

SERVICE & MAINTENANCE

Model 80HX 80HX+6 80HXER

3120863

May 14, 2002



AUSTRALIAN OFFICE

JLG INDUSTRIES, INC.
P.O. Box 5119
11 Bolwarra Road
Port Macquarie, Australia
Telephone: 065 811111
Fax: 065 810122

EUROPEAN OFFICE

JLG INDUSTRIES (EUROPE)
Kilmarting Place,
Tannochside Park
Uddingston, Scotland, G71 5PH
Telephone: 01698 811005
Main Fax: 01698 811055
Parts Fax: 01698 811455

CORPORATE OFFICE

JLG INDUSTRIES, INC.
1 JLG Drive
McConnellsburg, PA.
17233-9533
USA
Telephone: (717) 485-5161
Fax: (717) 485-6417

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.

REVISION LOG

October, 1997	- Original Issue
March 1, 1999	- Revised
September 7, 2000	- Revised
May 14, 2002	- Revised

TABLE OF CONTENTS

SUBJECT - SECTION, PARAGRAPH	PAGE NO.
SECTION A - INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS	
A General	A-1
B Hydraulic System Safety	A-1
C Maintenance	A-1
SECTION 1 - SPECIFICATIONS	
1.1 Capacities	1-1
1.2 Component Data	1-1
Engine - Deutz F4L912	1-1
Tires	1-1
Drive Motor Displacement Machines Built Prior to Jan. 1992	1-1
Drive Motor Displacement Machines Built from Jan. 1992 to Present	1-1
Drive Hub Ratios	1-1
Steer System	1-1
Swing System	1-1
Hydraulic Pump	1-2
Auxiliary Power Pump	1-2
Hydraulic Filter - Tank	1-2
Hydraulic Filter - Inline (Racine Valve Only)	1-2
1.3 Performance Data	1-2
Travel Speed	1-2
Gradeability	1-2
Turning Radius (Outside)	1-2
Boom Speed (Telescope)	1-2
Boom Speed (Lift)	1-2
Swing Speed 360°	1-2
Boom Elevation	1-2
Machine Weight	1-2
Machine Stowed Height	1-2
Machine Stowed Length	1-2
Machine Width	1-2
Maximum Tire Load	1-4
Wheelbase	1-4
1.4 Torque Requirements	1-4
1.5 Lubrication	1-4
Deutz Engine	1-4
Lubrication Specifications	1-5
1.6 Pressure Settings	1-10
80 HX	1-10
80HX w/Hydraulic Controls	1-10
80HX w/Oscillating Axle	1-10
1.7 Major Components Weights	1-11
1.8 Cylinder Specifications	1-11
1.9 Boom Tape	1-11
1.10 Critical Stability Weights	1-11
1.11 Serial Number Location	1-12
SECTION 2 - PROCEDURES	
2.1 General	2-1
2.2 Servicing and Maintenance Guidelines	2-1
General	2-1
Safety and Workmanship	2-1
Cleanliness	2-1
Components Removal and Installation	2-1

TABLE OF CONTENTS (continued)

SUBJECT - SECTION, PARAGRAPH	PAGE NO.
Component Disassembly and Reassembly	2-1
Pressure-Fit Parts	2-1
Bearings	2-2
Gaskets	2-2
Bolt Usage and Torque Application	2-2
Hydraulic Lines and Electrical Wiring	2-2
Hydraulic System	2-2
Lubrication	2-2
Battery	2-2
Lubrication and Servicing	2-2
2.3 Lubrication Information	2-2
Hydraulic System	2-2
Hydraulic Oil	2-3
Changing Hydraulic Oil	2-3
Lubrication Specifications	2-3
2.4 Cylinders - Theory Of Operation	2-4
Double Acting Cylinders	2-4
2.5 Valves - Theory Of Operation	2-4
Holding Valves	2-4
Solenoid Control Valves (Bang-Bang)	2-4
Proportional Control Valve - Vickers (See Figure 2-1)	2-4
Main Relief Valves	2-4
Relief Valves	2-4
2.6 Boom Chains (See Figure 2-2.)	2-6
Adjusting Procedures	2-6
Inspection Procedures	2-7
Auxiliary Boom Chains	2-8
2.7 Wear Pads	2-9
2.8 Cylinder Checking Procedure	2-9
Cylinders Without Counterbalance Valves - Steer Cylinder and Master Cylinder	2-9
Cylinders With Single Counterbalance Valve - Lift Cylinder, Telescope Cylinder and Extend- A-Reach Lift Cylinder	2-10
Cylinders With Dual Counterbalance Valves - Platform Slave Level Cylinder, Lockout Cylinder and Extend-A-Reach Level Cylinder	2-10
2.9 Cylinder Repair	2-11
Disassembly	2-11
Cleaning and Inspection	2-16
Assembly	2-17
2.10 Cylinder Removal and Installation	2-19
Telescope Cylinder Removal	2-19
Telescope Cylinder Installation	2-20
Boom Lift Cylinder Removal	2-20
Boom Lift Cylinder Installation	2-21
2.11 Telescope Cylinder Eccentric Bushing	2-21
2.12 Boom Maintenance	2-21
Removal	2-21
Disassembly	2-24
Inspection	2-25
Assembly	2-26
Installation	2-28
2.13 Tilt Alarm Switch	2-28
Manual Adjustment	2-28
Voltmeter Adjustment	2-29
2.14 Limit Switch Adjustments	2-29

TABLE OF CONTENTS (continued)

SUBJECT - SECTION, PARAGRAPH	PAGE NO.
Boom Limit Switch	2-29
Horizontal Cut-Out Switch	2-29
Drive Cut-Out Switch - Dutch Specifications	2-29
2.15 Throttle Checks and Adjustments - Deutz Engine (See Figure 2-16.)	2-30
2.16 Pressure Setting Procedures	2-32
2.17 Racine Proportional Air Gap Adjustment	2-32
2.18 Swing Bearing	2-44
Turntable Bearing Mounting Bolt Condition Check	2-44
Wear Tolerance	2-45
Swing Bearing Torque Values	2-45
2.19 Torque Hub (See Figure 2-33.)	2-47
Disassembly	2-47
Cleaning and Inspection	2-47
Repair	2-49
Input Shaft Assembly	2-51
Assembly	2-51
2.20 Drive Brake, Ausco - Machines Built Prior to 1992	2-55
Disassembly	2-55
Cleaning and Inspection	2-57
Assembly	2-57
2.21 Drive Brake, Mico - Machines Built From 1992 to Present	2-57
Disassembly	2-57
Inspection	2-59
Assembly	2-59
2.22 Controllers	2-60
PQ	2-60
OEM	2-60
VICKERS (All Hydraulic)	2-60
2.23 Oscillating Axle Bleeding Procedure	2-60
Lockout Cylinder Bleeding (Without Holding Valves)	2-60
Lockout Cylinder Bleeding (With Holding Valves)	2-60
2.24 Oscillating Axle Lockout Test	2-61
2.25 Basket Rotator Brake	2-61
2.26 Free Wheeling Option	2-62
To Disengage Drive Motors and Brakes (Free Wheel) for Towing, etc.	2-62
To Engage Drive Motors and Brakes (Normal Operation)	2-62
2.27 Spark Arrestor Mufflers	2-62
2.28 Footswitch Adjustment	2-62
2.29 Hydraulic Pump W/Hayes Pump Drive Coupling Lubrication	2-62
2.30 Dual Fuel System	2-62
Changing from gasoline to LP-Gas	2-62
Changing from LP Gas to Gasoline	2-62
2.31 Preventive Maintenance and Inspection Schedule	2-63
2.32 Capacity Indicator	2-66
Capacity Indicator Cable Adjustment	2-66
Capacity Indicator Boom Tape Replacement	2-66
Installation Procedure	2-66
Capacity Indicator Dial Decal Replacement	2-66
Indicator Decal Installation	2-66
SECTION 3 - TROUBLESHOOTING	
3.1 General	3-1
3.2 Troubleshooting Information	3-1
3.3 Hydraulic Circuit Checks	3-1

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1-1.	Torque Chart	1-3
1-2.	Lubrication Diagram	1-6
1-3.	Serial Number Locations	1-12
2-1.	Proportional Control Valve	2-5
2-2.	Typical Boom Assembly	2-6
2-3.	Boom Positioning and Support - Cylinder Repair	2-9
2-4.	Cylinder Barrel Support	2-11
2-5.	Typical Hydraulic Cylinders (Sheet 1 of 4)	2-12
2-6.	Typical Hydraulic Cylinders (Sheet 2 of 4)	2-13
2-7.	Typical Hydraulic Cylinders (Sheet 3 of 4)	2-14
2-8.	Typical Hydraulic Cylinders (Sheet 4 of 4)	2-15
2-9.	Cylinder Rod Support	2-16
2-10.	Poly-Pak Seal Installation	2-17
2-11.	Telescope Cylinder Eccentric Bushing	2-21
2-12.	Boom Assembly (Sheet 1 of 2)	2-22
2-13.	Boom Assembly (Sheet 2 of 2)	2-23
2-14.	Tilt Switch Adjustment	2-28
2-15.	Tilt Switch Adjustment - Voltmeter	2-29
2-16.	Adeco Actuator Adjustments - F4L912	2-31
2-17.	Racine Proportional Air Gap Adjustment, Machines Built Prior to Mid 1987	2-32
2-18.	Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 1 of 4)	2-33
2-19.	Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 2 of 4)	2-34
2-20.	Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 3 of 4)	2-35
2-21.	Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 4 of 4)	2-36
2-22.	Pressure Setting - All Hydraulic Machines (Sheet 1 of 4)	2-37
2-23.	Pressure Setting - All Hydraulic Machines (Sheet 2 of 4)	2-38
2-24.	Pressure Setting - All Hydraulic Machines (Sheet 3 of 4)	2-39
2-25.	Pressure Setting - All Hydraulic Machines (Sheet 4 of 4)	2-40
2-26.	Solenoid Valve Pressure Settings - Machines Built to Present	2-41
2-27.	Solenoid Valve Pressure Settings - 4 Wheel Steer	2-42
2-28.	Extend-A-Reach Valve Pressure and Speed Settings	2-43
2-29.	Swing Bearing Tolerance Boom Placement	2-44
2-30.	Swing Bearing Bolt Feeler Gauge Check	2-44
2-31.	Swing Bearing Tolerance Measuring Point	2-45
2-32.	Swing Bearing Torquing Sequence	2-46
2-33.	Torque Hub Assembly	2-48
2-34.	Drive Brake, Ausco - Machines Built Prior to 1992	2-56
2-35.	Drive Brake, Mico - Machines Built from 1992 to Present	2-58
2-36.	Spring Loading	2-59
2-37.	Belleville Washers	2-61
2-38.	Boom Tape Replacement	2-66
2-39.	Capacity indicator Dial	2-66
3-1.	Wiring Schematic (Sheet 1 of 4)	3-20
3-2.	Wiring Schematic (Sheet 2 of 4)	3-21
3-3.	Wiring Schematic (Sheet 3 of 4)	3-22
3-4.	Wiring Schematic (Sheet 4 of 4)	3-23
3-5.	Hydraulic Schematic (Sheet 1 of 6)	3-24
3-6.	Hydraulic Schematic (Sheet 2 of 6)	3-25
3-7.	Hydraulic Schematic (Sheet 3 of 6)	3-26
3-8.	Hydraulic Schematic (Sheet 4 of 6)	3-27
3-9.	Hydraulic Schematic (Sheet 5 of 6)	3-28
3-10.	Hydraulic Schematic (Sheet 6 of 6)	3-29

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1-1	Torque Requirements	1-4
1-2	Hydraulic Oil	1-4
1-3	Mobil EAL 224 H Specs	1-5
1-4	Mobil DTE 13M Specs	1-5
1-5	Lubrication Specifications	1-5
1-6	Lubrication Chart	1-7
1-7	Major Component Weights	1-11
1-8	Cylinder Specifications	1-11
1-9	Critical Stability Weights	1-11
2-1	Chain Stretch Tolerance	2-8
2-2	Cylinder Piston Nut Torque Specifications	2-19
2-3	Holding Valve Torque Specification	2-19
2-4	Preventive Maintenance and Inspection Schedule	2-64
3-1	Platform Assembly - Troubleshooting	3-2
3-2	Boom Assembly - Troubleshooting	3-3
3-3	Turntable Assembly - Troubleshooting	3-8
3-4	Chassis Assembly - Troubleshooting	3-9
3-5	Hydraulic System - Troubleshooting	3-15
3-6	Electrical System - Troubleshooting	3-18

THIS PAGE LEFT BLANK INTENTIONALLY.

SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Fuel Tank - 98 L.

Hydraulic Oil Tank - 208 L.

Hydraulic System (Including Tank) - Approx. 250 L

Torque Hub, Drive - 1.3 L.

Torque Hub, Swing - 0.5 L.

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

Engine Crankcase (Ford LSG & LRG 423) w/Filter - 4.7 L.

Engine Crankcase (Deutz F4L912) w/Filter - 9 L.

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

1.2 COMPONENT DATA

Engine - Deutz F4L912

Oil Capacity - 9 L w/Filter, 8 L w/o Filter.

Low RPM 1800.

High RPM 2400.

Alternator - 60 Amp, belt drive.

Battery - 85 Amphour, 550 CCA, 12 VDC.

Horsepower - 70 @ 2400 RPM, no load

Tires

Foam-Filled Tires - 15 x 19.5

Drive Motor Displacement Machines Built Prior to Jan. 1992

Cessna - 82.6 cc/rev.

Vickers - 41cc/rev.

2 Speed Cessna - 40.6 cc/rev.

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

Drive Motor Displacement Machines Built from Jan. 1992 to Present

Rexroth - 46 cc/rev.

Drive Hub Ratios

2WD/2WS with fixed or oscillating front axle - 24:1.

2WD/4WS with oscillating front axle - 24:1.

4WD - 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 6.35 mm overall.

Swing System

Swing Motor - Displacement - 74 cc/Rev.

Swing Hub - Ratio - 69.50:1.

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

SECTION 1 - SPECIFICATIONS

Hydraulic Pump

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

First Section to Proportional Valve-Drive, Lift, Swing - 91 LPM.

Second Section to High Drive - 91 LPM.

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 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 - 72 LPM.

Second Section to High Drive - 72 LPM.

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 36 LPM.

Clockwise Rotation.

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

First Section to Proportional Valve-Drive, Lift, Swing - 72 LPM.

Second Section to High Drive - 55 LPM.

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 36 LPM.

Clockwise Rotation.

Machines with Vickers Valves.

First Section to Proportional Valve-Drive, Lift, Swing - 57 LPM.

Second Section to High Drive - 34 LPM.

Third Section to Bang-Bang Valve Level, Telescope, Steer, Rotate - 34 LPM.

Clockwise Rotation.

Auxiliary Power Pump

Two section, 14.2 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

5.6 KM/HR.

Gradeability

25%.

Turning Radius (Outside)

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. 14,424 KG.

80HX+6 - approx. 16,738 KG.

Machine Stowed Height

2.9 M

Machine Stowed Length

80HX - 10.2 M

80HX+6 - 11.2 M

Machine Width

With axles retracted - 2.4 m

With axles extended - 3 m

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

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



SAE GRADE 5



SAE GRADE 8

Figure 1-1. Torque Chart

SECTION 1 - SPECIFICATIONS

Maximum Tire Load

80HX - 7037 kg @ 7.2 kg/cm²

80HX + 6 - 8299 kg @ 7.5 kg/cm²

Wheelbase

3 m

1.4 TORQUE REQUIREMENTS

Table 1-1. Torque Requirements

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

* 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

Deutz Engine

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

When Outside Temp is Consistently	Use SAE Viscosity Number
-29° C - -4° C.	*10W
-9.5° C - +10° C.	20W-20
+4.5° C - +29.5° C.	30
Above 24° C.	40

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

When Outside Temp is Consistently	Use SAE Viscosity Number
-40° C - +24° C.	*5W-20
-20.5° C - +21° C.	(Synthetic) 10W-30
-20.5° C - +29.5° C.	10W-40
-9.5° C - +24° C.	15W-30
Above +9.5° C.	15W-40

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

Table 1-2. 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 1-3. 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 1-4. 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 1-5. 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.

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

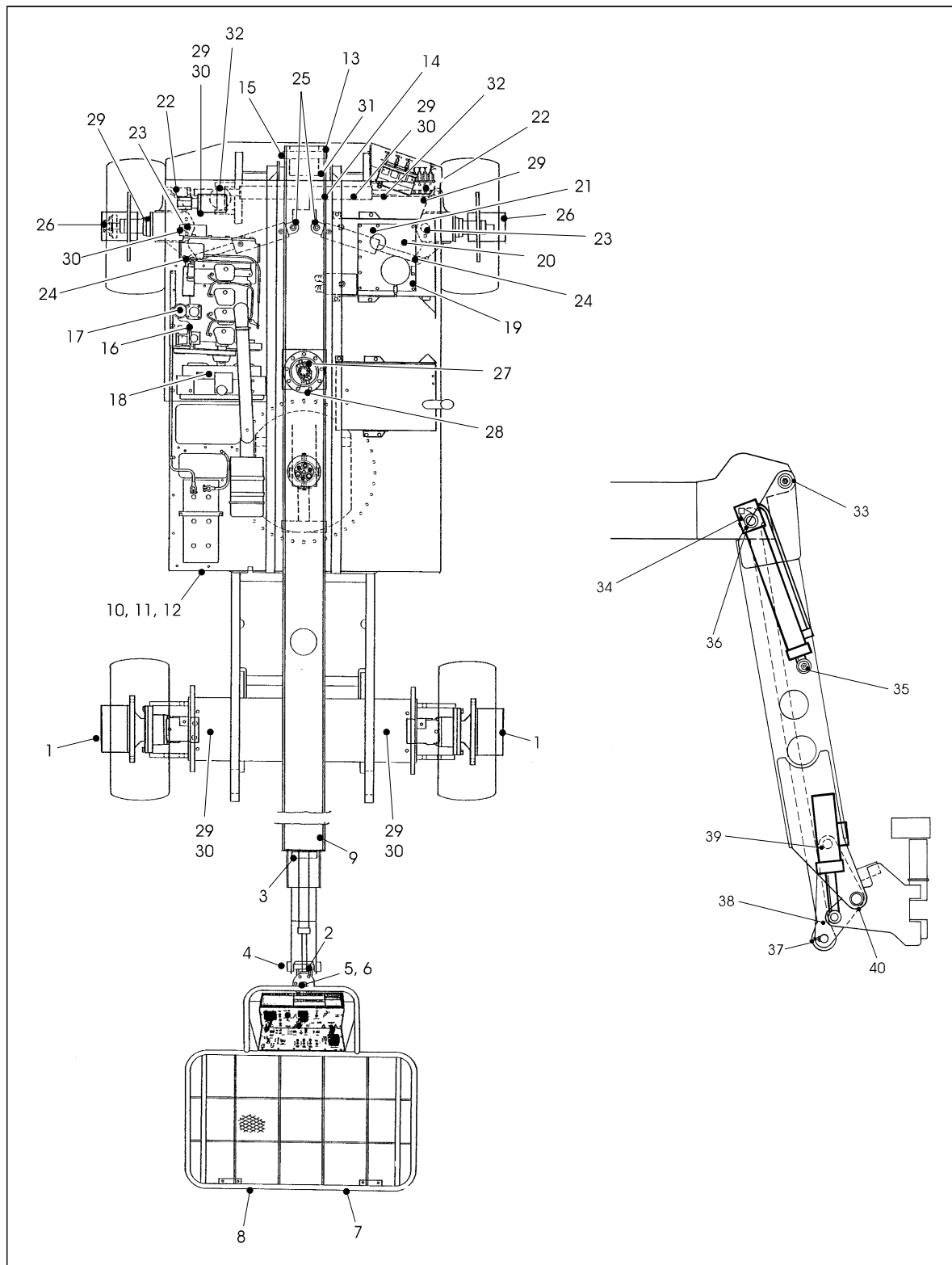
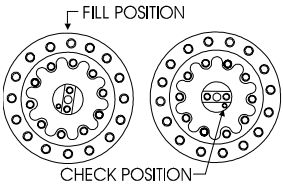
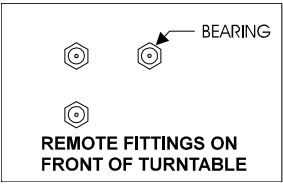
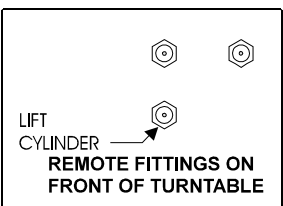
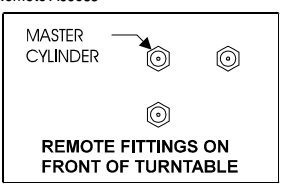


Figure 1-2. Lubrication Diagram

Table 1-6. 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	1.3 L. (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				

SECTION 1 - SPECIFICATIONS

Table 1-6. Lubrication Chart

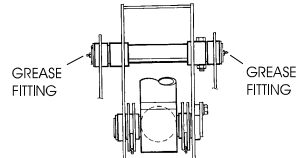
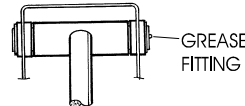
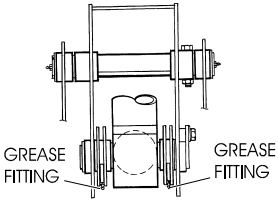
	Components	Number/Type Lube Points	Capacity	Lube	Interval		Hours		Comments
					3 Months 150 hrs	6 Months 300 hrs	1 Year 600 hrs	2 Years 1200 hrs	
14	Boom Chain Retract Sheave	1 Grease Fitting	A/R	MPG	X				
15	Boom Pivot Bushings	2 Grease Fittings	A/R	MoS ₂	X				
16	Engine Crankcase	Fill Cap	Refer to 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	0.5L. (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				
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				

Table 1-6. 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	
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 EPGL HO MPG	Engine Oil Extreme Pressure Gear Lube Hydraulic Fluid (Mobil #424 or equivalent) Multi-Purpose Grease	

SECTION 1 - SPECIFICATIONS

1.6 PRESSURE SETTINGS

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

80 HX

Proportional Relief - Standard 220 Bar;
Prop. Tele 265 Bar.

Sequence (Load Sense) - 31 Bar.

Pressure Reducing (Pilot Press) - 38 Bar.

Drive - 214 Bar; Prop. Tele. 259 Bar.

Lift Up - 207 Bar.

Lift Down - 103 Bar

Swing - 103 Bar.

Telescope In - 207 Bar; Prop. Tele 259 Bar.

Tele Out - 103 Bar.

Solenoid Main Relief - 214 Bar.

2 Wheel Steer - 138 Bar; w/axle lift cyl. - 152 Bar

2 Wheel Steer w/4WD - 138 Bar; w/axle lift cyl. 152 Bar.

4 Wheel Steer - 138 Bar w/axle lift cyl. - 152 Bar.

Extend-A-Reach Up - 172 Bar.

Extend-A-Reach Down - 76 Bar.

80HX w/Hydraulic Controls

Proportional Relief - Standard 220 Bar;
Prop. Tele 265 Bar.

Sequence (Load Sense) - 28 to 41 Bar.

Pressure Reducing (Pilot Press) - 41 Bar.

Hyd. Controls Back Pressure - Relief 8.6 Bar;
Press. Red. 5.5 to 8.2 Bar

Drive - 214 Bar; Prop. Tele. 259 Bar.

Lift Up - 207 Bar.

Lift Down - 103 Bar

Swing - 103 Bar.

Telescope In - 207 Bar; Prop. Tele 259 Bar.

Tele Out - 103 Bar.

Solenoid Main Relief - 214 Bar

2 Wheel Steer - 138 Bar; w/axle lift cyl.- 152 Bar

2 Wheel Steer w/4WD - 138 Bar; w/axle lift cyl.- 152 Bar.

4 Wheel Steer - 138 Bar; w/axle lift cyl. - 152 Bar.

Extend-A-Reach Up - 172 Bar.

Extend-A-Reach Down - 76 Bar.

80HX w/Oscillating Axle

Proportional Relief - Standard 220 Bar;
Prop. Tele 265 Bar.

Sequence (Load Sense) - 31 Bar.

Pressure Reducing (Pilot Press) - 38 Bar).

Drive - 214 Bar; Prop. Tele. 259 Bar.

Lift Up - 207 Bar.

Lift Down - 103 Bar

Swing - 103 Bar.

Telescope In - 207 Bar Prop. Tele 259 Bar.

Tele Out - 103 Bar.

Solenoid Main Relief - 214 Bar

2 Wheel Steer - 103 Bar

2 Wheel Steer w/4WD - 103 Bar.

4 Wheel Steer; Axle Lift Cyl. - 152 Bar.

Extend-A-Reach Up - 172 Bar

Extend-A-Reach Down - 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	63.5 mm	387 mm	31.75 mm
Slave Level	63.5 mm	387 mm	31.75 mm
Lift	203 mm	781 mm	89 mm
Lockout (Oscillating Axle)	102 mm	124 mm	31.75 mm
Lockout (4WD)	102 mm	108 mm	31.75 mm
Telescope	89 mm	6551 mm	63.5 mm
Steer (2WD)	76 mm	205 mm	31.75 mm
Steer (4WD)	76 mm	249 mm	38 mm
Extend-A-Reach			
Lift	76 mm	322 mm	51 mm
Slave	89 mm	184 mm	44.5 mm

1.9 BOOM TAPE

Red - 99 cm.

Yellow - 86.4 cm.

Blue - 492.5 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.

ble 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.

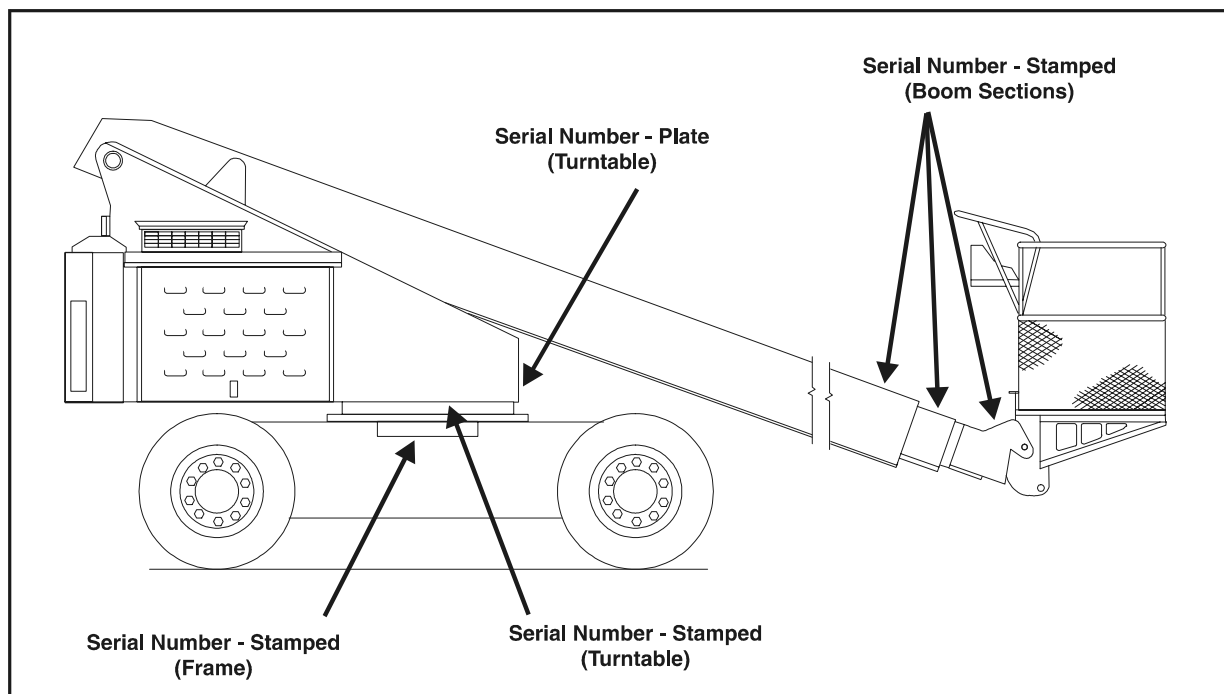


Figure 1-3. Serial Number Locations

SECTION 2. PROCEDURES

2.1 GENERAL

This section provides information necessary to perform maintenance on the aerial platform. Descriptions, techniques and specific procedures are designed to provide the safest and most efficient maintenance for use by personnel responsible for ensuring the correct installation and operation of machine components and systems.

CAUTION

WHEN AN ABNORMAL CONDITION IS NOTED AND PROCEDURES CONTAINED HEREIN DO NOT SPECIFICALLY RELATE TO THE NOTED IRREGULARITY, WORK SHOULD BE STOPPED AND TECHNICALLY QUALIFIED GUIDANCE OBTAINED BEFORE WORK IS RESUMED.

The maintenance procedures included consist of servicing and component removal and installation, disassembly and assembly, inspection, lubrication and cleaning. Information on any special tools or test equipment is also provided where applicable.

2.2 SERVICING AND MAINTENANCE GUIDELINES

General

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

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 eye-bolt 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 the Torque Chart in 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 Section 1.

2.3 LUBRICATION 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 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-20 and a viscosity index of 152, or BP Energol SHS46.

NOTE: *Start-up of hydraulic system with oil temperatures below -26° C (-15° F) 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 -26° C (-15° F).*

3. The only exception to the above is to drain and fill the system with Mobil DTE 11 oil or its equivalent. This will allow start up at temperatures down to -29° C (-20°F). However, use of this oil will give poor performance at temperatures above 49° C (120° F). Systems using DTE 11 oil should not be operated at temperatures above 93° C (200°F) under any condition.

Changing Hydraulic Oil

1. Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 40 hours of operation and every 250 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 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.

2.5 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 2-1)

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.

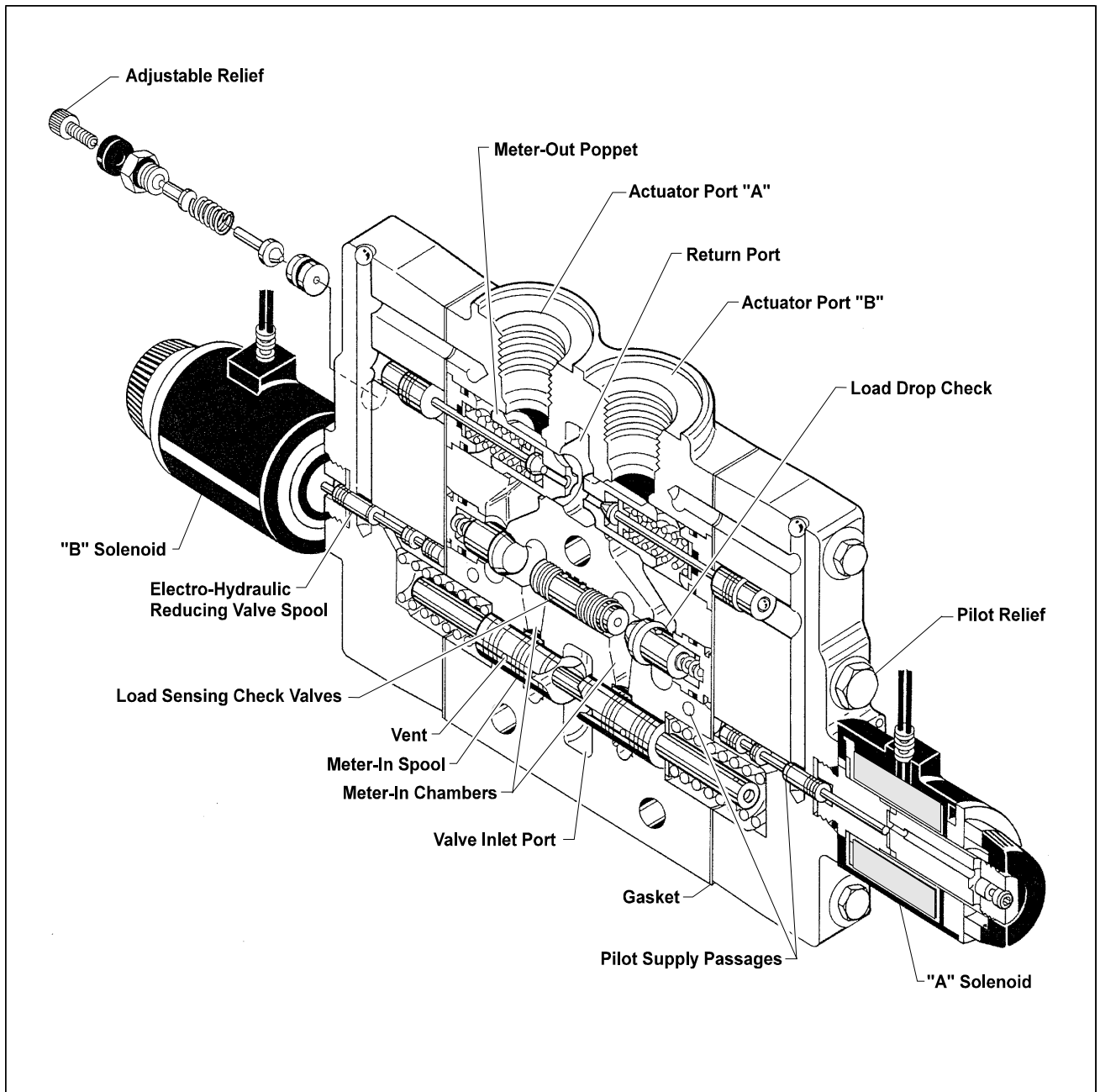


Figure 2-1. Proportional Control Valve

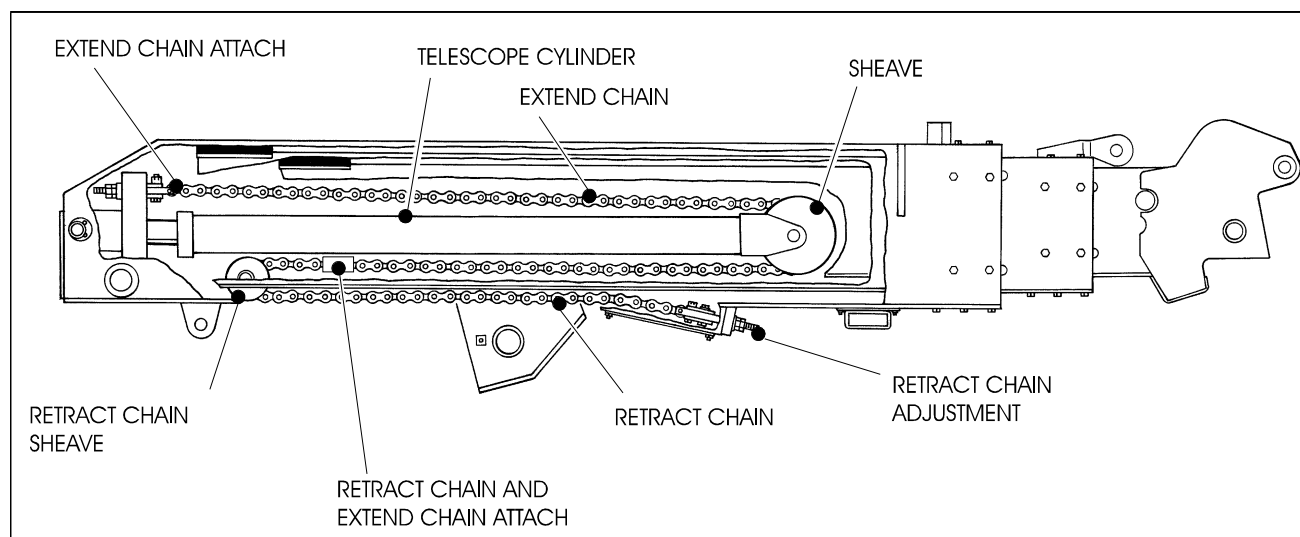


Figure 2-2. Typical Boom Assembly

2.6 BOOM CHAINS (SEE FIGURE 2-2.)

Adjusting Procedures

⚠ WARNING

ENSURE THE MACHINE IS ON A FIRM AND LEVEL SURFACE.

1. Fully retract the boom in the horizontal position ($\pm 5^\circ$) with no load in the platform.
2. Extend the platform approximately 1 meter (3 ft.).
3. Torque the boom retract chain adjuster to 69 NM (50 ft. lbs.), then torque the boom extend chain adjuster to 69 NM (50 ft. lbs.).
4. Retract the platform approximately 0.3 m (1 ft.).
5. Check the boom extend chain adjusters (69 NM {50 ft. lbs.} required).
6. Retract the platform approximately 0.3 m (1 ft.) once again.
7. Recheck the extend chain adjusters (69 NM {50 ft. lbs.} required).
8. Extend the platform approximately 0.3 m (1 ft.). Check for proper operation of boom.
9. Recheck the retract chain adjuster torque. (69 NM {50 ft. lbs.} 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 2.12, 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.

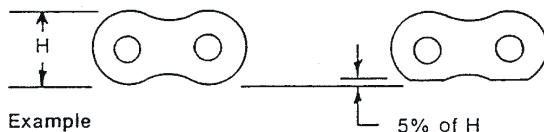
⚠ WARNING

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:

1. **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"

2. **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.

3. **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.
4. **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.



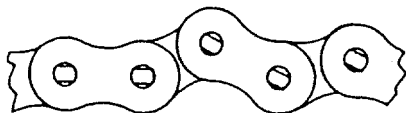
5. **Tight Joints:** All joints in the roller chain should flex freely. On roller chain, tight joints are usually caused by rust/corrosion, or the inside plates "walking" off the bushing. Limber up rusty/corroded chains (after inspecting care fully) with a heavy application of oil (preferably a hot oil 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:

1. Bent pins or plates.
2. Rusty joints.
3. Peened plate edges.

SECTION 2 - PROCEDURES

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

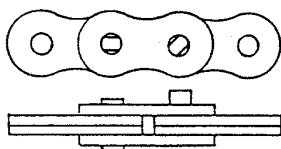
TIGHT JOINTS



6. **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.

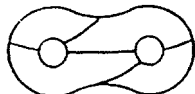
7. **Stress Corrosion Cracking:** The outside link plates, which are heavily press-fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (aperture) but tend to extend in an arc-like path, often parallel to the rolling grain of the material.

ABNORMAL PROTRUSION OR TURNED PINS



Also, more than 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.

8. **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 2-1. Chain Stretch Tolerance

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

Auxiliary Boom Chains

The auxiliary boom chains are used as a safety device, to prevent the boom from retracting in the event that an extend chain should break. As the boom would begin to retract, tension would be placed on the auxiliary chain, stopping the boom and tripping a limit switch to shut down the machine.

The auxiliary boom chain is located on top of the boom. One end of the chain is attached to an adjustable clevis on top of the front end of the base section, and uses belleville washers and adjusting nuts to adjust chain tension. The other end of the chain is attached to a fixed clevis on top of the fly section. A limit switch is installed adjacent to the adjustable clevis on the base section, and when tripped, shuts down the machine. Adjust chain tension so there is no slack in the chain and set the cam on the switch so the switch trips when the belleville washers compress 1 to 1.3 cm.

⚠ WARNING

REPLACE THE BELLEVILLE WASHERS ONCE THEY HAVE BEEN COMPRESSED.

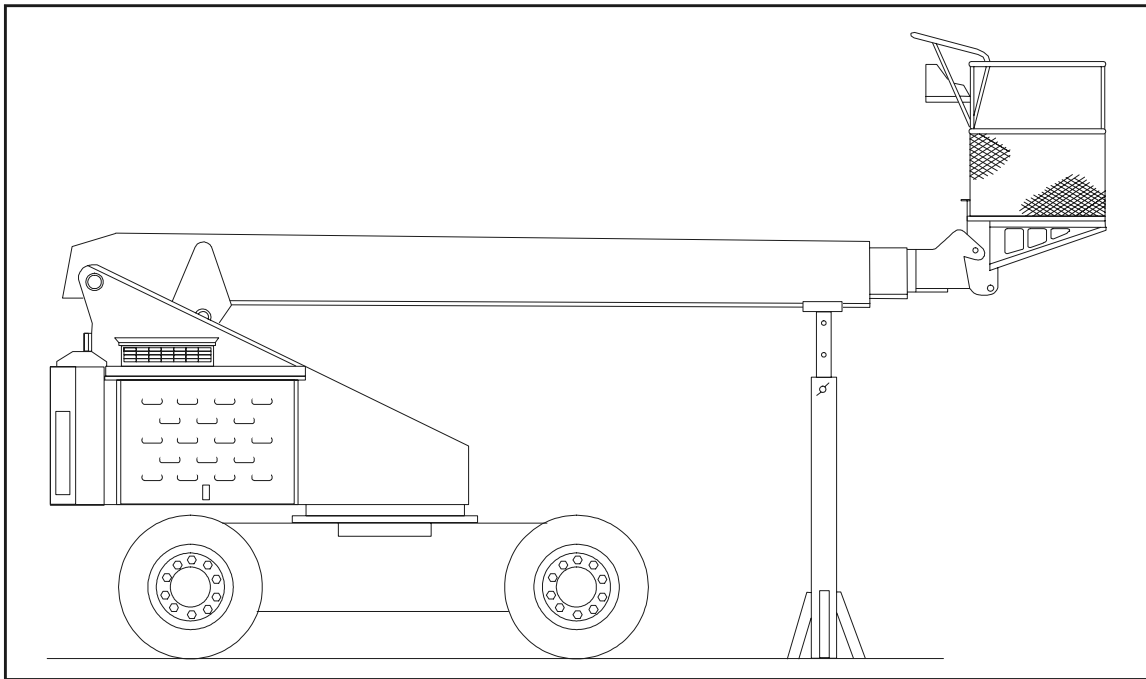


Figure 2-3. Boom Positioning and Support - Cylinder Repair

2.7 WEAR PADS

1. Shim up wear pads within 1.5 mm tolerance between wear pad and adjacent surface.
2. Replace wear pads when worn within 3 mm of threaded insert.

2.8 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 2.5 CM BELOW THE BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE PROP IN PLACE. REFER TO FIGURE 2-2.

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.

2.9 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 2-5., Figure 2-6., Figure 2-7., and Figure 2-8. 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.

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.

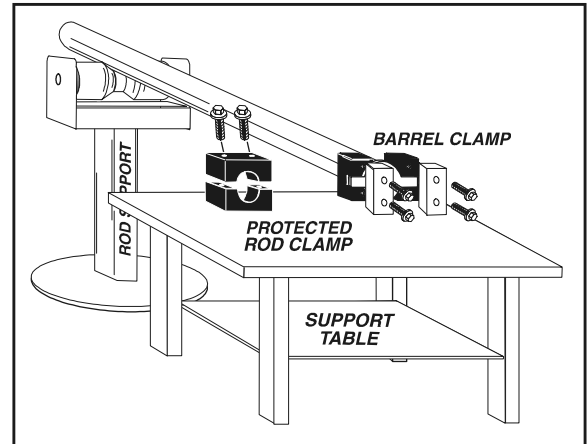


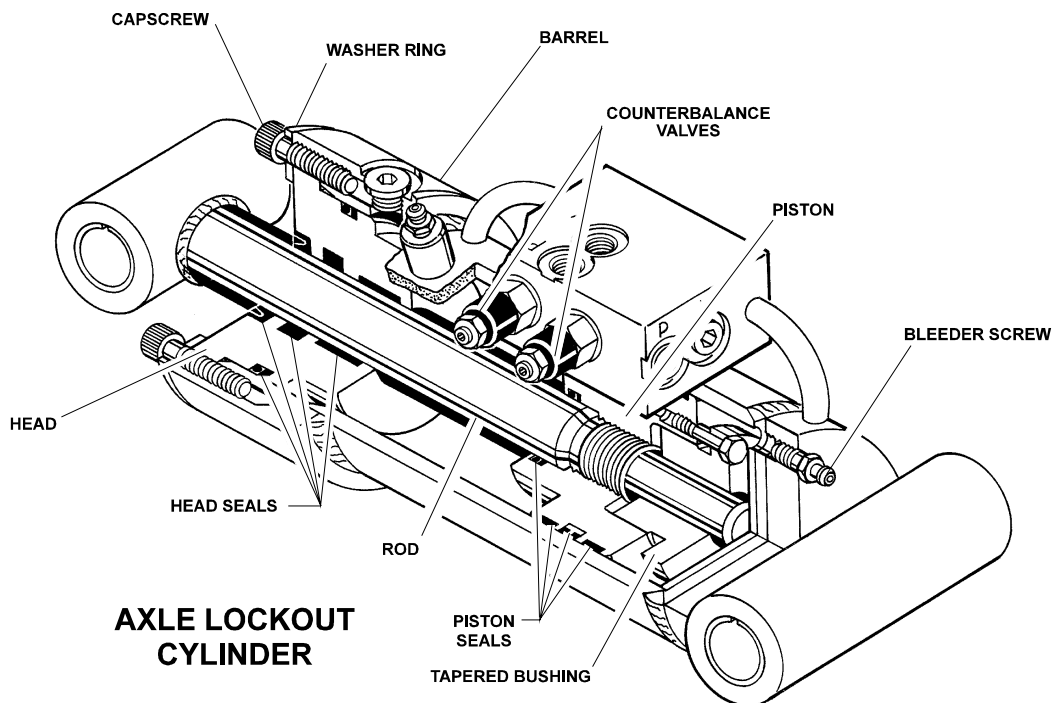
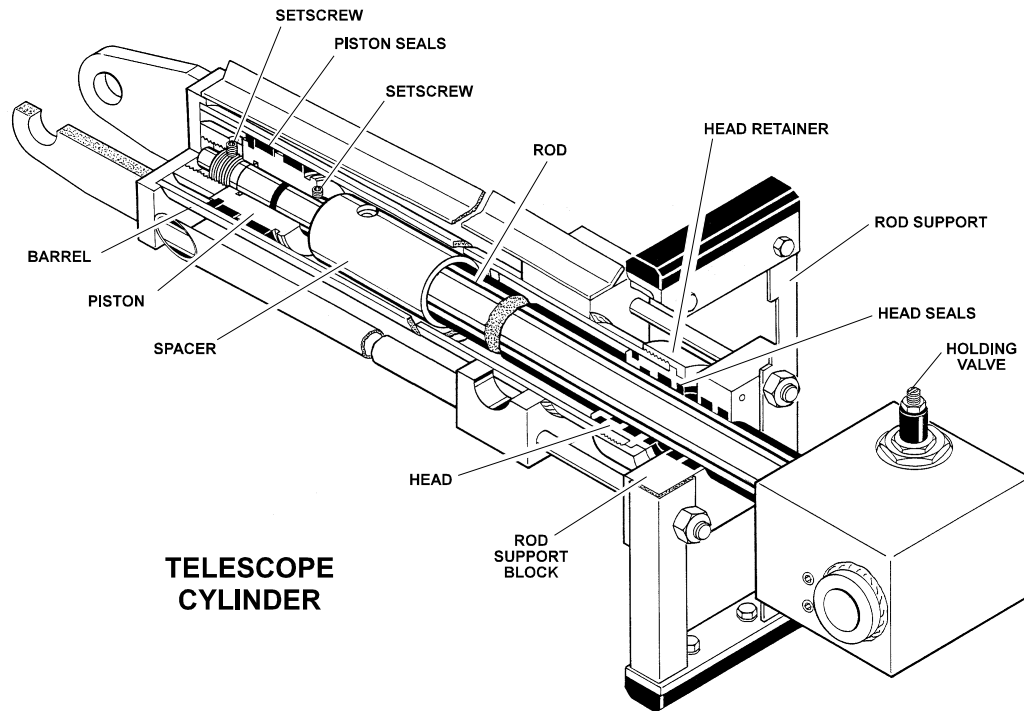
Figure 2-4. Cylinder Barrel Support

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.



Note: Due to design changes, the cylinders shown may not be an exact representation of those on your particular machine.

Figure 2-5. Typical Hydraulic Cylinders (Sheet 1 of 4)

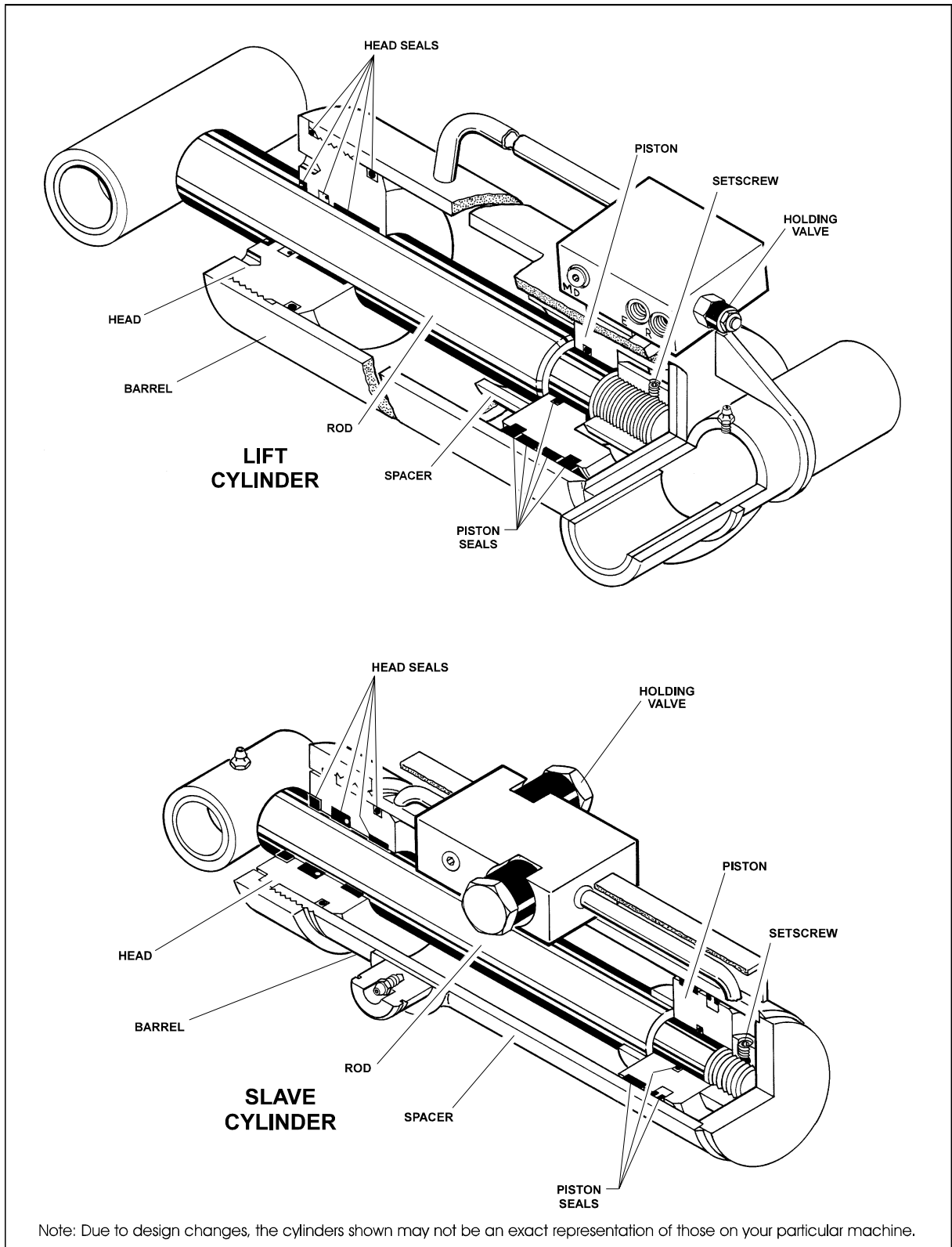
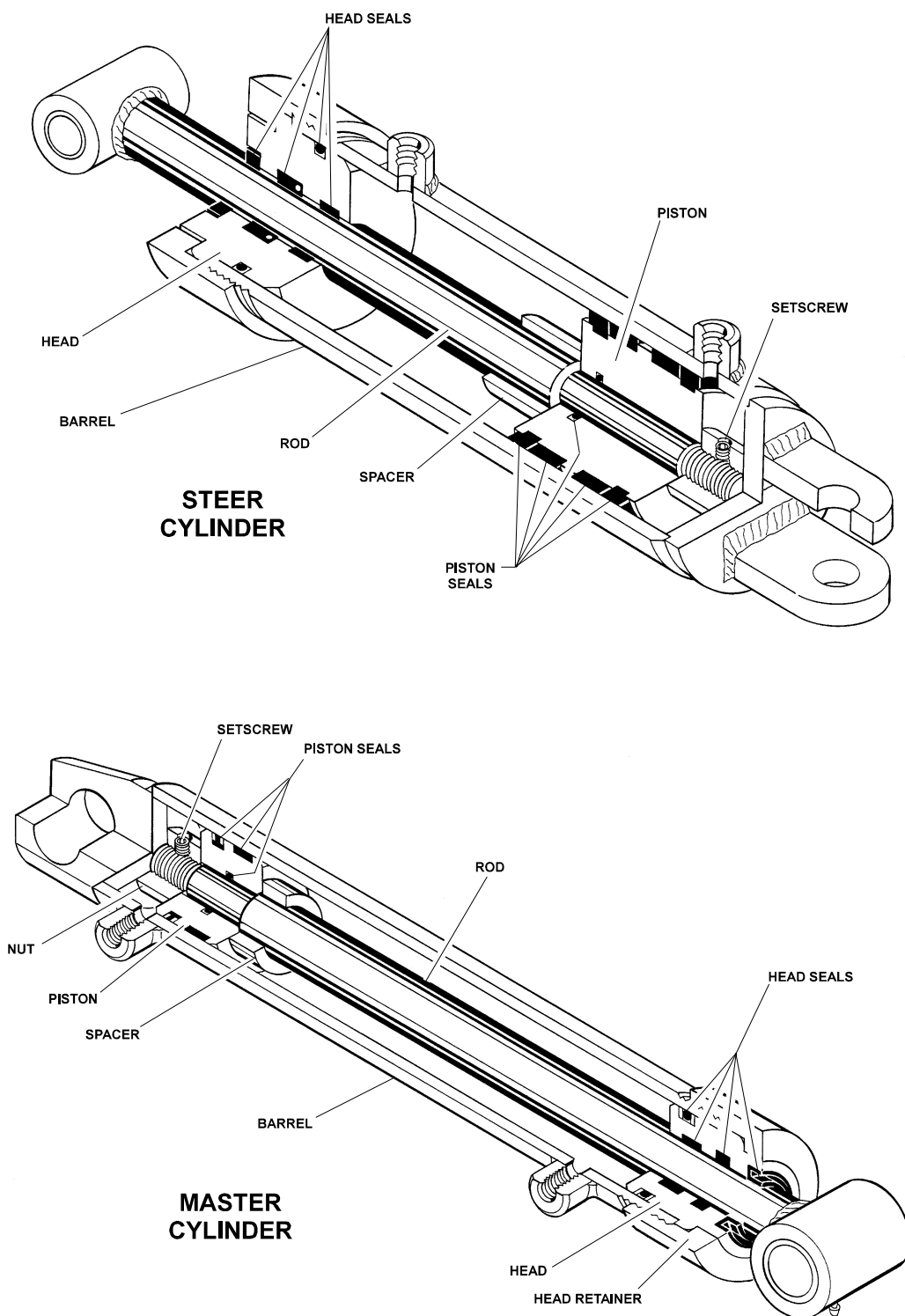


Figure 2-6. Typical Hydraulic Cylinders (Sheet 2 of 4)



Note: Due to design changes, the cylinders shown may not be an exact representation of those on your particular machine.

Figure 2-7. Typical Hydraulic Cylinders (Sheet 3 of 4)

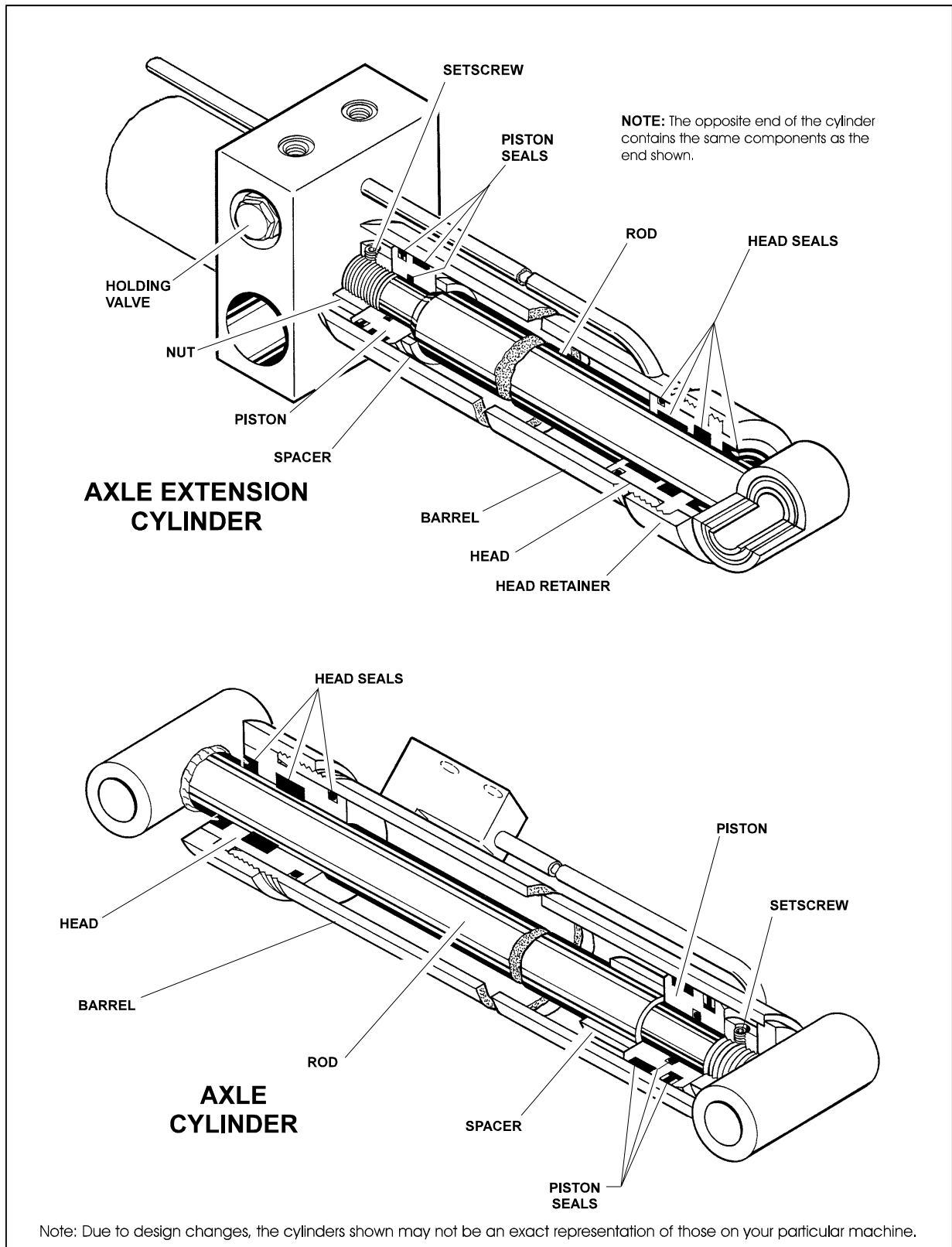


Figure 2-8. Typical Hydraulic Cylinders (Sheet 4 of 4)

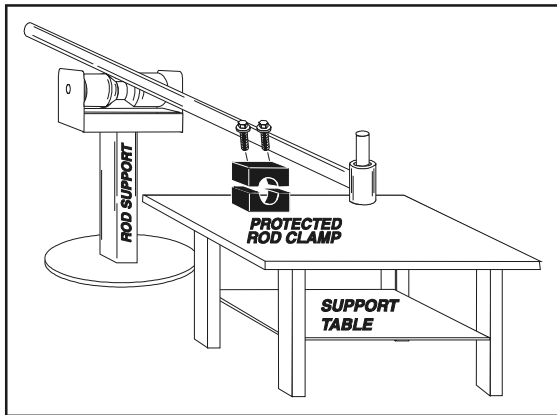


Figure 2-9. Cylinder Rod Support

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.
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.

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.

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.

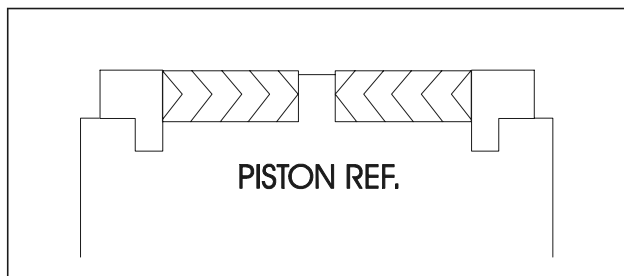


Figure 2-10. Poly-Pak Seal Installation

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 2-2 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 2-2 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 2-3, 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 2-2. Cylinder Piston Nut Torque Specifications

Description	Nut Torque Value (Wet)	Setscrew Torque Value (Dry)
Lift Cylinder	814 Nm	5 Nm
Slave Cylinder	109 Nm	12 Nm
Master Cylinder	109 Nm	12 Nm
Steer Cylinder	109 Nm	12 Nm
Steer Cylinder (Oscillating Axle)	380-456 Nm	N/A
Lockout Cylinder	N/A	N/A
Telescope Cylinder	814 Nm	12 Nm
Axle Extension Cyl.	7 Nm	12 Nm
Axle Extension Cyl. (Oscillating Axle)	138 Nm	12 Nm
Axle Lift Cylinder	553 Nm	12 Nm
Tie-Rod Cylinder (Oscillating Axle)	210-250 Nm	N/A
Extend-A-Reach		
Lift Cylinder	271 Nm	12 Nm
Slave Cylinder	271 Nm	12 Nm

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

Table 2-3. Holding Valve Torque Specification

Description	Torque Value
SUN - 7/8 HEX M20 x 1.5 THDS.	41-48 Nm
SUN - 1 1/8 HEX 1-14 UNS THDS.	61-68 Nm
SUN - 1 1/4 HEX M36 x 2 THDS.	204-217 Nm
RACINE - 1 1/8 HEX 1 1/16-12 THDS.	68-75 Nm
RACINE - 1 3/8 HEX 1 3/16-12 THDS.	102-109 Nm
RACINE - 1 7/8 HEX 1 5/8-12 THDS.	136-149 Nm

2.10 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 2-3.)
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.

SECTION 2 - PROCEDURES

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) lock-washer 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 Section 2.6, Boom Chains (See Figure 2-2.) 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 2-3.)
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.

2.11 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 2-11.)

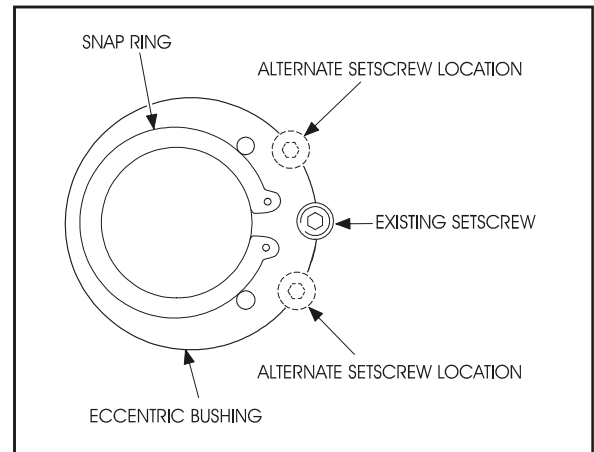


Figure 2-11. Telescope Cylinder Eccentric Bushing

2.12 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 2200 kg.

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

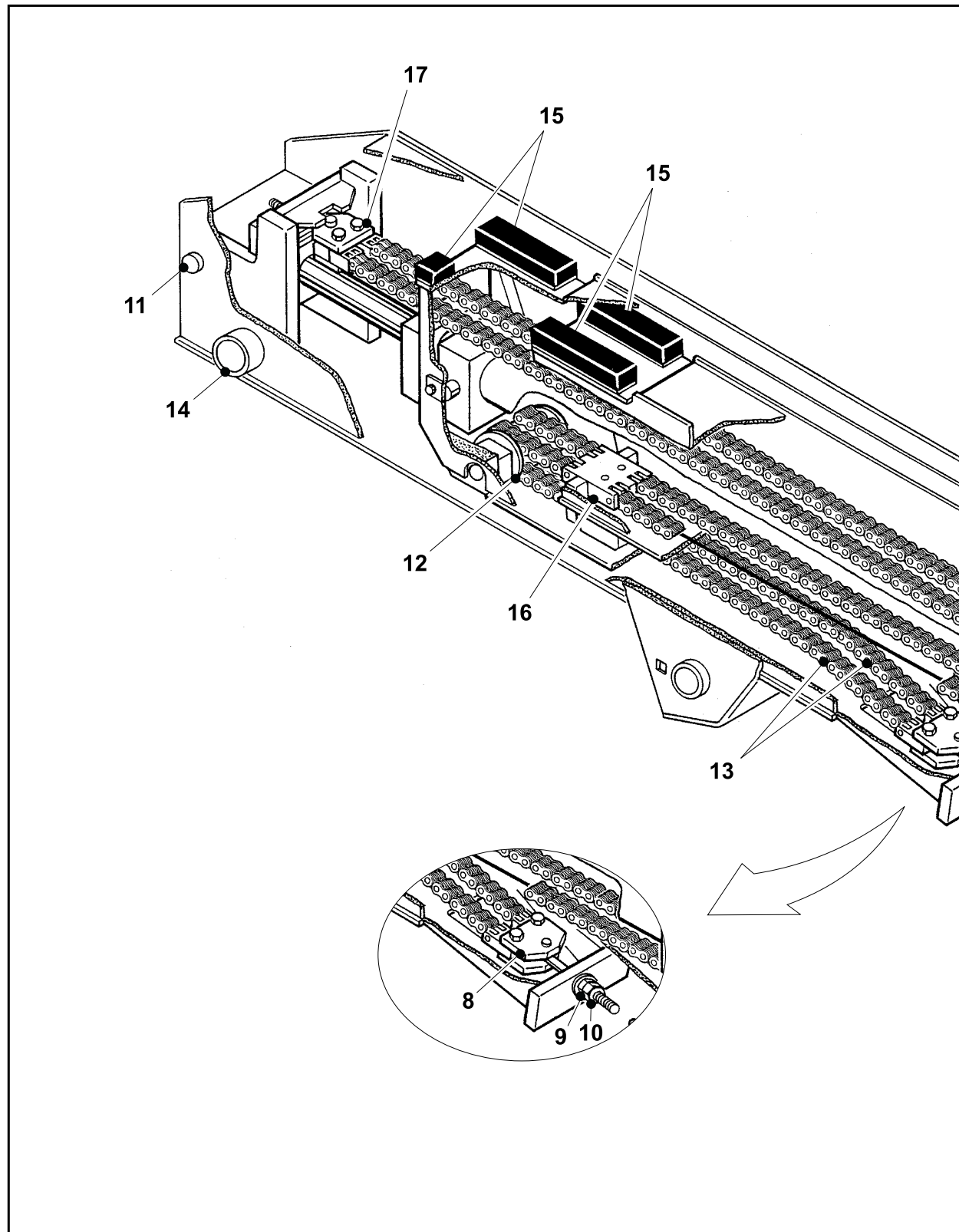


Figure 2-12. Boom Assembly (Sheet 1 of 2)

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

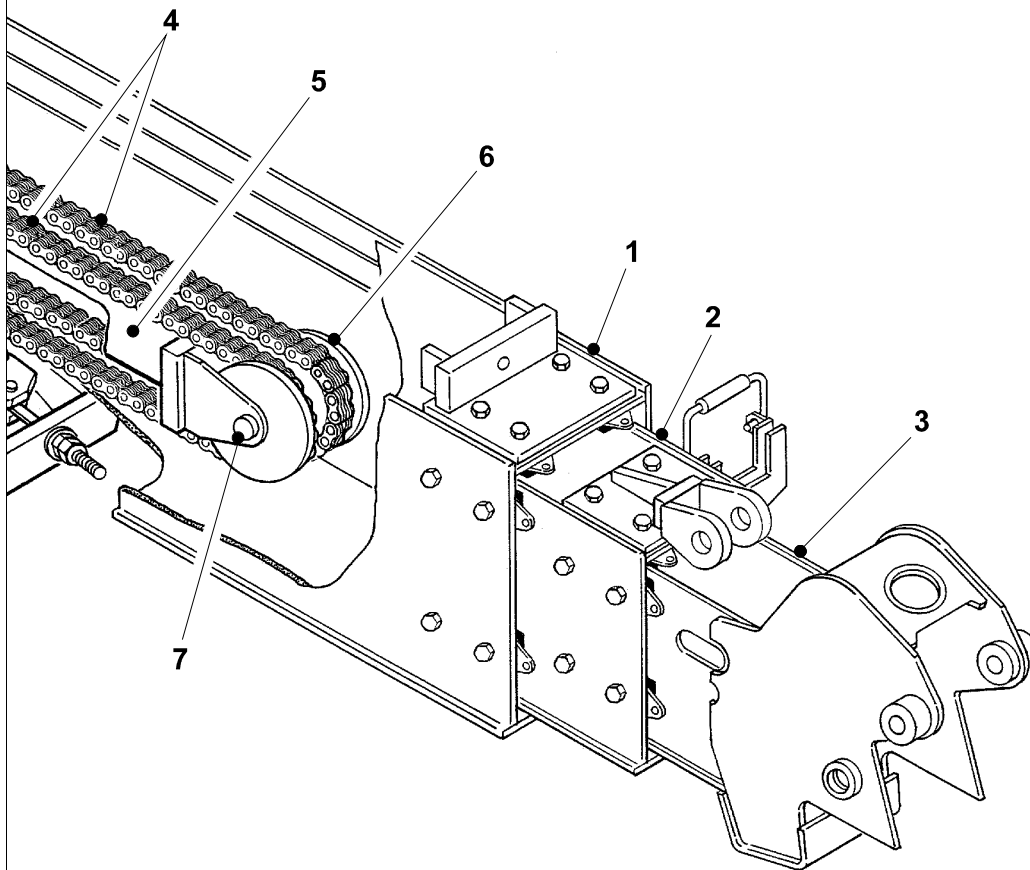


Figure 2-13. Boom Assembly (Sheet 2 of 2)

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.
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.

SECTION 2 - PROCEDURES

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 1.5 mm clearance (if the action is centered, there will be 0.8 mm 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 1.5 mm 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 1.5 mm clearance.
9. Attach the extension chain to the appropriate clevis 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 1.5 mm clearance.
11. Install wear pads into the forward portion of the mid section. Shim the boom, if necessary, for a total of 5 mm 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 1.5 mm clearance.
19. Install wear pads into the forward portion of the base section. Shim the boom, if necessary, for a total of 5 mm 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 2.6).
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, lock washers 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 lock-washers.
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.

2.13 TILT ALARM SWITCH

NOTE: There are two methods of adjustment, a manual adjustment and an adjustment using a voltmeter.

⚠ CAUTION

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

Manual Adjustment

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

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

2. Level the base of the indicator by tightening the three flange nuts through approximately one half of its spring travel. DO NOT ADJUST THE “X” NUT DURING THE REMAINDER OF THE PROCEDURE.
3. With the electrical connections complete, slowly tighten one of the “Y” nuts until the circuit is closed and the light on the Platform Control Console illuminates.

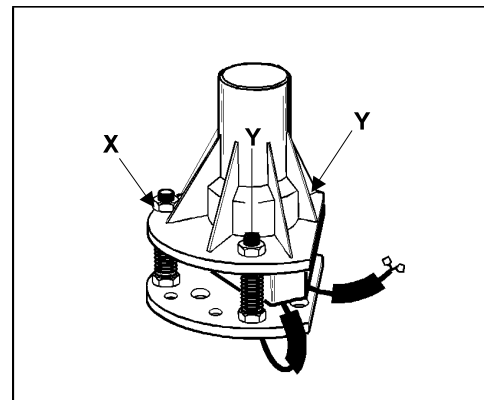


Figure 2-14. Tilt Switch Adjustment

4. Slowly back off the nut, counting the number of turns, until the circuit is again closed and the light again illuminates.
5. Divide the number of turns determined in step 4 in half. Tighten the nut this many turns. The line determined by this nut and the “X” nut is now parallel to the ground.

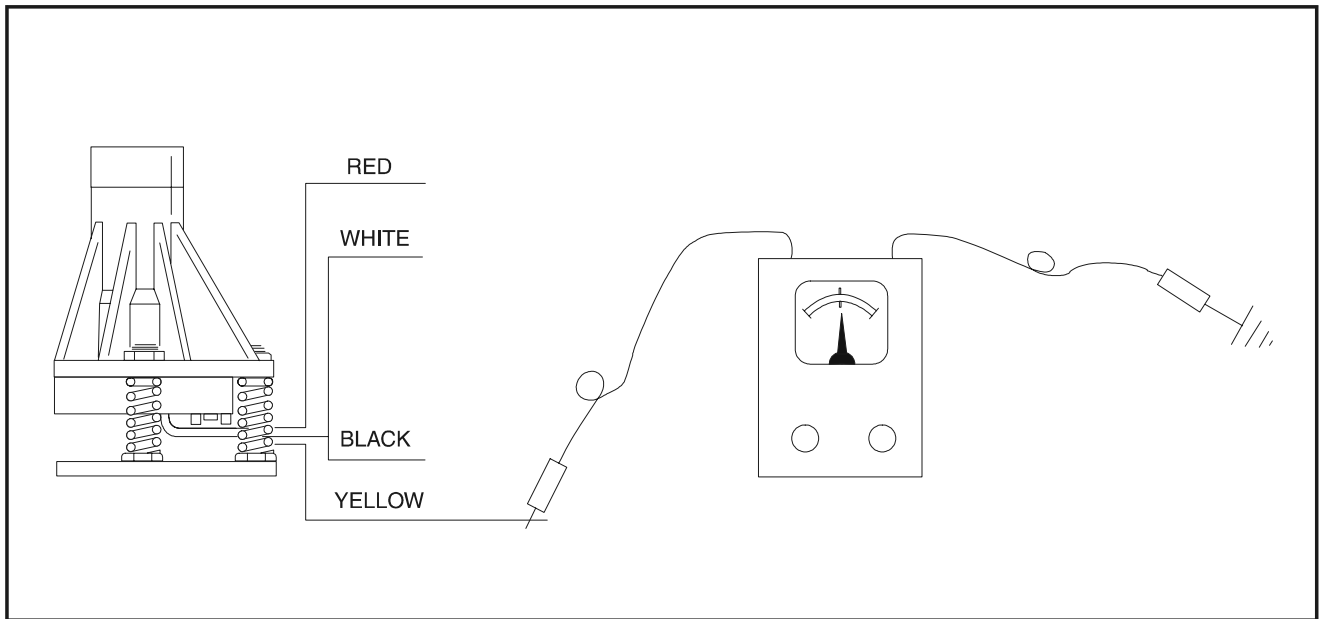


Figure 2-15. Tilt Switch Adjustment - Voltmeter

6. Repeat steps 3 thru 5 for the remaining "Y" nut. The switch is now level.
7. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the flange nuts have been tightened too far. Loosen the "X" nut and repeat steps 3 thru 7.

Voltmeter Adjustment

1. Park the machine on a flat, level surface. Ensure the machine is level and the tires are filled to the rated pressure.
2. If the engine is not running, turn the ignition switch to ON.
3. Connect the black lead of the voltmeter to ground and the red lead to the yellow wire protruding from the pot on the bottom of the sensor.
4. Adjust the leveling nuts to obtain the highest possible voltage reading.
5. Check voltage at the trip point in all four directions. If the voltage reading is not symmetrical, repeat step 4 above.

2.14 LIMIT SWITCH ADJUSTMENTS

Boom Limit Switch

The boom limit switch is located on the left side of the base section of the boom. The switch will activate when the boom is extended past a set point with the axles retracted. When activated, the switch cuts out Telescope Out and Lift Up. Adjust the limit switch to trip at 3 meters of boom extension.

Horizontal Cut-Out Switch

The horizontal cut-out switch is located on the right side of the boom at the boom pivot pin. When activated, the switch cuts out the High Engine, High Drive, and 2 Speed functions. On machines built to Italian specifications, the switch also cuts out the Drive function. Adjust the switch to activate when the boom reaches horizontal.

Drive Cut-Out Switch - Dutch Specifications

On machines built to Dutch specifications, a drive cut-out switch is located on the left side of the boom at the boom pivot pin. When activated, the switch cuts out the Drive function. Adjust the switch to activate when the work platform reaches a height of 8 meters.

2.15 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE (SEE FIGURE 2-16.)

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 foot-switch. 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 foot-switch to get low engine.

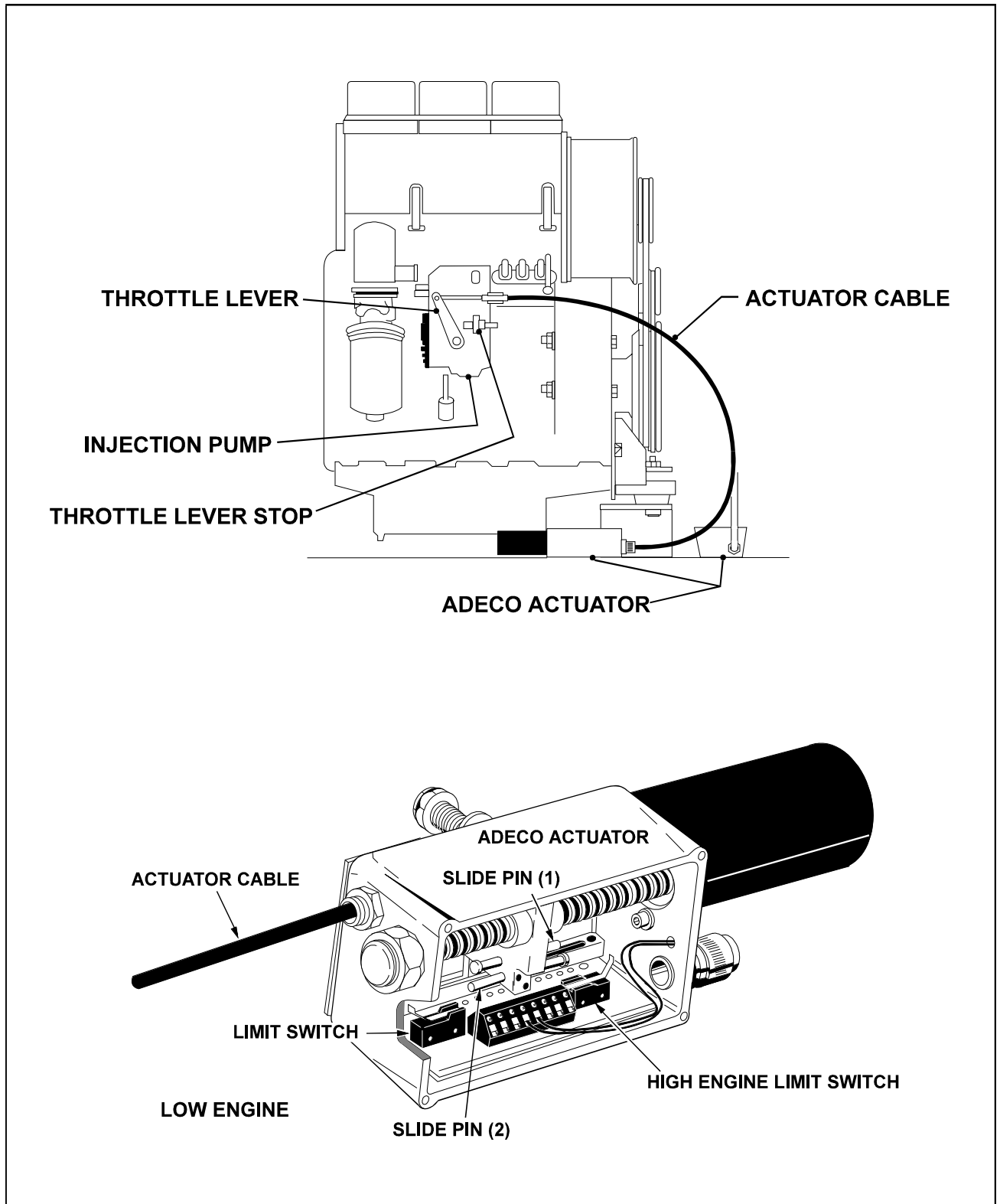


Figure 2-16. Adeco Actuator Adjustments - F4L912

2.16 PRESSURE SETTING PROCEDURES

1. Vickers Proportional Valve Pressure Setting, Machines Built To Present are shown in Figure 2-18., Figure 2-19., Figure 2-20., and Figure 2-21.
2. Vickers All Hydraulic Pressure Setting are shown in Figure 2-22., Figure 2-23., Figure 2-24., and Figure 2-25.
3. Solenoid Valve Pressure Settings Machines Built To Present are shown in Figure 2-26.
4. Solenoid Valve Pressure Settings 4 W/S are shown in Figure 2-27.
5. Extend - A - Reach Valve Pressure and Speed Settings are shown in Figure 2-28.

All parts must be clean and properly assembled before making these checks.

1. With all parts assembled as shown in Figure 2-17., 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 0.45-.5mm with 0.5 mm 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.

2.17 RACINE PROPORTIONAL AIR GAP ADJUSTMENT

NOTE: *The assembly in Figure 2-17. 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.

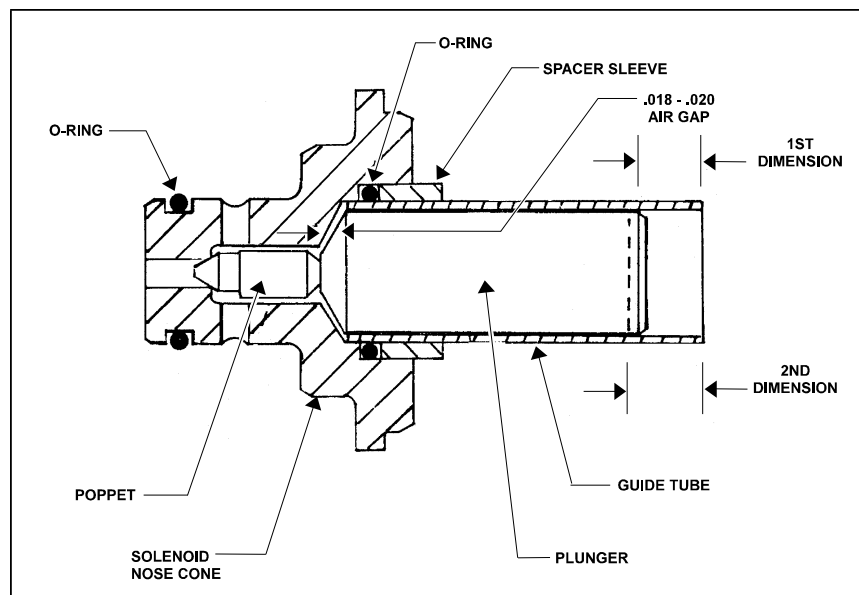


Figure 2-17. Racine Proportional Air Gap Adjustment, Machines Built Prior to Mid 1987

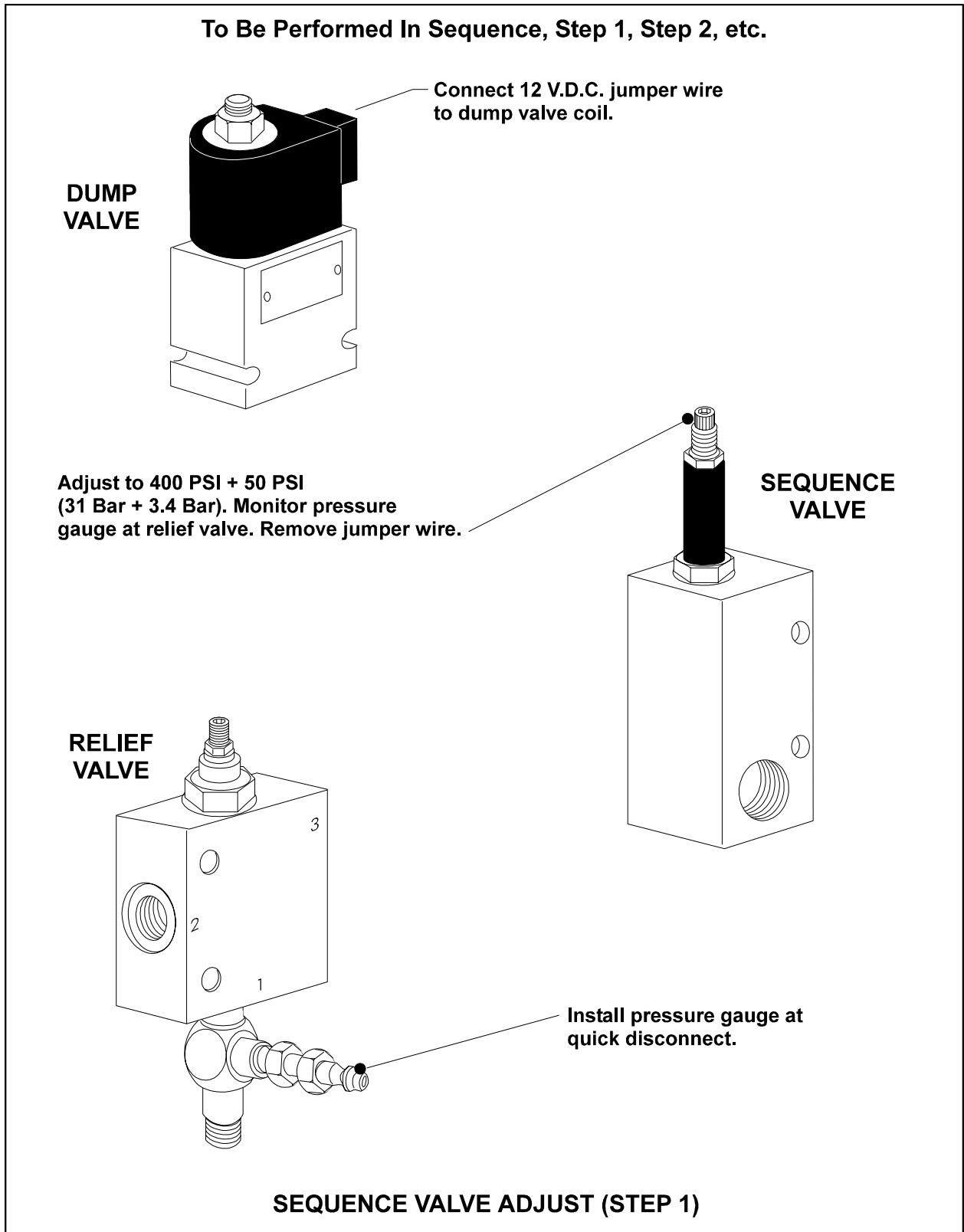
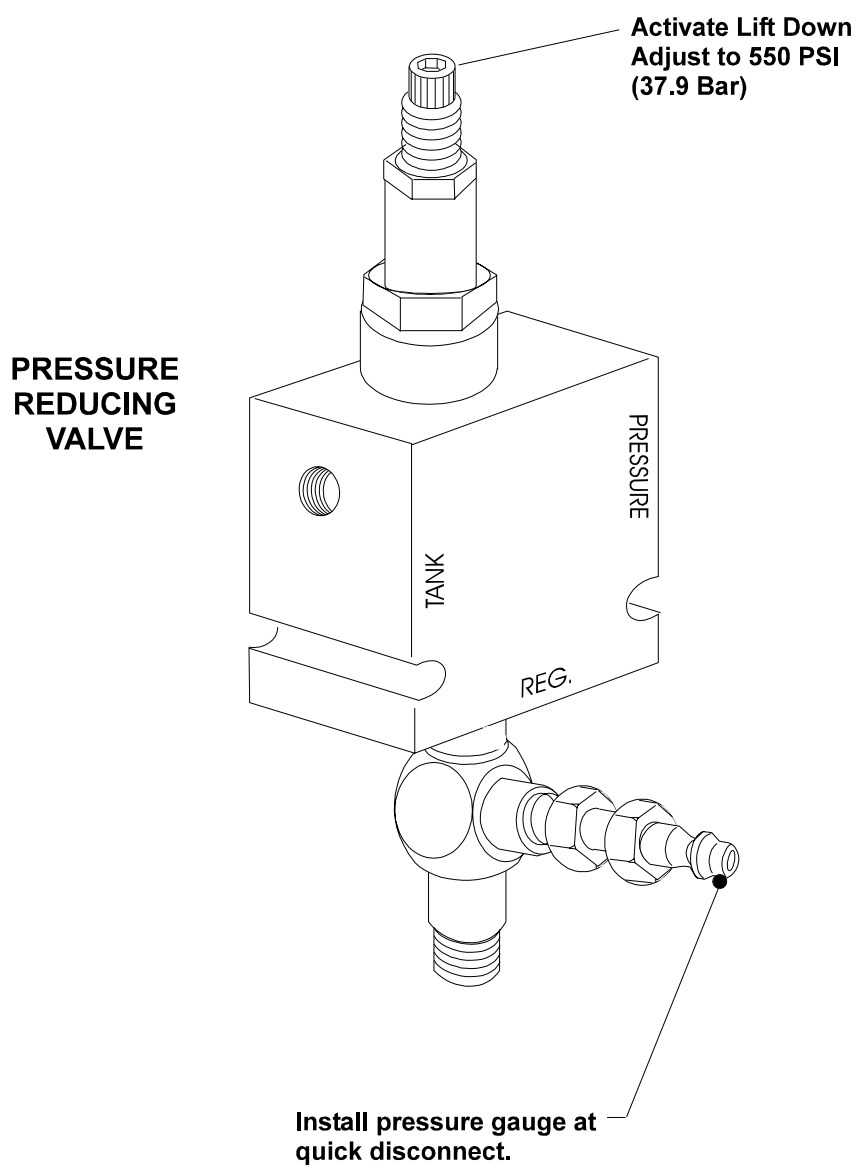


Figure 2-18. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 1 of 4)



PILOT PRESSURE ADJUST (STEP 2)

Figure 2-19. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 2 of 4)

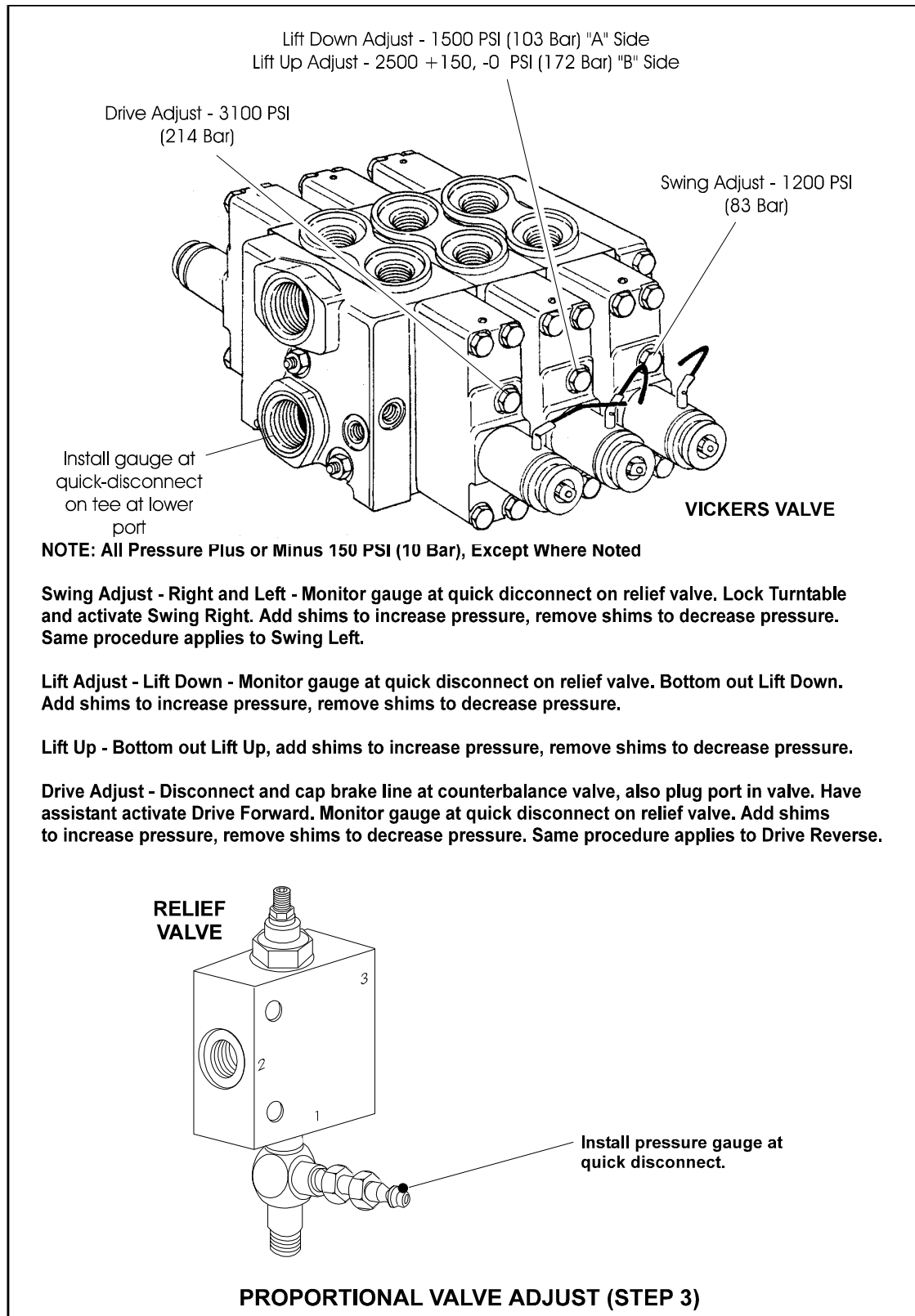
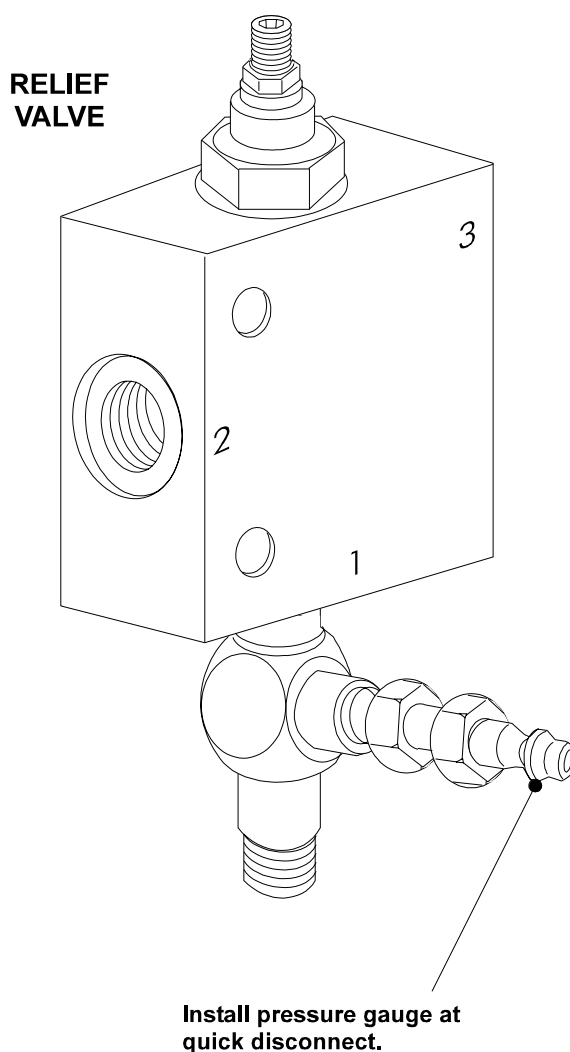


Figure 2-20. Vickers Proportional Valve Pressure Setting - Mid 1992 to Present (Sheet 3 of 4)



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

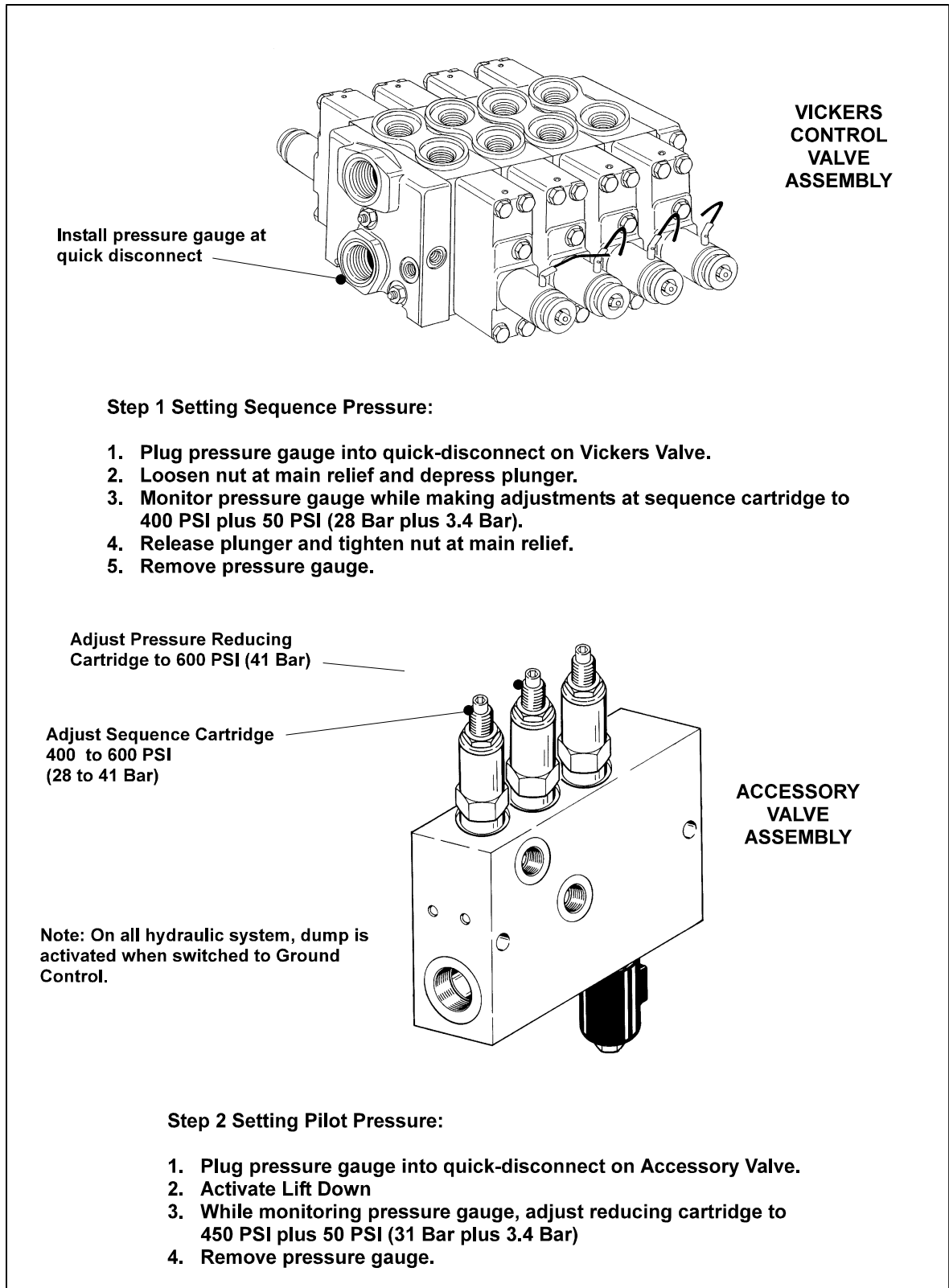
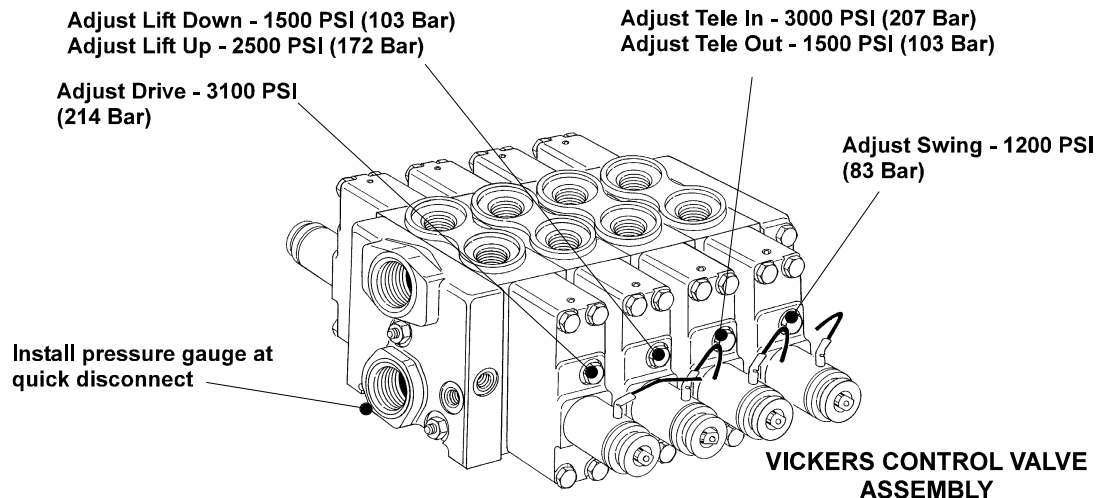


Figure 2-22. Pressure Setting - All Hydraulic Machines (Sheet 1 of 4)



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.

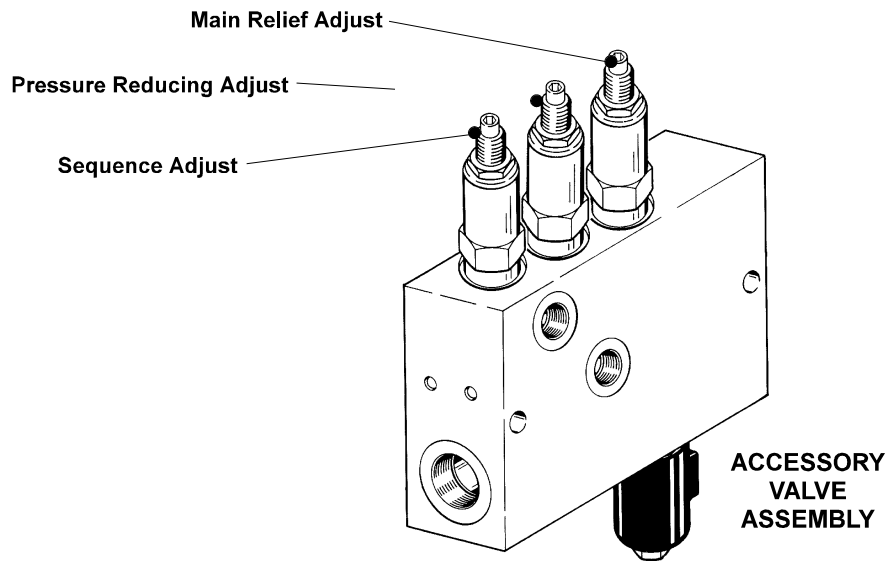
TELE ADJUST - TELE IN

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 2-23. 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.

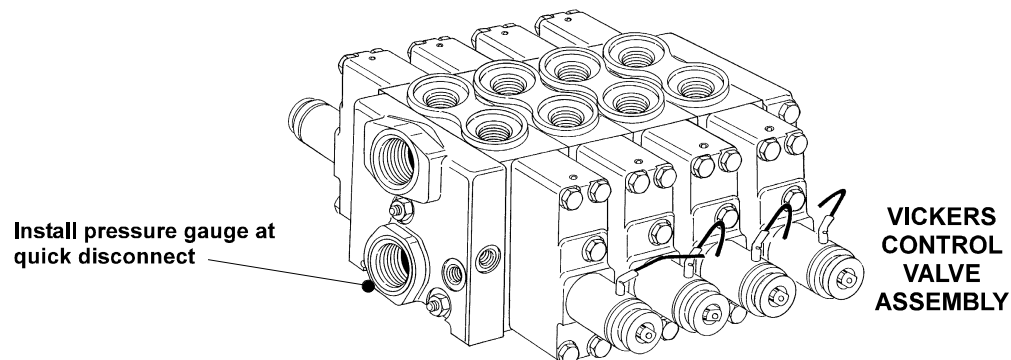


Figure 2-24. Pressure Setting - All Hydraulic Machines (Sheet 3 of 4)

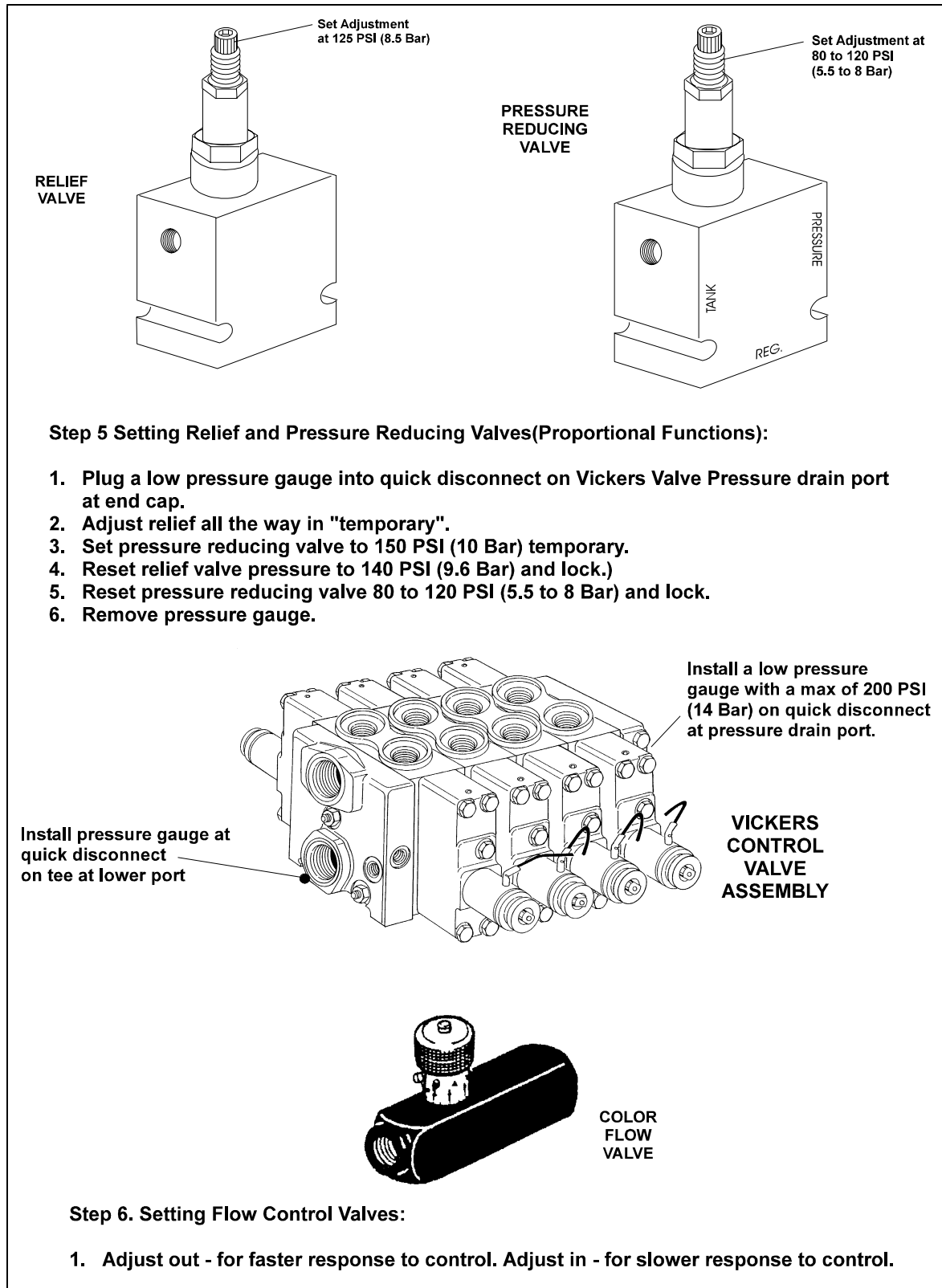


Figure 2-25. Pressure Setting - All Hydraulic Machines (Sheet 4 of 4)

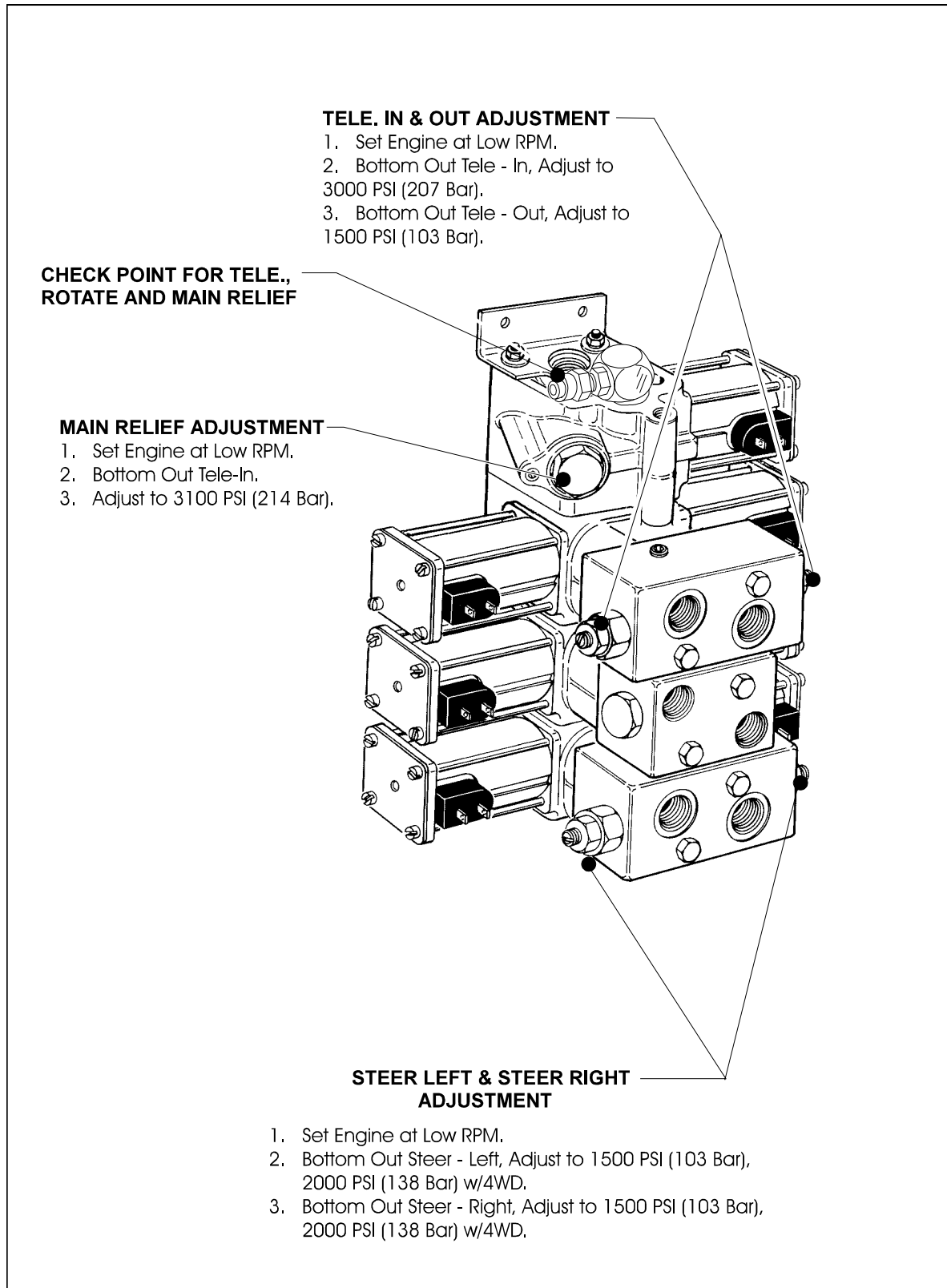


Figure 2-26. Solenoid Valve Pressure Settings - Machines Built to Present

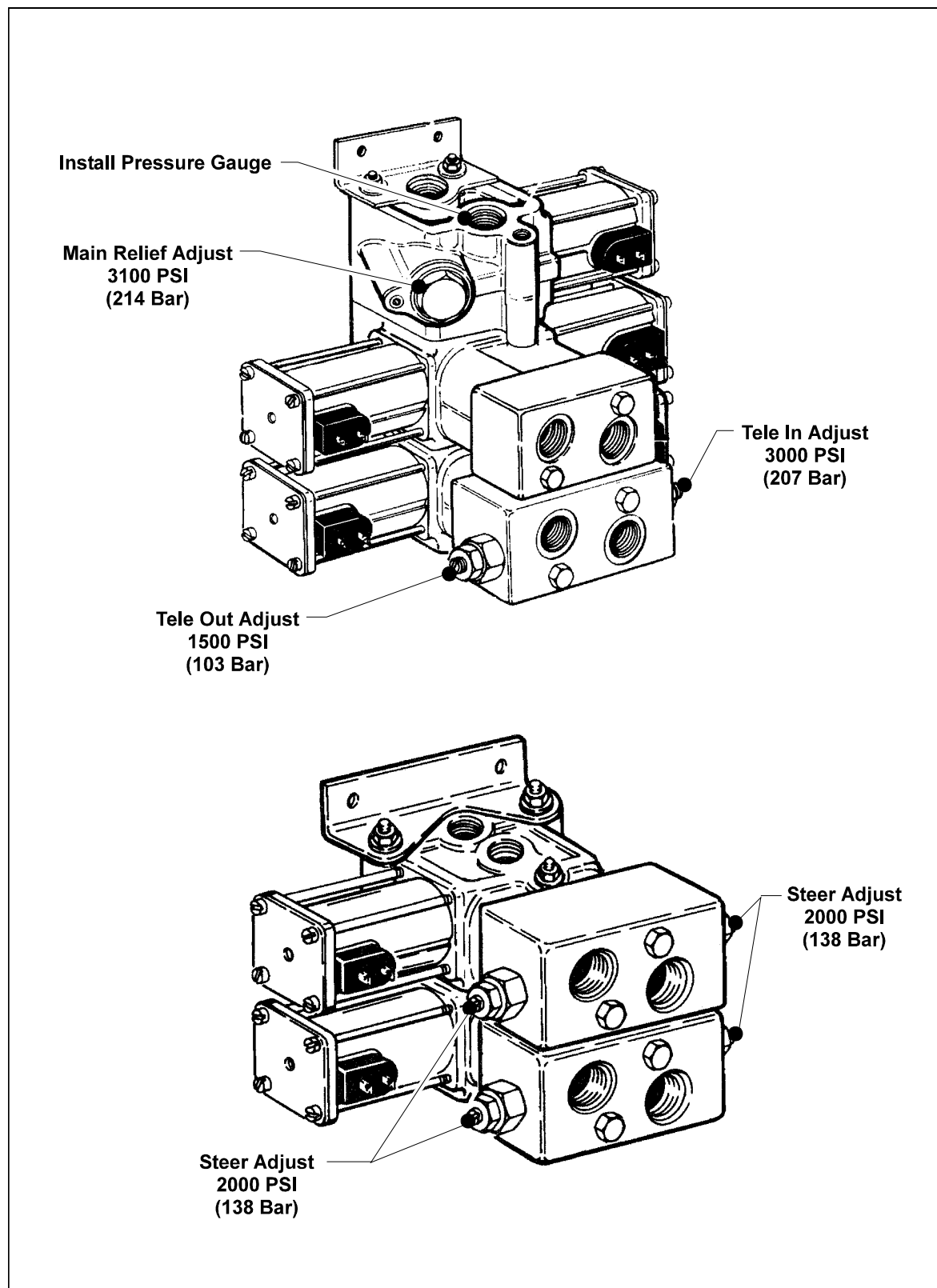


Figure 2-27. Solenoid Valve Pressure Settings - 4 Wheel Steer

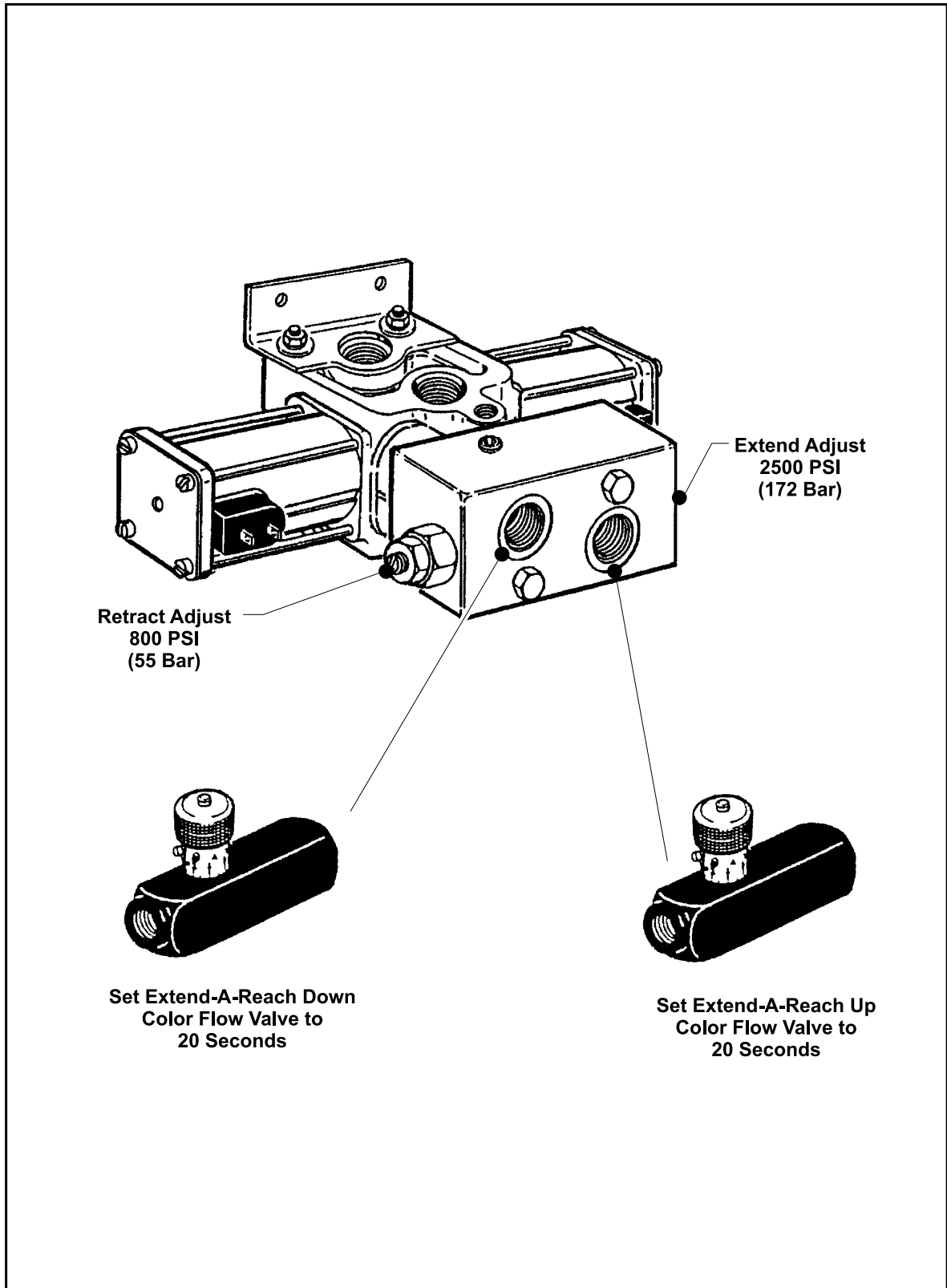


Figure 2-28. Extend-A-Reach Valve Pressure and Speed Settings

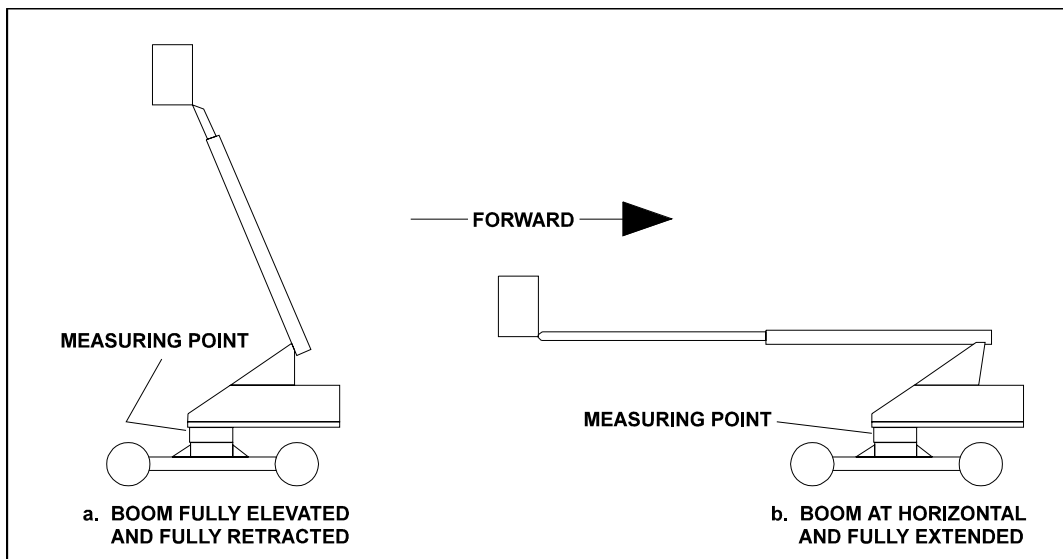


Figure 2-29. Swing Bearing Tolerance Boom Placement

2.18 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 2-30., 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 2-30., 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 2-30., 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.

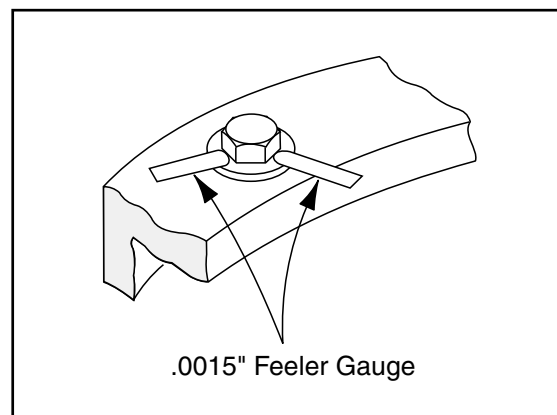


Figure 2-30. Swing Bearing Bolt Feeler Gauge Check

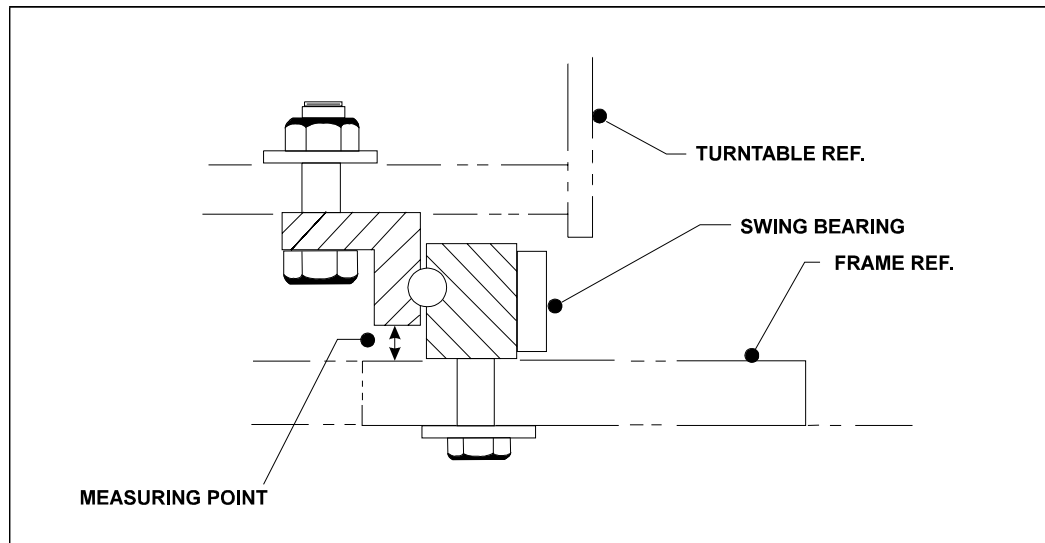


Figure 2-31. Swing Bearing Tolerance Measuring Point

Wear Tolerance

1. From the underside of the machine, at rear center, with the boom fully elevated and fully retracted (See Figure 2-29.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 2-29.)
2. At the same point, with the boom at horizontal and fully extended (See Figure 2-29.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 2-31.)
3. If a difference greater than 1.45 mm is found, the swing bearing should be replaced.
4. If a difference less than 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.

Swing Bearing Torque Values

1. Outer Race - 235 NM wet, 304 NM dry.
2. Inner Race - 235 NM wet, 304 NM dry.
3. Swing Bearing Torquing Sequence, see Figure 2-32.

⚠ WARNING

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

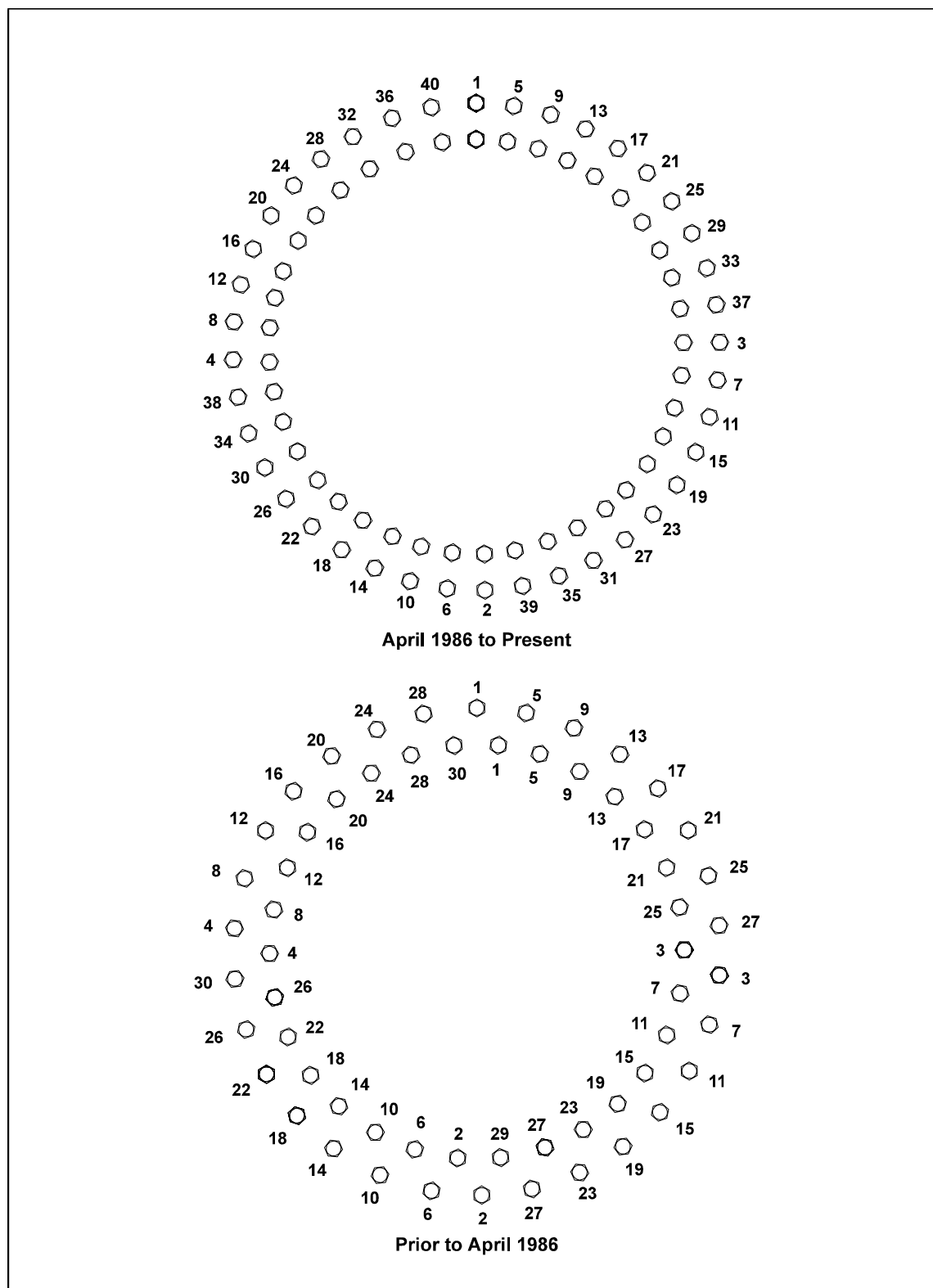


Figure 2-32. Swing Bearing Torquing Sequence

2.19 TORQUE HUB (SEE FIGURE 2-33.)

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.
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.

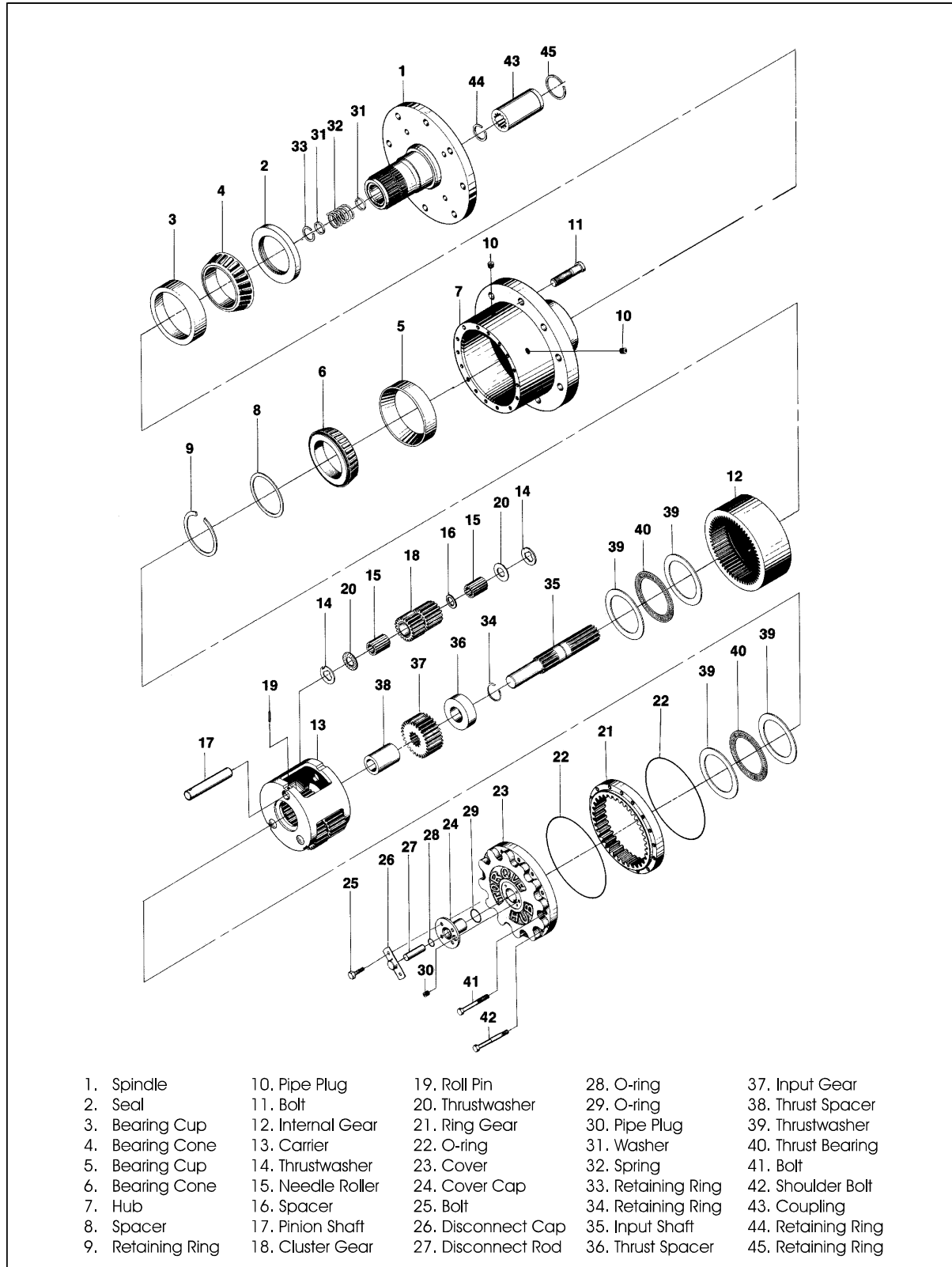


Figure 2-33. Torque Hub Assembly

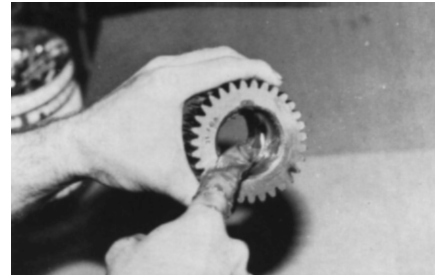
Repair**Cover Assembly.**

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 8-9 NM).
10. Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 8-9 NM).
11. Turn cover over and push disconnect rod into cover cap. Rod will be held in place by friction from o-ring.

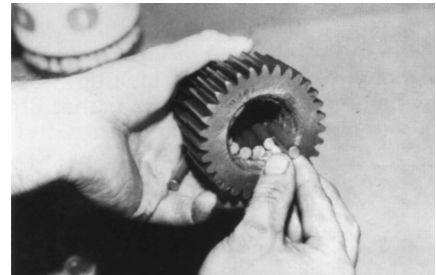
Carrier Assembly.

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.

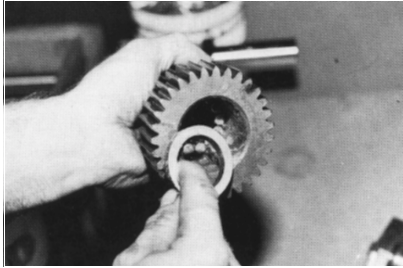
5. Remove spacer (16) from cluster gear bore and remove second set of sixteen needle rollers (15).
6. Repeat steps 1 thru 5 for remaining two cluster gears.
7. Clean and inspect all parts in accordance with paragraph b. Replace parts as necessary.
8. Apply a coat of grease or petroleum jelly to cluster gear bore.



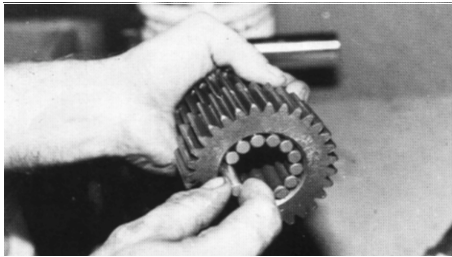
9. Place sixteen needle rollers into cluster gear bore.



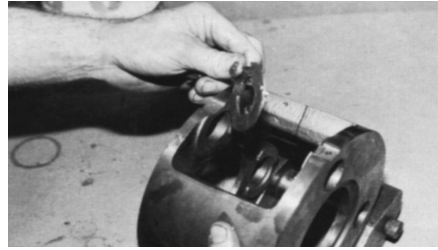
10. Place spacer into opposite side of cluster gear and against needle rollers.



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



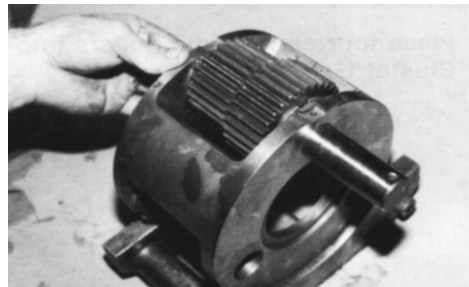
12. Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.



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.



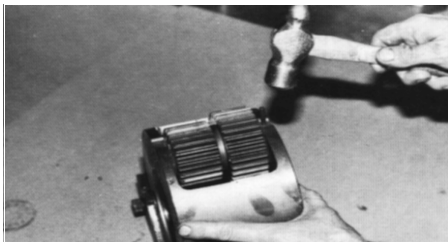
15. Drive anti-roll pin flush into carrier hole, locking planet shaft into place.
16. Repeat steps 8 thru 15 for remaining two cluster gears.

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.

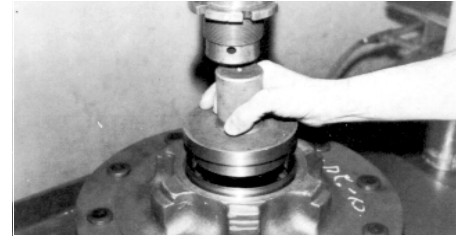


4. Place washer (31), spring (32), and washer (31), in that order, onto input shaft.

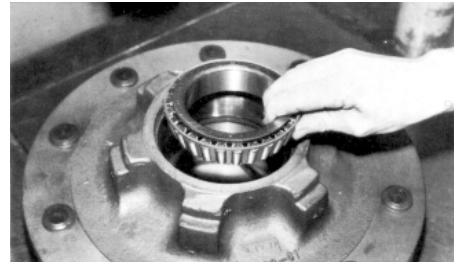


5. Install retaining ring into input shaft groove to secure spacers and spring to shaft.

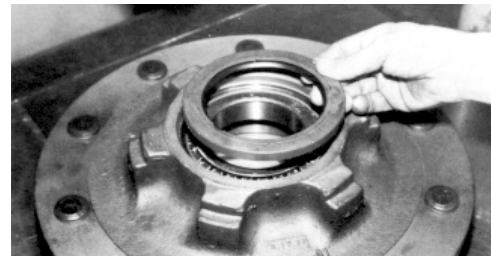
Assembly



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

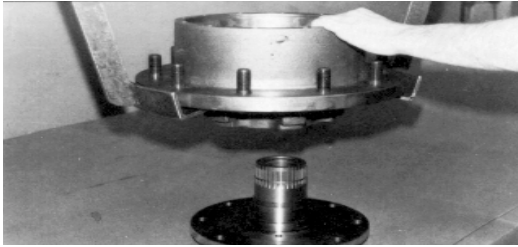


2. Place bearing cone (4) into bearing cup (3) in small end of hub.



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.

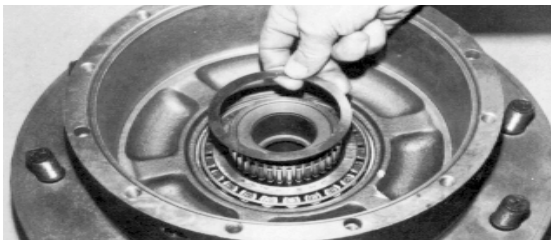
SECTION 2 - PROCEDURES



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.



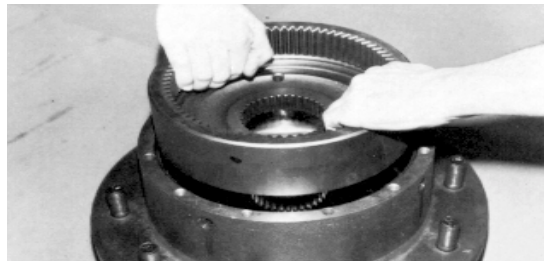
6. Place bearing shim (8) over end of spindle and against bearing cone.

⚠ CAUTION

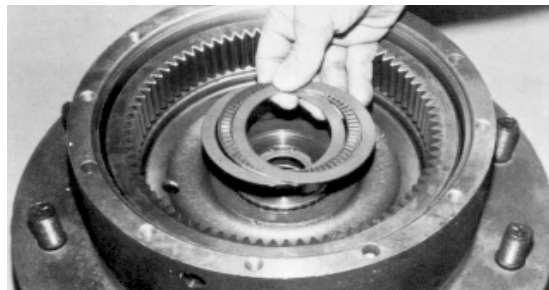
EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.



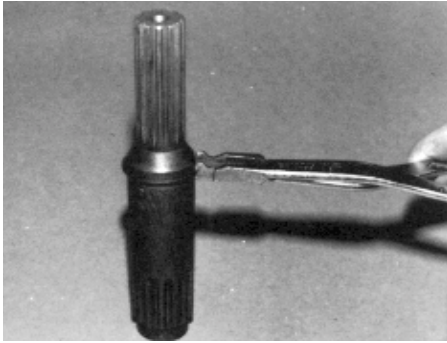
7. Install new retaining ring (9) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.



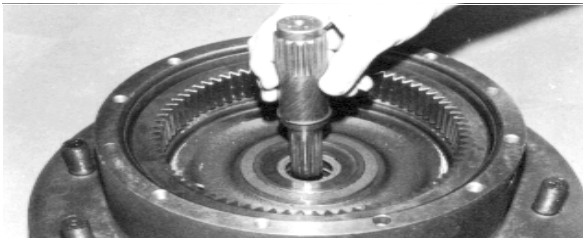
8. Place internal gear (12) onto end of spindle.



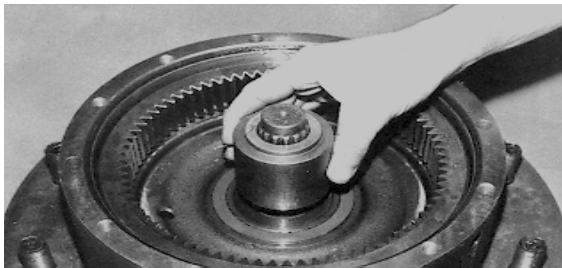
9. Install thrust washers and thrust bearing (39, 40) on the portion of the spindle which extends into the internal gear.



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



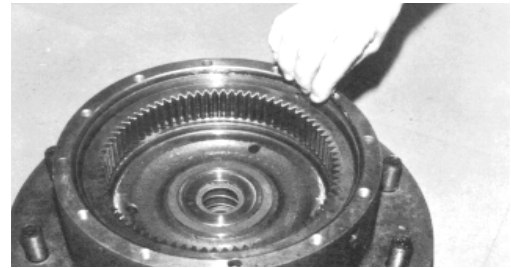
11. Place input shaft assembly into spindle bore with unsplined end facing out.



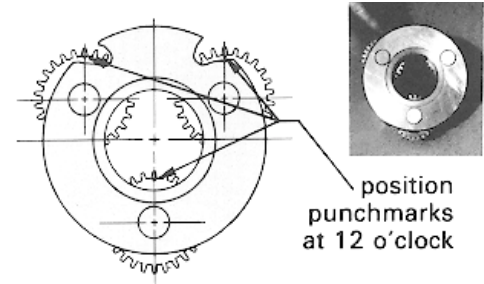
12. Place thrust spacer (36) over input shaft (35) with counterbore side facing spindle.



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

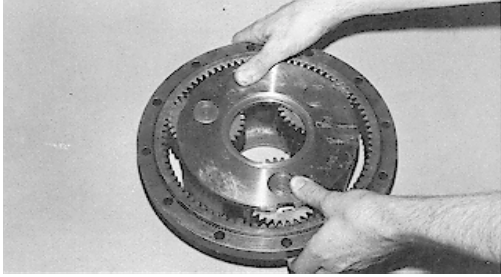


14. Place o-ring (22) into hub counterbore. Use petroleum or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.

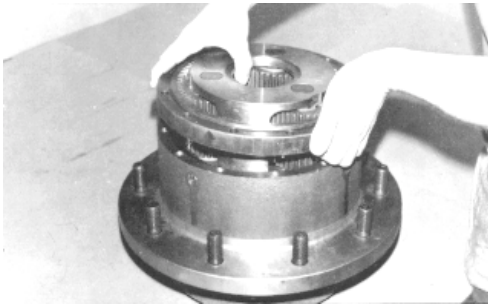


15. Place carrier assembly on a flat surface with large gears up and positioned as shown above. Find punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin. Marked tooth will be located just under carrier on upper two gears.

SECTION 2 - PROCEDURES

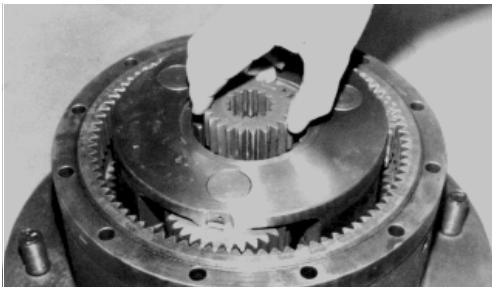


16. With shoulder side of ring gear (21) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation.

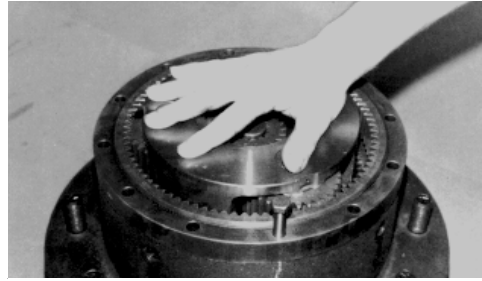


17. While holding ring gear, input gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked X over one of counterbored holes in hub.

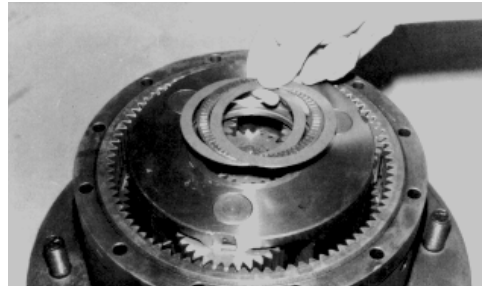
NOTE: If gears do not mesh easily or carrier assembly does not rotate freely, then remove carrier and ring gear and check cluster timing.



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.



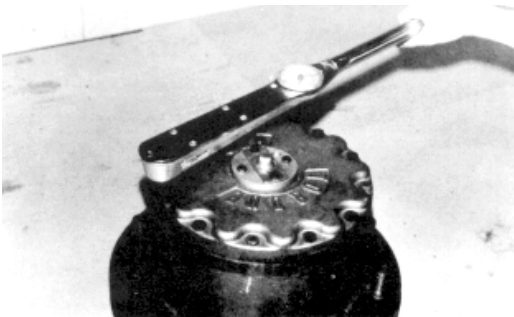
21. Place o-ring (22) into cover assembly counterbore. Use petroleum jelly or grease to hold o-ring in place.



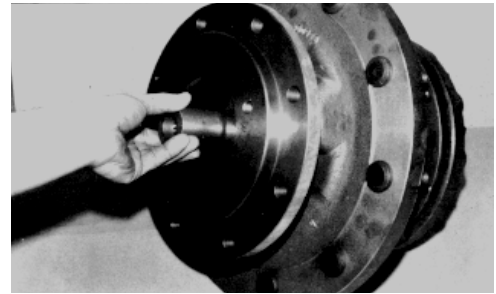
22. Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.



23. Locate four shoulder bolts (42) 90 degrees apart into counterbored holes in hub marked in step (16). Torque shoulder bolts to 31-36 NM.



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

2.20 DRIVE BRAKE, AUSCO - MACHINES BUILT PRIOR TO 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 (1 Bar) into hydraulic inlet. Direct piston away from operator.

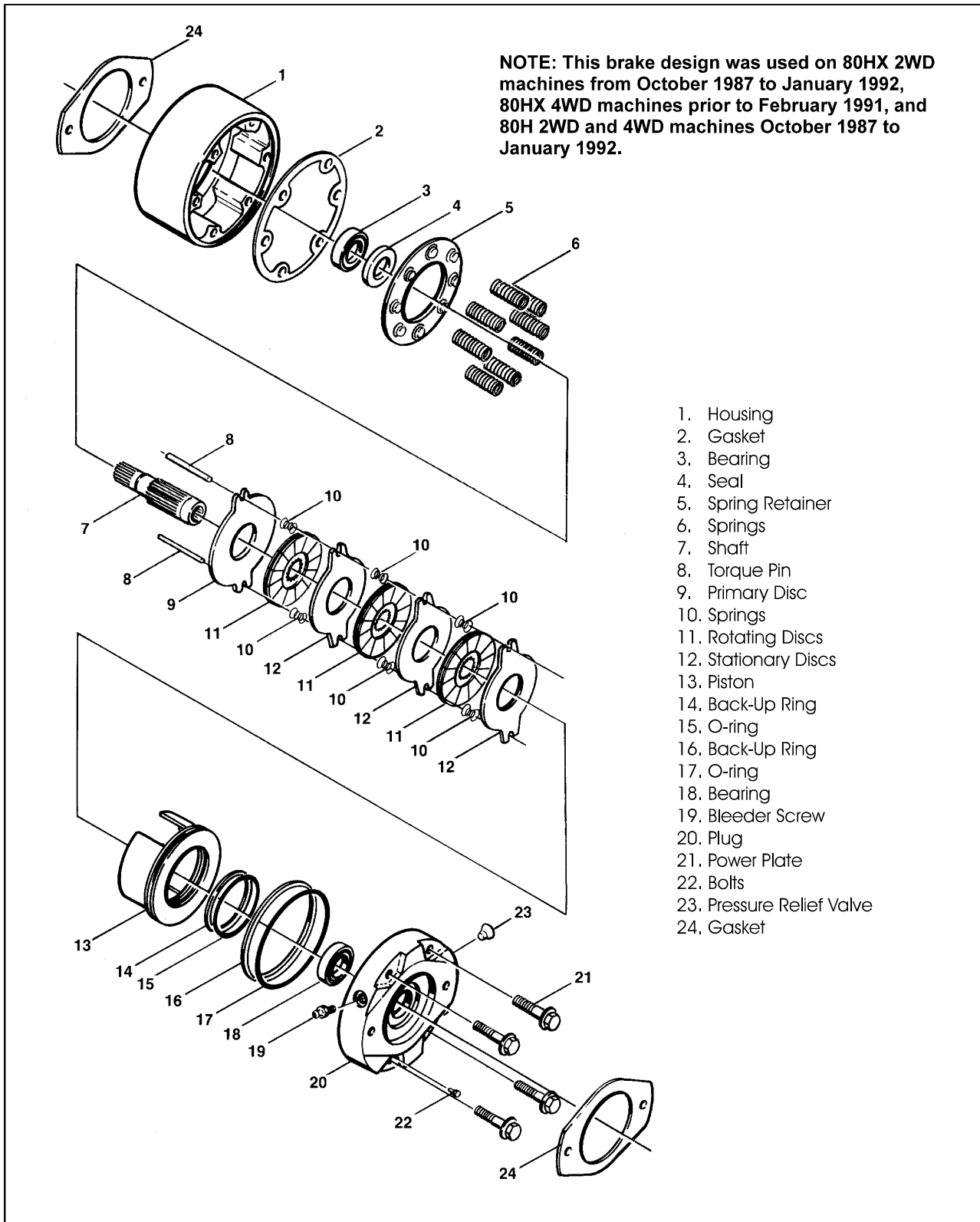


Figure 2-34. Drive Brake, Ausco - Machines Built Prior to 1992

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.

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.

2.21 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 LOOSEENED 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).

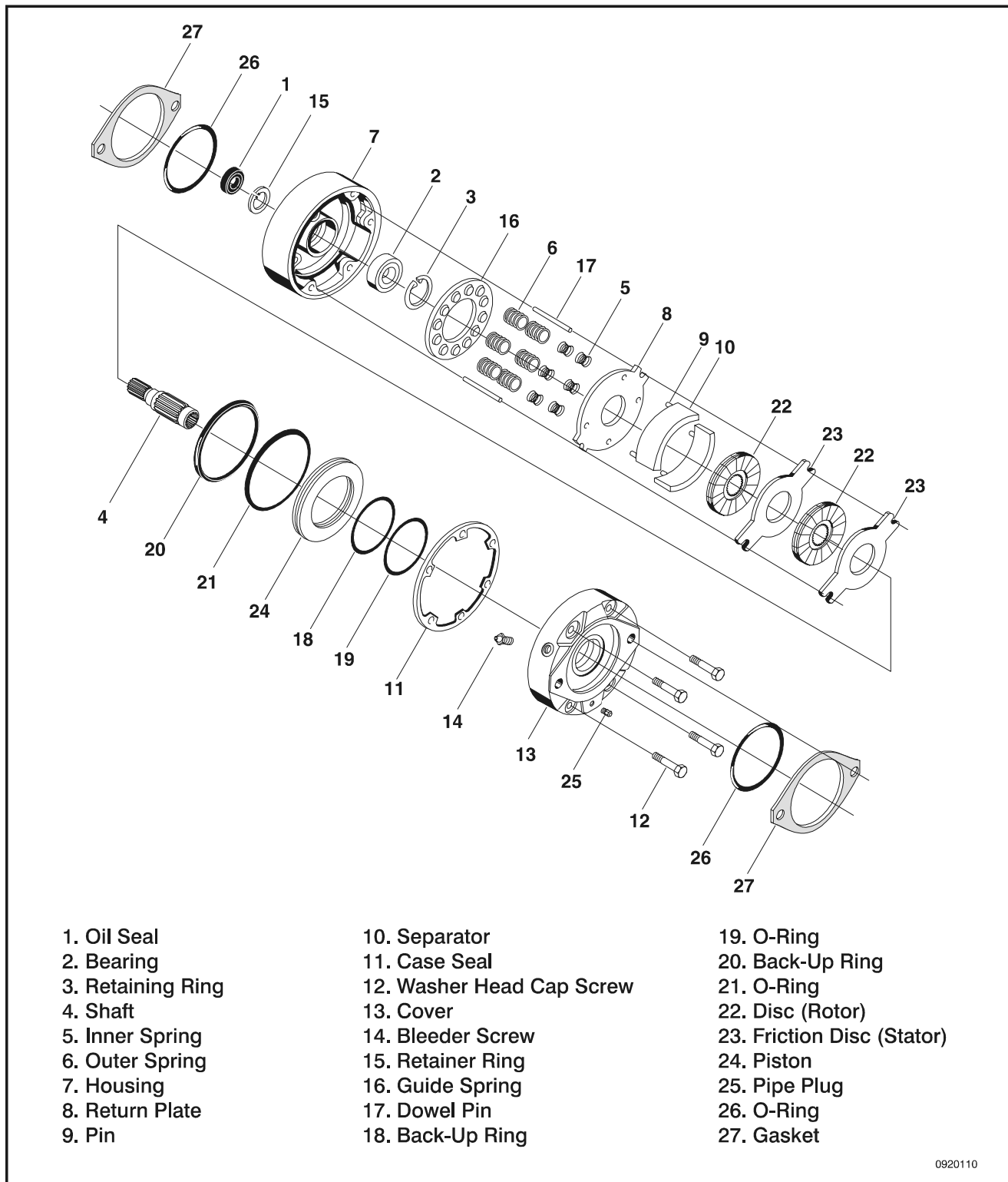


Figure 2-35. Drive Brake, Mico - Machines Built from 1992 to Present

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).

5. Insert dowel pins (17), spring guide (16) and springs (5,6) in housing (7) as shown in Figure 2-36., Spring Loading.

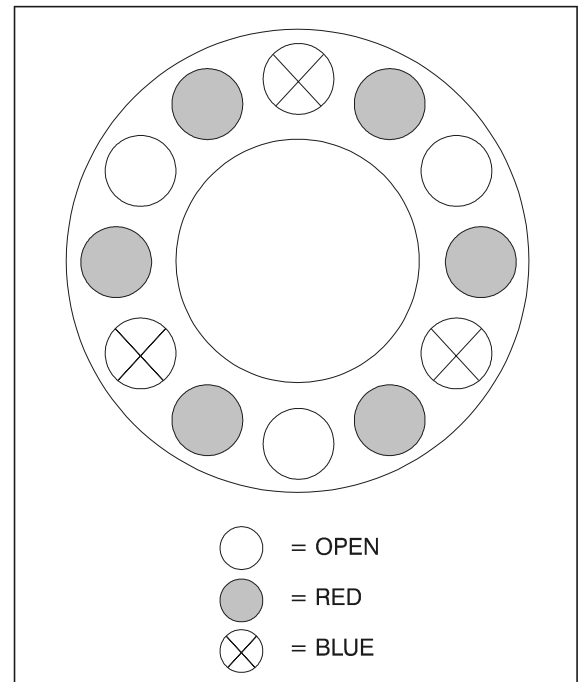


Figure 2-36. Spring Loading

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.

SECTION 2 - PROCEDURES

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.

2.22 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.

2.23 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.
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.

2.24 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.

2.25 BASKET ROTATOR BRAKE

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

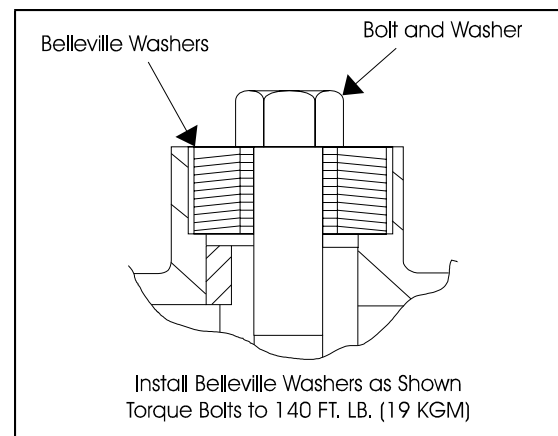


Figure 2-37. Belleville Washers

2.26 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.

2.27 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).

2.28 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.

2.29 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.

2.30 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.

2.31 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.

SECTION 2 - PROCEDURES

Table 2-4.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					YEARLY
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	
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 2-4.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					YEARLY
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	
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		

2.32 CAPACITY INDICATOR

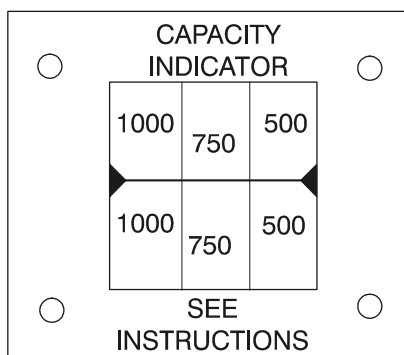
The capacity indicator is a mechanical gage that indicates the allowable maximum weight in the platform in reference to the angle of the boom.

⚠ 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

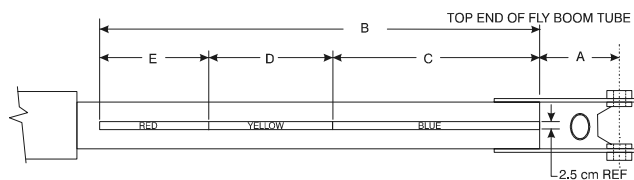
Replacement of boom tape is required when tape is illegible or missing.

⚠ 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	31 cm	678 cm	492.5 cm	86 cm	99 cm
CSA App.	31 cm	678 cm	437 cm	42"	53"

Figure 2-38. 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.

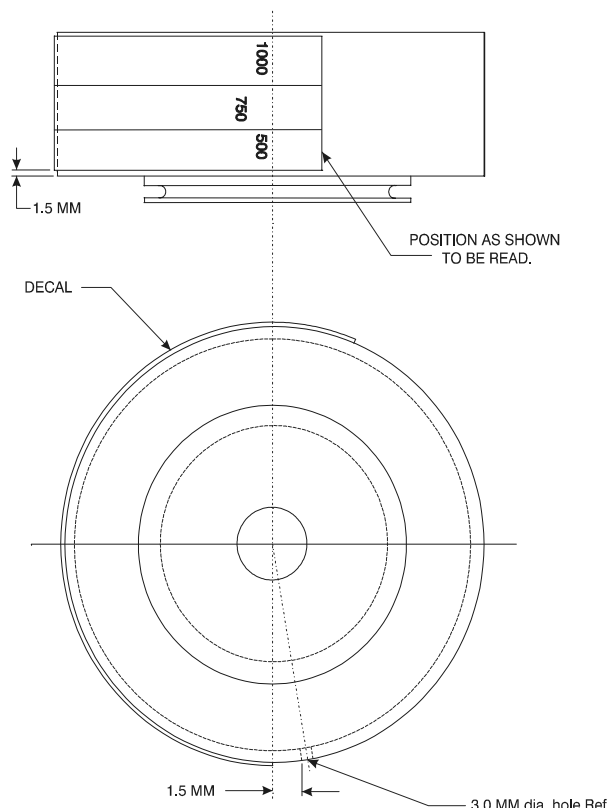


Figure 2-39. Capacity indicator Dial

SECTION 3. TROUBLESHOOTING

3.1 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.

3.2 TROUBLESHOOTING INFORMATION

The troubleshooting procedures are listed and defined in Table 3-1 through 3-6. 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.

3.3 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.

SECTION 3 - TROUBLESHOOTING

Table 3-1.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.

Table 3-2. 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.

SECTION 3 - TROUBLESHOOTING

Table 3-2. 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 3-2. 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. Solenoid failure. Tripped circuit breaker. Damaged level limit switch. Defective relay, main terminal box. Defective platform switch.	Repair or replace wiring. Replace solenoid. Reset circuit breaker. Replace switch, repair or replace holder. Replace relay. Replace switch.
TELESCOPE SYSTEM.		
No response to telescope control.		
	Telescope function not activated within 7 seconds after footswitch was depressed. Telescope control switch inoperative. Hydraulic system oil low. Damaged wiring on control switch or solenoid valve. Control valve not functioning properly. Restricted or broken supply line on valve bank or hydraulic pump. Telescope cylinder not functioning properly. Hydraulic pump not functioning properly.	Recycle footswitch. Repair or replace control switch. Replenish oil as necessary. Repair or replace wiring. Repair or replace valve. Clean or replace line. Repair or replace cylinder. Repair or replace pump.
Boom will not extend.		
	Telescope function not activated within 7 seconds after footswitch was depressed. Control valve not functioning properly. Restricted or broken hydraulic line or fitting. Pressure setting incorrect. Telescope cylinder not functioning properly.	Recycle footswitch. Repair or replace control valve. Clean, repair, or replace line or fitting. Check pressure/re-adjust as necessary. Repair or replace cylinder.

SECTION 3 - TROUBLESHOOTING

Table 3-2. 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 object(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 3-2.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.

SECTION 3 - TROUBLESHOOTING

Table 3-3.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.

Table 3-4.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.

SECTION 3 - TROUBLESHOOTING

Table 3-4.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 3-4.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.

SECTION 3 - TROUBLESHOOTING

Table 3-4.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 3-4.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.

SECTION 3 - TROUBLESHOOTING

Table 3-4.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.

Table 3-5. 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.

SECTION 3 - TROUBLESHOOTING

Table 3-5. 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 (TEX-ACO 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 3-5. 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.

SECTION 3 - TROUBLESHOOTING

Table 3-6. Electrical System - Troubleshooting

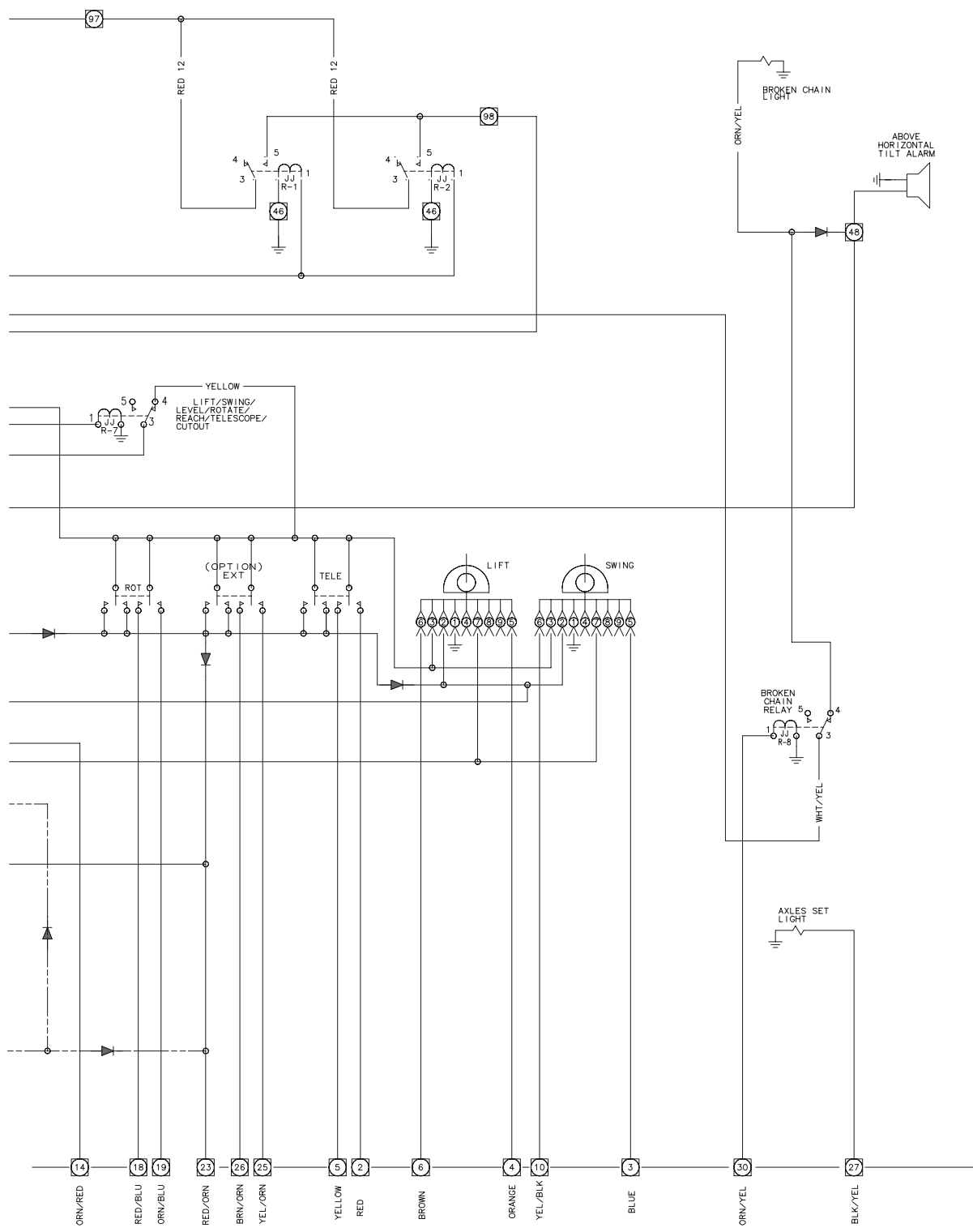
TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM CONTROLS.		
No power to platform controls.		
	15 Amp self-reset circuit breaker open.	Check footswitch to ensure that both switches are making contact when pedal is depressed. Repair or replace footswitch as necessary.
	Contact block in footswitch malfunctioning.	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 3-6. 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.

3-20





NOTE: ALL UNSPECIFIED CONDUCTORS
EQUIVALENT TO 1.5mm²
CONDUCTORS SPECIFIED
12 = 3.0mm²
10 = 4.5mm²
9 = 6.0mm²

1870003A

Figure 3-2. Wiring Schematic (Sheet 2 of 4)

SECTION 3 - TROUBLESHOOTING



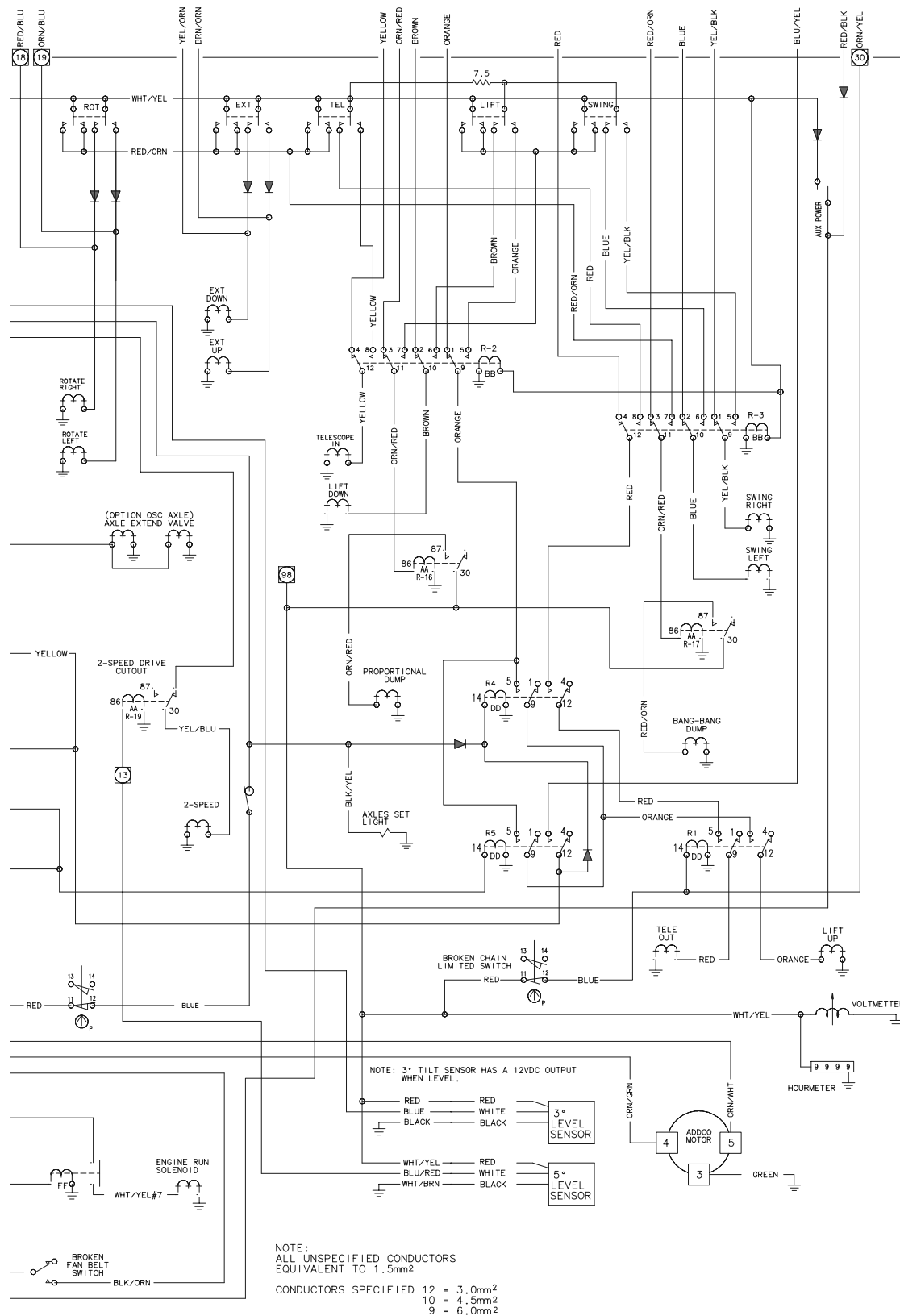


Figure 3-4. Wiring Schematic (Sheet 4 of 4)

1870003A

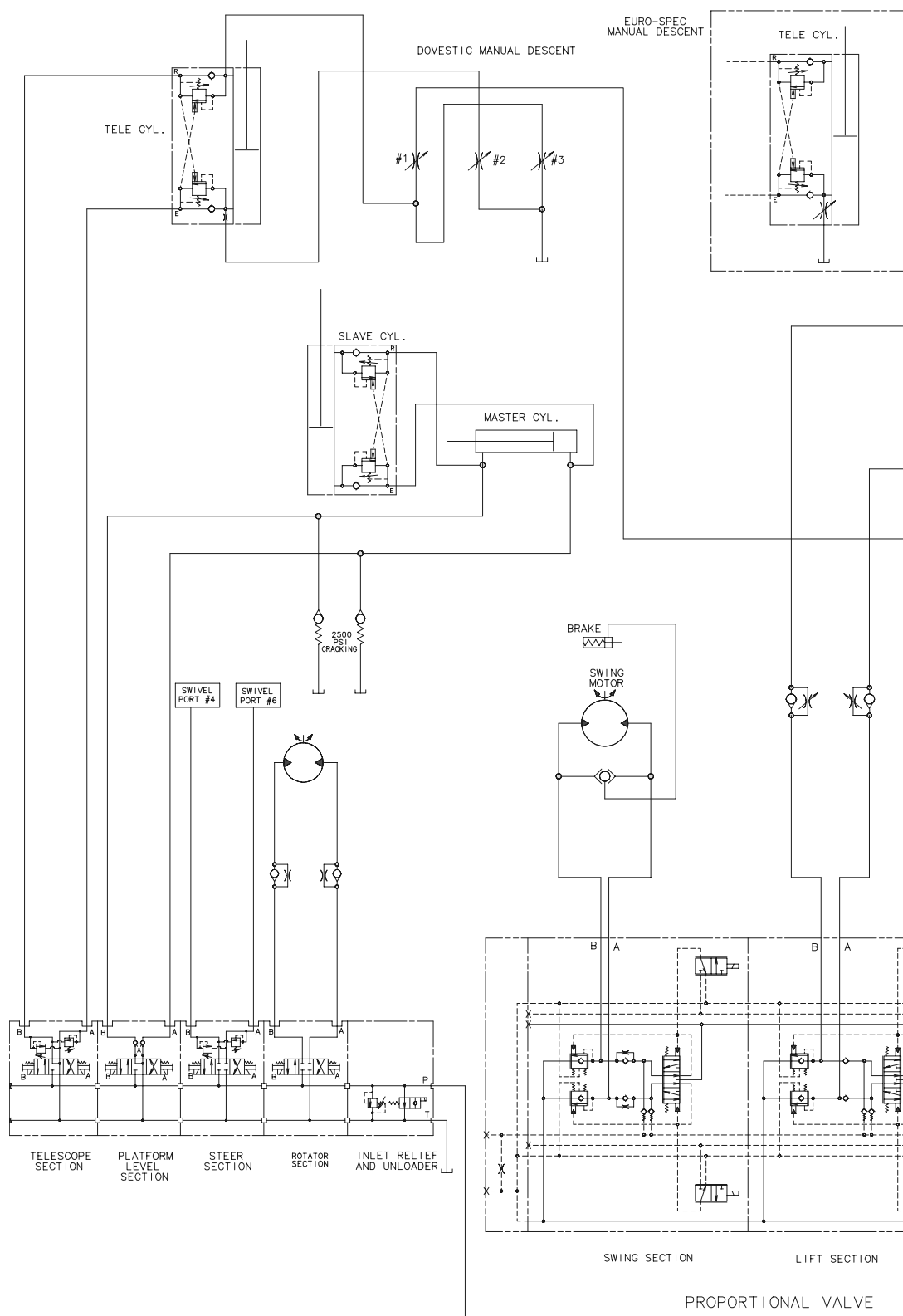


Figure 3-5. Hydraulic Schematic (Sheet 1 of 6)

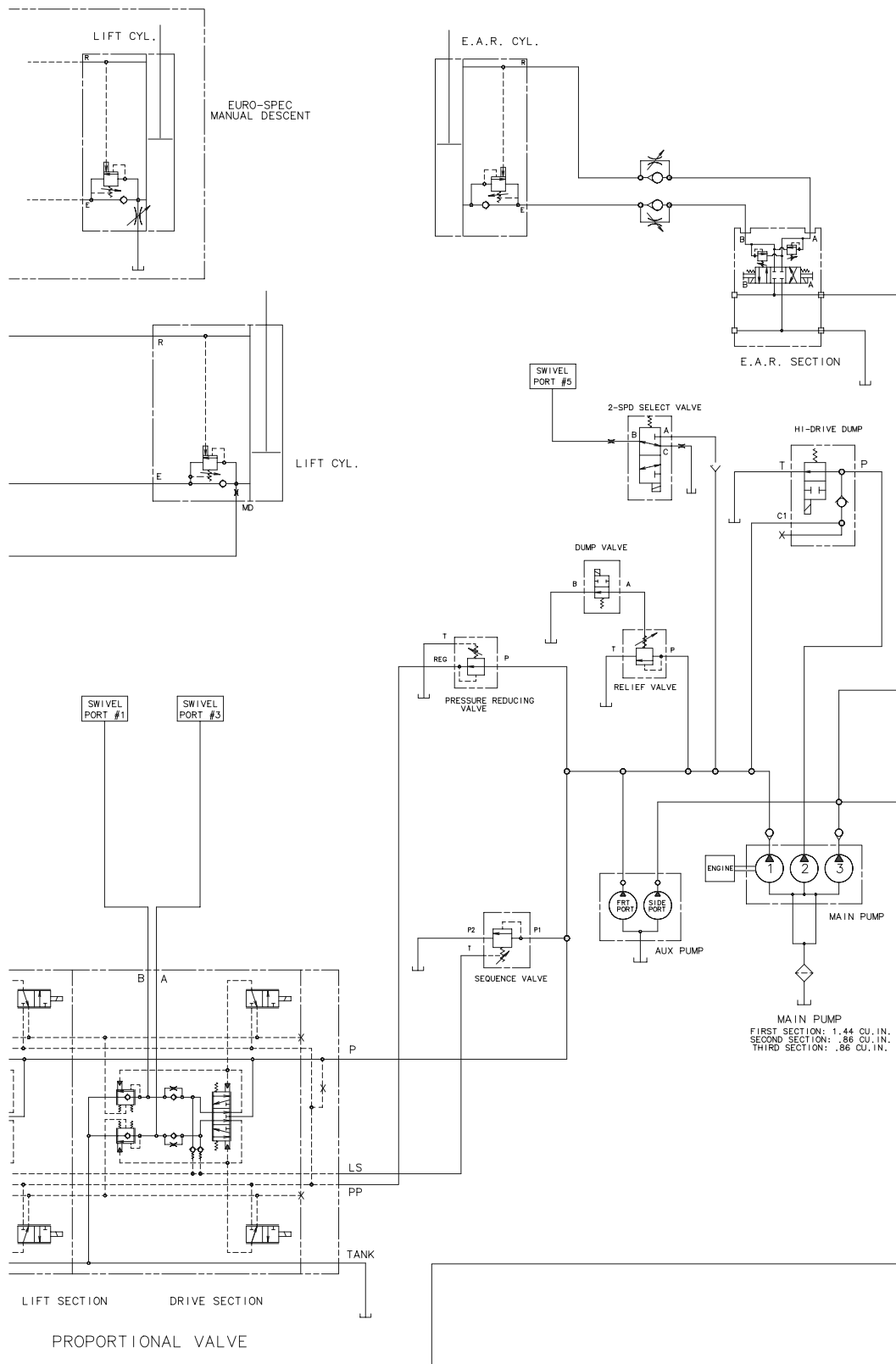


Figure 3-6. Hydraulic Schematic (Sheet 2 of 6)

2792231-

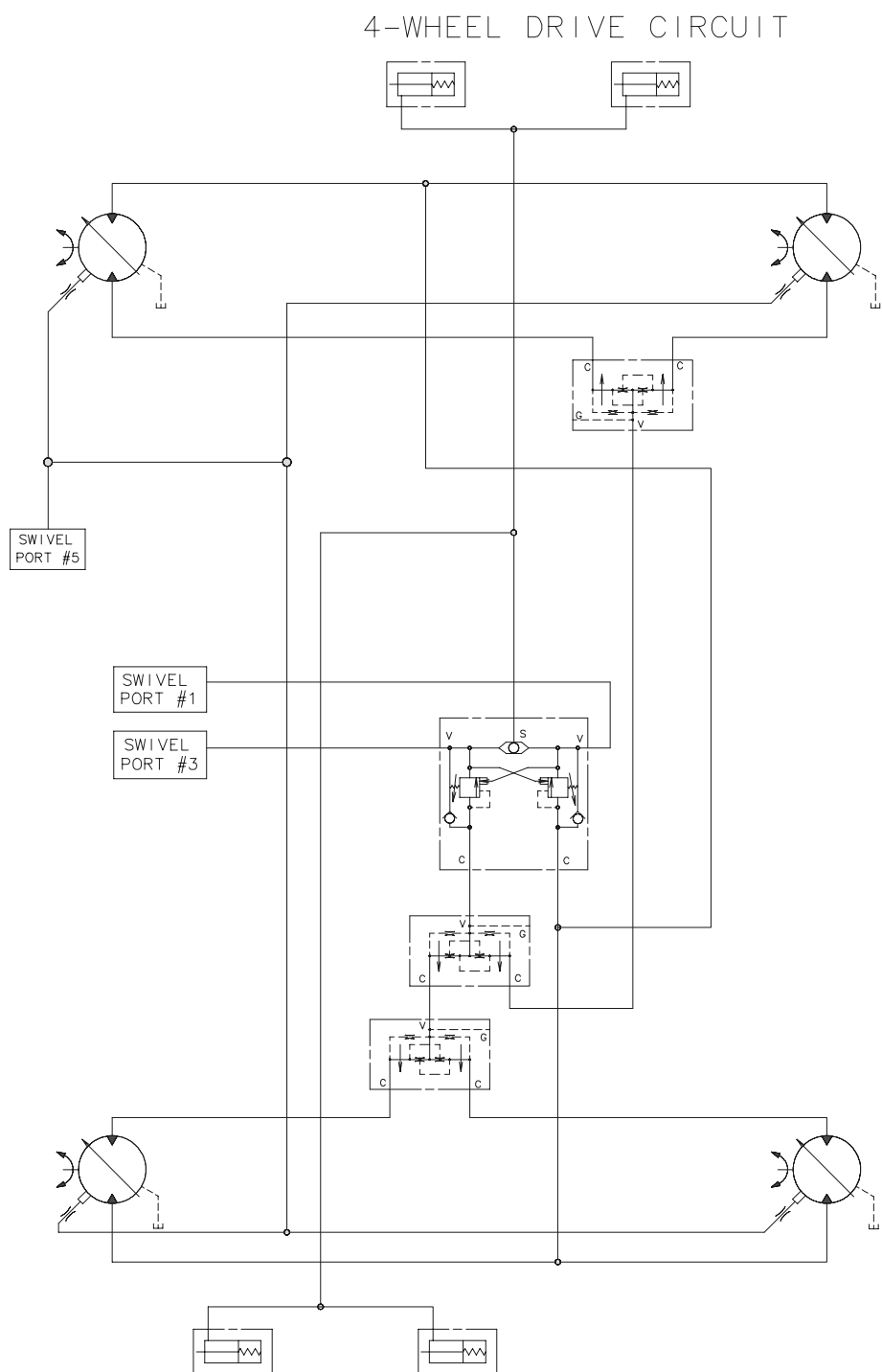


Figure 3-7. Hydraulic Schematic (Sheet 3 of 6)

2-WHEEL DRIVE CIRCUIT

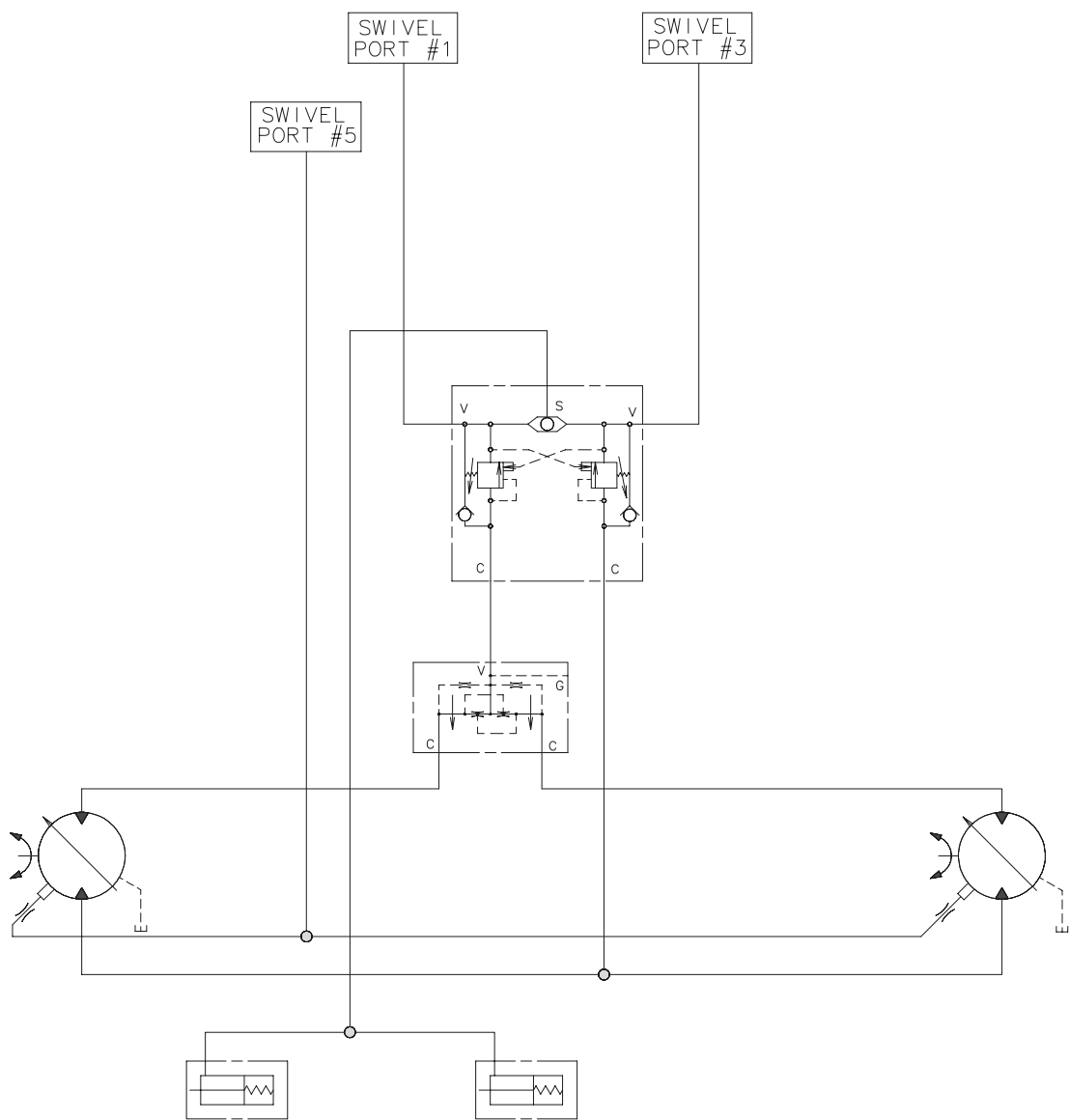


Figure 3-8. Hydraulic Schematic (Sheet 4 of 6)

2792231-

EXTENDABLE AXLE AND 4-WHEEL STEER W/TOW OPTION

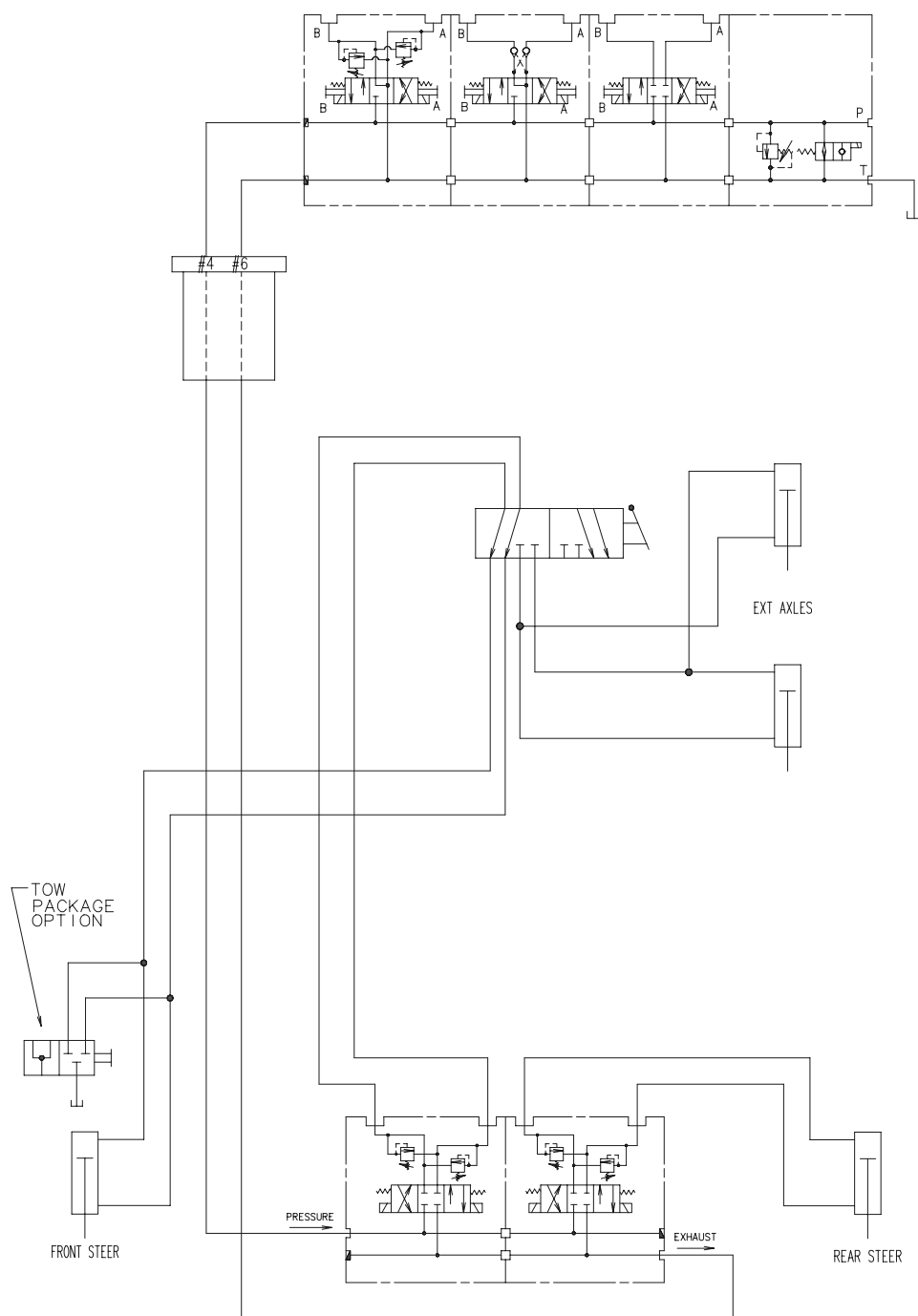
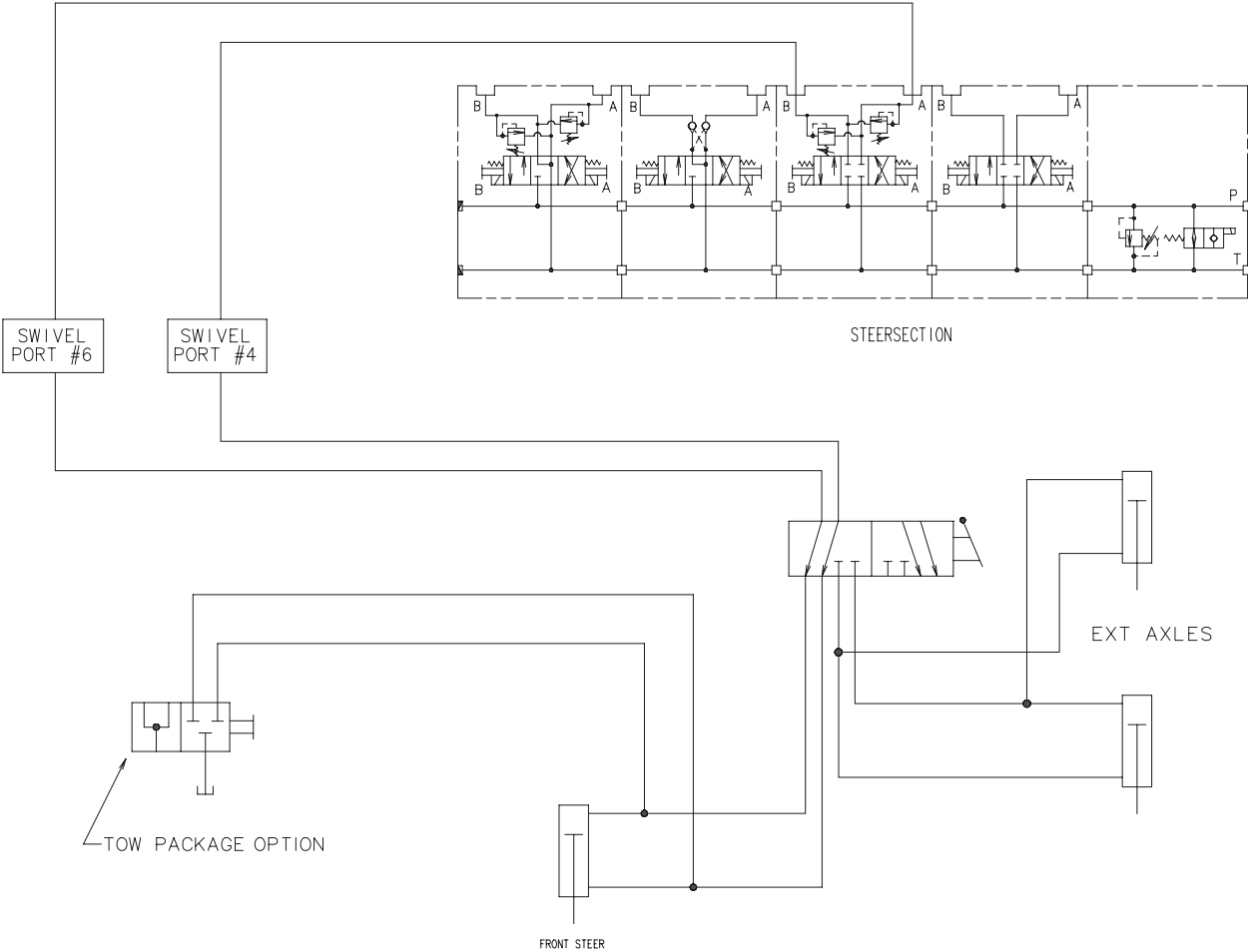


Figure 3-9. Hydraulic Schematic (Sheet 5 of 6)

EXTENDABLE AXLE AND 2-WHEEL STEERW/TOW OPTION



2792231-

Figure 3-10. Hydraulic Schematic (Sheet 6 of 6)

This page left blank intentionally.



Corporate Office
JLG Industries, Inc.
1 JLG Drive
McConnellsburg PA. 17233-9533
USA
Phone: (717) 485-5161
Fax: (717) 485-6417

JLG Worldwide Locations

JLG Industries (Australia)
P.O. Box 5119
11 Bolwarra Road
Port Macquarie
N.S.W. 2444
Australia
Phone: (61) 2 65 811111
Fax: (61) 2 65 810122

JLG Industries (UK)
Unit 12, Southside
Bredbury Park Industrial Estate
Bredbury
Stockport
SK6 2sP
England
Phone: (44) 870 200 7700
Fax: (44) 870 200 7711

JLG Deutschland GmbH
Max Planck Strasse 21
D-27721 Ritterhude/Ihlpohl
Bei Bremen
Germany
Phone: (49) 421 693 500
Fax: (49) 421 693 5035

JLG Industries (Italia)
Via Po. 22
20010 Pregnana Milanese - MI
Italy
Phone: (39) 02 9359 5210
Fax: (39) 02 9359 5845

JLG Latino Americana Ltda.
Rua Eng. Carlos Stevenson,
80-Suite 71
13092-310 Campinas-SP
Brazil
Phone: (55) 19 3295 0407
Fax: (55) 19 3295 1025

JLG Europe B.V.
Jupiterstraat 234
2132 HJ Foofddorp
The Netherlands
Phone: (31) 23 565 5665
Fax: (31) 23 557 2493

JLG Industries (Norge AS)
Sofeimyrveien 12
N-1412 Sofienyr
Norway
Phone: (47) 6682 2000
Fax: (47) 6682 2001

JLG Polska
Ul. Krolewska
00-060 Warszawa
Poland
Phone: (48) 91 4320 245
Fax: (48) 91 4358 200

JLG Industries (Europe)
Kilmartin Place,
Tannochside Park
Uddingston G71 5PH
Scotland
Phone: (44) 1 698 811005
Fax: (44) 1 698 811055

JLG Industries (Pty) Ltd.
Unit 1, 24 Industrial Complex
Herman Street
Meadowdale
Germiston
South Africa
Phone: (27) 11 453 1334
Fax: (27) 11 453 1342

Plataformas Elevadoras
JLG Iberica, S.L.
Trapadella, 2
P.I. Castellbisbal Sur
08755Castellbisbal
Spain
Phone: (34) 93 77 24700
Fax: (34) 93 77 11762

JLG Industries (Sweden)
Enkopingsvagen 150
Box 704
SE - 175 27 Jarfalla
Sweden
Phone: (46) 8 506 59500
Fax: (46) 8 506 59534
