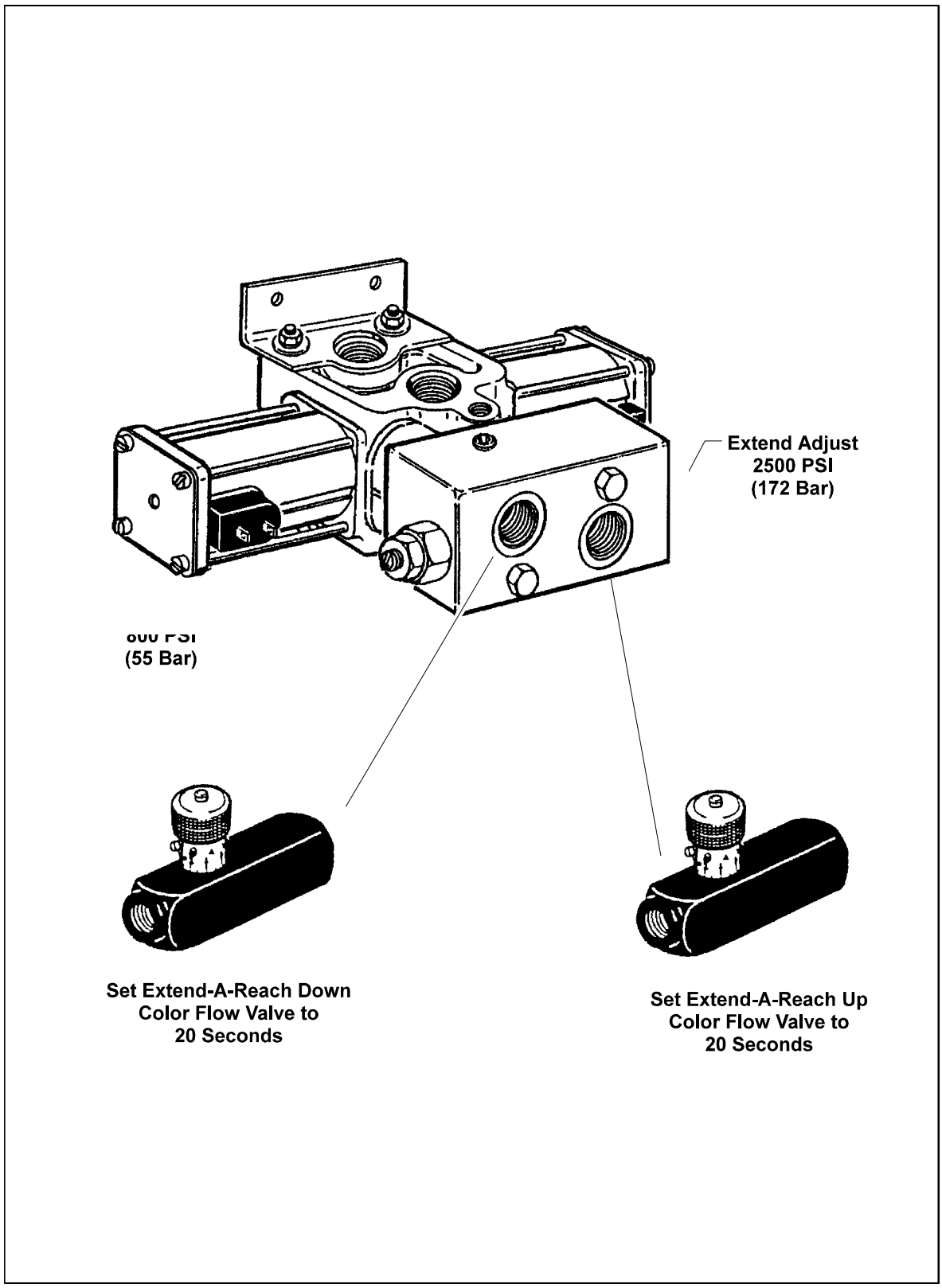


Figure 5-30. Extend-A-Reach Valve Pressure and Speed Settings

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SECTION 6. TROUBLESHOOTING & SCHEMATICS

6.1 GENERAL

This section contains troubleshooting information to be used for locating and correcting most of the operating problems which may develop in the aerial platform. 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.

Troubleshooting and maintenance information pertaining to the prime mover (engine) that are not contained in this manual are contained in the applicable engine maintenance manual.

6.2 TROUBLESHOOTING INFORMATION

The troubleshooting procedures are listed and defined in Table 6-1 through 6-6. As an aid to table use, the aerial platform is divided into six major groups, each covered separately within this section. These groups are as follows: platform assembly, boom assembly, turntable assembly, chassis assembly, hydraulic system and electrical system.

Each malfunction within an individual group or system is followed by a listing of probable causes which will enable determination of the applicable remedial action. The probable causes and the remedial action should, where possible, be checked in order listed in the tables.

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

It should also be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems. For this reason, every effort has been made to ensure that all likely problems in these areas are given the fullest possible treatment. In the remaining machine groups only those problems which are symptomatic of greater problems of which have more than one probable cause and remedy are included. This means that problems for which the probable cause and remedy may be immediately obvious are not listed in this section.

The first rule for troubleshooting and circuit that is hydraulically operated and electrically controlled is to determine if the circuit is lacking hydraulic oil or 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.

6.3 HYDRAULIC CIRCUIT CHECKS

The first reference for improper function of a hydraulic system, where the cause is not immediately apparent, should be the Troubleshooting Chart. 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 control 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.

Table 6-1.Platform Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Automatic leveling inoperative.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Dual check valves dirty/inoperative.	Clean or replace as necessary.
	Restricted or broken hydraulic line or fitting on slave cylinder or main lift cylinder.	Clean, repair, or replace line or fitting.
	Worn seal(s) in slave level or main lift cylinder.	Replace seal(s).
	Counterbalance valve in slave cylinder defective.	Replace counterbalance valve.
	Slave level or main lift cylinder not functioning properly.	Slave level or main lift cylinder not functioning properly.
Platform will not maintain level attitude.		
	Counterbalance valve on slave leveling cylinder improperly adjusted or not functioning properly.	Replace valve.
	Worn seal(s) in slave level or main lift cylinder.	Replace seal(s).
	Damaged slave level or main lift cylinder.	Repair or replace cylinder.
No response to platform leveling controls.		
	Level function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Level control switch inoperative.	Repair or replace control switch lever.
	Hydraulic system oil low.	Replenish oil as necessary.
	System orifice plugged/dirty.	Clean orifice.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	No electric to dump or control valve.	See proper wiring diagram.
	Slave cylinder not functioning properly.	Repair or replace pump.
Platform will not adjust "up" or "down" to level.		
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Slave cylinder not functioning properly.	Repair or replace cylinder.
	Electrical failure.	See proper wiring diagram.
	Orifice plugged.	Clean orifice.

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Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	CONTROL VALVES	
Valve spool sticking.		
	Dirt in oil causing excessive temperature build-up.	Flush system and change oil using recommended viscosity
	Moisture in oil.	Flush system and change oil using recommended viscosity
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting. Repair as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Tie-bolts in valve over torqued.	Correctly torque bolts.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.		
	Dirt or other foreign material under seal.	Remove and repair valve as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Remove valve and repair or replace as necessary.
	BOOM ELEVATION SYSTEM.	
No response to lift control switch.		
	Lift function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Lift control switch inoperative.	Repair or replace control switch.
	Lift cylinder holding valve inoperative.	Repair or replace holding valve.
	Dump valve (bypass) not operating.	Determine cause and repair or replace valve.
	Electrical malfunction.	See wiring diagram.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder
Boom will not raise.		
	Lift function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Load capacity exceeded (personnel or equipment on platform).	Reduce load.(Refer to capacity placard.)
	Hydraulic system oil low.	Replenish oil as necessary.
	Electrical failure to valves.	See proper wiring diagram.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Bypass valve (dump) not functioning.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Binding lift cylinder or boom pivot pin.	Repair or replace cylinder or pin.
Boom will not lower.		
	See: Boom will not raise.	
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Holding valve not functioning properly.	Re-adjust or replace valve.
Boom raises and lowers erratically.		
	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Counterbalance valve on lift cylinder improperly adjusted or not functioning properly.	Replace valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
Boom drifts down.		
	Worn seals in lift cylinder.	Replace seals.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Pump Volume, Wheel Motor Speed and High Engine does not operate below horizontal.		
	Damaged wiring on level limit switch.	Repair or replace wiring.
	Solenoid failure.	Replace solenoid.
	Tripped circuit breaker.	Reset circuit breaker.
	Damaged level limit switch.	Replace switch, repair or replace holder.
	Defective relay, main terminal box.	Replace relay.
	Defective platform switch.	Replace switch.
TELESCOPE SYSTEM.		
No response to telescope control.		
	Telescope function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Telescope control switch inoperative.	Repair or replace control switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Control valve not functioning properly.	Repair or replace valve.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Boom will not extend.		
	Telescope function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Control valve not functioning properly.	Repair or replace control valve.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Pressure setting incorrect.	Check pressure/re-adjust as necessary.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom extends and retracts erratically.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Wear pads worn.	Replace pads as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in telescope cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
	Counterbalance valve not functioning properly.	Replace counterbalance valve.
BOOM SWING SYSTEM		
No response to swing control.		
	Swing function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Swing control switch not functioning.	Repair or replace swing control switch.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Swing motor not functioning properly.	Repair or replace motor.
	Restrictor valve(s) plugged.	Clean or replace restrictor valve.
	Foreign objects(s) wedged between swing motor pinion and swing gear.	Remove objects, check for damage, and repair or replace component(s) as required.
	Pressure reducing valve in swing circuit malfunctioning.	Repair or replace pressure reducing valve.
	No electric power to valve.	See proper wiring diagram.
Boom will swing in one direction only.		
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Foreign object(s) wedged between swing motor pinion and swing gear.	Remove object(s), check for damage and repair or replace component(s) as required.
	Swing control switch not functioning properly.	Repair or replace swing control switch.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom swings erratically in either direction.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Lack of lubricant on swing gear or speed reducer pinion.	Lubricate as required. (See Lubrication Chart.)
	Swing motor not functioning properly.	Repair or replace swing control switch.
	Worn or broken teeth on swing gear or swing motor pinion.	Replace gear(s) as required.
	Restrictor valves(s) plugged.	Clean or replace restrictor valve.

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Table 6-3.Turntable Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
CONTROL VALVE.		
Valve Spool Sticking.		
	Dirt in oil causing excessive temperature built-up.	Change oil using recommended viscosity and flush system.
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting.Repair as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.		
	Dirt or other foreign material under seal.	Remove and replace valve as necessary.
	Valve spool scored.	Repair or replace valve.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Repair or replace valve as necessary.

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Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
POWER PLANT.		
Engine will not start.		
	Station power selector switch not in required position.	Actuate switch as required.
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Defective starter motor.	Replace starter motor.
	Damaged wiring in ignition circuit (broken wire on starter).	Repair, replace wiring.
	Ignition switch not functioning properly.	Replace switch.
	Ignition relay not functioning properly.	Replace relay.
	Ignition circuit shorted to ground.	See proper wiring diagram.
	Battery cable(s) not making contact.	Clean and tighten cable(s).
	Start lockout not working.	See wiring diagram. Check relay.
Engine will not start (ignition OK).		
	No fuel.	Replenish fuel as necessary.
	Clogged fuel filter.	Replace fuel filter.
	Choke solenoid malfunction.	Replace choke solenoid.
	Restricted or broken fuel line.	Clean or replace fuel line.
	Fuel shut-off valve in carburetor stuck or frozen.	Repair or replace fuel shut-off. Check for electrical power.
	Battery discharged.	Charge battery, replace if defective.
	Fuel pump not working.	Replace fuel pump.
	Cam timing belt jumped time or broken.	Repair or replace timing belt.
	Ignition timing slipped.	Repair timing.
Engine will not accelerate above low.		
	Damaged wiring on speed control switch or high engine solenoid.	Repair or replace wiring.
	Drive controller not functioning properly.	Replace controller.
	Actuator not functioning properly.	Repair or replace solenoid.
	Excessive load on engine.	Reduce load.

Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Engine worn badly.	Rebuild engine.
	Engine improperly timed.	Time engine.
	Engine overheating.	Determine cause of overheating and remedy.
	Dirty fuel filter.	Replace filter.
	Fuel line pinched.	Replace fuel line.
	Throttle governor not working properly.	Repair or replace governor.
Engine surges.		
	Governor not adjusted properly.	Correctly adjust governor.
Strong fuel odor.		
	Fuel tank overfilled.	Check fuel tank and immediately wipe up spilled fuel.
	Fuel tank damaged.	Drain all fuel from tank and remove tank for replacement or repair.
	Fuel line from tank damaged.	Replace fuel line.
	Carburetor flooding.	Repair, replace or adjust carburetor.
FRONT FRAME AXLE AREA.		
One or both wheels will not steer.		
	Steering link or tie rod broken or attaching hardware missing.	Replace steering link, tie rod or hardware as necessary.
One or both front wheels will not rotate or rotate erratically.		
	Wheel hub or bearings damaged or not lubricated.	Replace hub or bearings as necessary and repack bearings with approved grease.
REAR FRAME AXLE AREA.		
Difficulty encountered when moving machine.		
	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Flow divider sticking.	Repair or replace flow divider.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Grade too steep.	See WARNING Placard on platform for specified grades and sideslopes.
	Towing valve not closed.	Close towing valve.

Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	Drive brakes "dragging".	Re-adjust pressure.
	System pressure too low.	Re-adjust pressure.
	Drive hub(s) defective.	Repair or replace hub.
	Engine RPM's not set.	Correctly set engine RPM.
	Drive motors worn.	Repair or replace drive motors.
	Counterbalance valve defective.	Replace counterbalance valve.
	Low amperage on controller.	Correctly adjust controller.
DRIVE SYSTEM.		
No response to control.		
	Drive function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken pump supply line.	Clean, repair or replace line.
	Restricted or broken line on valve bank.	Clean, repair or replace line.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Air in wheel brake circuit.	Bleed circuit, determine and correct cause.
	Fuse is blow-out on control card.	Replace fuse.
	Damaged wiring on control switch.	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Brake(s) not releasing.	Determine cause and repair or replace.
Machine will not travel in forward.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Counterbalance valve sticking on return side.	Adjust return counterbalance out 3 turns - cycle drive - return to original position.

Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Motor turns slowly in the direction of the last command.		
	Valve not returning to neutral.	Check neutral springs.
	Function speed switch malfunction.	Replace function switch.
	Sticking spool due to contamination.	Remove end cap and check spool freedom. Repair as necessary.
Motor turns slowly at maximum command.		
	Valve spool is not traveling far enough due to:	Repair or replace drive motor(s).
	Worn, leaking drive motor(s).	Repair or replace drive motor(s).
	Engine RPM's set too low.	Properly adjust engine RPM's.
	Low control pressure supply.	Replace pressure regulator if necessary.
	Function speed switch malfunction.	Replace switch.
	Amperage too low on controller.	Correctly adjust controller.
	Defective pump, low oil volume.	Repair or replace pump.
Poor response, function shuts off slowly when command is removed.		
	Low spool spring preload.	Check for correct spring and shims in end caps.
	Sticking spool due to contamination.	Remove end cap and check spool freedom.
	Ramp set too high in controller.	Adjust controller.
	Sticking control handle.	Repair or replace controller.
STEERING SYSTEM.		
No response to steer control.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic system pressure too low.	Adjust pressure.
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line on valve bank, hydraulic pump or rotary coupling. (If equipped.)	Clean, repair or replace line.

Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	If equipped, swivel coupling leaking internally. (Seals defective.)	Repair or replace coupling.
	Steer control valve not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine hard to steer or steering is erratic.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressure.
	Bent linkage (tie rods).	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Steering inoperative.		
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Control switch not functioning properly.	Replace switch.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valves as required.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine will not steer left or to the right.		
	Wiring on control switch is damaged.	See proper wiring diagram.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	No oil flow or pressure to steer circuit.	Take pressure reading at steer valve and adjust as necessary.
	Bent cylinder rod.	Repair or replace cylinder.
	Damaged tie rod.	Replace tie rod.
	Crossover relief valve sticking.	Repair crossover relief valve.
	Cylinder packing defective.	Repair or replace cylinder.

Table 6-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Machine wanders; steering not firm.		
	Crossover relief valve set too low or not functioning properly.	Reset, repair or replace valve as required.
	Steer linkages loose.	Tighten linkage.
	Steer wheel toe-in not set properly.	Adjust toe-in for 1/4 inch overall.
	Spindle bushings badly worn.	Replace bushings.

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Table 6-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
HYDRAULIC SYSTEMS - GENERAL.		
Hydraulic pump noisy.		
	Air entering system through broken line or fitting. (Suction Side.)	Repair or replace line or fitting.
	Suction screen dirty.	Clean suction screen.
	Air bubbles in oil. (Reservoir oil too low.	Replenish oil as required.
	Suction hose squeezed shut.	Determine cause and repair.
	Oil filter dirty.	Replace hydraulic filter.
	Wrong type of hydraulic oil.	Replace hydraulic oil.
Pump cavitating. (Vacuum in pump due to oil starvation.)		
	Restricted suction line.	Clean, repair, or replace line.
	Restricted reservoir air vent.	Clean or replace vent.
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Air leak in suction side of tank.	Repair leak.
	Restricted suction strainer.	Clean strainer.
System overheating.		
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Bypass valve not operating properly.	Repair or replace valve.
	Main relief valve set too low.	Reset valve as required.
	Hydraulic system oil low.	Replenish oil as necessary.
	Port relief set too high.	Reset valve as required.
	Restricted or blocked return line.	Repair or replace line.

Table 6-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering oil.		
	Restricted suction line.	Clean, repair, or replace line.
	Air entering system through broken line or fitting.	Repair or replace line or fitting.
	Broken pump drive shaft/pump coupling.	Repair or replace pump/pump coupling. **Note: 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).**
Function sluggish during operation. (System pressure too low.)		
	Main relief valve set too low.	Reset valve as required.
	Pump section not delivering sufficient oil.	Repair or replace pump section or pump.
	Main relief valve stuck in open position.	Clean, repair, or replace valve. (Check system oil for contamination.)
	Oil viscosity too low.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Leak in component, line or fitting.	Repair or replace component, line or fitting.
	Scored valve spool; scored cylinder.	Replace valve; replace cylinder.
	Amperage too low on controller.	Correctly adjust controller.
	Low sequence pressure.	Reset valve as required.
	Low pilot pressure.	Reset valve as required.
	Wrong/defective spool in drive section.	Repair or replace drive section.
	Shuttle balls leaking in proportional valve.	Repair or replace valve.
	Low voltage in electrical system.	Correct low voltage problem.
System(s) operate erratically.		
	Sticking or binding valve spools, pistons.	Clean, repair, or replace components as required.
AUXILIARY HYDRAULIC SYSTEM.		
Auxiliary hydraulic pump inoperable.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Engine is running.	Shut down engine.
	Check valve in system leaking.	Repair or replace check valve.
	Battery requires charging or will not hold a charge.	Charge or replace battery as required.

Table 6-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Damaged wiring on control switch or auxiliary pump.	See proper wiring diagram.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Pump motor solenoid not functioning properly.	Replace solenoid.
	Pump motor not functioning properly.	Repair or replace motor.

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Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM CONTROLS.		
No power to platform controls.		
	15 Amp self-reset circuit breaker open.	Check footswitch to ensure that both switches are making contact when pedal is depressed. Repair or replace footswitch as necessary.
	Contact block in footswitch malfunctioning.	Repair, replace or adjust contact block as required.
	Faulty power circuit wiring.	Check wiring continuity. Refer to proper wiring diagram.
	Select switch in wrong position.	Place select switch to correct position.
ENGINE STARTER SYSTEM.		
Starter will not crank.		
	Discharged battery or loose battery terminals.	Check and charge battery or replace battery as necessary. Clean and secure battery terminals.
	Starter relay faulty or faulty relay connections.	Using a test meter, check relay coil terminals for presence of electrical power and for energization of relay coil. Also check relay terminals for correct switching of contacts. Replace relay as necessary.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Malfunctioning ignition switch.	Using a test meter, check ignition switch for correct switching of contacts. Replace switch as necessary.
	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. See proper wiring diagram.
	Faulty start lockout system.	See correct wiring diagram.
	Faulty start switch.	Replace switch.
Engine continues to crank.		
	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. See proper wiring diagram.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Faulty start switch.	Replace switch.

Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENTS AND INDICATORS.		
Travel warning horn inoperative.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring in horn circuit.	Repair or replace wiring.
	Damaged horn.	Replace horn.
Hourmeter inoperative.		
	Damaged wiring in hourmeter circuit.	Repair or replace wiring.
	Defective pressure switch.	Replace pressure switch.
	Inoperative hourmeter.	Replace hourmeter.
Tilt alarm circuit.		
	Damaged wiring in tilt alarm circuit.	Repair or replace wiring. See proper wiring diagram.
	Tilt alarm inoperative.	Replace tilt alarm.
	Tilt alarm not adjusted properly.	Adjust tilt alarm.
	Defective bulb in tilt light.	Replace bulb.
High engine speed will not function.		
	Boom above horizontal.	Lower boom.
	Horizontal limit switch malfunctioning.	Repair or replace limit switch.
	Drive controller defective.	Replace controller.
	High engine solenoid malfunctioning.	Repair or replace solenoid valve.
	Drive pressure switch malfunctioning.	Replace pressure switch.
	Electrical malfunction.	See wiring diagram.
	Defective engine governor.	Repair or replace governor.

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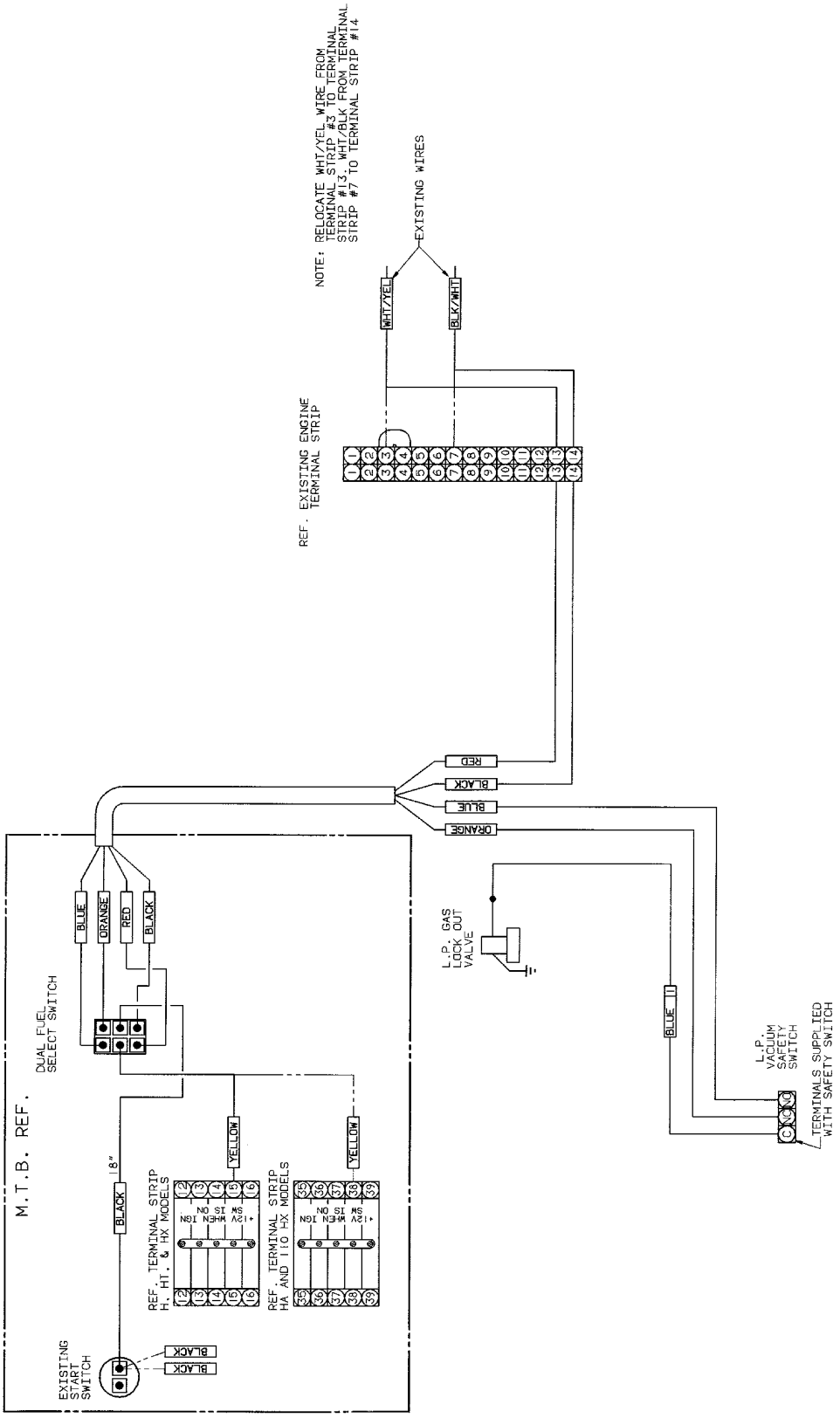

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Figure 6-1. Wiring Schematic Dual Fuel

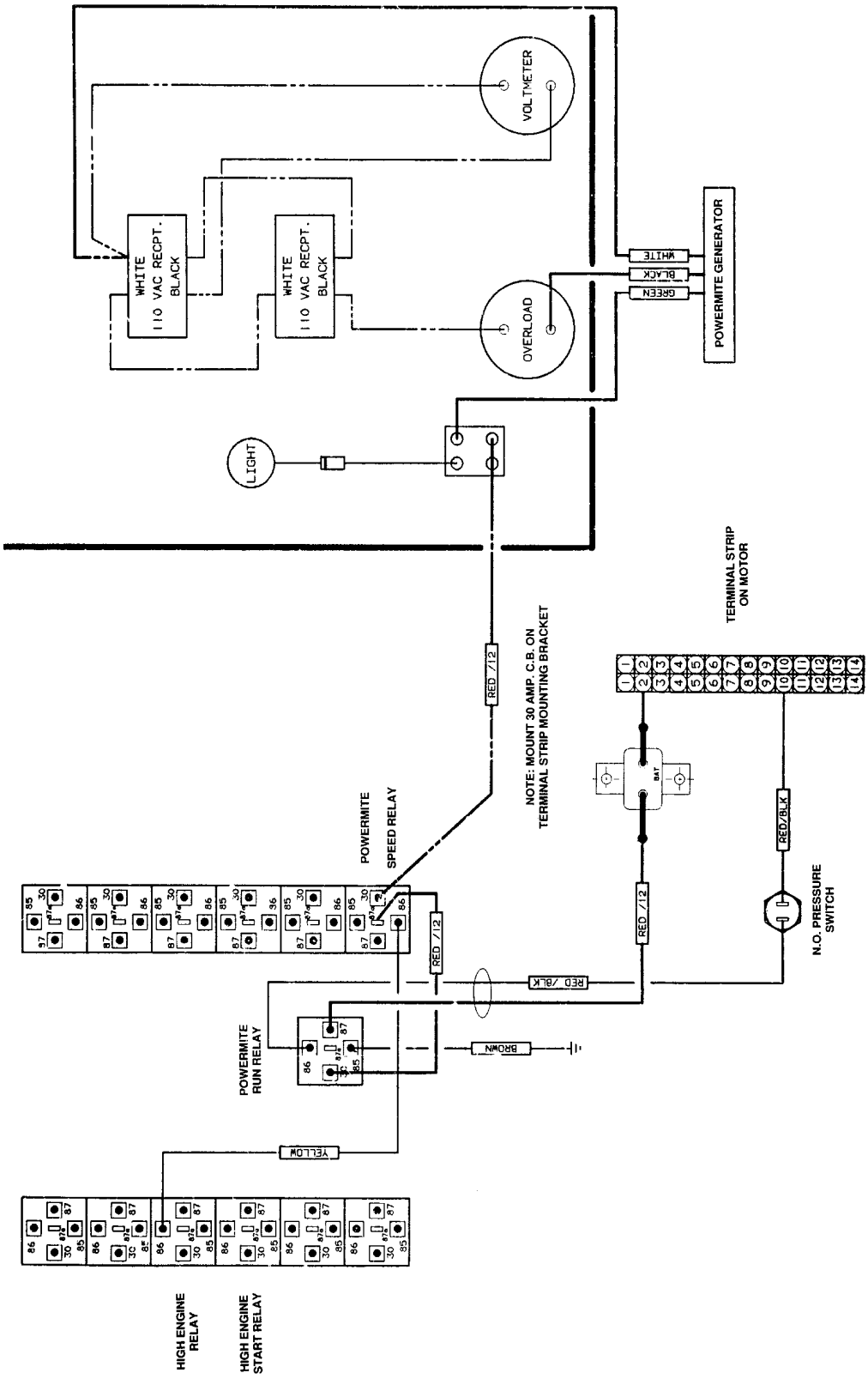

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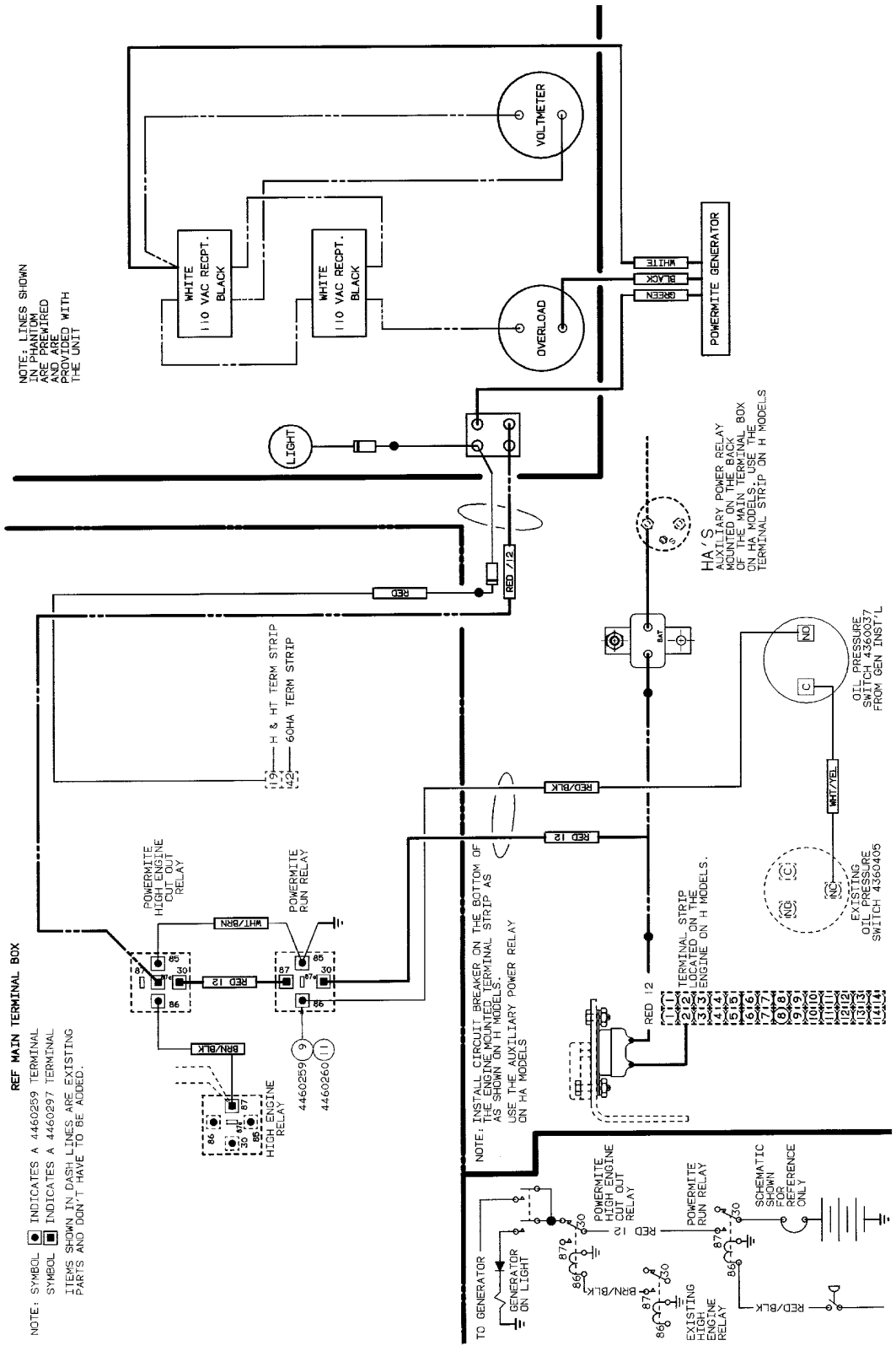
Figure 6-2. Wiring Diagram - Generator (Deutz Engines)



4932806 B

Figure 6-3. Wiring Diagram - Generator (Ford Engine)

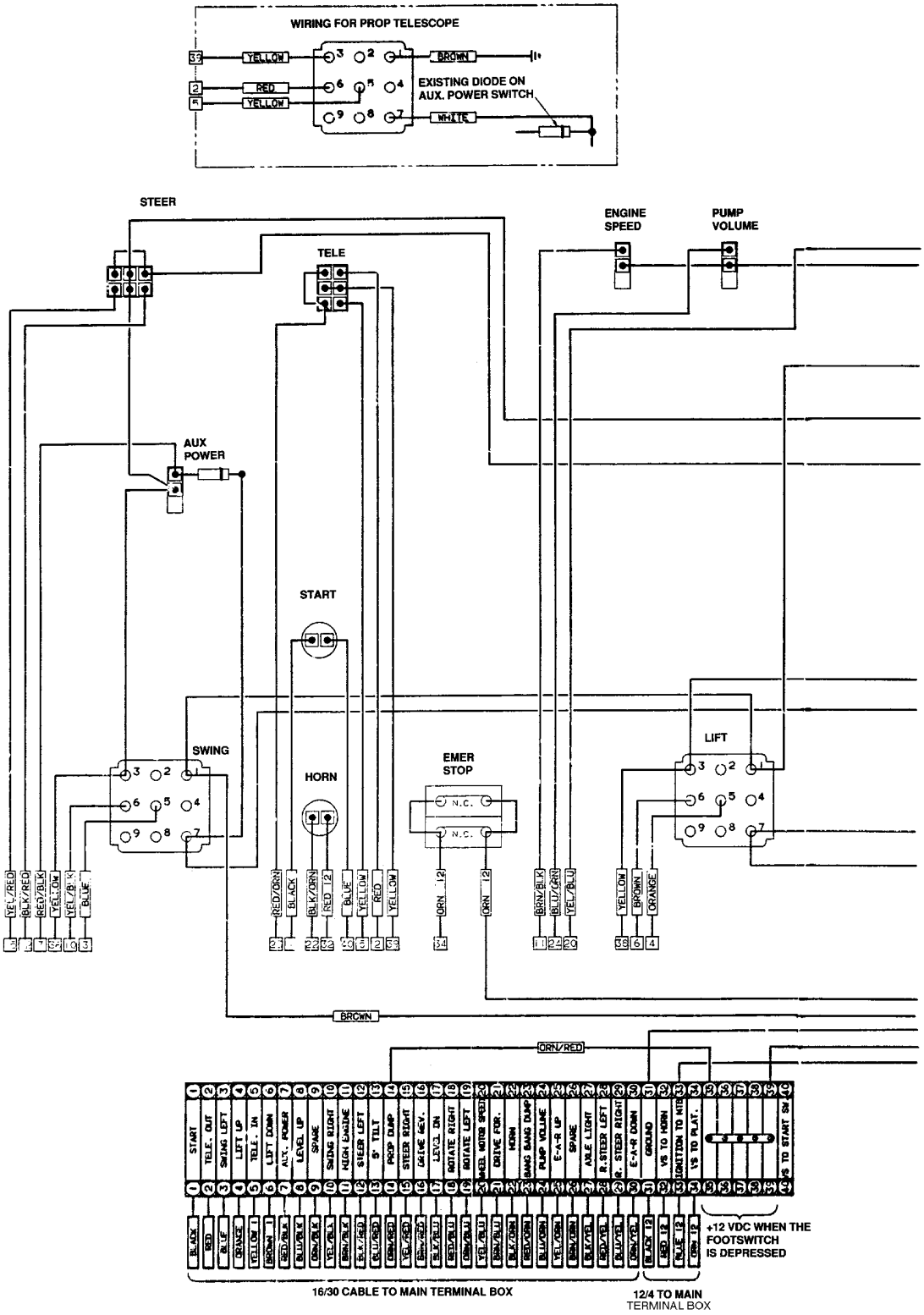


Figure 6-4. Wiring Diagram - Platform Console Standard Controls (Sheet 1 of 2)

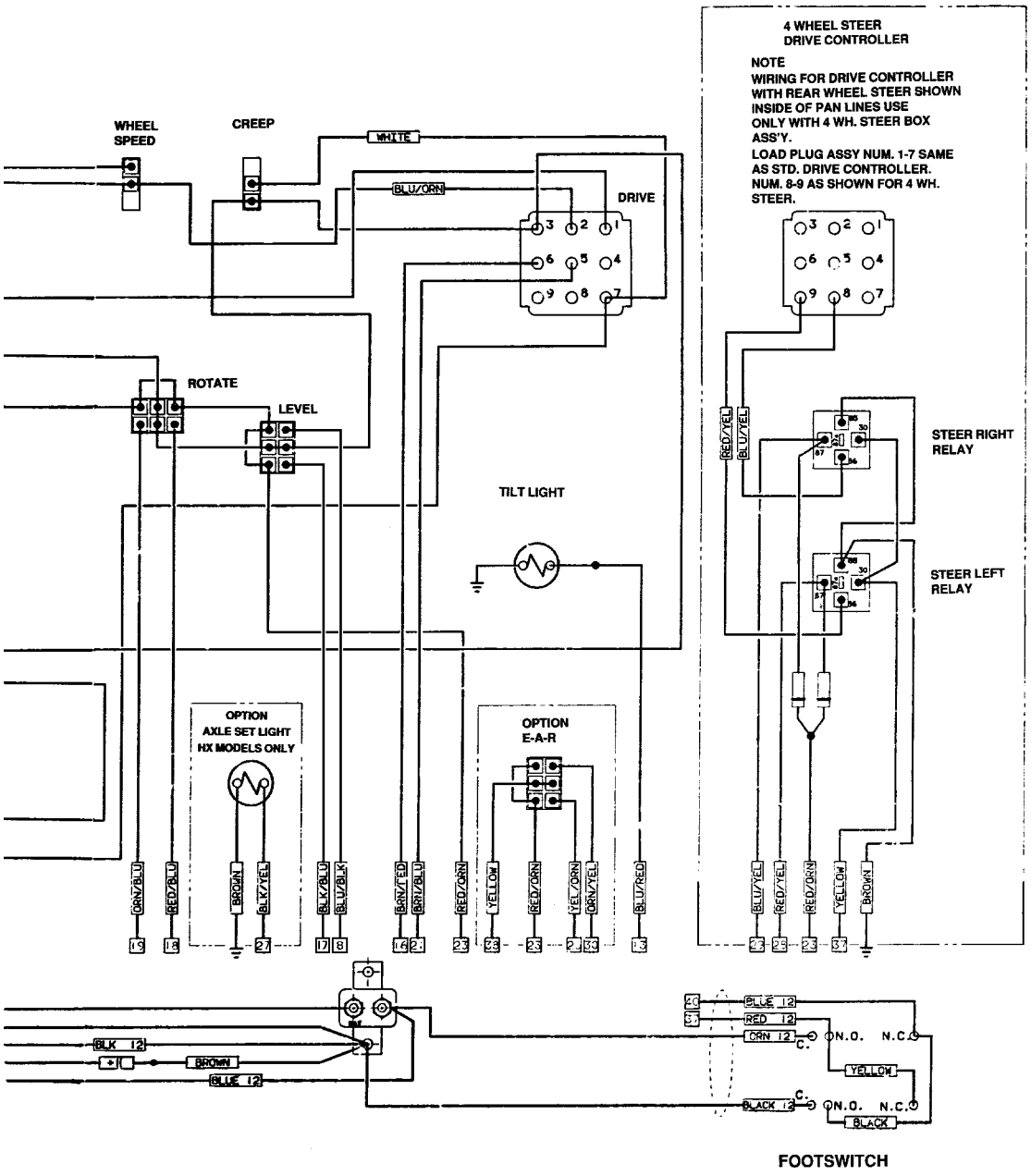


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Figure 6-5. Wiring Diagram - Platform Console Standard Controls (Sheet 2 of 2)

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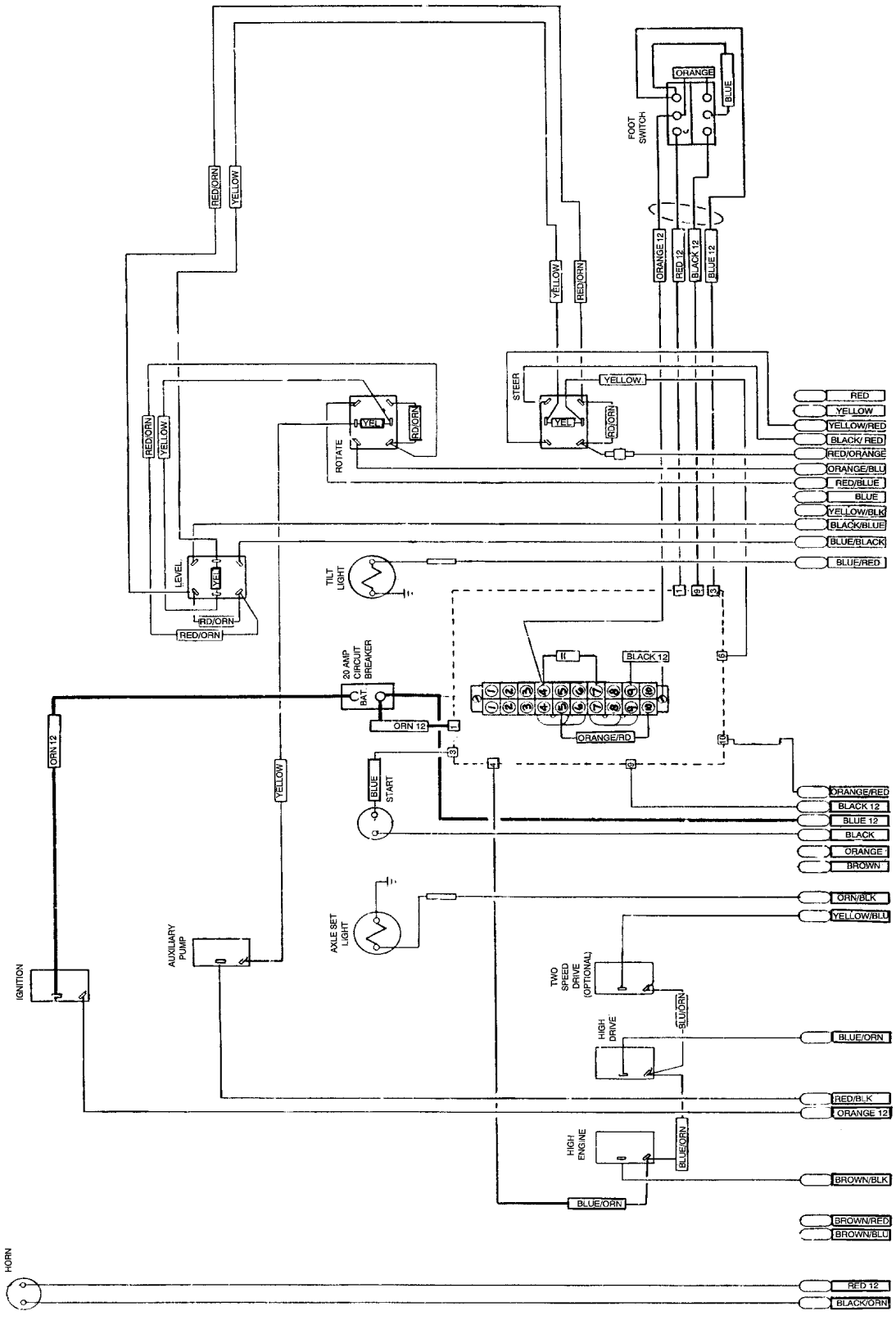

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Figure 6-6. Wiring Diagram - Platform Console Hydraulic Controls

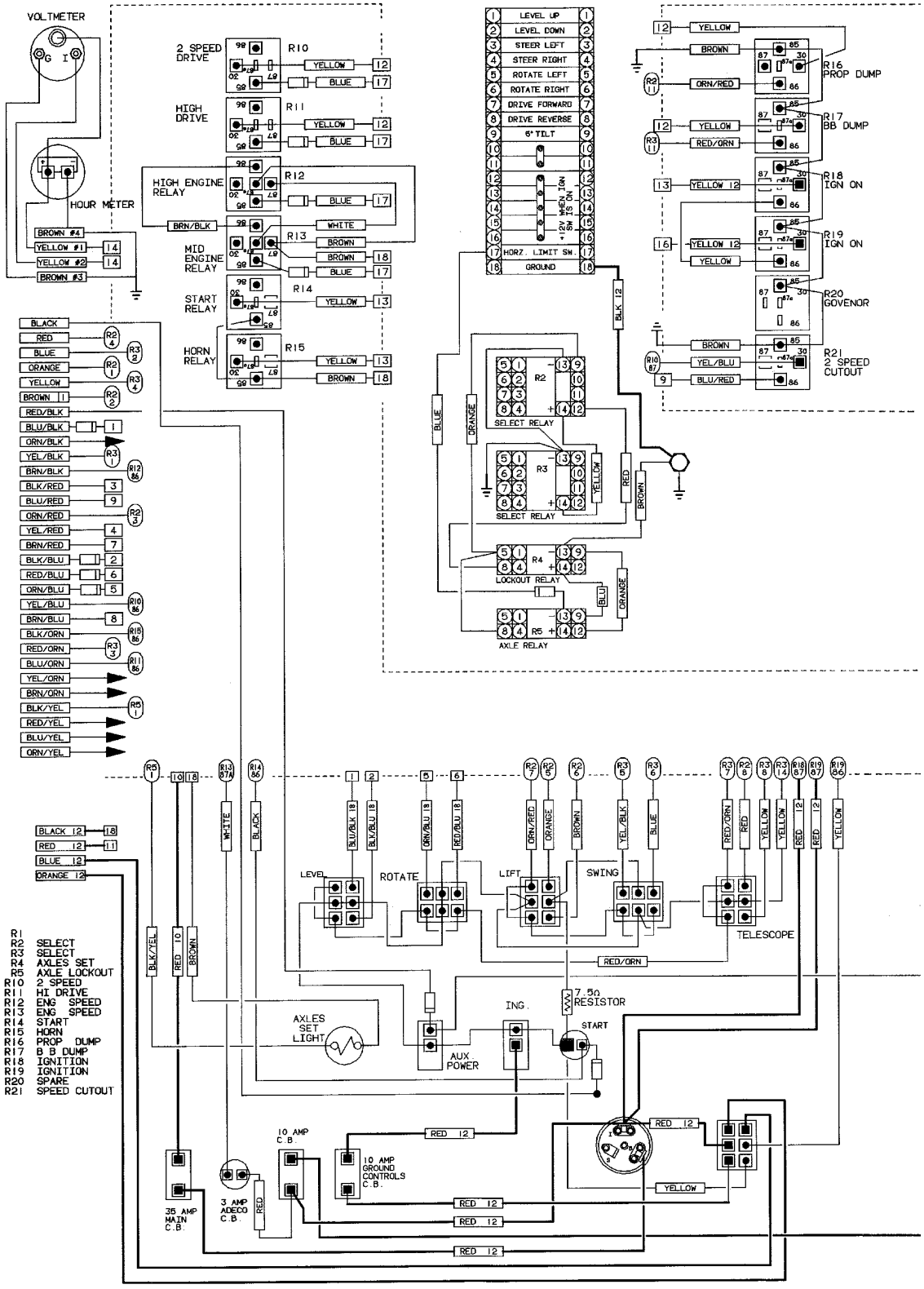

Figure 6-7. Wiring Diagram - Standard (Deutz Engine/Fixed Axle/Standard Controls) (Sheet 1 of 2)

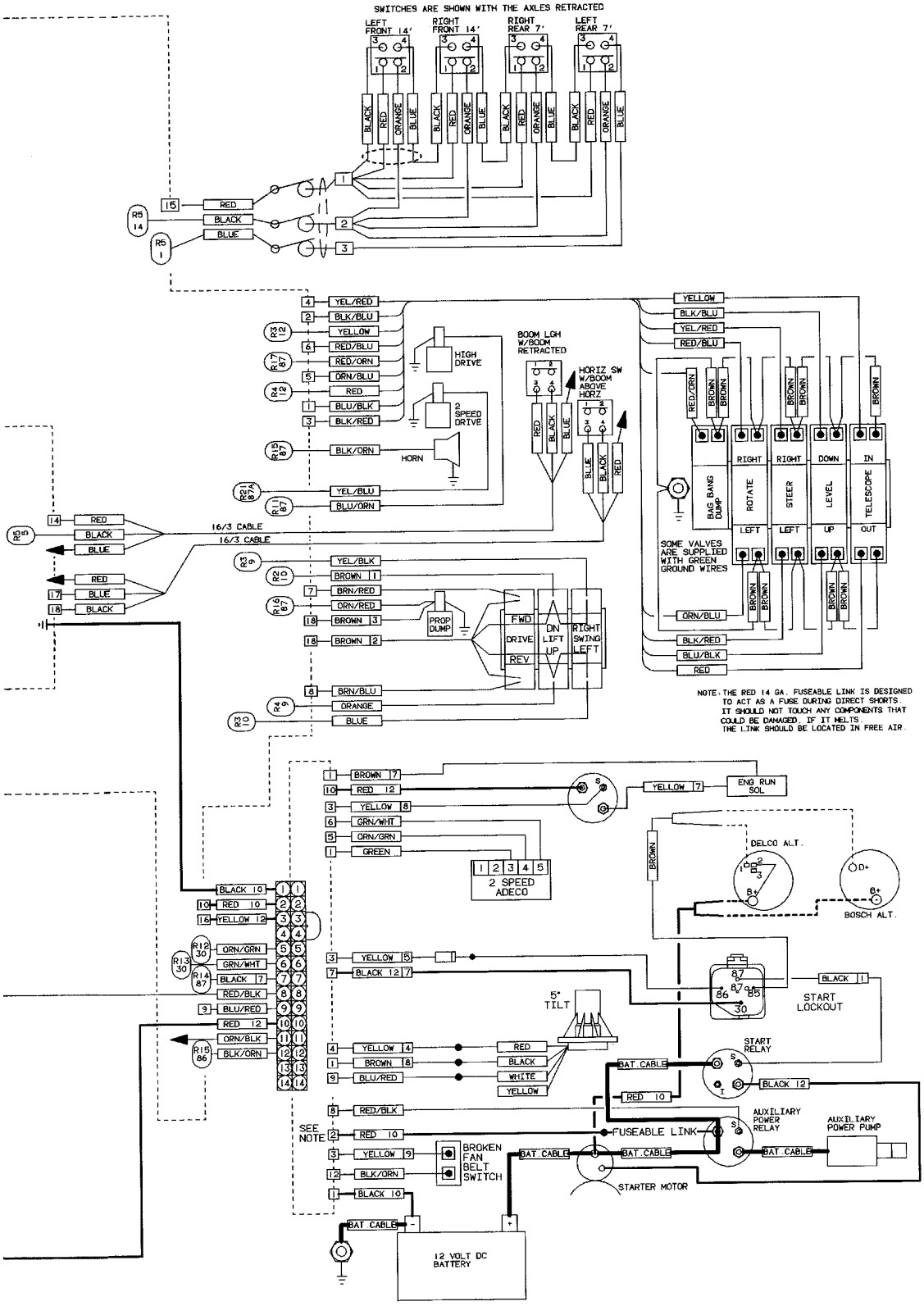

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Figure 6-8. Wiring Diagram - Standard (Deutz Engine/Fixed Axle/Standard Controls)(Sheet 2 of 2)

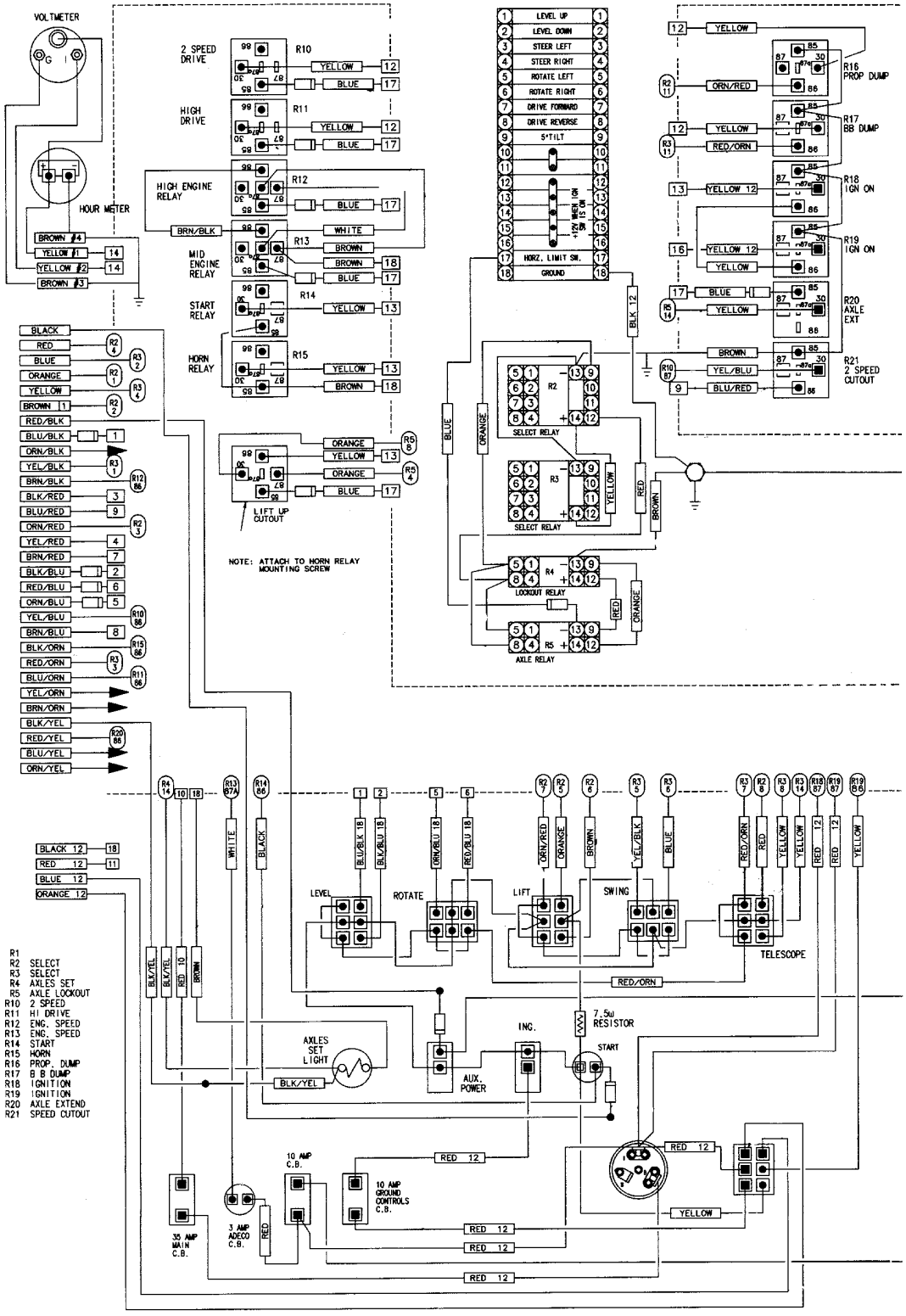

Figure 6-9. Wiring Diagram - Standard (Deutz Engine/Oscillating Axle/Standard Controls)(Sheet 1 of 2)

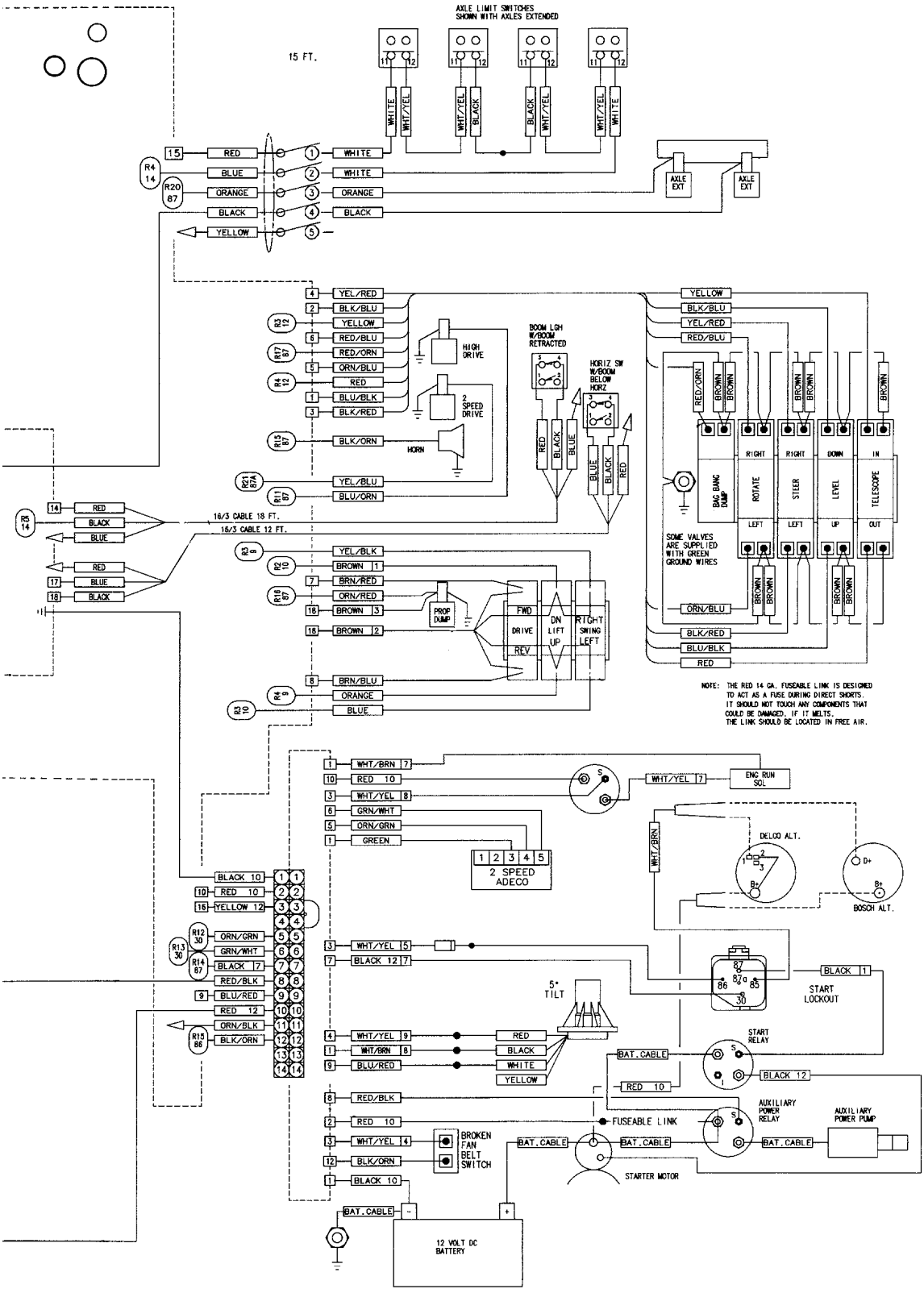

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Figure 6-10. Wiring Diagram - Standard (Deutz Engine/Oscillating Axle/Standard Controls)(Sheet 2 of 2)

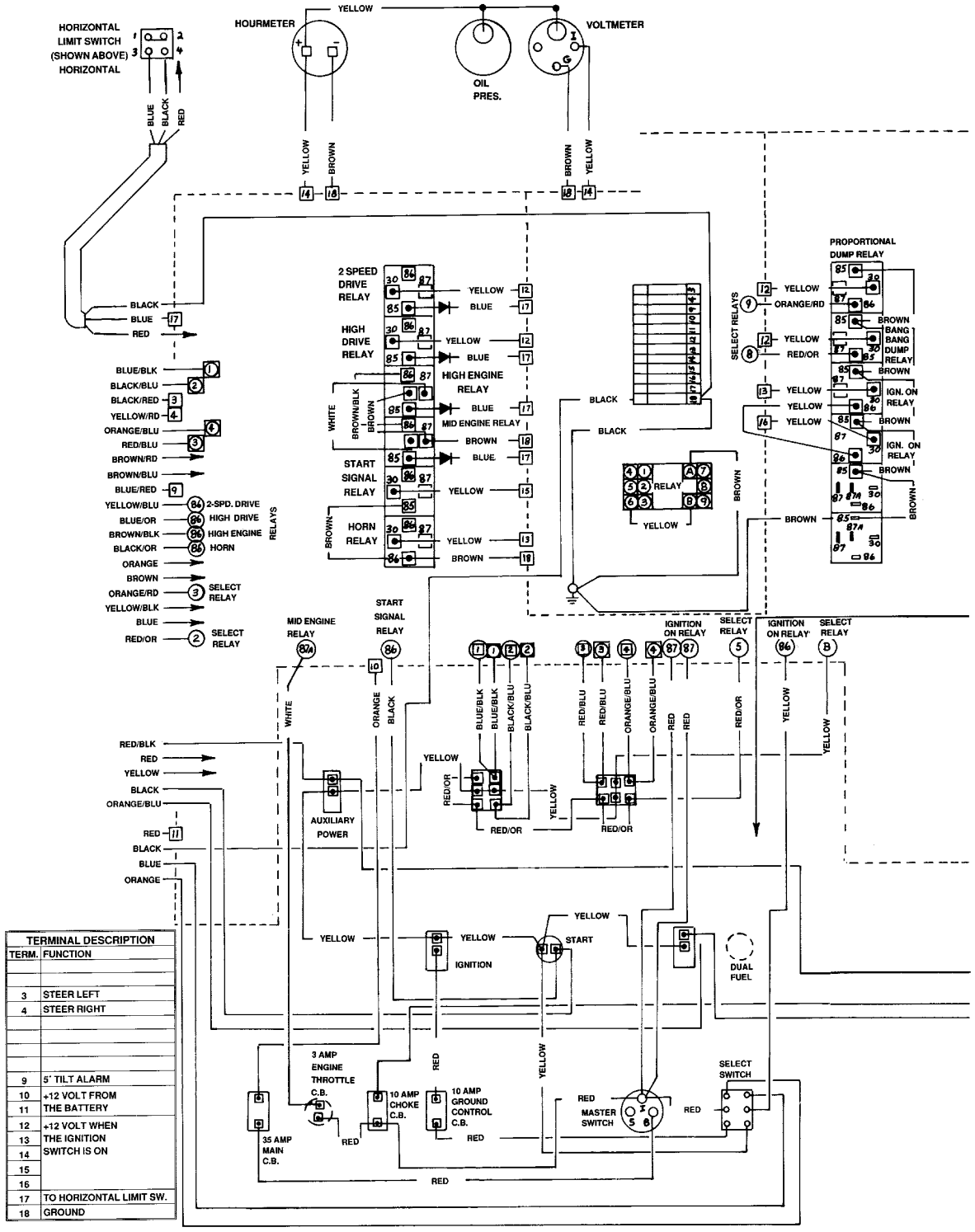

Figure 6-11. Wiring Diagram - Standard (Deutz Engine/Hydraulic Controls)(Sheet 1 of 2)

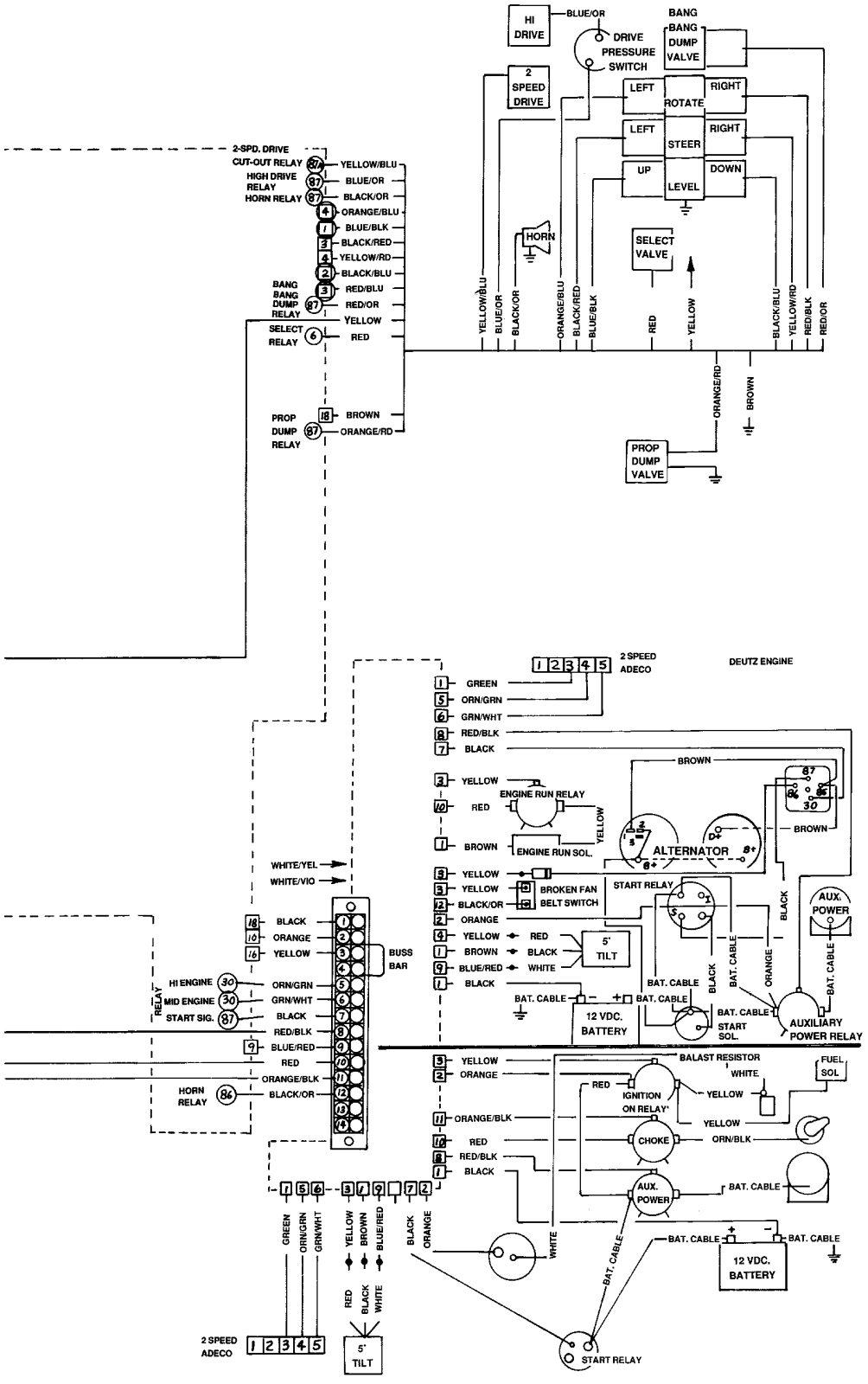

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Figure 6-12. Wiring Diagram - Standard (Deutz Engine/Hydraulic Controls)(Sheet 2 of 2)

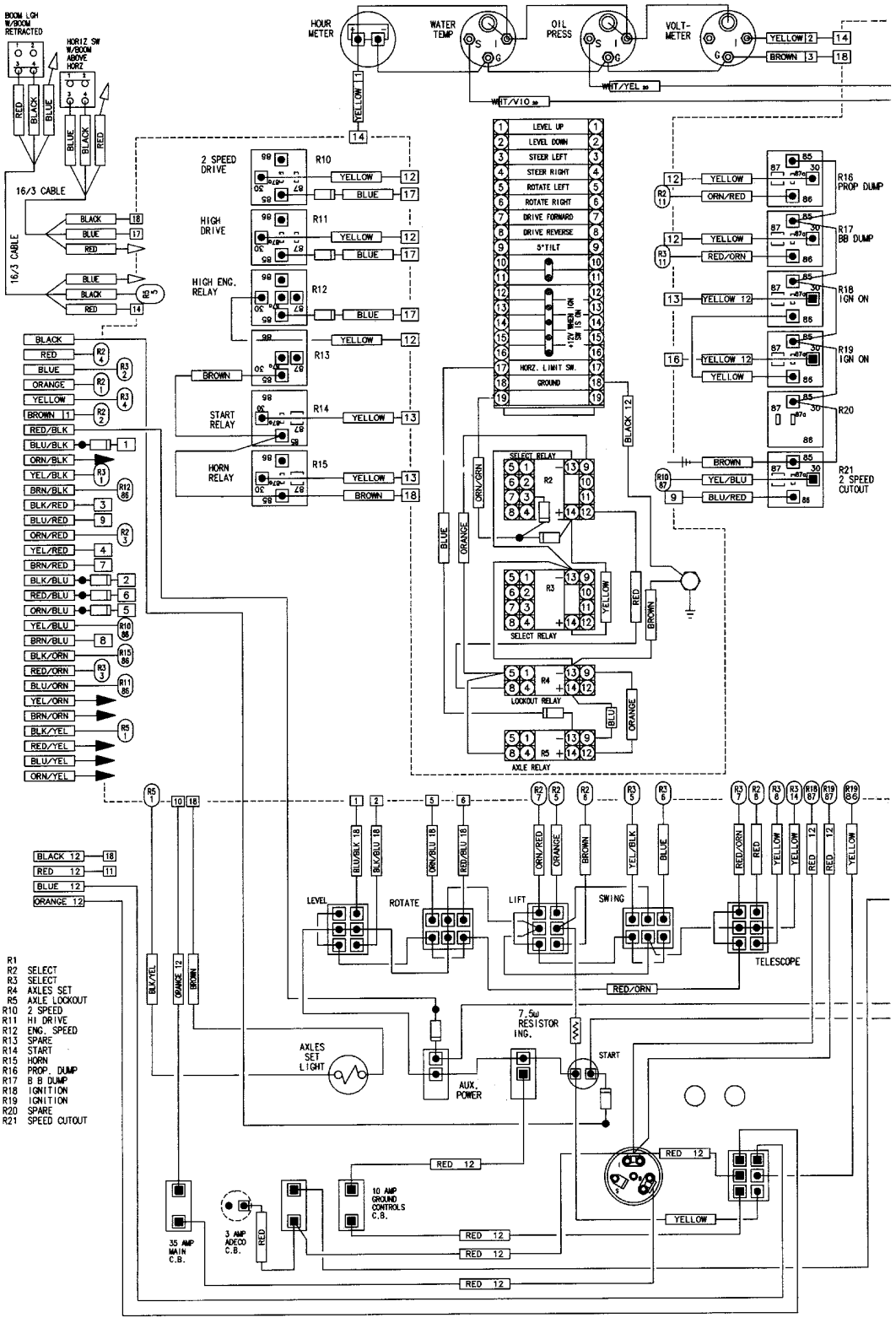

Figure 6-13. Wiring Diagram - Standard (Ford Engine/Fixed Axle/Standard Controls)(Sheet 1 of 2)

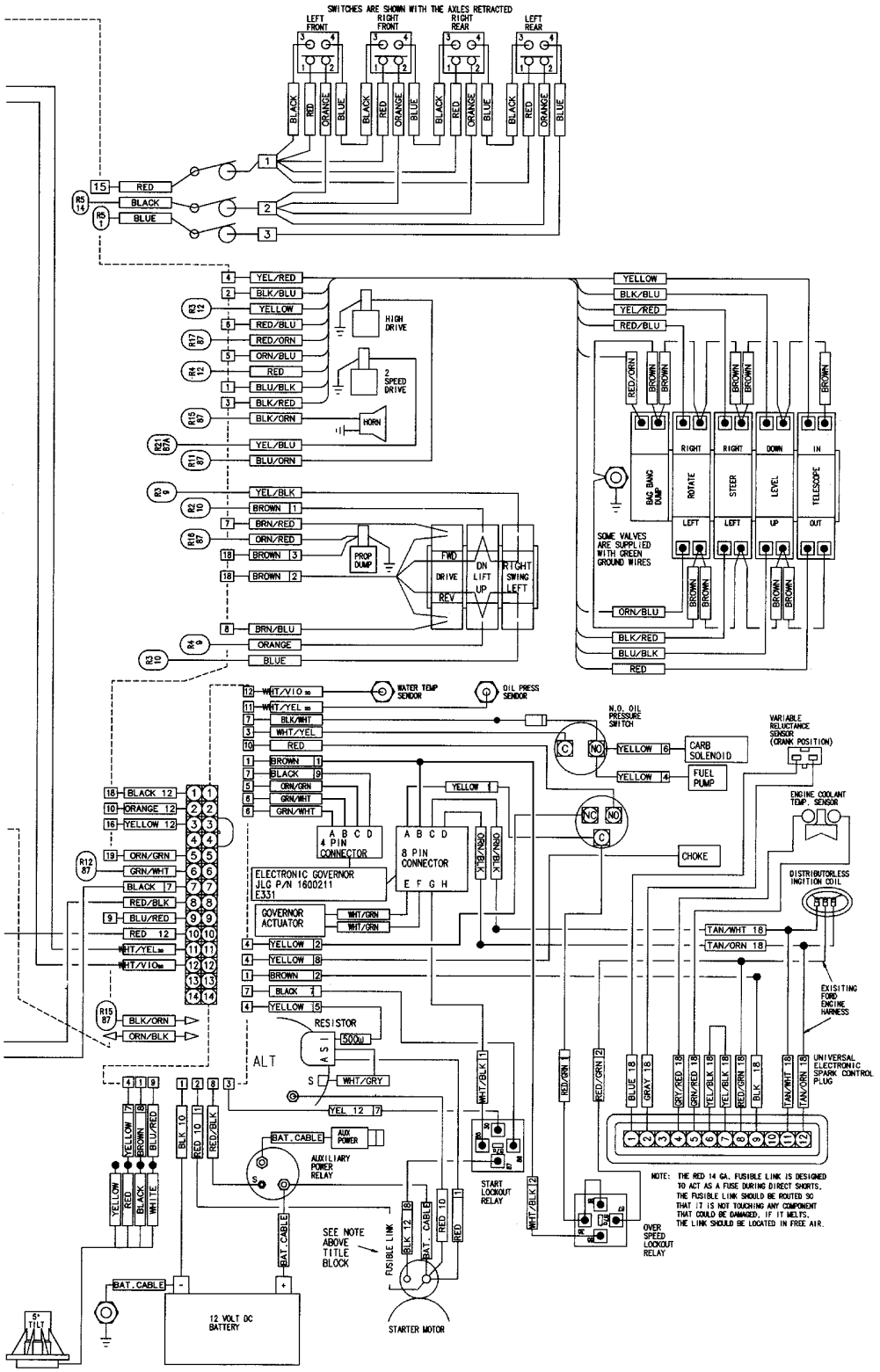

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Figure 6-14. Wiring Diagram - Standard (Ford Engine/Fixed Axle/Standard Controls)(Sheet 2 of 2)

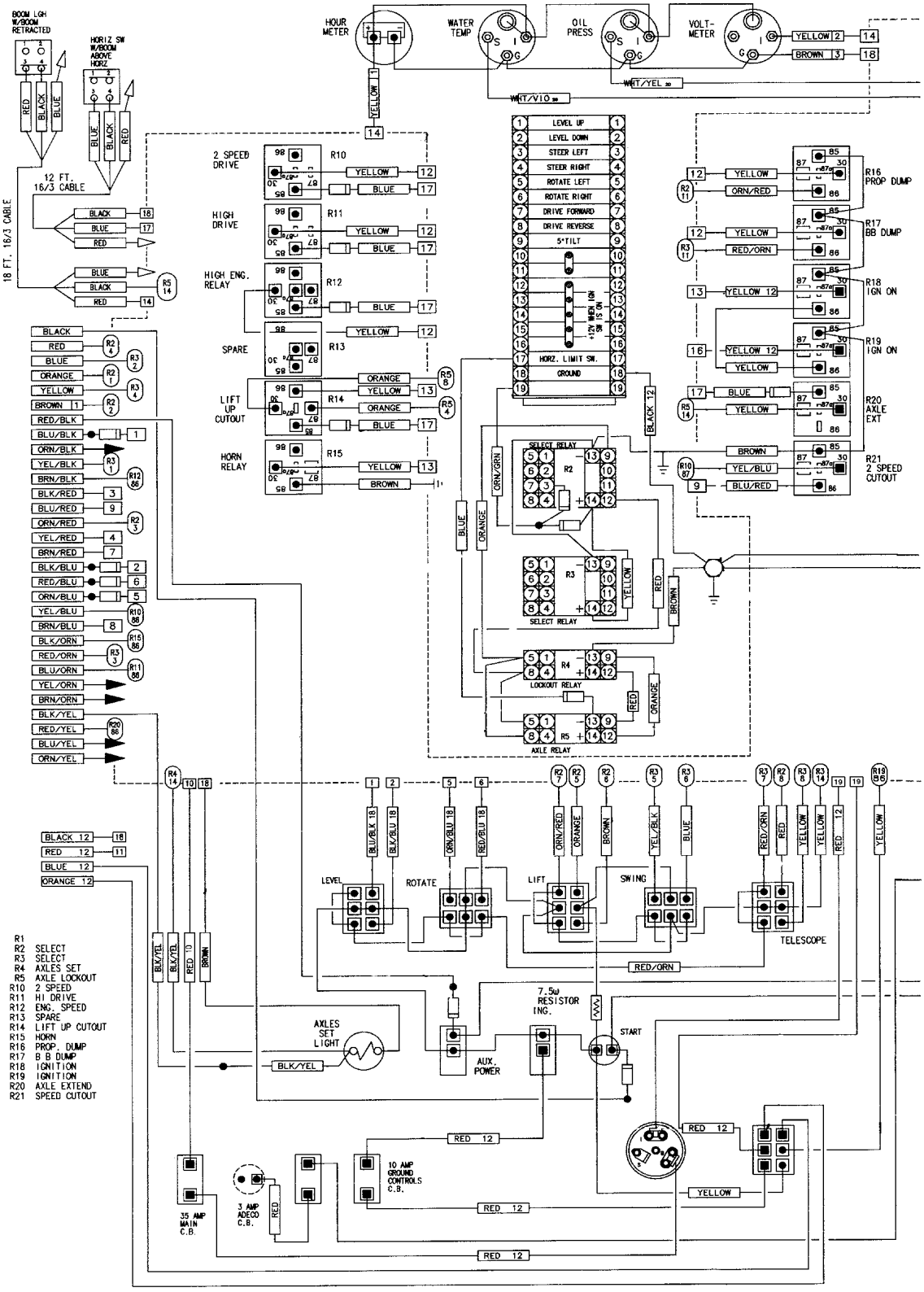

Figure 6-15. Wiring Diagram - Standard (Ford Engine/Oscillating Axle/Standard Controls)(Sheet 1 of 2)

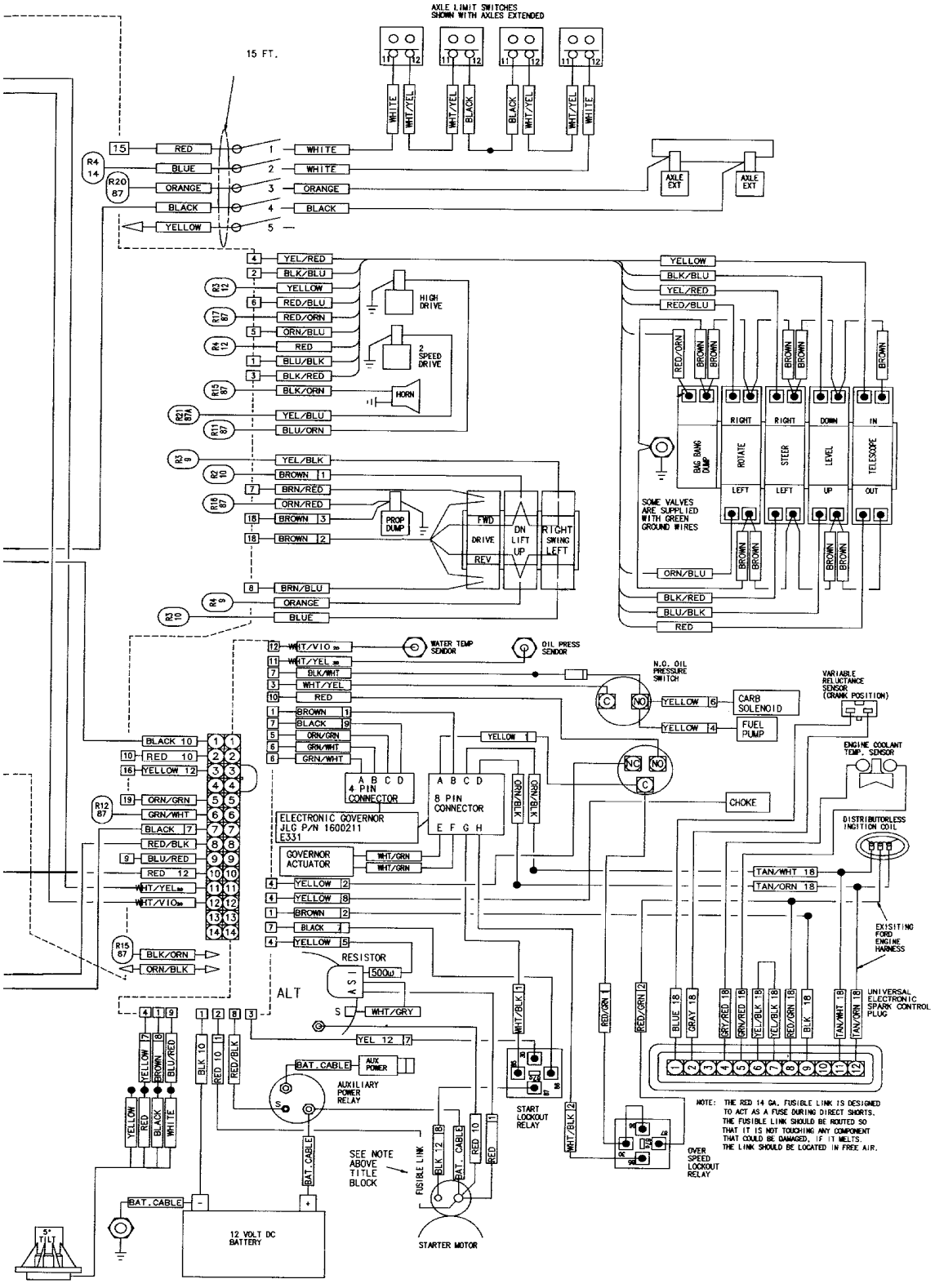

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Figure 6-16. Wiring Diagram - Standard (Ford Engine/Oscillating Axle/Standard Controls)(Sheet 2 of 2)

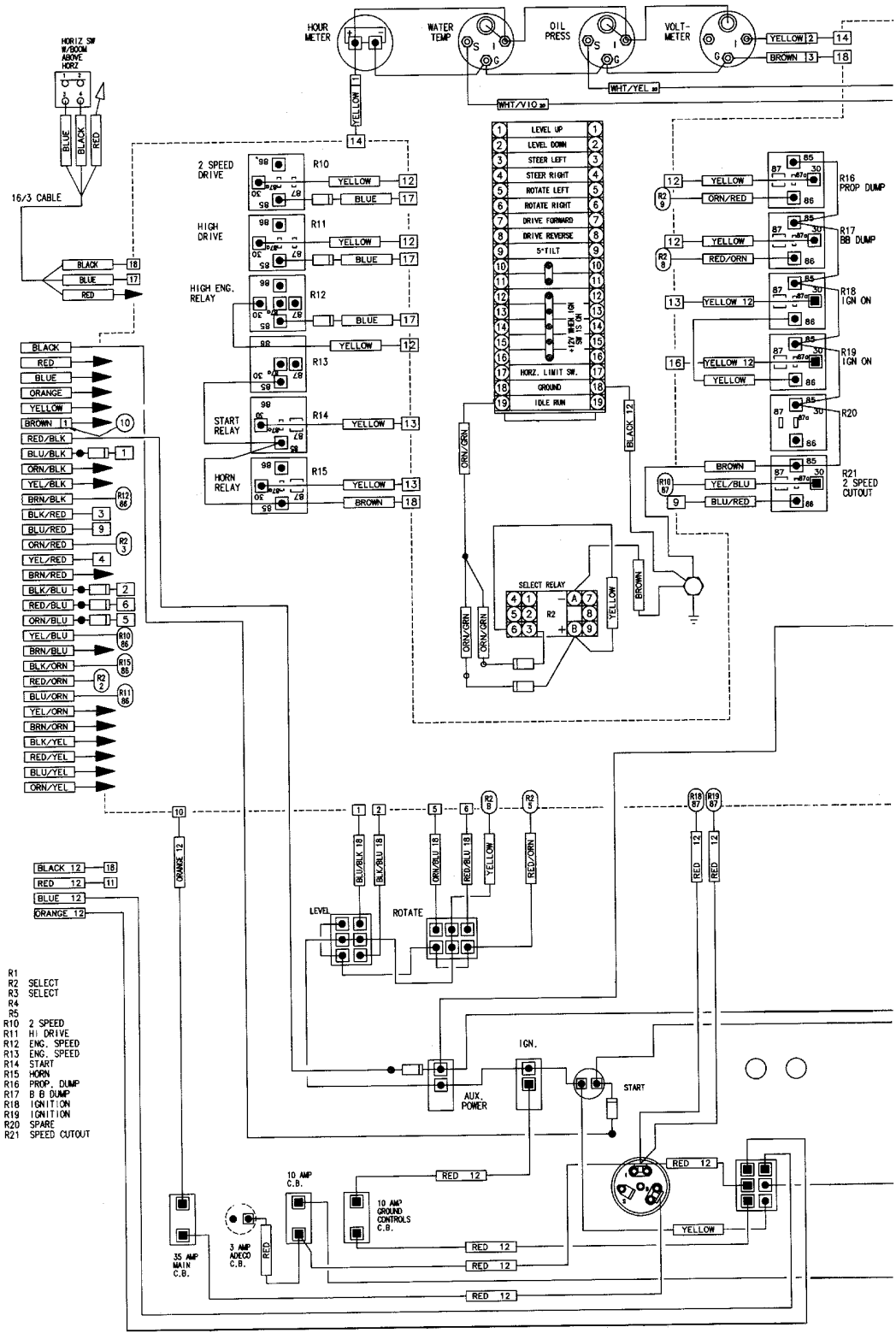

Figure 6-17. Wiring Diagram - Standard (Ford Engine/Hydraulic Controls)(Sheet 1 of 2)

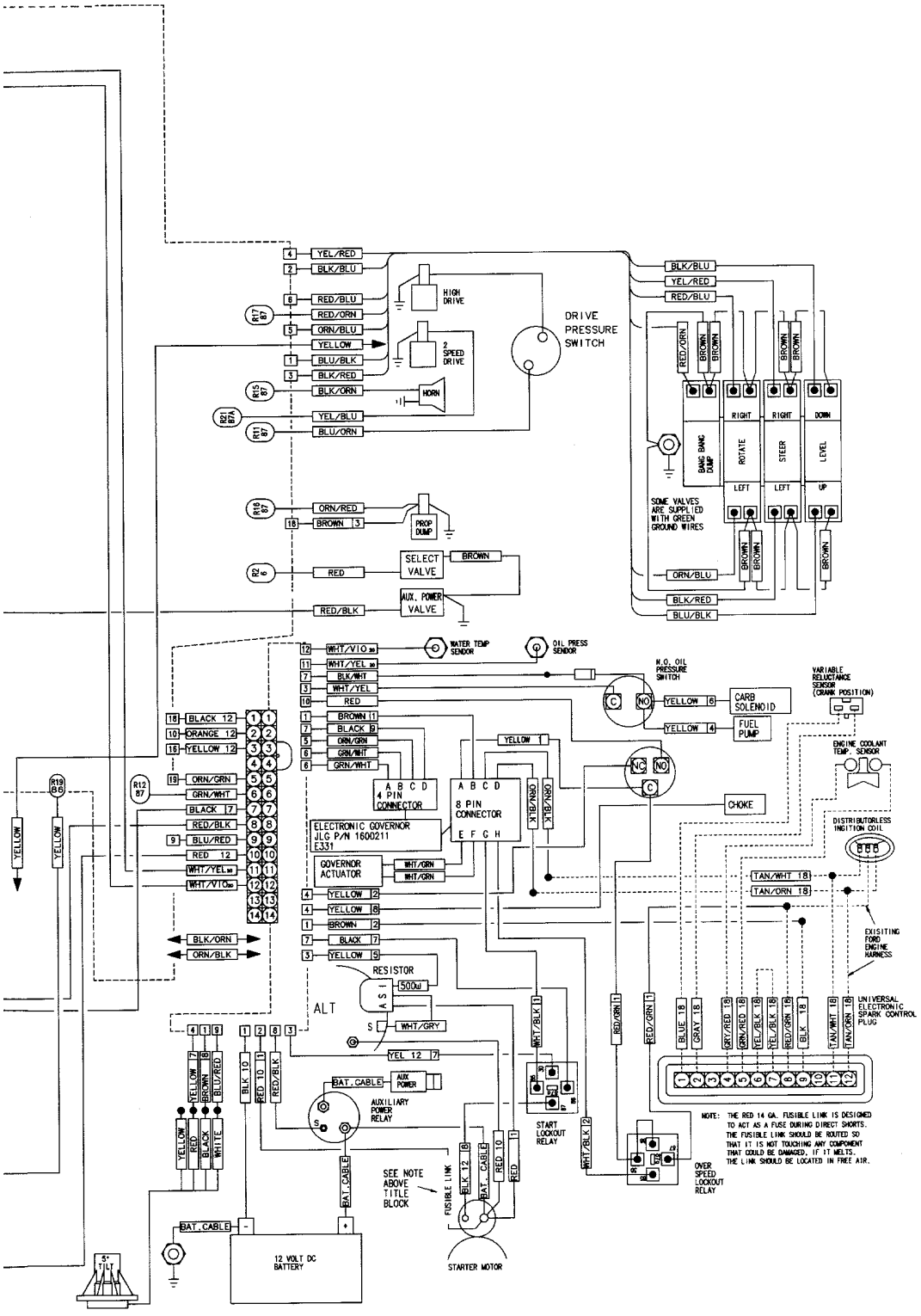

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Figure 6-18. Wiring Diagram - Standard (Ford Engine/Hydraulic Controls)(Sheet 2 of 2)

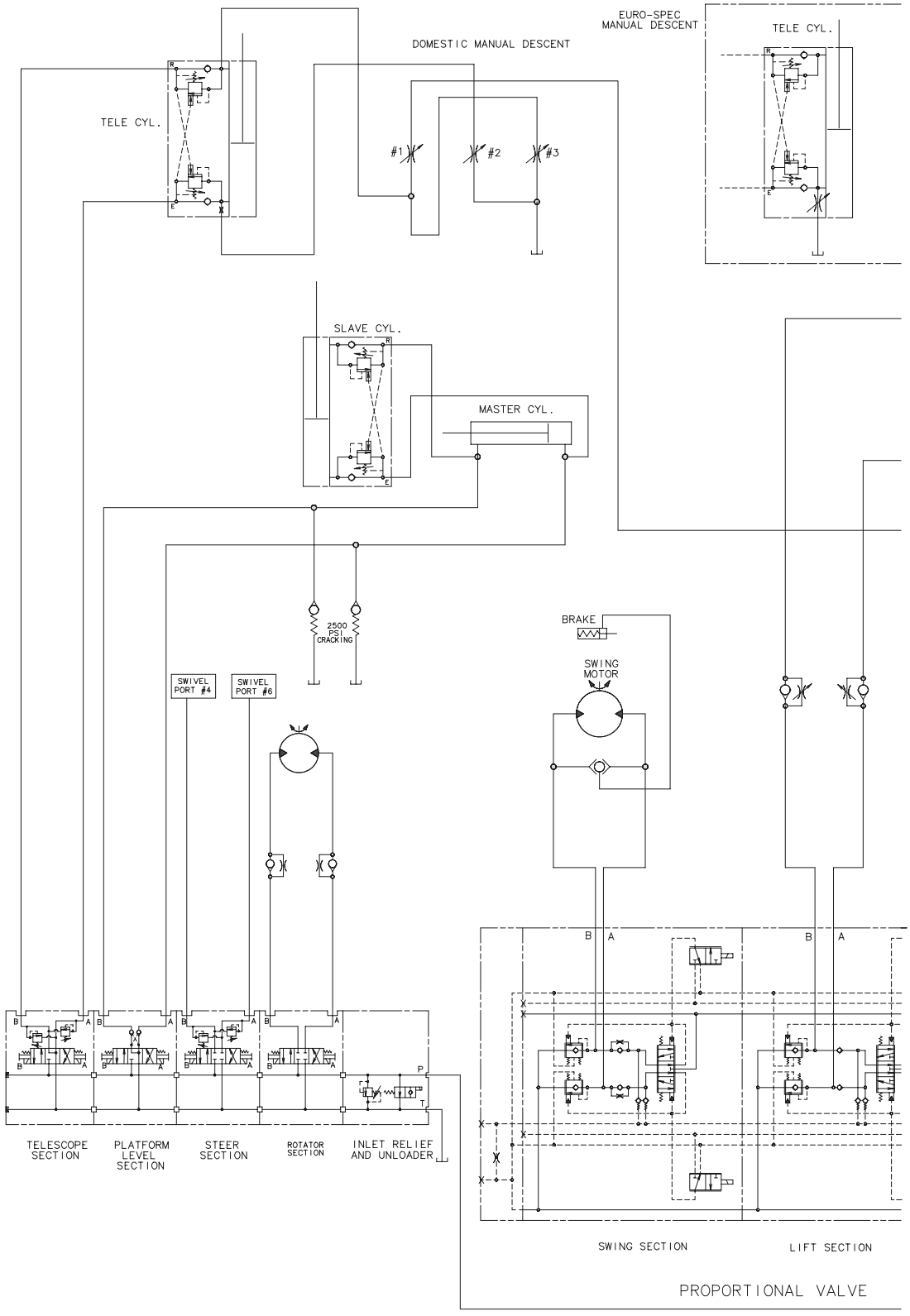

Figure 6-19. Hydraulic Schematic (Sheet 1 of 6)

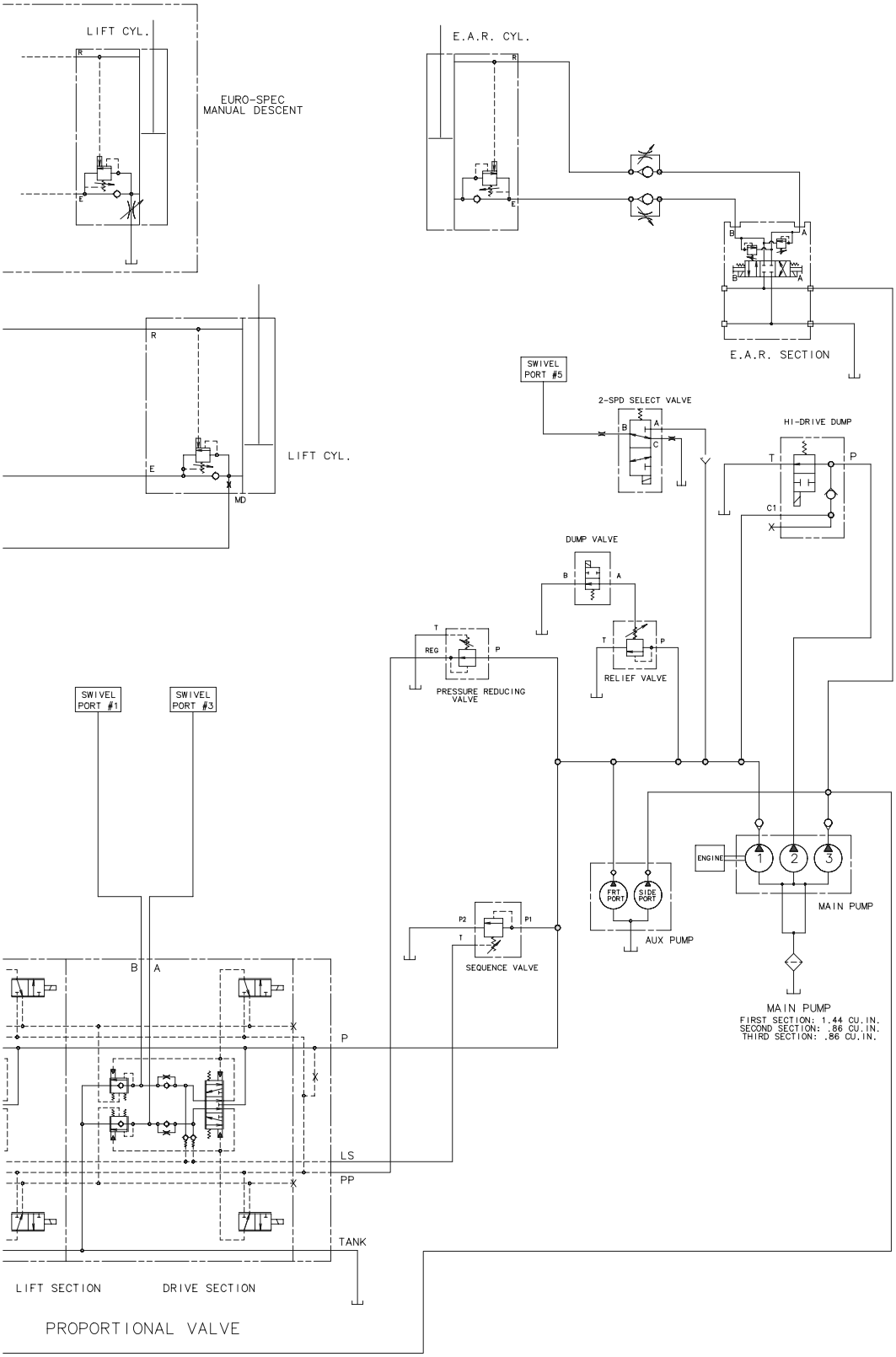

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Figure 6-20. Hydraulic Schematic (Sheet 2 of 6)

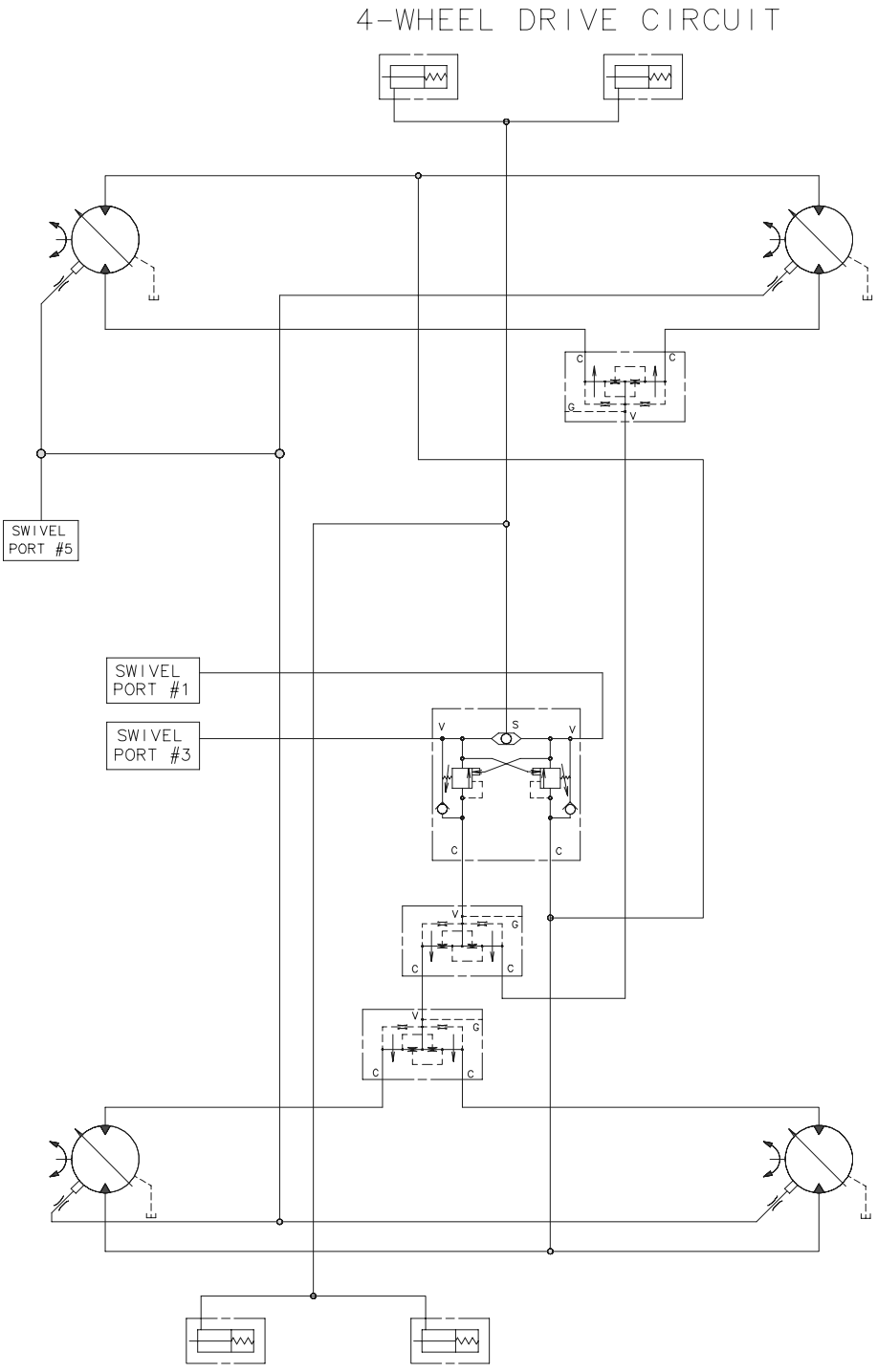

Figure 6-21. Hydraulic Schematic (Sheet 3 of 6)

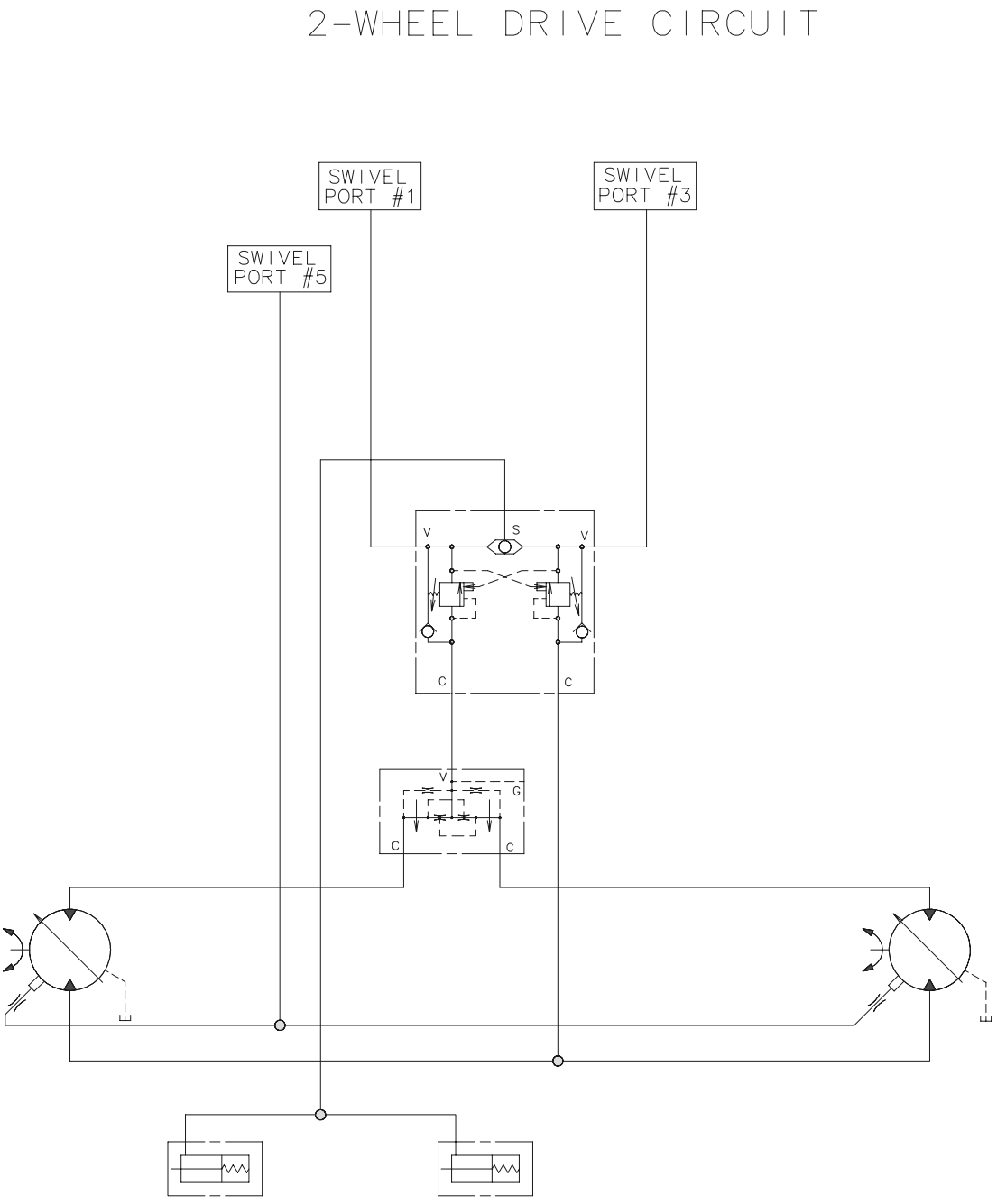

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Figure 6-22. Hydraulic Schematic (Sheet 4 of 6)

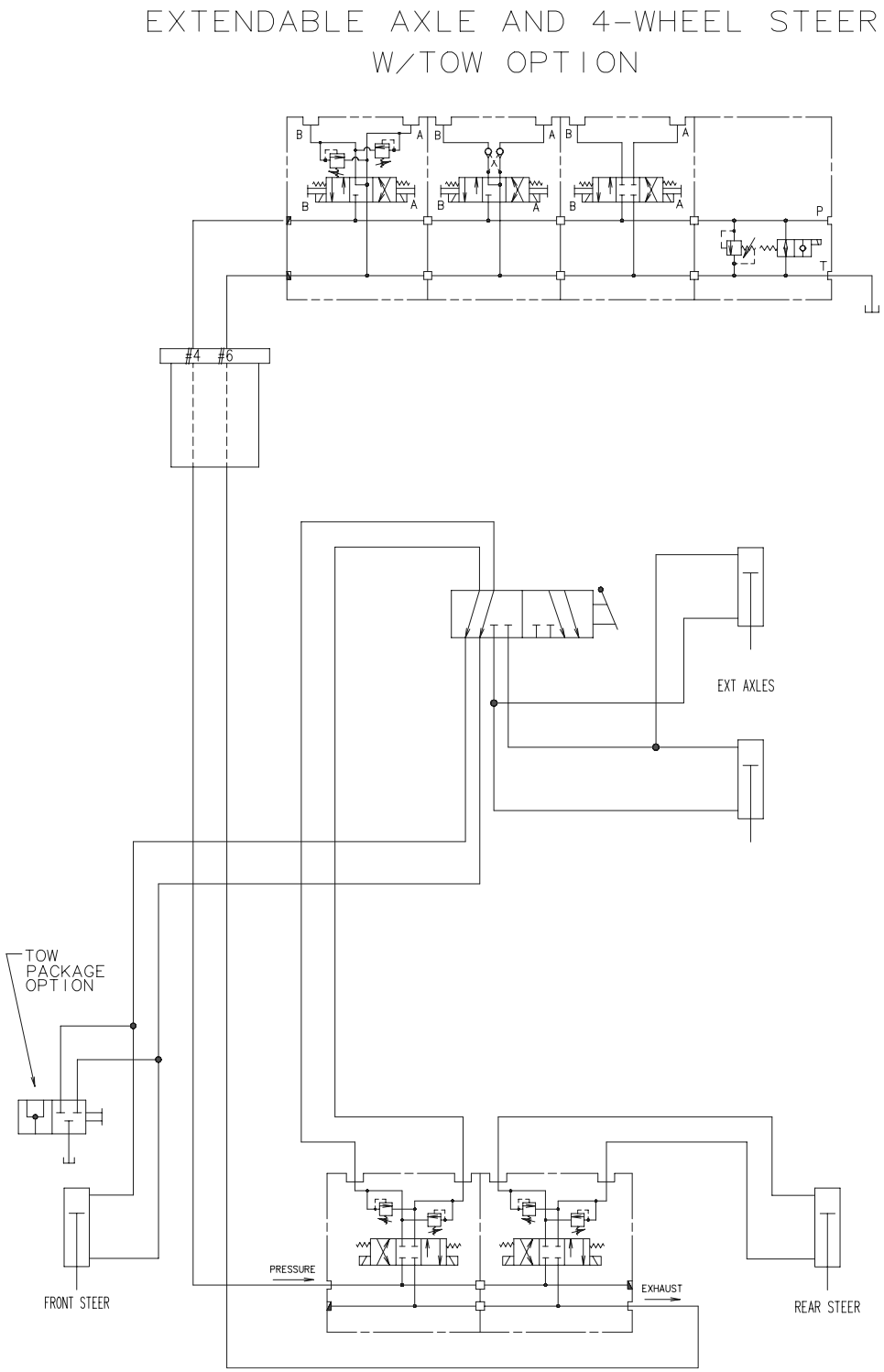

Figure 6-23. Hydraulic Schematic (Sheet 5 of 6)

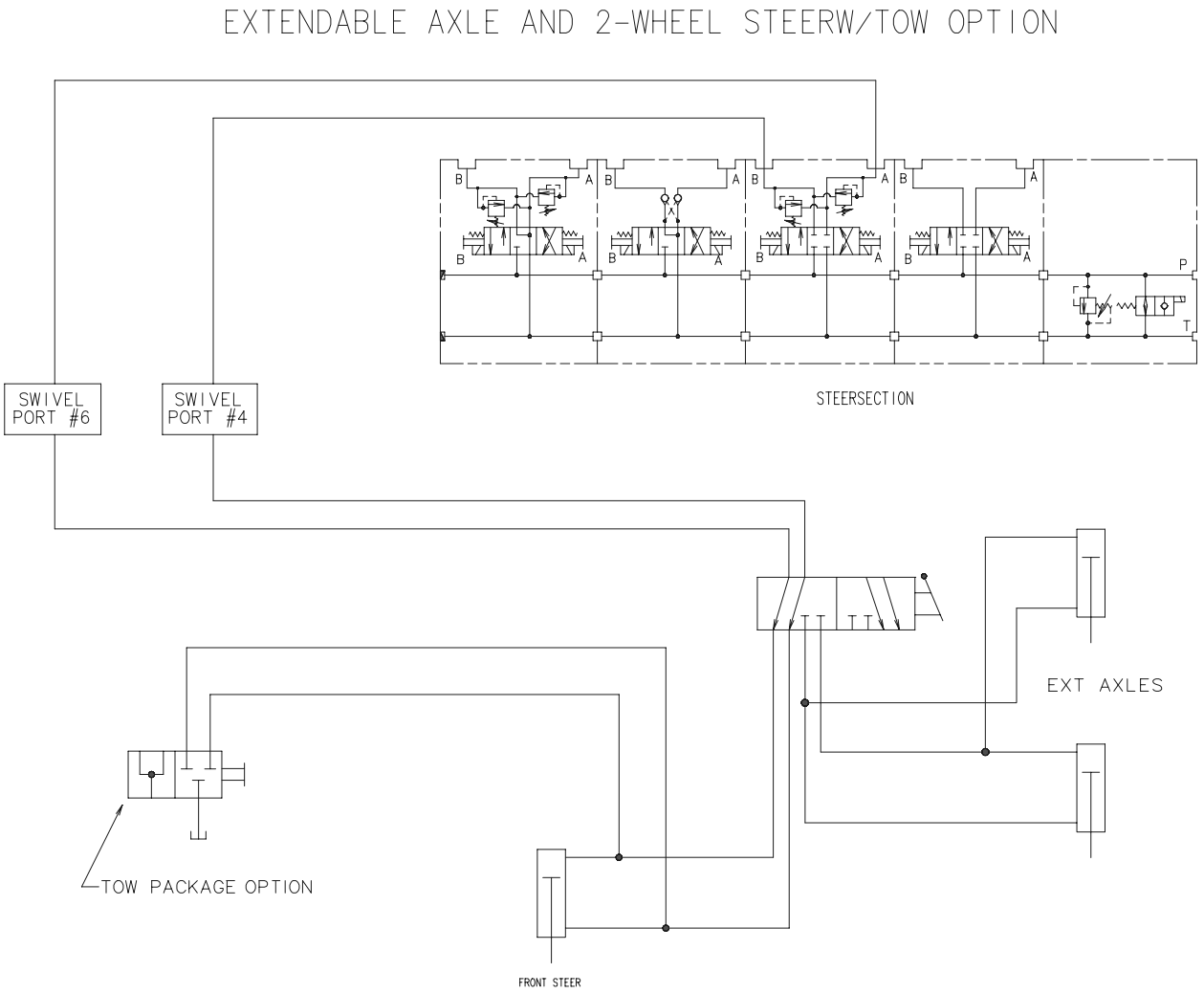

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Figure 6-24. Hydraulic Schematic (Sheet 6 of 6)

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