



Service and Maintenance Manual

Models

1532E3

1932E3

2033E3

2046E3

2646E3

2658E3

3120878

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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

SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A.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.

A.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.

A.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 SERVICE MANUAL.
- 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.

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Hydraulic Oil Tank

1532E3/1932E3

14.0 liters (3.7 gallons) at full mark on tank

12.1 liters (3.2 gallons) at add mark on tank

2033E3/2046E3/2646E3/2658E3

14.8 liters (3.9 gallons) at full mark on tank

12.9 liters (3.4 gallons) at add mark on tank

Hydraulic System (Including Tank)

1532E3/1932E3 - Approximately 16.8 liters (4.4 gallons)

2033E3/2046E3/2646E3/2658E3 - Approximately 19.3 liters (5.1 gallons)

1.2 COMPONENT DATA

Hydraulic Pump/Electric Motor Assembly

24 Volts DC motor w/single section gear pump

All models 11.4 lpm (3.0 gpm)

Battery Charger

20 Amp SCR

120/240 Volts AC - 50 Hz input

24 Volts DC - 20 Amp output w/auto timer

Batteries (4)

All models - 6 Volt, 220 Amp Hour

Optional - (2033E3/2046E3/2646E3/2658E3) 6 Volt, 245 Amp Hour

Steer/Drive System

TIRES - 1532E3/1932E3

Standard - 4.50 x 14.00 - Solid, Non-Marking

Optional - 4.50 x 14.00 - Solid, Rib

TIRES - 2033E3/2046E3/2646E3/2658E3

Standard - 5.00 x 16.00 - Solid, Non-Marking

Optional - 5.00 x 16.00 - Solid, Rib

Optional (2046E3/2646E3/2658E3) - 7.50 x 16.00 - Solid, Flotation Tread

PARKING BRAKE - Single cylinder, spring applied, hydraulically released

DRIVE MOTORS

1532E3/1932E3 - 162 cm[3] (9.9 in.[3]) displacement

2033E3 - 229 cm[3] (14.0 in.[3]) displacement

2046E3/2646E3/2658E3 - 266 cm[3] (16.2 in.[3]) displacement

Hydraulic Filter - Inline

Return - Bypass Type

10 Microns Nominal

Platform Size

1532E3/1932E3 - 0.8 m x 1.6 m (30 in x 64 in)

2033E3 - 0.8 m x 2.4 m (30 in x 94 in)

2046E3/2646E3 - 1.1 m x 2.4 m (42 in x 94 in)

2658E3 - 1.4 m x 2.4 m (54 in x 94 in)

1.3 PERFORMANCE DATA

Travel Speed

1532E3/1932E3

Low Speed - 2.1 kmh (1.3 mph)

Elevated Speed - 0.80 kmh (0.5 mph)

Maximum Speed - 3.7 kmh (2.3 mph)

2033E3

Low Speed - 2.4 kmh (1.5 mph)

Elevated Speed - 0.80 kmh (0.5 mph)

Maximum Speed - 3.9 kmh (2.4 mph)

2046E3

Low Speed - 2.1 kmh (1.3 mph)

Elevated Speed - 0.80 kmh (0.5 mph)

Maximum Speed - 3.9 kmh (2.4 mph)

2646E3/2658E3

Low Speed - 2.1 kmh (1.3 mph)

Elevated Speed - 0.80 kmh (0.5 mph)

Maximum Speed - 3.4 kmh (2.1 mph)

SECTION 1 - SPECIFICATIONS

Gradeability

All Models - 25%

Inside Turning Radius

1532E3/1932E3/2033E3 - 7.6 cm (3 in)

2046E3/2646E3/2658E3 - 40.6 cm (16 in)

Inside Turning Angle

1532E3/1932E3/2033E3 - 87°

2046E3/2646E3/2658E3 - 80°

Lift (No Load in Platform)

Table 1-1. Lift Speeds

MODEL	LIFT UP (sec)	LIFT DOWN (sec)
1532E3	16-21	24-32
1932E3	17-22	24-32
2033E3	33-38	30-35
2046E3	34-39	28-33
2646E3	48-53	30-35
2658E3	59-69	30-35

Platform Capacity

1532E3 - 270 kg (600 lb)

1932E3 - 230 kg (500 lb)

2033E3/2646E3 - Standard - 340 kg (750 lb).

2046E3/2658E3 - 450 kg (1,000 lb).

If machine is equipped with optional pipe racks, maximum load on pipe racks is 45 kg (100 lb). Maximum total capacity of pipe racks and platform combined is as follows:

2033E3/2646E3 - 295 kg (650 lb)

2046E3/2658E3 - 408 kg (900 lb)

Manual Platform Extension Capacity

All Models - 120 kg (265 lb) - 1 person

Machine Weight

Table 1-2. Machine Weights

MODEL	CE	AUST
1532E3	1250 kg	1160 kg
1932E3	1315 kg	1315 kg
2033E3	2035 kg	2035 kg
2046E3	1970 kg	1790 kg
2646E3	2165 kg	2075 kg
2658E3	2330 kg	2125 kg

Wheelbase

1532E3/1932E3 - 1.3 m (50.0 in)

2033E3/2046E3/2646E3/2658E3 - 1.9 m (73.0 in)

Machine Height (Platform Fully Elevated)

1532E3 - 4.6 m (15 ft)

1932E3 - 5.8 m (19 ft)

2033E3/2046E3 - 6.1 m (20 ft)

2646E3/2658E3 - 7.9 m (26 ft)

Machine Height (Platform Lowered)

1532E3 - 1.9 m (75.75 in)

1932E3 - 2.0 m (79.75 in)

2033E3/2046E3 - 2.0 m (79.0 in)

2646E3/2658E3 - 2.2 m (88.0 in)

Platform Railing Height

Standard Handrails

1532E3/1932E3/2033E3/2046E3 - 1.0 m (39.5 in)

2646E3/2658E3 - (Fold down rails standard) 1.1 m (43.5 in)

Fold-Down Handrails

All Models - 1.1 m (43.5 in)

Machine Height (Platform Lowered - Fold Downs Folded)

1532E3 - 1.8 m (72 in)

1932E3 - 1.9 m (76 in)

2033E3/2046E3 - 1.7 m (65.5 in)

2646E3/2658E3 - 1.9 m (74.5 in)

Machine Length

1532E3/1932E3 - 1.8 m (71.25 in)

2033E3/2046E3/2646E3/2658E3 - 2.5 m (100 in)

Machine Width

1532E3/1932E3 w/standard tires - 0.8 m (32.5 in)

2033E3 w/standard tires - 0.8 m (33.0 in)

2046E3/2646E3 w/standard tires - 1.2 m (46.0 in)

2658E3 w/standard tires - 1.5 m (58.0 in)

2046E3/2646E3/2658E3 w/optional flotation tires - 1.5 m (60.0 in)

Ground Clearance

With Platform Lowered.

1532E3/1932E3/2033E3 - 7.6 cm (3.00 in)

2046E3/2646E3/2658E3 - 8.9 cm (3.50 in)

With Platform Elevated - (Pothole Protection System Lowered)

All Models - 1.9 cm (0.75 in)

Maximum Tire Load

1532E3 - 481 kg (1,060 lb)

1932E3 - 499 kg (1,100 lb)

2033E3 - 640 kg (1,410 lb)

2046E3 - 776 kg (1,710 lb)

2646E3 - 794 kg (1,750 lb)

2658E3 - 885 kg (1,950 lb)

Maximum Bearing Pressure

1532E3 - 6.5 kg/cm² (92 psi)

1932E3 - 6.6 kg/cm² (94 psi)

2033E3 - 7.2 kg/cm² (102 psi)

2046E3 - 8.2 kg/cm² (117 psi)

2646E3 - 8.4 kg/cm² (119 psi)

2658E3 - 9.1 kg/cm² (130 psi)

1.4 TORQUE REQUIREMENTS

Table 1-3. Torque Requirements

DESCRIPTION	TORQUE VALUE (DRY)	INTRVAL HOURS
Wheel Lugs	147-168 Nm (105-120 ftlb)	50
Wheel Hub to Drive Motor	169-203 Nm* (125-150 ftlb)	600
Motor Controller Battery Terminal Nuts	7Nm (60 in lb)	At Controller Replacement Only

* Torque nut to 169-203 Nm (dry) (125-150 ft lbs), then add extra torque to line up the slot with the hole in the shaft to install the cotter pin.

NOTE: When maintenance becomes necessary or a fastener has loosened refer to Figure 1-2., Torque Chart to determine proper torque value.

1.5 LUBRICATION

Hydraulic Oil

Table 1-4. Hydraulic Oil

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
0° F to +23° F (-18° C to -5° C)	10W
0° F to +210° F (-18° C to +99° C)	10W-20,10W-30
50° F to +210° F (+10° C to +210° C)	20W-20

NOTE: Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152 .

NOTE: When temperatures remain consistently below -7° C (20° F), JLG recommends the use of Mobil DTE13M hydraulic oil.

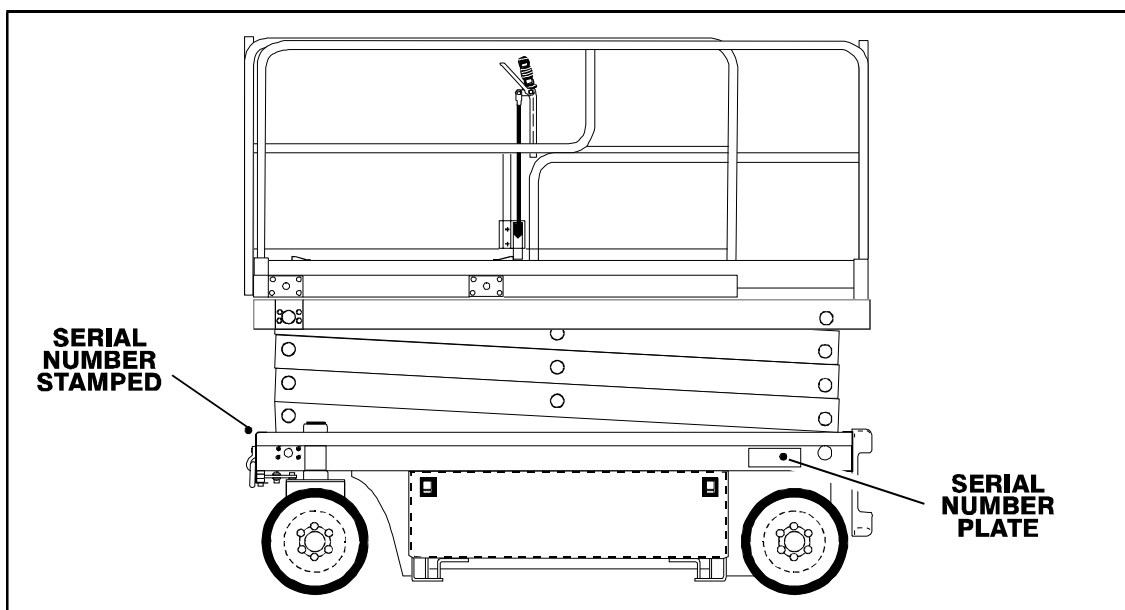


Figure 1-1. Serial Number Location

1.6 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The serial number plate is located on the left rear side of the machine frame, just above the left rear tire and wheel assembly. In addition, if the serial number plate is damaged or missing, the machine serial number is stamped on the right front of the frame

⚠ WARNING

TO AVOID PERSONAL INJURY, USE SAFETY PROP FOR ALL MAINTENANCE REQUIRING PLATFORM TO BE ELEVATED.

Table 1-5. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobilfluid 424.

NOTE: Operate lift function through one complete cycle before checking oil level. Oil level should be at the full mark or within 1.5 cm (0.5 in) below the full mark.

1.7 CYLINDER SPECIFICATIONS

NOTE: All dimensions are given in inches (in), with the metric equivalent, centimeters (cm), given in parentheses.

Table 1-6. Cylinder Specifications

DESCRIPTION	BORE	STROKE	ROD DIA
Lift Cylinder (1532E3/1932E3)	3.00 (7.6)	30.38 (77.2)	2.00 (5.1)
Lift Cylinder (2033E3/2046E3)	3.50 (8.9)	48.19 (122.40)	2.00 (5.1)
Lift Cylinder (2646E3/2658E3)	4.00 (10.2)	48.44 (123.0)	2.50 (6.4)
Steer Cylinder - All Models	1.50 (3.8)	6.35 (15.9)	0.75 (1.9)
Parking Brake Cylinder - All Models	2.00 (5.1)	1.75 (4.4)	1.00 (2.5)

1.8 PRESSURE SETTINGS

Main Relief - 3000 psi + 50/- 0 psi (207 bar + 3.4/- 0 bar).

Steer Relief - 2100 psi (145 bar).

Lift Up Relief

1532E3 - 112 bar (1625 psi)

1932E3 - 138 bar (2000 psi)

2033E3 - 105 bar (1525 psi)

2046E3 - 124 bar (1800 psi)

2646E3 - 124 bar (1800 psi)

2658E3 - 145 bar (2100 psi)

Powered Deck Extension Relief (If Equipped)

207 bar (3000 psi).

1.9 LIMIT SWITCHES

The machines are equipped with the following limit switches:

Tilt Alarm (optional 1-1/2° or 2°)

Illuminates a light on the platform and sounds an alarm when the machine is 1-1/2° or 2°, depending on which tilt the machine is equipped with, out of level in any direction.

High Drive Cut-Out

High drive speed is cut out when the platform is raised above the stowed position.

Drive Cut-Out (Models 2033E3, 2046E3, 2646E3, and 2658E3 with Powered Deck Extension)

On these machines, the Drive function is cut out when the powered deck extension is extended with the platform raised above the stowed position.

Electronic Armguard Switch

Lift down is cut out when the gap between the arms is in the range of 13 cm to 20 cm (5 in to 8 in). This will cut out lift down and sound the platform alarm for 1/2 second on, 1/2 second off, and repeat this for three seconds. After three seconds the operator must re-select the lift function and continue lifting down.

Temperature Switch

This switch prevents the high drive function from engaging when the oil temperature is very cold. The machine will remain in low drive until the oil has warmed and will then automatically move up to high drive.

1.10 CRITICAL STABILITY WEIGHTS

Table 1-7. Critical Stability Weights

Component	1532E3/1932E3	2033E3/2046E3/ 2646E3/2658E3
Tires-Solid (each)	24 lb (11 kg)	31 lb (14 kg)
Tires-Solid-Non-Marking (each)	24 lb (11 kg)	30 lb (14 kg)
Motor/Pump Assembly	41 lb (19 kg)	41 lb (19 kg)
Batteries - Standard, (each)	63 lb (21 kg)	63 lb (21 kg)
Batteries - Standard (combined)	252 lb (114 kg)	252 lb (114 kg)

SECTION 1 - SPECIFICATIONS

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				CLAMP LOAD (KG)	TORQUE (as received)
				CLAMP LOAD (KG)	(LUB.)	(LOCTITE 262)	(LOCTITE 242 OR 271)	(DRY OR LOC. 263)	(LUB.)	(LOCTITE 262)	(LOCTITE 242 OR 271)		
4	40	0.2845	0.0153	172	1	1	—	—	—	—	—	—	—
	48	0.0168	0.0168	191	1	1	—	—	—	—	—	—	—
6	32	0.0232	0.0232	263	2	2	—	—	—	—	—	—	—
	40	0.0258	0.0258	277	2	2	—	—	—	—	—	—	—
8	32	0.0356	0.0356	408	4	3	—	—	—	—	—	—	—
	36	0.0374	0.0374	426	4	3	—	—	—	—	—	—	—
10	24	0.0445	0.0445	508	5	4	—	—	—	—	—	—	—
	32	0.0508	0.0508	583	6	4	—	—	—	—	—	—	—
1/4	20	0.0808	0.0808	916	11	9	—	—	—	—	—	—	—
	28	0.0925	0.0925	1052	14	10	—	—	—	—	—	—	—
5/16	18	0.1331	0.1331	1515	23	18	—	—	—	—	—	—	—
	24	0.1473	0.1473	1678	26	19	—	—	—	—	—	—	—
3/8	16	0.1969	0.1969	2241	41	31	—	—	—	—	—	—	—
	24	0.09525	0.2230	2540	48	34	—	—	—	—	—	—	—
7/16	14	0.2700	0.3015	3085	68	48	—	—	—	—	—	—	—
	20	0.3604	0.4061	4105	102	75	—	—	—	—	—	—	—
1/2	13	0.4623	0.5156	5874	163	122	—	—	—	—	—	—	—
	20	0.5740	0.6502	7394	231	176	—	—	—	—	—	—	—
9/16	12	0.8484	0.9474	10796	407	298	—	—	—	—	—	—	—
	18	1.1735	1.2929	14697	637	475	—	—	—	—	—	—	—
5/8	11	1.5875	1.5392	17509	868	651	—	—	—	—	—	—	—
	18	2.2225	1.6840	19142	949	719	—	—	—	—	—	—	—
3/4	10	1.9050	2.1742	21546	1193	895	—	—	—	—	—	—	—
	16	2.8575	2.4613	24404	1519	1139	—	—	—	—	—	—	—
7/8	9	3.1750	2.7254	27035	1681	1247	—	—	—	—	—	—	—
	14	3.4925	2.9337	29076	1980	1492	—	—	—	—	—	—	—
1	8	3.8100	3.3401	33113	2278	1708	—	—	—	—	—	—	—
1-1/8	12		3.5687	35381	2630	1980	—	—	—	—	—	—	—
1-1/4	7		4.0132	39781	2983	2224	—	—	—	—	—	—	—
1-1/2	6						—	—	—	—	—	—	—
1-1/2	12						—	—	—	—	—	—	—

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



SAE GRADE 5



SAE GRADE 8

Figure 1-2. Torque Chart

SECTION 2. PROCEDURES

2.1 GENERAL

This section provides information necessary to perform maintenance on the scissor lift. 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.

NOTE: Maintenance procedures provided in this section apply to all six scissor lift models covered in this manual. Procedures that apply to a specific model will be so noted.

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 eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90°.
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.

SECTION 2 - PROCEDURES

3. If a 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.

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 is 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.

Batteries

Clean batteries, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry batteries 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, except as recommended, 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 Hydraulic Oil Table in previous section for recommendations for viscosity ranges.

2. JLG recommends Mobilfluid 424, which has an SAE viscosity of 10W-30 and a viscosity index of 152, which has an SAE viscosity of 10W-20 and a viscosity index of 152.

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 13M 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 13M oil should not be operated at temperatures above 94°C (200°F) under any condition.

Changing Hydraulic Oil

1. Use of any of the recommended crankcase or hydraulic oils increases JLG's recommended oil change interval to 1200 hours. However, filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. When changing the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If you are unable to obtain the same type of oil supplied with the machine, consult your local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.
2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.
3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

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

2.4 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. The Lift and Steer systems incorporate double acting cylinders. 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 the 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.

A holding valve is used in the Lift circuit to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

2.5 VALVES - THEORY OF OPERATION

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 consists 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.

SECTION 2 - PROCEDURES

Proportional Control Valves

The proportional control 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 a sequence valve. The sequence valve senses the difference between the load and pump outlet pressure, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valve's 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 sequence valve. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard.

Relief Valves

Main relief valves are installed at various points within the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

Crossover 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 circuit.

2.6 COMPONENT FUNCTIONAL DESCRIPTION

Hydraulic Pump

The main hydraulic pump is an integral part of the electric motor/pump assembly, located at the rear of the battery and ground control tray on the frame of the machine. The pump is a single section pump that provides an output of 11.4 lpm (3.0 gpm).

Lift Cylinder Counterbalance/Manual Descent Valve

The lift cylinder counterbalance/manual descent valve is located on top of the lift cylinder. The counterbalance valve is used to hold the platform in place when raised. A cable is connected to the valve which, when pulled, manually opens the lift down port and allows the platform to be lowered in the event hydraulic power is lost.

Positive Traction Valve

The positive traction solenoid valve is located on the main control valve and is activated by a switch on the platform control box. When activated, it equally divides the flow of hydraulic oil in the drive circuit to send an equal amount of oil to each drive motor.

2.7 WEAR PADS

Sliding Pads

The original thickness of the sliding pads is 51 mm (2.0 in). Replace sliding pads when worn to 48 mm (1.875 in).

2.8 CYLINDER CHECKING PROCEDURES

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

Cylinder w/o Counterbalance Valves - Platform Extension Cylinder (If Equipped), Brake Cylinder and Steer Cylinder

IMPORTANT

OPERATE FUNCTIONS FROM GROUND CONTROL STATION ONLY.

WARNING

WHEN WORKING ON THE LIFT CYLINDER, RAISE THE PLATFORM COMPLETELY AND SUPPORT THE PLATFORM USING A SUITABLE OVERHEAD LIFTING DEVICE. DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

1. Using all applicable safety precautions, activate motor and fully extend cylinder to be checked. Shut down motor.

2. Carefully disconnect hydraulic hose from retract port of 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 motor and activate cylinder extend function. Check retract port for leakage.
4. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to retract port and retract cylinder.
5. With cylinder fully retracted, shut down motor and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate motor and activate cylinder retract function. Check extend port for leakage.
7. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, then activate cylinder through one complete cycle and check for leaks.

Cylinders w/Single Counterbalance Valves - Lift Cylinder

IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

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

WARNING

WHEN WORKING ON THE LIFT CYLINDER, RAISE THE PLATFORM COMPLETELY AND SUPPORT THE PLATFORM USING A SUITABLE OVERHEAD LIFTING DEVICE. DO NOT FULLY EXTEND LIFT CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Raise platform completely then retract cylinder slightly to avoid trapping pressure. Place a suitable overhead lifting device approximately 2.5 cm (1 in) below the platform.
3. Shut down hydraulic system and allow machine to sit for 10-15 minutes. Carefully remove hydraulic hoses from 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. If no repairs are necessary or when repairs have been made, carefully reconnect hydraulic hoses to the appropriate ports.
6. Remove lifting device from platform, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

2.9 ARM ASSEMBLY MAINTENANCE

IMPORTANT

IT IS RECOMMENDED THAT WHEN PERFORMING MAINTENANCE ON THE ARM ASSEMBLY THE MACHINE BE PARKED IN THE STOWED POSITION (FULLY LOWERED).

Platform Removal

Remove the platform from the arm assembly, with the platform extension and rail assemblies intact, as follows:

1. Disconnect electrical control cable from platform control box.
2. Disconnect any other options that lead to the platform from the arm assembly

NOTE: The approximate weight of the platform and rail assemblies is 227 kg (500 lb). When removing the platform and rail assemblies, be sure the lifting device being used is capable of handling these weights.

3. Using an overhead crane, or suitable lifting device, use nylon straps to support platform and rail assemblies.
4. Remove pin retaining hardware from front and rear deck pins.
5. Using a suitable brass drift and a hammer, remove pins from the pivot mounts on the under side front of the platform and from the slide blocks in rear.
6. Using all applicable safety precautions, carefully lift platform and rail assemblies clear of arm assembly and lower to ground or suitable supported work surface.

SECTION 2 - PROCEDURES

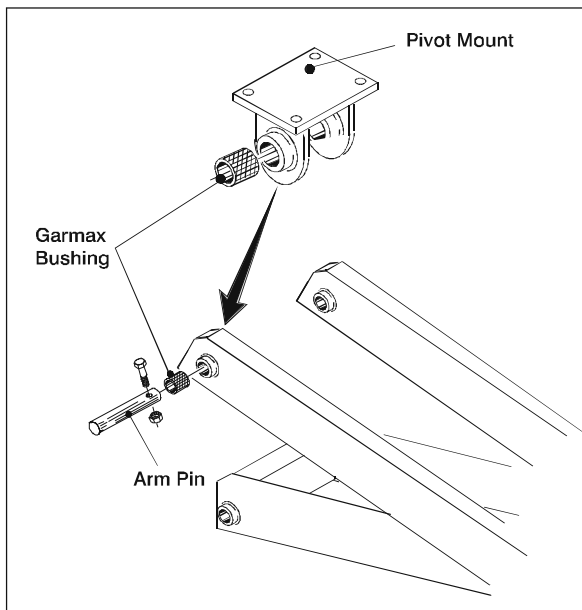


Figure 2-1. Platform Removal

Disassembly of Arms

NOTE: If performing maintenance on any of the arms or arm bushings be sure and pull the pins outward. DO NOT try to drive the pins through or they will fall into the cross tubes of the inner arms.

1. Remove hardware, from the pin, that secures the pin to the arm.
2. Place a pry bar or suitable prying device behind the washer and retaining ring and pull the arm pin out.
3. Using a suitable lifting device, lift the arm to be removed and lower to the ground or suitable supported work surface.
4. Repeat this, if necessary, in order to perform maintenance on various arms.

NOTE: If the removal of the lift cylinder becomes necessary refer to lift cylinder removal section, steps 2 through 6.

2.10 LIFT CYLINDER REMOVAL AND INSTALLATION

Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the motor and raise the platform. Shut down the engine and attach a suitable lifting device to the platform.

2. Remove the bolt and locknut securing the cylinder rod attach pin to the upper inner arm assembly. Using a suitable brass drift, drive out the rod end attach pin from the arm assembly.
3. Retract the lift cylinder rod completely.
4. Tag and disconnect the hydraulic lines, then cap the lift cylinder hydraulic lines and ports.
5. Remove the bolt and locknut securing the barrel end attach pin to the lower arm assembly. Using a suitable brass drift, drive out the barrel end attach pin from the arm assembly.
6. Carefully remove the cylinder from the scissor lift and place in a suitable work area.

Lift Cylinder Installation

1. Install lift cylinder in place using suitable slings, aligning barrel end attach pin mounting holes on lower arm assembly.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the lower arm assembly. Secure in place with the bolt and locknut.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Extend the cylinder rod until the attach pin hole aligns with those in the upper arm assembly. Using a suitable drift, drive the cylinder rod attach pin through the aligned holes, taking care to align the pin retaining hole with the hole in arm assembly. Secure the pin in place with the bolt and locknut.
5. Lower platform to stowed position and shut down motor. Check hydraulic fluid level and adjust accordingly.

2.11 LIFT CYLINDER REPAIR

NOTE: The following procedures apply to the lift cylinder only.

Disassembly

⚠ IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA. BE SURE TO CLEAN ALL DIRT OR OTHER FOREIGN SUBSTANCES FROM CYLINDER OPENINGS - PARTICULARLY AT THE HEAD.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

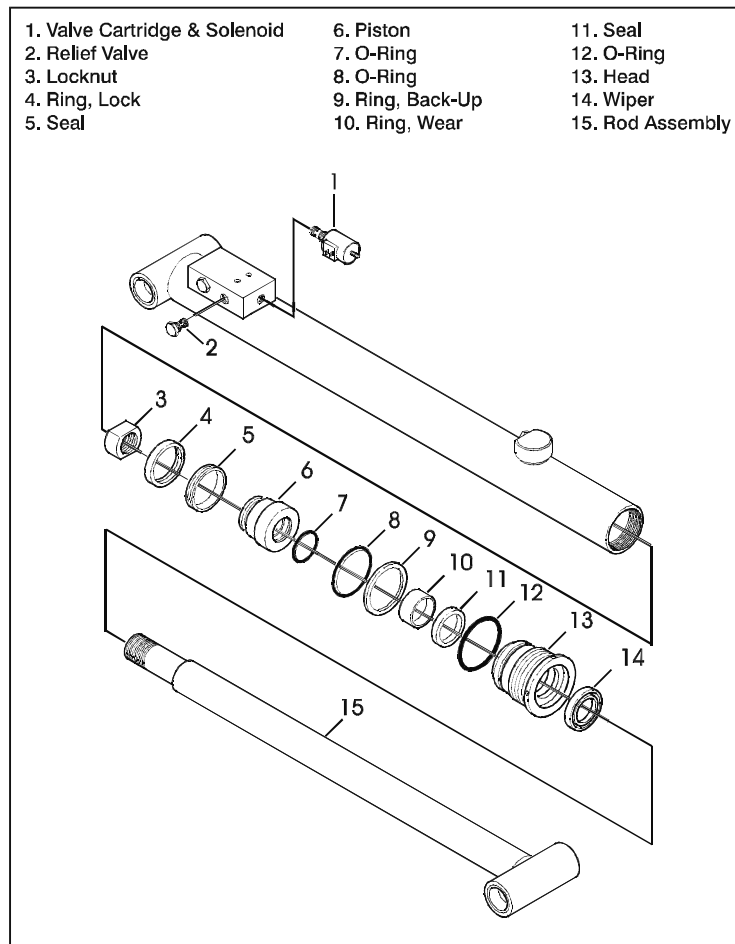


Figure 2-2. Lift Cylinder Components Assembly

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if necessary.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.
5. To aid in realignment, mark cylinder head and barrel with a center punch.
6. Using a suitable spanner wrench, loosen the spanner nut retainer and remove the spanner nut from the cylinder barrel.

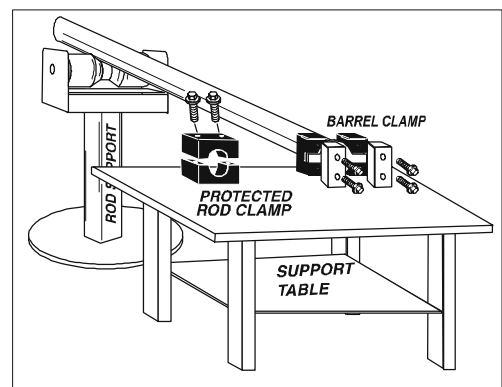


Figure 2-3. Barrel Support

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

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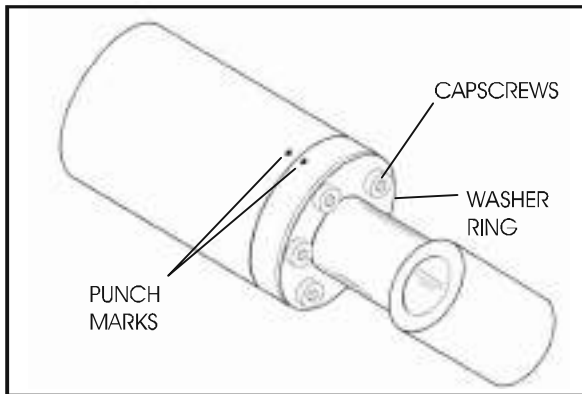


Figure 2-4. Capscrew Removal

⚠ 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.

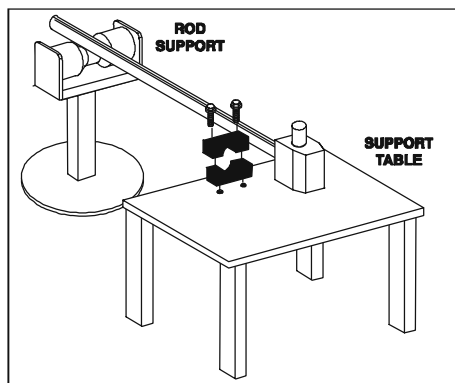


Figure 2-5. Rod Support

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. If applicable, loosen and remove the nut which attaches the piston to the rod, then remove the piston from the rod.
11. If applicable, loosen and remove the cap screw(s) securing the tapered bushing to the piston.
12. Insert the capscrew(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston, then remove the bushing from the piston.

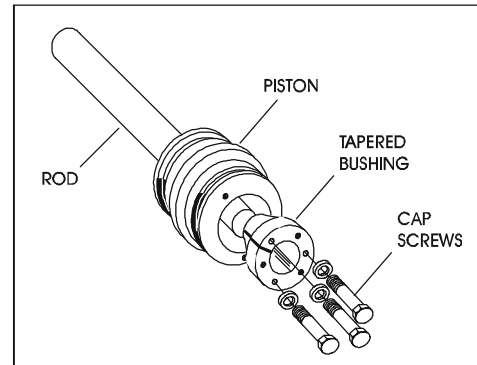


Figure 2-6. Tapered Bushing Removal

13. Screw the piston counter-clockwise, by hand, and remove the piston from the cylinder rod.
14. Remove and discard the piston o-rings, back-up rings, guidelock rings and hydrolock seals.
15. If applicable, remove the piston spacer from the rod.
16. Remove the rod from the holding fixture. Remove the cylinder head and retainer plate from the rod.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.

11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct lubrication and excessive wear. If necessary, replace bearings as follows:
 - a. Thoroughly clean steel bushing hole of burrs, dirt, etc. to facilitate bearing installation.
 - b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod or barrel (as applicable) must be replaced.
 - c. Lubricate inside of steel bushing with WD-40 prior to bearing installation.
 - d. Using arbor of the correct size, carefully press the bearing into the steel bushing.

NOTE: Install the cylinder pin into the Oil-lite bearing dry. Lubrication is not required with chrome pins and bearings.

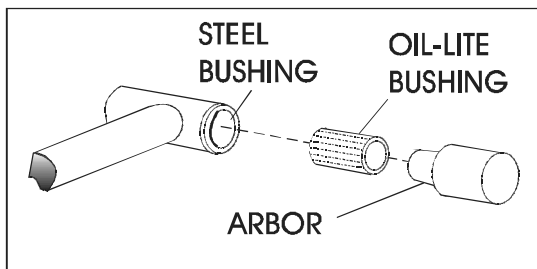


Figure 2-7. Oil-lite Bearing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTE: Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. Apply a light film of hydraulic oil to all components prior to assembly.

1. Using a special tool, pictured in the following illustration, install a new rod seal into the applicable cylinder head gland groove. Refer to the following illustration for the proper tool size.

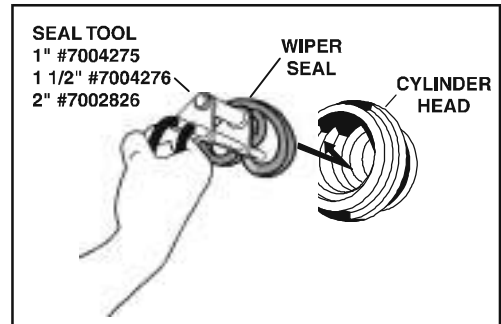


Figure 2-8. Rod Seal Installation

⚠ IMPORTANT

WHEN INSTALLING NEW "POLY-PAK" TYPE PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO FIGURE 2-13., POLY-PAK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

2. Using a soft mallet, tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable head gland groove.



Figure 2-9. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.
4. Install a washer ring onto the rod, then carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer onto the rod.
6. If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.

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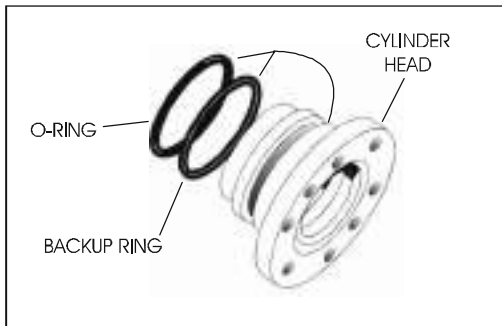


Figure 2-10. Installation of Head Seal Kit

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
9. Thread the piston onto the rod until it abuts the spacer end and install the tapered bushing.

NOTE: When installing the tapered bushing, the piston and mating end of the rod must be free of oil.

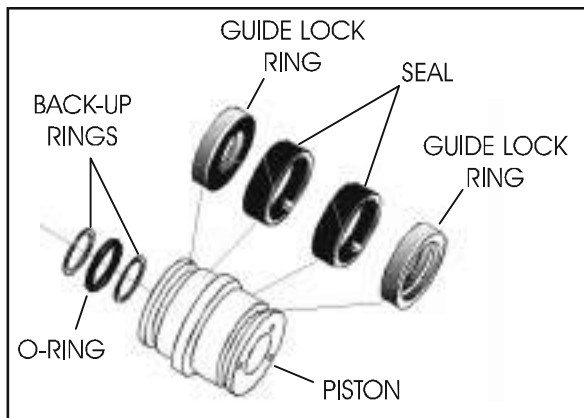


Figure 2-11. Piston Seal Kit Installation

⚠ WARNING

WHEN REBUILDING THE LIFT CYLINDER, APPLY LOCTITE #242 TO TAPERED BUSHING BOLTS, THEN TIGHTEN BOLTS SECURELY. REFER TO TABLE 2-1, CYLINDER COMPONENT TORQUE SPECIFICATIONS FOR PROPER BOLT TORQUE VALUES.

10. Install the bolts into the bushing using Loctite #242. Refer to Table 2-1, Cylinder Component Torque Specifications for proper bolt torque values.

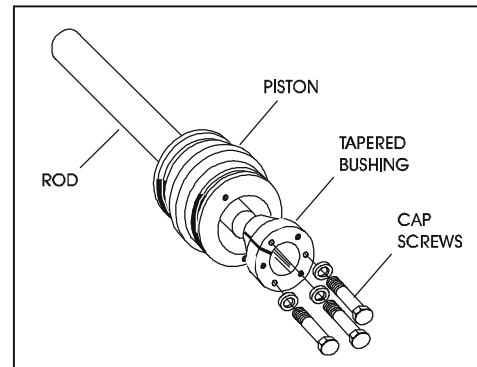


Figure 2-12. Tapered Bushing Installation

11. Remove the cylinder rod from the holding fixture.
12. Place new guidelock and hydrolock seals in the applicable outside diameter grooves of both the piston and the cylinder head.

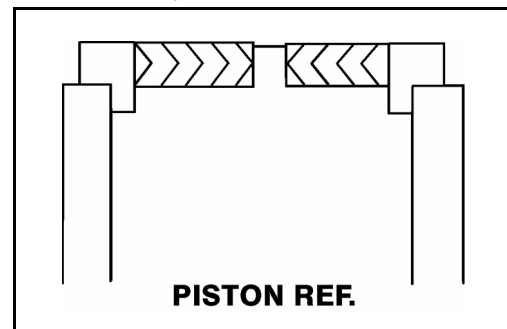


Figure 2-13. Poly-Pak Piston Seal Installation

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

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

14. With the barrel clamped securely, and while adequately supporting the rod, insert the piston end into the cylinder barrel. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the cylinder barrel.
16. Secure the cylinder head gland using the washer ring and socket head bolts. Refer to Table 2-1, Cylinder Component Torque Specifications for proper bolt torque specifications.

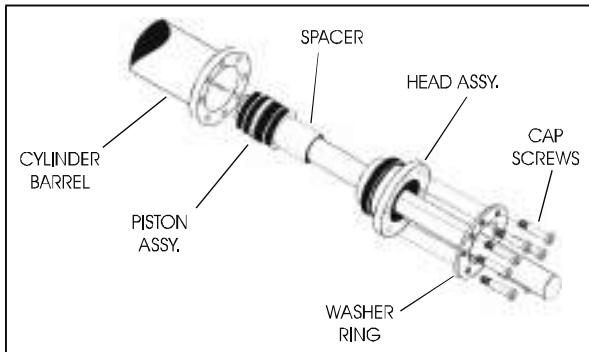


Figure 2-14. Rod Assembly Installation

17. 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.
18. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable.

Table 2-1. Cylinder Component Torque Specifications

Component	Torque Value (w/Loctite)
Tapered Bushing Retaining Screws - Lift Cylinder	108 Nm (80 ft lb)
Head Retaining Screws	12 Nm (9 ft lb)
Piston Nut - 1532E3/1932E3	508-610Nm (375-450 lb)
Piston Nut - 2033E3/2046E3/ 2646E3/2658E3	1085-1356 Nm (800-1000 ft lb)

2.12 LIFT CYLINDER REPAIR

Disassembly

⚠ IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA. BE SURE TO CLEAN ALL DIRT OR OTHER FOREIGN SUBSTANCES FROM CYLINDER OPENINGS - PARTICULARLY AT THE HEAD.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

⚠ 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.

5. Using a suitable spanner wrench inserted in the holes provided, turn the cylinder head counter-clockwise to remove it from the cylinder barrel. If the head is difficult to turn or moves erratically, tap the tube adjacent to the head with a brass or plastic mallet while turning it.
6. Attach a suitable pulling device to the cylinder rod end.
7. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston and head as possible.
9. Remove the lock nut which attaches the piston to the rod, and remove the piston.
10. Slide the head off the rod from the piston end.
11. Remove and discard the sealing o-ring, wiper, u-cup seal, static o-ring, static back-up ring and wear ring.
12. Remove the piston guidelock ring.
13. Remove and discard the piston o-ring and seals, then remove the piston spacer.
14. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer, if applicable. Discard the o-rings, back-up rings, rod seals, and wiper seals.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scratches or pits deep enough to catch the fingernail. Pits that go to the base metal are unacceptable. Scratches that catch the fingernail but are not to the base metal, less than 12.7 mm (0.5 inch) long and primarily in the circum-

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ferential direction are acceptable provided they cannot cut the rod seal. Chrome should be present over the entire surface of the rod; the lack of chrome on the rod surface is unacceptable. If an unacceptable condition exists, repair or replace the rod.

3. Inspect the threaded portion of the rod for excessive damage. Dress the threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scratches and pits. There should be no scratches or pits deep enough to catch the fingernail. Scratches that catch the fingernail but are less than 12.7 mm (0.5 inch) long and primarily in the circumferential direction are acceptable provided they cannot cut the piston seal.
5. Inspect the threaded portion of the barrel tube for damage. Dress the threads as necessary.
6. Inspect piston outside surface for scratches or polishing. Deep scratches are unacceptable. Polishing indicates uneven loading and when this occurs, the diameter should be checked for out-of-roundness. If out-of-roundness exceeds 0.178 mm (0.007 inch), this is unacceptable. Check the condition of the seal and o-ring, looking particularly for metallic particles embedded in the seal and o-ring surfaces. Remove the seal and o-ring. Damage to the seal grooves, particularly on the sealing surfaces, is unacceptable. If an unacceptable condition exists, replace the piston.
7. Inspect the piston spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
8. Inspect the cylinder head inside bore for scratches or polishing. Deep scratches are unacceptable. Polishing indicates uneven loading and when this occurs, the bore should be checked for out-of-roundness. If out-of-roundness exceeds 0.178 mm (0.007 inch), this is unacceptable. Check for the condition of the dynamic seals, looking particularly for metallic particles embedded in the seal surface. It is normal to cut the static seal on the retaining ring groove upon disassembly. Remove the rod seal, static o-ring, backup ring, and rod wiper. Damage to the seal grooves, particularly on the sealing surfaces, is unacceptable. If an unacceptable condition exists, replace the head.
9. Inspect the port block fittings and holding valve. Replace as necessary.
10. Inspect the oil ports 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. Refer to the Illustrated Parts Manual.

NOTE: Apply a light film of hydraulic oil to all components prior to assembly.

IMPORTANT

WHEN INSTALLING NEW "POLY-PAK" TYPE PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO FIGURE 2-7 FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

1. Using round-nose pliers or special installation tools, twist the loaded u-cup seal into a "C" shape and allow it to snap into the groove. Use a similar technique for installing the wiper.
2. Install a new static o-ring and back-up o-ring into the static seal groove, verifying that the back-up o-ring is closest to the threads. Install a new sealing o-ring into the groove between the threads and the flange lip. Install a new wear ring into the inside applicable head groove. If possible, the head/seal assembly should sit for at least one hour to allow the seals to elastically restore.
3. Carefully slide the head assembly onto the cylinder rod, ensuring that the wiper seal, o-ring and wear ring are not damaged or dislodged.
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. Place a new o-ring in the inner piston diameter groove.
6. Carefully place the piston on the cylinder rod, ensuring that the o-ring is 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

APPLY "LOCQUIC PRIMER T" AND LOCTITE #242 TO PISTON NUT THREADS, THEN TIGHTEN NUT TO TORQUE SHOWN IN TABLE 2-1.

9. Torque the piston nut to the proper torque as outlined in the Figure 2-1, Cylinder Component Torque Specifications

10. Remove the cylinder rod from the holding fixture.
11. Install new seals and a new guidelock ring in the applicable outside diameter grooves of the piston.
12. Position the cylinder barrel in a suitable holding fixture.

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

13. With barrel clamped securely, and while adequately supporting the rod, insert the piston end of the rod into the cylinder barrel. Ensure that the piston seals are not damaged or dislodged.
14. Continue pushing the rod into the barrel until the cylinder head can be inserted into the cylinder barrel.
15. Slide the head into the barrel and engage the threads. Turn the head counterclockwise until the first thread just passes the engagement point (the head will move noticeably), then turn the head clockwise until it is hand-tight or fully seated. Insert a spanner wrench into the holes provided and tighten 1/8 to 1/4 turn past fully seated.
16. 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.
17. If removed, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable. Torque the holding valve cartridge to 68-75 Nm (50-55 ft lb).

2.13 BRAKE CYLINDER REPAIR

Disassembly

⚠ IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Tag and disconnect the hoses from the cylinder ports.

⚠ WARNING

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Place the cylinder barrel into a suitable holding fixture.

3. Using a suitable pair of snap ring pliers, carefully remove the retaining ring from the cylinder barrel.
4. Attach a suitable pulling device to the cylinder rod end.

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, GUIDE, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

5. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
7. Carefully remove the piston locknut and piston from the cylinder rod. Remove and discard the piston ring and o-rings.
8. Carefully remove the guide from the cylinder rod. Remove and discard the o-ring, back-up ring, rod seal, and wiper ring.
9. Remove the cylinder rod from the holding fixture.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
7. Inspect cylinder guide inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
8. Inspect seal and o-ring grooves in guide for burrs and sharp edges. Dress applicable surfaces as necessary.

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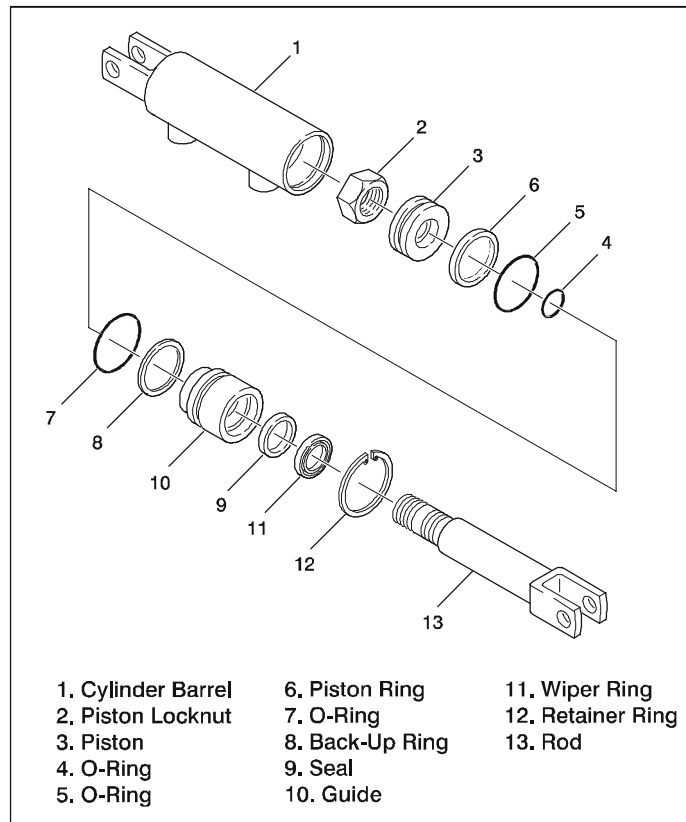


Figure 2-15. Brake Cylinder Assembly

9. Inspect cylinder guide outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
10. Inspect the oil ports 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.

Apply a light film of hydraulic oil to all components prior to assembly.

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
2. Place a new wiper ring, rod seal, o-ring, and back-up ring into the applicable cylinder guide grooves.
3. Carefully install the guide on the rod, ensuring that the wiper ring and rod seal are not damaged or dislodged. Push the guide onto the rod.
4. Place a new piston ring and o-rings on the piston.

5. Carefully place the piston on the threaded end of the cylinder rod, ensuring that the o-ring is not damaged or dislodged. Push the piston onto the rod as far as it will go.
6. Install the piston locknut on the threaded end of the cylinder rod and torque to 136-163 Nm (100-120 ft. lb.).
7. Remove the cylinder rod from the holding fixture.
8. Position the cylinder barrel in a suitable holding fixture.

⚠ DANGER

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, GUIDE, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

9. With the barrel clamped securely, and while adequately supporting the cylinder rod, insert the piston end of the rod into the cylinder barrel. Ensure that the piston ring and o-ring are not damaged or dislodged.

10. Continue pushing the rod into the barrel until the cylinder guide can be inserted into the cylinder barrel.
11. Using all applicable safety precautions, secure the cylinder rod assembly with a new retaining ring.
12. Reconnect the hydraulic hoses to the applicable cylinder ports.

2.14 STEER CYLINDER REPAIR

Disassembly

IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Tag and disconnect the hoses from the cylinder ports.

WARNING

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Place the cylinder barrel into a suitable holding fixture.
3. Using a suitable hammer, tap around the outside of the cylinder barrel and guide to shatter the Loctite.
4. Using a suitable spanner wrench, carefully remove the guide from the rod Clevis end of the cylinder barrel.
5. Attach a suitable pulling device to the clevis end of cylinder rod section one.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, GUIDE, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

6. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
7. Using a suitable hammer, tap around the outside of the cylinder barrel and guide to shatter the Loctite.
8. Using a suitable spanner wrench, carefully remove the remaining guide from the cylinder barrel. Remove and discard the wiper ring, rod seal, back-up ring and o-ring.
9. Using suitable protection, clamp cylinder rod section two in a vise or similar holding fixture.

10. Carefully remove cylinder rod section one from cylinder rod section two and carefully remove the piston from the cylinder rod. Remove and discard the piston seal and o-ring.
11. Carefully remove the guide from cylinder rod section one. Remove and discard the o-ring, back-up ring, rod seal, and wiper ring.
12. Remove the cylinder rod from the holding fixture.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
7. Inspect cylinder guide inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
8. Inspect seal and o-ring grooves in guide for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder guide outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
10. Inspect the oil ports 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. Refer to the Illustrated Parts Manual.

Apply a light film of hydraulic oil to all components prior to assembly.

1. Using suitable protection, clamp the cylinder rod section one in a vise or similar holding fixture.

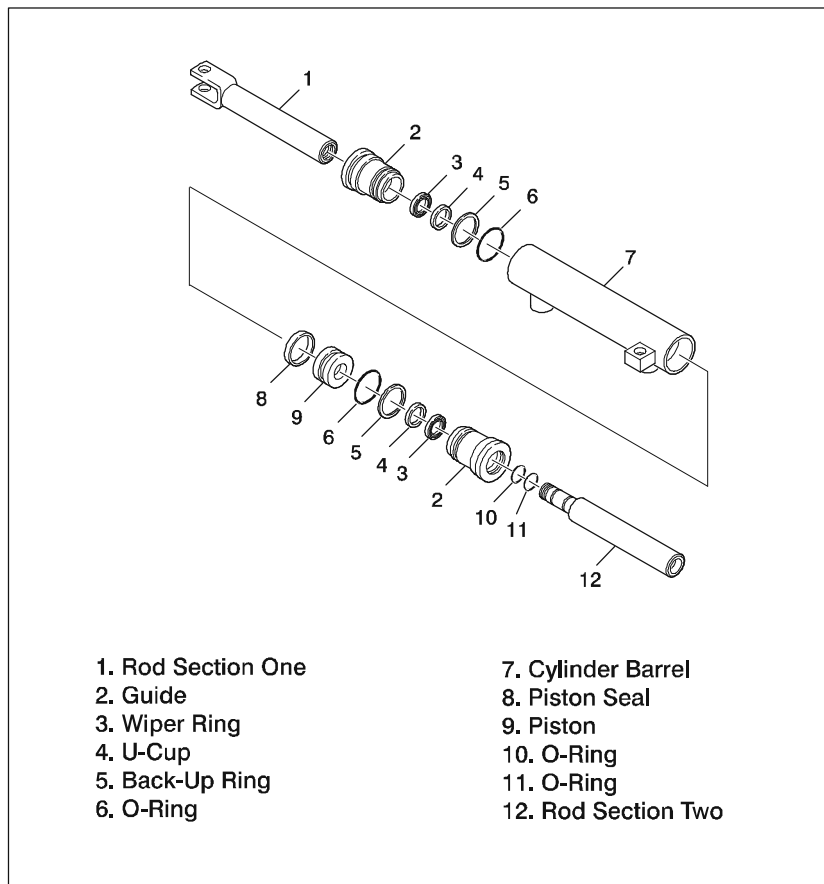


Figure 2-16. Steer Cylinder Repair

2. Place a new wiper ring, rod seal, o-ring, and back-up ring into the cylinder rod guide grooves.
3. Carefully install the cylinder rod guide on rod section one, ensuring that the wiper ring and rod seal are not damaged or dislodged. Push the guide onto the rod section.
4. Place a new piston ring on the piston and a new o-ring on the threaded end of cylinder rod section two.
5. Carefully place the piston on the threaded end of cylinder rod section two, ensuring that the o-ring is not damaged or dislodged. Push the piston onto the rod as far as it will go.
6. Attach cylinder rod section one to the threaded end of cylinder rod section two and assemble.
7. Remove the cylinder rod assembly from the holding fixture.
8. Position the cylinder barrel in a suitable holding fixture.

⚠ IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, CYLINDER ROD GUIDE, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

9. With the barrel clamped securely, and while adequately supporting the cylinder rod assembly, insert the piston end of the rod assembly into the cylinder barrel. Ensure that the piston ring and o-ring are not damaged or dislodged.
10. Continue pushing the rod into the barrel until the cylinder rod guide can be inserted into the end of the cylinder barrel.
11. Coat the threads of the cylinder rod guide with Loctite #242 then secure the cylinder rod guide to the cylinder barrel using a suitable spanner wrench.
12. On the remaining cylinder rod guide place a new wiper ring, rod seal, o-ring, and back-up ring into the cylinder rod guide grooves.

13. Carefully install the cylinder rod guide onto rod section two and slide the guide into the end of the cylinder barrel.
14. Coat the threads of the cylinder rod guide with Loctite #242 then secure the cylinder rod guide to the cylinder barrel using a suitable spanner wrench.
15. Reconnect the hydraulic hoses to the applicable cylinder ports.

2.15 TILT SWITCH ADJUSTMENT (IF EQUIPPED)

NOTE: The machine may be equipped with a tilt switch (sensor), factory set to activate when the machine is out of level in any direction at 5° and will cut out 2 speed drive. Consult factory for tilt sensor adjustment. The only field adjustment necessary is leveling the switch on the spring loaded studs. There are two methods of adjustment, a manual adjustment and an adjustment using a voltmeter.

CAUTION

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

Manual Adjustment

1. Park the machine on a flat, level surface and ensure the machine is level.

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

2. Level the base of the indicator by tightening the three flange nuts. Tighten each nut 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 (the light on the Platform Control Console illuminates, the tilt alarm sounds).
4. Slowly back off the nut, counting the number of turns, until the circuit is closed again.
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.
6. Repeat steps 3 through 5 for the remaining "Y" nut. The switch is now level.

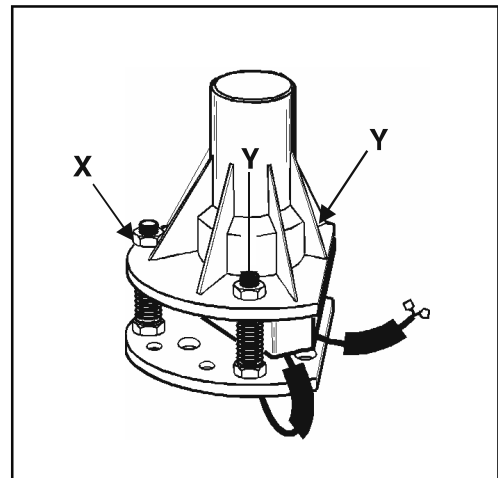


Figure 2-17. Tilt Switch Leveling - Manual Adjustment

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 through 7.

Voltmeter Adjustment

1. Park the machine on a flat, level surface and ensure the machine is level.
2. If the motor 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 the voltage at the trip point in all four directions. If the voltage reading is not symmetrical, repeat step 4 above.

2.16 LIMIT SWITCH ADJUSTMENT

Platform Limit Switch

The platform limit switch is located on the left side of the frame of the machine. When activated, the switch cuts out the High Drive function. Adjust the switch to activate when the platform is raised above the stowed position.

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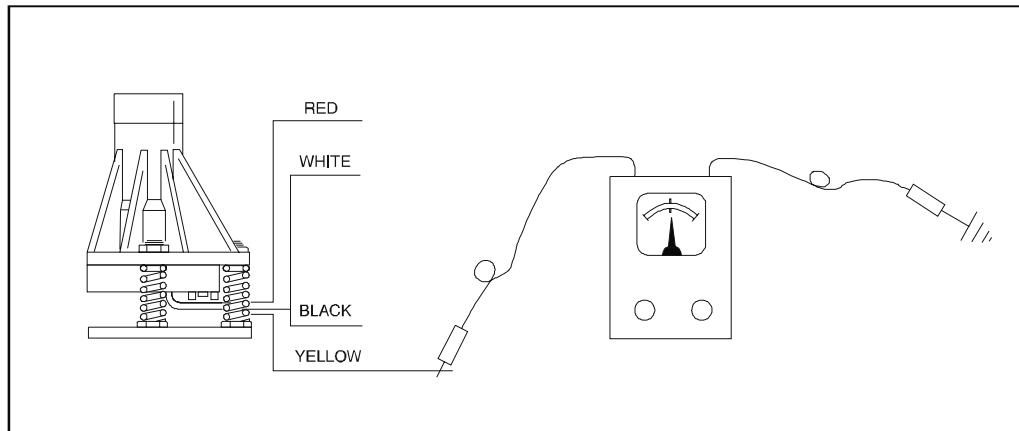


Figure 2-18. Tilt Switch Leveling - Voltmeter Adjustment

2.17 PRESSURE SETTING PROCEDURES

NOTE: Make all pressure adjustments with motor operating and hydraulic oil at normal operating temperature. In addition, all functions must be operated from the platform control station in order to achieve full pump speed. It may be necessary to use an assistant to adjust the pressure settings while operating the functions from the platform control station.

Lift Relief Adjustments

1. Install a pressure gauge at gauge port MP, located at the bottom front of the valve body. The port is identified by a stamping on the valve body.
2. From the platform control station, activate the lift up function by pressing the lift switch and activating the controller to the full forward position.
3. While monitoring the pressure gauge at MP, adjust the lift up relief as follows:
 - 1532E3 - 112 bar (1625 psi)
 - 1932E3 - 138 bar (2000 psi)
 - 2033E3 - 105 bar (1525 psi)
 - 2046E3 - 124 bar (1800 psi)
 - 2646E3 - 124 bar (1800 psi)
 - 2658E3 - 145 bar (2100 psi)

Main Relief and High Drive Pressure Switch Adjustment

1. Install a pressure gauge at gauge port MP, located at the bottom front of the valve body. The port is identified by a stamping on the valve body.
2. Close the steer relief valve completely by turning clockwise.
3. Activate the steer switch in either direction until the steer cylinder bottoms out.
4. Adjust your main pressure to 207 bar (3000 psi).
5. Once you have adjusted your main pressure be sure and reset your steer pressure to 145 bar (2100 psi).

NOTE: In the event that the above procedure will not allow you to reach the proper pressure take the following steps:

6. With the pressure gauge still installed and the steer valve still closed remove the power from the drive forward or drive reverse valves.
7. Activate the joystick in the direction that the power was removed from.
8. Adjust your main pressure to 207 bar (3000 psi).

Steer Adjustment

1. If necessary, connect a pressure gauge to gauge port MP, then open the Steer/Tow valve.
2. Activate drive by pressing the drive switch and activating the controller to the full forward position. While holding the controller, activate steer right and check steer right pressure. If necessary, adjust steer right pressure to 145 bar (2100 psi).
3. Activate drive by pressing the drive switch and activating the controller to the full forward position. While holding the controller, activate steer left and check steer left pressure. If necessary, adjust steer left pressure to 145 bar (2100 psi)..

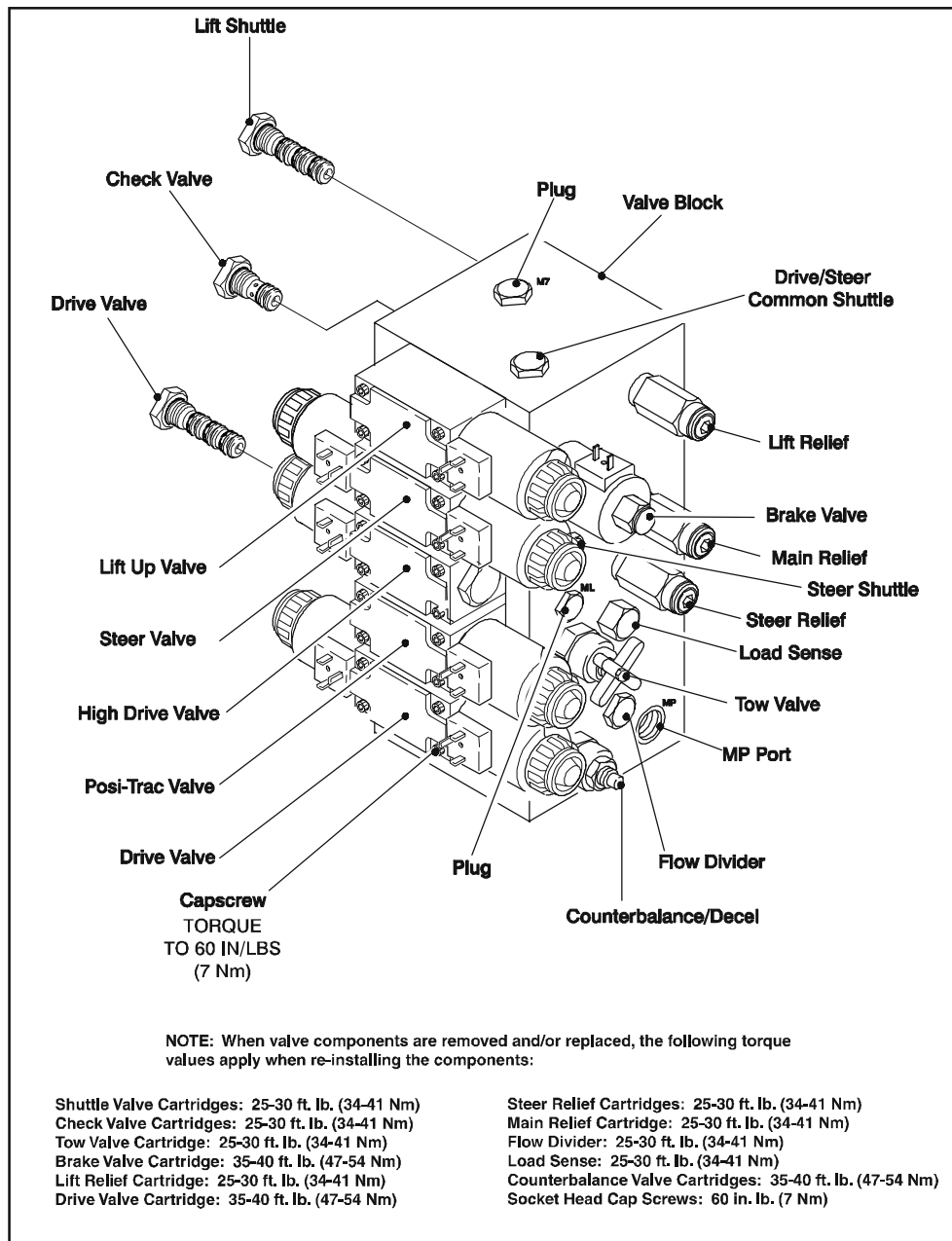


Figure 2-19. Pressure Setting Adjustments

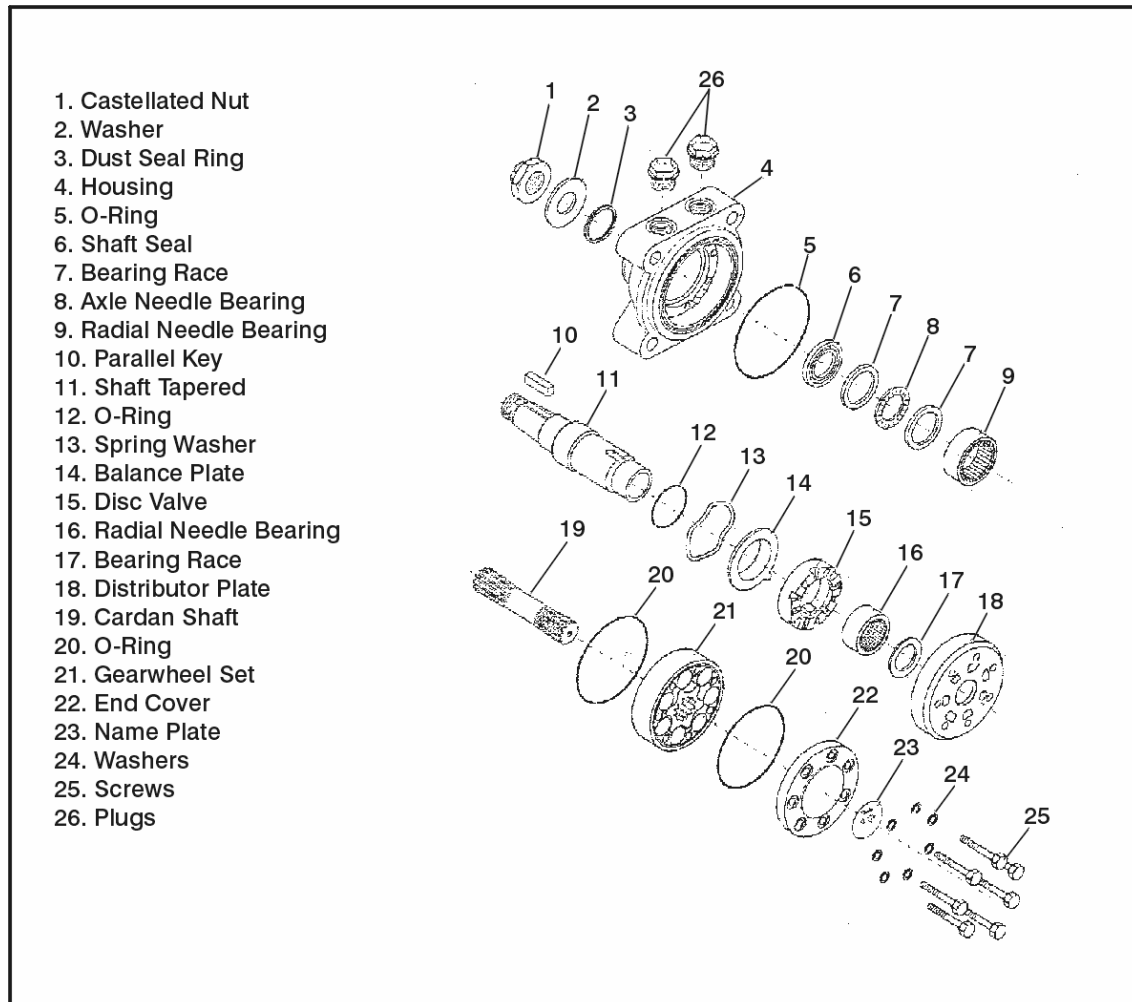


Figure 2-20. Drive Motor (Sauer Danfoss)

2.18 DRIVE MOTOR (SAUER DANFOSS)

Dismantling

1. Place motor in proper holding device that allows access to the output shaft.
2. Carefully remove end cover sideways being sure to catch any parts that may fall from the gearwheel.
3. The needle bearings will fall out during dismantling and can be collected and reused. The outer ring and thrust bearing need not be removed.
4. With the housing in the holding device, press the shaft out of the housing. Collect the needle bearings for possible re-use.
5. Remove the housing from the holding device and place on a workbench. With a screwdriver, gently lever the dust seal ring from the housing.
6. Extract the shaft seal from the housing.
7. Press the remaining parts out using hydraulic equipment.
8. Clean all parts carefully with a low aromatic kerosene.

Assembly

NOTE: Before assembly, inspect all parts and replace if necessary.

Before assembly, lubricate all parts with hydraulic oil and grease rubber parts with vasoline.

1. Turn motor housing so the rear end faces upwards. Press shaft seal into housing.
2. The bearing race can be fitted in any position.
3. Place the needle bearings in the outer ring and hold them in place with grease. Place the whole bearing into the housing. Press the bearing into position using pressure equipment if necessary.
4. Carefully insert shaft through bearing housing.
5. Place O-ring (greased) in bearing housing O-ring recess.
6. Place spring washer on balance plate, insert O-ring in recess and lubricate with grease. Place balance plate lightly in position so that it engages. Be careful not to damage the O-ring.
7. Place the disc valve on the shaft with channels upwards so that the long tab on the disc valve engages with the slot in the shaft.
8. If there is a difference in the spline length, fit the cardan shaft with the long spline end in the output shaft. Mark the bottom of the cardan spline that lies adjacent to the long tab on the disc valve.
9. Place the needles in the outer ring and hold them in place with grease. Carefully place the distributor plate on the bearing housing so that the shaft enters the bearing. Press the distributor plate until it stops on the housing and line up the screw holes.
10. Place the O-rings (greased) in the gearwheel O-ring recesses. If there is a recess on one end of the splined hole, position the gearwheel with recess on the same side as the smallest screw hole (stage hole) in the gearwheel rim. Fit the gearwheel set with this side facing the motor.
11. **Clockwise Revolution:**
Fit the gearwheel set on the cardan shaft so that the top of a tooth in the external teeth of the gearwheel is vertically over the mark on the cardan shaft. Turn the gearwheel set counterclockwise until the cardan shaft and gearwheel engage (15°). Turn the gearwheel rim to line up the screw holes.
12. **Counterclockwise Revolution:**
Fit the gearwheel set on the cardan shaft so that the top of a tooth in the external teeth of the gearwheel is vertically over the mark on the cardan shaft. Turn the gearwheel set clockwise until the cardan shaft and the gearwheel engage (15°). Turn the gearwheel to line up the screw holes.
13. Rotate the end cover to line up the screw holes.
14. Use new washers and a 13 mm socket spanner. Torque to 3.75 - 4.25 daNm (330-380 lbf in).
15. Screw in plastic plugs.
16. Turn the motor over and strike the dust seal into place with a plastic hammer and suitable mandrel.
17. Secure the key in place with tape.

2.19 POTHOLE PROTECTION SYSTEM LIMIT SWITCH

Adjustment

1. With the pothole protection system in the fully down position, mount the limit switch on the bracket in the rear of the machine.
2. Adjust the switch to provide for 1.6mm maximum clearance between the roller and the cam.

⚠ CAUTION

WHEN MOUNTING OR ADJUSTING THE LIMIT SWITCH, BE SURE THAT THE SAFETY PROP IS BEING USED PROPERLY

3. Tighten the switch mounting hardware.

2.20 JLG SMART SYSTEM™ ANALYZER KIT INSTRUCTIONS

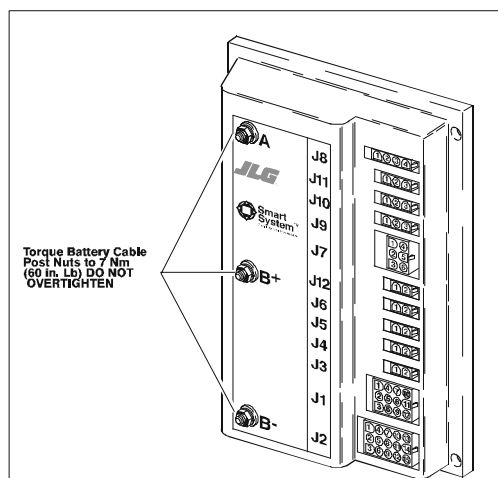


Figure 2-21. JLG SMART System™ Controller

⚠ IMPORTANT

WHEN INSTALLING A NEW SMART SYSTEM CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS. REFER TO ANALYZER KIT NO. 2901443.

⚠ IMPORTANT

WHEN INSTALLING A NEW SMART SYSTEM CONTROLLER ON THE MACHINE, ELECTRICAL SILICONE GREASE, JLG PART NUMBER 0100076 OR 7016397, MUST BE APPLIED TO THE BACK OF THE CONTROLLER.

⚠ IMPORTANT

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 52 BAR (750 PSI) AT A MINIMUM DISTANCE OF 30.5 CM (12 IN) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

INTRODUCTION

The JLG designed SMART System™ is a 24 Volt multiplex motor control unit installed on the electric scissor lift models 1532E3, 1932E3, 2033E3, 2046E3, 2646E3 and 2658E3.

The SMART System™ has **reduced** the need for **exposed** terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep and max-speed for the lift, drive, steering and optional power deck functions. The function select membrane board, in the upper control box, also eliminates the need for toggle switches and a separate power enable button as this feature is built into each function select button on the board itself.

The lift, drive and optional power deck functions are controlled by a joystick, with steering being controlled by a rocker switch built into the top of the joystick. Drive, lift, and the optional power deck functions are selected by first pushing the appropriate momentary select buttons on the membrane board and then moving the joystick either in the "A" or "B" direction. If the joystick is not activated within three seconds of selecting a function, it will be necessary to re-select a function. High drive and positive traction are used in conjunction with the drive function.

The motor controller will control current output, as programmed for smooth operation and maximum cycle time. Ground control speeds for platform lift and the optional power deck are also programmed into the motor controller. The motor controller also features an adjustable time limit for positive traction. Another power saving feature is the high speed drive current limit. This feature will automatically control the drive speed and controller output when it exceeds the pre-set current limit for a specified time and reduce the motor speed, thus conserving power.

For safety, the machines are equipped with pothole protection and elevation cutback. The pothole protection is employed as the platform is raised. If the pothole protection does not extend, the drive function will be disabled. When the platform is raised, the drive function goes into creep mode.

The JLG SMART System™ controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes an hourmeter, beacon light, tilt switch (light and/or alarm), power deck, power deck extension limit, function cutout, and ground alarm. These options may be added later but some must be programmed into the motor controller when installed.

The SMART System™ may be accessed by utilizing a custom designed, hand held analyzer (JLG kit no. 2901443) which will display two lines of information at a time, by scrolling through the program.

NOTE: *The date code is determined by the first four digits of the controller serial number which is located on the label attached to the front of the controller.*

The part number of the controller is located on the controller decal.

To Connect the Hand Held Analyzer:

1. Connect the four pin end of the cable supplied with the analyzer, to the top connection of the motor controller and connect the remaining end of the cable to the analyzer.

NOTE: *The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.*

2. Power up the SMART System™ by turning the lower key to the platform position and pulling both emergency stop buttons on.

Using the Analyzer:

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

HELP:

PRESS ENTER

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

The top level menus are as follows:

HELP

DIAGNOSTICS

RUN SYSTEMS TEST (NOTE: Ensure machine is fully lowered before running systems test)

ACCESS LEVEL

PERSONALITIES

MACHINE SETUP

CALIBRATIONS (level 0 Manufactures Access Only)

If you press **ENTER**, at the **HELP:PRESS ENTER** display, and a fault is present during power up, the analyzer display will scroll the fault across the screen. If there was no fault detected during power up, the display will read:
HELP: EVERYTHING OK

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

LOGGED HELP

1: STARTUP (2/1)

At this point, the analyzer will display the current fault, if any are present. You may scroll through the fault logs to view what the last fifteen faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC** two times.

NOTE: *The STARTUP (2/1) is not a fault. It is used to separate faults between powerups.*

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

PLATFORM

GROUND

SYSTEMS

DATA LOG

VERSIONS

DRIVE

LIFT

STEER

GROUND MODE

MACHINE

Pressing **ENTER** with any of the above displayed menus, will display additional sub-menus within the selected menu. In some cases, such as **DRIVE**, the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected menus while in access level 2. Remember, you may always cancel a selected menu item by pressing the **ESC** key.

Changing the Access Level of the Hand Held Analyzer:

When the analyzer is first connected, you will be in access level 2 which enables you to only view most configuration settings which cannot be changed until you enter a pass-

SECTION 2 - PROCEDURES

word to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:

MENU:

ACCESS LEVEL 2

Press **ENTER** to select the **ACCESS LEVEL** menu.

Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 3.

Repeat this process until you have entered all five digits of the password which is **33271**.

Once the correct password is displayed, press **ENTER**.

The access level should display the following, if the password was entered correctly:

MENU:

ACCESS LEVEL 1

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

Adjusting Configuration Using the Hand Held Analyzer on All 1600289 Controllers:

Once you have gained access to level 1, and a personality item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

PERSONALITIES:

DRIVE ACCEL 1.0s

There will be a minimum and maximum for the value to ensure efficient operation. The value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at access level 1.

When a machine digit item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

GROUND ALARM:

2=DRIVE

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you

wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selecting the machine model to match the size of the machine, the personality settings will all default to the factory recommended settings. **Note: Refer to the appropriate Machine Personality Settings Table, and the Machine Setup Table in the JLG Service Manual for the recommended factory settings. Refer to the JLG part number of the controller, printed on the front label, to select the correct table in the manual.**

NOTE: Password 33271 will give you access to level 1, which will permit you to change all machine personality settings. There are some settings that JLG strongly recommends that you do not change. These settings are so noted below:

ELEVATION CUTBACK

POSITRAC TIMEOUT

HIGH DRIVE CURRENT LIMIT

HIGH DRIVE TIME LIMIT

WARNING

CHANGING THESE SETTINGS MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

IMPORTANT

WHEN INSTALLING A NEW SMART SYSTEM CONTROLLER ON THE MACHINE, ELECTRICAL SILICONE GREASE, JLG PART NUMBER 0100076 OR 7016397, MUST BE APPLIED TO THE BACK OF THE CONTROLLER.

IMPORTANT

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 52 BAR (750 PSI) AT A MINIMUM DISTANCE OF 30.5 CM (12 IN) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

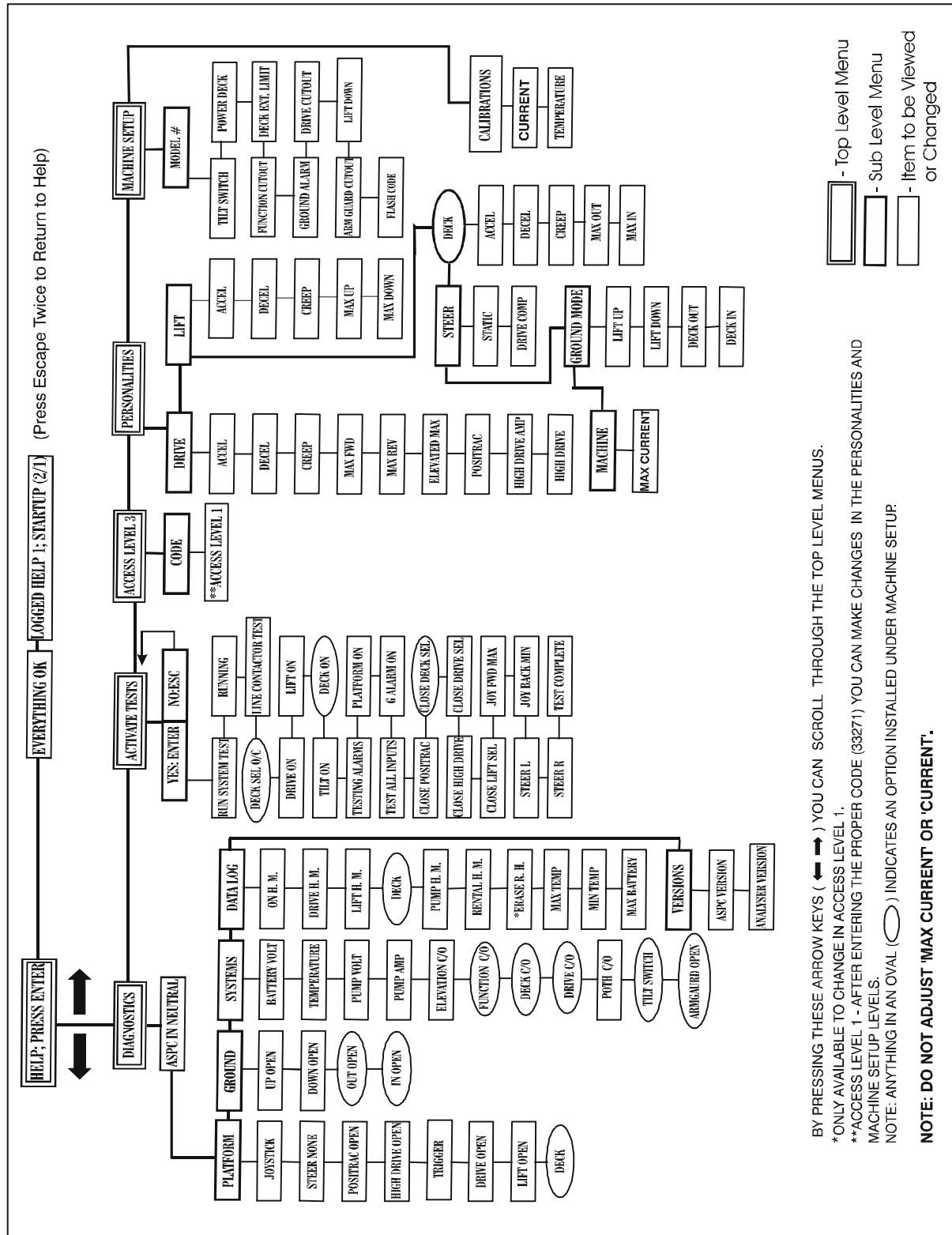


Figure 2-22. Organizational Chart

2.21 MACHINE PERSONALITY SETTINGS

Table 2-2. Machine Personality Settings

PERSONALITY	MIN	MAX
DRIVE-ACCEL	0.5 SEC	5.0 SEC
DRIVE-DECEL	0 SEC	5.0 SEC
DRIVE CREEP	1%	25.0%
DRIVE SPEED MAX (LOW)	50%	100%
DRIVE SPEED MAX (HIGH)	50%	100%
*ELEVATION MAX	*0%	*40%
*POSI-TRAC TIME	*0 Sec	*60 Sec
*HIGH DRIVE OVERCURRENT	*50 Amp	*200 Amp
HIGH DRIVE TIME OUT	0 Sec	25 Sec
LIFT ACCEL	0.5 Sec	5.0 Sec
LIFT DECEL	0.0 Sec	1.5 Sec
LIFT CREEP	1%	25%
LIFT UP MAX	50%	100%
MAX DOWN	30%	100%
DECK ACCEL	0.5 Sec	5.0 Sec
DECK DECEL	0 Sec	5 Sec
DECK CREEP	1%	25%
DECK EXT MAX	0	100%
DECK RET MAX	0	100%
STEER STATIC	20%	50%
STEER (DRIVE COMP)	0	35%
GROUND LIFT UP MAX	0%	100%
GROUND LIFT DOWN	0%	100%
GROUND DECK OUT	0%	100%
GROUND DECK IN	0%	100%
<p>*JLG strongly recommends that these settings not be changed. Changing these settings may adversely affect the performance of your machine.</p> <p>NOTE: Personality settings can be adjusted within the adjustment range in order to achieve optimum machine performance.</p>		

2.22 MACHINE MODEL DEFAULT SETTINGS

Table 2-3. Machine Model Default Settings Chart

Adjustment	1532E3	1932E3	2033E3	2046E3	2646E3	2658E3
DRIVE ACCELERATION	1.0 sec	1.0 sec	1.0 sec	1.0 sec	1.0 sec	1.0 sec
DRIVE DECELERATION	0.5 sec	0.5 sec	0.5 sec	0.5 sec	0.5 sec	0.5 sec
DRIVE CREEP	10%	10%	12%	12%	12%	12%
DRIVE SPEED MAX (LOW)	70%	70%	100%	100%	100%	100%
DRIVE SPEED MAX (HIGH)	70%	70%	85%	85%	85%	85%
ELEVATION MAX*	25%*	25%*	30%*	30%*	37%*	36%*
POSITRAC TIME	10 sec	10 sec	10 sec	10 sec	10 sec	10 sec
HIGH DRIVE OVER CURRENT	140 amps	140 amps	140 amps	140 amps	140 amps	140 amps
HIGH DRIVE TIME OUT*	5.0 sec*	5.0 sec*	5.0 sec*	5.0 sec*	5.0 sec*	5.0 sec**
LIFT ACCEL	1.0 sec	1.0 sec	1.0 sec	1.0 sec	1.0 sec	1.0 sec
LIFT DECEL	0.0 sec	0.0 sec	0.0 sec	0.0 sec	0.0 sec	0.0 sec
LIFT CREEP	10%	10%	15%	15%	15%	15%
LIFT UP MAX	90%	90%	100%	100%	100%	100%
DECK ACCEL	0.5 sec	0.5 sec	0.5 sec	0.5 sec	0.5 sec	0.5 sec
DECK DECEL	0.0 sec	0.0 sec	0.0 sec	0.0 sec	0.0 sec	0.0 sec
DECK CREEP	10%	10%	10%	10%	10%	10%
DECK EXTENSION SPEED MAX.	100%	100%	100%	100%	100%	100%
DECK RETRACTION MAX	80%	80%	80%	80%	80%	80%
STATIC STEER	30%	30%	30%	30%	30%	30%
STEER (DRIVE COMP)	15%	15%	15%	15%	15%	15%
GROUND LIFT UP MAX	100%	100%	100%	100%	100%	100%
GROUND DECK IN MAX	50%	50%	50%	50%	50%	50%
GROUND DECK OUT MAX	50%	50%	50%	50%	40%	40%

NOTE: WARNING: Changing the machine model will set all personalities back to the factory default settings. check the machine model adjustment chart for the correct settings for each model. if your machine does not match the proper settings for each model, adjust the settings as necessary in accordance with the chart.

NOTE: * JLG strongly recommends that these settings not be changed. Changing these settings may adversely affect the performance of your machine.

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2.23 MACHINE CONFIGURATION INFORMATION

NOTE: The following information is to be used when working with the MACHINE SETUP menu. When configuring the E Series scissor lift, the machine configuration

must be completed before any personality settings can be changed. Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default values.

Table 2-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Setting Before Programming
1 (MODEL NUMBER)	1	MODEL 1532E3	3
	2	MODEL 1932E3	
	3	MODEL 2033E3	
	4	MODEL 2046E3	
	5	MODEL 2646E3	
	6	MODEL 2658E3	
2 (TILT SWITCH)	0	No tilt switch installed.	0
	1	Tilt switch installed for North american, CE, and optional for Latin American machines. This digit will allow the SMART System™ to indicate when the machine is out of level by lighting the light in the platform box. If the machine is elevated and tilted, the SMART System™ will also sound the platform alarm continuously. No functions are cutback or cutout.	
	2	Tilt switch for Australia, Japanese, and option for Latin American machines. This digit will allow the SMART System™ to indicate when the machine is out of level by lighting the light in the platform box. If the machine is elevated and tilted, the SMART System™ will also sound the platform alarm continuously and the lift up and drive functions are cutout.	
3 (POWER DECK)	0	No power deck installed.	0
	1	Machine equipped with power deck.	
4 (DECK EXT. LIMIT SWITCH)	0	Deck extension limit switch not installed. (This cannot be zero if there is a power deck installed.)	0
	1	Cuts out LIFT DOWN when deck is extended. This digit is used with roll out decks that require a deck extension cutout. Sounds platform alarm for one second on, one second off, one second on, and three seconds off while operator tries to perform the function that has been cut out (provided the platform alarm has been installed).	
	2	Cuts out HIGH DRIVE when deck is extended and below elevation. Cuts out DRIVE when deck is extended and above elevation. This digit is used with a power deck. Sounds platform alarm for one second on, one second off, one second on, and three seconds off while operator tries to perform the function that has been cut out and during the LIFT DOWN function (provided the platform alarm has been installed).	

Table 2-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Setting Before Programming
5 (FUNCTION CUTOUT)	0	No function cutout installed.	0
	1	Overload switch for French, Japanese machines. — Cuts out all functions. Sounds platform alarm for two seconds on, two seconds off, while operator tries to perform the function that has been cut out (provided the platform alarm is installed).	
6 (GROUND ALARM)	0	No ground alarm installed.	0
	1	Descent alarm. — Sounds when LIFT DOWN is active.	
	2	Travel alarm. — Sounds when DRIVE function is active.	
	3	Motion alarm. — Sounds whenever the DRIVE, LIFT or DECK function is active.	
7 (DRIVE CUTOUT)	0	No drive cutout switch installed.	0
	1	Cuts out DRIVE when deck is elevated above a predetermined elevation (varies with machine model).	
8 (ARM GUARDS))	0	No arm guard cutout.	0
	1	European (CE Specification) machines — LIFT DOWN cutout must activate when the gap between the arms is 5 in. to 8 in. (13 cm to 20 cm). Here it will cut out LIFT DOWN and sound the platform alarm for 1/2 second on, 1/2 second off, and repeat this for three seconds. After three seconds, the operator must re-select the LIFT function and continue to operate LIFT DOWN. If the wires to the limit switch used to detect the deck height are cut or the switch has failed, the platform alarm will sound as mentioned. The operator can re-select the LIFT function and then LIFT DOWN for ten seconds, at which time it will cut out again and the process must be repeated.	
9 (Flash Codes)	0	LED Only	0
	1	LED and lamps in platform control box	
	2	LED and alarm	
	3	LED, lamps in control box and alarm	

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2.24 JLG SMART SYSTEM™ HELP MESSAGES AND FLASH CODES

Table 2-5. Help Messages

NO FLASH CODE IS INDICATED FOR THE FOLLOWING HELP MESSAGES; THEY ARE INTENDED TO HINT AT A POSSIBLE PROBLEM IF THE MACHINE IS NOT BEHAVING AS EXPECTED	
EVERYTHING OK	The "normal" help message in platform mode.
GROUND MODE OK	The "normal" help message in ground mode.
ALARM SOUNDING: ARMGUARD PROTECTION ACTIVE	Arm guard protection has tripped during lift down and is preventing lift down for three seconds.
ALARM SOUNDING: DECK EXTENDED DURING LIFT DOWN	The deck extension cutout is preventing lift down.
ALARM SOUNDING: OVERLOADED	The function cutout is active; some functions may be prevented.
ALARM SOUNDING: TILTED & ABOVE ELEVATION	The machine is tilted while above elevation; some functions may be prevented.
DECK PREVENTED - NOT AVAILABLE	A deck function has been selected but there is no power deck.
DIFFERENT FUNCTION SELECTED & IGNORED	A platform function selection (drive, lift, or deck) has been pressed while another function is in use.
DRIVING AT CUTBACK - ABOVE ELEVATION	Drive speed is limited to cutback because the machine is above elevation.
DRIVING AT CUTBACK - POTHOLE STILL ENGAGED	drive speed is limited to cutback because the pothole protection is still engaged while the machine is not above elevation.
FUNCTION SELECTED BUT TRIGGER SWITCH OPEN	A function has been selected but the trigger switch is open; when the trigger switch is closed the function will begin if it is still selected.
HIGH DRIVE PROBLEM - CUTOUT	The high drive function has been selected but is prevented by a cutout (high drive is not allowed while above elevation or when the deck is extended).
HIGH DRIVE PROBLEM - MOTOR CURRENT EXCEEDED	The high drive function was selected but was ended because pump motor current was too high.
JOYSTICK MOVED BUT NO FUNCTION SELECTED	The drive, lift or deck function must be selected before the joystick is moved from neutral.
POSITRAC PROBLEM - NOT ALLOWED DURING HIGH DRIVE	The positrac function has been selected but is not allowed while the high drive function is in use.
PUMP MOTOR AT CURRENT LIMIT	Pump motor current has reached the maximum allowed and is being limited.
STEER SELECTED BUT TRIGGER SWITCH OPEN	Steering has been selected but the trigger switch is open; when the trigger switch is closed steering will begin if it is still selected.
TESTS ACTIVE - RECYCLE EMS TO END	The system tests have been activated; normal machine operation is not allowed.

Table 2-6. JLG SMART System™ Flash Codes & Help Messages

Code	Description
2-1 - Indicates problems with EMS inputs	STARTUP - Neither EMS is active - the system is just switching on or is discharging the capacitor bank. A welded line contactor might also cause this.
2-2 - Indicates problems with platform controls	ALL FUNCTIONS PREVENTED - NO DATA FROM PLATFORM BOX - The signal from the MUX board in the platform box is not available; drive, lift and deck functions cannot be selected. FUNCTION PROBLEM - PERMANENTLY SELECTED - The drive, lift or deck function select is active for more than ten seconds; any active function will be stopped. FUNCTIONS LOCKED OUT - RELEASE THEN RESELECT - The selected function is not allowed; release the joystick to clear the fault. HIGH DRIVE PROBLEM - PERMANENTLY SELECTED - The high drive function select is active for more than ten seconds; the high drive function will be stopped. FUNCTION SELECTED BUT TRIGGER NEVER CLOSED - Occurs after ten seconds with the joystick in neutral, but trigger switch never closed. JOYSTICK FAULTY - WIPER OUT OF RANGE - Occurs if wiper voltage is invalid. JOYSTICK FAULTY - CENTER OUT OF RANGE - Occurs if center tap voltage is invalid. JOYSTICK FAULTY - STEER SWITCHES ACTIVE TOGETHER JOYSTICK LOCKED OUT - RELEASE THEN RESELECT PORITRAC PROBLEM - PERMANENTLY SELECTED TRIGGER INTERLOCK TRIPPED - Trigger switch was closed for more than ten seconds with no function selected. WAITING FOR TRIGGER SWITCH TO BE OPEN - Trigger switch was closed when platform mode was selected.
2-3 - Indicates problems with ground controls	GROUND FUNCTIONS LOCKED OUT - RELEASE THEN RESELECT - A ground mode function (lift or deck) was selected when ground mode was selected
2-5 - Indicates a function is prevented due to a cutout	DECK PREVENTED - FUNCTION CUTOUT ACTIVE DRIVE PREVENTED - DECK EXTENDED & ABOVE ELEVATION DRIVE PREVENTED - DRIVE CUTOUT ACTIVE - Drive is selected while drive cutout is active and drive cutout is configured to prevent drive. DRIVE PREVENTED - FUNCTION CUTOUT ACTIVE - Drive is selected while function cutout ("overload") is active and configured to cut out drive functions. DRIVE PREVENTED - POT HOLE NOT ENGAGED DRIVE PREVENTED - TILTED & ABOVE ELEVATION - Drive is selected while tilted and above elevation and tilt is configured to prevent drive. LIFT DOWN CUTOUT - ARMGUARD PROTECTION ACTIVE LIFT DOWN PREVENTED - DECK EXTENDED LIFT PREVENTED - FUNCTION CUTOUT ACTIVE LIFT UP PREVENTED - TILTED & ABOVE ELEVATION STEER LOCKED OUT - RELEASE THEN RESELECT STEER PREVENTED - DECK EXTENDED & ABOVE ELEVATION STEER PREVENTED - FUNCTION CUTOUT ACTIVE STEER PREVENTED - NOT AVAILABLE STEER PREVENTED - TILTED & ABOVE ELEVATION
3-1 - Indicates that a contactor did not close when energized	OPEN-CIRCUIT LINE CONTACTOR - The capacitor bank charge did not increase to battery supply when line contactor was energized (this could be due to a power wiring error).
3-2 - Indicates that a contactor did not open when de-energized	WELDED LINE CONTACTOR - The capacitor bank charge did not decrease from battery supply when line contactor was de-energized (this could be due to a power wiring error).

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Table 2-6. JLG SMART System™ Flash Codes & Help Messages

Code	Description
3-3 - Indicates that a contactor coil is short-circuit	<p>SHORT-CIRCUIT LINE CONTACTOR COIL - The line contactor was not energized when required, due to coil over current protection.</p> <p>VALVE OR LINE CONTACTOR ENERGIZED - CHECK WIRING - The drive circuit to the line contactor or a valve is active when no driver circuit is turned on (this could be due to a wiring error to the valves or line contactor).</p>
4-2 - indicates that the controller is over temperature	<p>CONTROLLER TO HOT - PLEASE WAIT - The controller heat sink temperature reached 75 degrees. The controller is shut down until it cools to below 70 degrees.</p>
4-4 - Indicates problems with the battery supply	<p>BATTERY TOO LOW - SYSTEM SHUT DOWN - Battery voltage is below 17V, EMS recycle required.</p> <p>BATTERY TOO HIGH - SYSTEM SHUT DOWN - Battery voltage is above 30 V, EMS recycle required.</p>
7-7 - Indicates problems with a motor	<p>CAPACITOR BANK FAULT - CHECK MOTOR WIRING - The capacitor bank is not charging. This is probably due to a power wiring error causing illegal current drain; it could also be due to a very low battery supply.</p> <p>POINT A LOW - CHECK POWER CIRCUITS - Pump point A is low when the MOSFETs are off. This is probably due to power wiring error.</p> <p>PUMP MOTOR OPEN-CIRCUIT - CHECK MOTOR & WIRING - Pump point A is collapsing when the pump MOSFETs are pulsed. This is probably due to an open circuit pump motor or a power wiring error.</p> <p>PUMP MOTOR STALLED - CHECK MOTOR & WIRING - The pump MOSFET protection circuit is active. This is due to massive current drain and could be a stalled pump motor or power wiring error.</p>
9-9 - Indicates problems with the controller	<p>CONTROLLER FAILURE: HWFS TEST STALLED - The hardware fail safe tests did not complete, but no reason can be determined.</p> <p>CONTROLLER FAILURE: HWFS TEST STALLED 15 - The hardware fail safe tests failed because the contactor drive fail safe did not trip within the allowed test time.</p> <p>NOTE: Anytime a reading of a 15- code appears the controller must be replaced.</p>

2.25 ANALYZER MENU STRUCTURE

In the following structure descriptions, an intended item is selected by pressing ENTER; pressing ESC steps back to the next outer level. The LEFT/RIGHT arrow keys move

between items in the same level. The UP/DOWN arrow keys alter a value if allowed

Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
HELP;PRESS ENTER	HELP LOGGED HELP		Displays current help/fault message Log of most recent help/fault messages: LEFT/RIGHT view
DIAGNOSTICS	ASPC IN... PLATFORM	JOYSTICK STEER POSI-TRAC HIGH DRIVE TRIGGER DRIVE LIFT DECK	Displays current controller mode. NEUTRAL/DRIVE/FORWARD/LIFT/etc. Displays joystick demand 0%...100% Preceded by "+" for forward/up/out, or by "-" for reverse/down/in. Displays steer status. (NONE/LEFT/RIGHT/etc.) Displays posi-trac switch status (OPEN/CLOSED) Displays high drive switch status (OPEN/CLOSED) Displays trigger switch status (OPEN/CLOSED) Displays drive mode select switch status (OPEN/CLOSED) Displays lift mode select switch status (OPEN/CLOSED) Displays deck mode select switch status (OPEN/CLOSED) Not displayed if POWER DECK = NO
	GROUND	UP DOWN OUT IN	Displays ground lift up switch status (OPEN/CLOSED) Displays ground lift down switch status (OPEN/CLOSED) Displays ground deck out switch status (OPEN/CLOSED) Not displayed if POWER DECK = NO Displays ground deck in switch status (OPEN/CLOSED) Not displayed if POWER DECK = NO

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Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
	SYSTEMS	BATTERY	Displays measured battery voltage NOTE: Only accurate when line contactor closed
		TEMPERATURE	Displays measured heatsink temperature
		PUMP VOLT	Displays calculated pump motor voltage
		PUMP AMP	Displays calculated pump motor current
		ELEVATION	Displays elevation cutout switch status (OPEN/CLOSED) Closed with platform fully lowered
DIAGNOSTICS/SYSTEMS (Continued)		FUNCTION C/O	Displays function cutout switch status (OPEN/CLOSED) Not displayed if FUNCTION CUTOUT=NO
		DECK C/O	Displays function cutout switch status (OPEN/CLOSED) Not displayed if POWER DECK=NO
		DRIVE C/O	Displays function cutout switch status (OPEN/CLOSED) Not Displayed if DRIVE CUTOUT = NO
		POTH C/O	Displays pothole cutout switch status (OPEN/CLOSED)
		TILT	Displays tilt switch status (LEVEL /TILTED) Not Displayed if TILT SWITCH = NO
		ARMGUARD	Displays armguard cutout switch status (OPEN/CLOSED) Not displayed if ARMGUARD CUTOUT = NO

Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
	DATALOG	ON DRIVE LIFT DECK PUMP RENTAL ERASE RENTAL (YES:ENTER,NO ESC) MAX, TEMP MIN, TEMP MAX BATTERY	Displays total controller on time NOTE: Up to four minutes lost at switch-off Displays total controller drive operation time Displays total controller lift operation time Displays total controller deck operation time NOTE: Not displayed if POWER DECK = NO Displays total controller pump running time NOTE: Includes drive, lift up, deck and steer Displays total controller pump running time NOTE: Can be reset Not available in level 3 ENTER resets rental datalog time to zero Displays maximum measured heatsink temperature Displays minimum measured heatsink temperature Displays maximum measured battery voltage
	VERSIONS	ASPC ANALYZER	Displays controller software version Displays analyzer software version
ACTIVATE TESTS	YES:ENTER,NO:ESC RUN SYSTEM TEST (Machine must be fully lowered before running systems test)		Not available once tests are activated ENTER activates system test NOTE: Cannot be done while controller is use (trigger switch closed) ENTER starts system test Not available until tests are activated Displays messages while system test runs Some messages are prompts, requiring user intervention ENTER can be pressed if a fault has been noted and to continue the system test. NOTE: A flashing message is critical, and prevents the system test from running.

SECTION 2 - PROCEDURES

Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
ACCESS LEVEL	CODE		Displays the current access level Level 3 - Personalities cannot be changed Level 2 - Most personalities can be changed Level 1 - All personalities can be changed Allows access level password to be entered Use LEFT/RIGHT to select digit Use UP/DOWN to change digit Use ENTER to update access level
PERSONALITIES	DRIVE	ACCEL DECEL CREEP LOW MAX	Displays/adjusts drive acceleration Displays/adjusts drive deceleration Displays/adjusts minimum drive speed Displays/adjusts maximum "low" drive speed NOTE: Used when high drive not selected
		HIGH MAX ELEVATED MAX POSI-TRAC HIGH DRIVE AMP HIGH DRIVE	Displays/adjusts maximum "high" drive speed NOTE: Used when high drive not selected Displays/adjusts maximum drive speed elevated NOTE: Used when elevation or pothole cutout switches are limiting max speed NOTE: Only adjustable in access level 1 Displays/adjusts posi-trac engaged time-out Displays /adjusts high drive motor overload current NOTE: Only adjustable in access level 1 Displays/adjusts high drive motor overload time-out
	LIFT	ACCEL DECEL CREEP MAX UP MAX DOWN N/A	Displays/adjusts lift acceleration Displays/adjusts lift deceleration Displays/adjusts minimum lift (up) speed Displays/adjusts maximum lift (up) speed Displays if there is no lift down (gravity) Displays/adjusts for power down machines for maximum lift down speed

Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
	DECK	ACCEL	Displays/adjusts deck acceleration
		DECEL	Displays/adjusts deck deceleration
		CREEP	Displays/adjusts minimum deck speed
		MAX OUT	Displays/adjusts maximum deck out speed
		MAX IN	Displays/adjusts maximum deck in speed
	STEER	STATIC	Displays/adjust steer speed NOTE: Used when not driving
		DRIVE COMP	Displays/adjusts steer compensation speed NOTE: Used as an additive when driving NOTE: Only adjustable in access level 1
	GROUND MODE	LIFT UP	Displays/adjusts fixed lift up speed
		LIFT DOWN N/A	Displays if no power lift down NOTE: Adjustable for power down machines
		DECK OUT	Displays/adjusts fixed deck speed out NOTE: Not displayed if POWER DECK = NO
		DECK IN	Displays/adjusts fixed deck speed in NOTE: Not displayed if POWER DECK = NO
	MACHINE	CURRENT	Displays/adjusts maximum motor current NOTE: DO NOT ADJUST

SECTION 2 - PROCEDURES

Table 2-7. Analyzer Menu Structure

TOP LEVEL MENU	SUB LEVEL MENU	ITEM TO BE VIEWED OR CHANGED	DESCRIPTION DISPLAY
MACHINE SETUP		MODEL NUMBER	Displays/adjusts machine model NOTE: All personalities reset to default when model number is altered
		TILT SWITCH	Displays/adjusts tilt switch presence/function
		POWER DECK	Displays/adjusts power deck presence
		DECK EXT. LIMIT	Displays/adjusts deck extension cutout switch presence/function
		FUNCTION CUTOUT	Displays/adjusts function cutout switch presence/function
		GROUND ALARM	Displays/adjusts ground alarm presence/function
		DRIVE CUTOUT	Displays/adjusts drive cutout switch presence/function
		ARMGAURD CUTOUT	Displays/adjusts armgaurd cutout switch presence/function
		FLASH CODE	Displays/adjusts how fault flash codes are indicated
			NOTE: Only available at level 1
CALIBRATIONS		CURRENT	Displays motor current calibration
		TEMPERATURE	Displays heatsink temperature calibration

2.26 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.

NOTE: *This machine requires periodic safety and maintenance inspections be a JLG Dealer. A decal located on the frame affords a place to record (stamp) inspection dates. Notify dealer if inspection is overdue.*

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 pump/motor 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. Check Inspection Decal for current inspection stamp.

*Inspection and Maintenance code 10 to be performed every two years (1200 hours).

SECTION 2 - PROCEDURES

Table 2-8. Preventive Maintenance and Inspection Schedule

AREA	INTERVAL					
PLATFORM	DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	1 YEAR
1. Controller	1,11					
2. Switches	1,11					
3. Placards and Decals	1,2					
4. Control Tags	1,2					
5. Hose and Cable		4,8				
6. Wear Pads			8			
7. Handrail and Chains	1,4					
CHASSIS						
1. Batteries	3	5				
2. Battery Charger	1					
3. Hydraulic Pump/Motor	1	5				
4. Valves	1	5				
5. Hydraulic Filter (See Lubrication Chart)		5				
6. Hydraulic hoses and Tubing	1	5				
7. Hydraulic Oil Tank*	1	5				
8. Hydraulic Tank Breather		6				14
9. Lift Cylinder	1,12	5,6,13	4			
10. Limit Switch	1,7					
11. Placards and Decals	1,2					16
12. Wheel and Tire Assemblies	1	8		9		
13. Drive Motors		1,5,6				
14. Drive Brake		1,6	8			
15. Steer Cylinder	1	5,6,13	4			
16. Steer Components	1	4,6	8			12
17. Wheel Bearings			8			
18. Sizzor Arms	1,4					
19. Safety Prop	1,4					
20. Wear Pads			8			
21. Pivot Pins/Bolts	1,4		7,8			
22. Switches, Ground Control	1,11					
23. Control Tags	1,2					
24. Hose and Cable	1	4,8				

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.

3.2 TROUBLESHOOTING INFORMATION

The troubleshooting procedures applicable to the aerial platform are listed and defined in Table 3-1, Hydraulic System Troubleshooting.

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

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 check of the circuit components, beginning with the control, would follow. For aid in troubleshooting, refer to the Illustrated Parts Manual for hydraulic diagrams of the various circuits.

3.4 JLG SMART SYSTEM™

The JLG SMART System™ uses a 24 Volt multiplex motor control unit, working in conjunction with a joystick controller and several switches, to operate all machine functions.

The SMART System™ has a built-in LED to indicate any faults which occur during operation of the machine. The system also stores the last ten trouble faults for use in troubleshooting the machine. Each fault is indicated by a first sequence of flashes, then short pause, followed by a second sequence, then a long pause before everything repeats.

When a fault occurs in normal operation, the flash fault repeats while the fault is present; as far as possible normal operation continues. If there is more than one fault present, the 'most important two' will be indicated alternately. Faults are grouped according to the first digit; the second digit provides an extra diagnostic indication.

In addition, the control unit may be programmed for any future options that are added to the machine. The SMART System™ may be adjusted using a custom designed analyzer or special system software installed on a personal computer (PC) or a laptop computer, operating under DOS or Windows. Both the analyzer (JLG kit no. 2901443) and the computer software (JLG kit no. 2900874) are available from JLG and include a connecting cable and SMART System™ adjustment procedures.

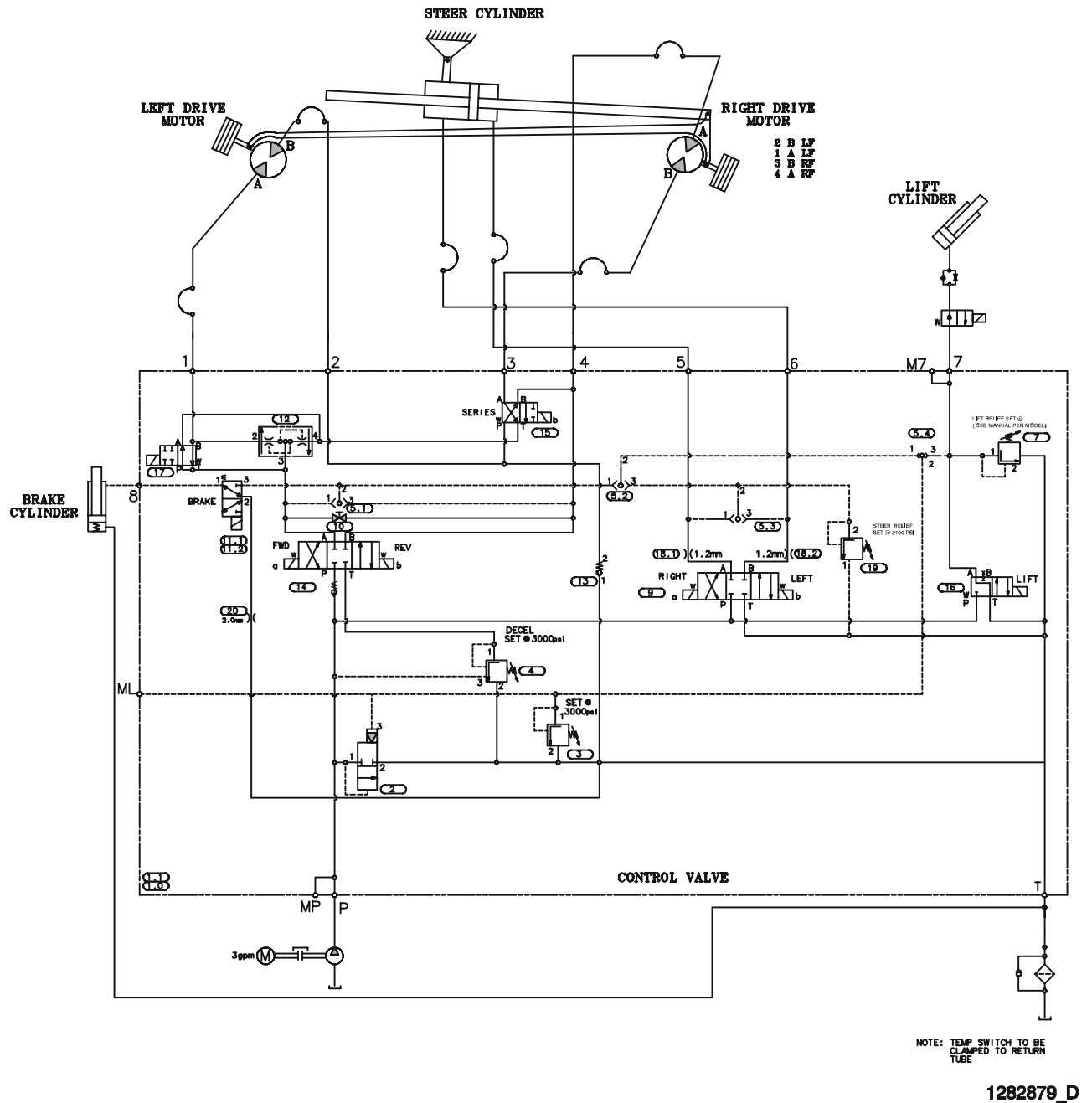
⚠ IMPORTANT

WHEN INSTALLING A NEW SMART SYSTEM CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS. REFER TO ANALYZER KIT NO. 2901443.

SECTION 3 - TROUBLESHOOTING

Table 3-1. Hydraulic System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic pump noisy	Air bubbles in oil (Reservoir too low)	Replenish oil as necessary
	Oil filter dirty	Clean and/or replace filter as necessary
Pump cavitating (Vacuum in pump due to oil starvation)	Oil in reservoir low	Replenish oil as necessary
	Restrictedly reservoir air vent	Clean vent
	Oil viscosity too high	Drain system and replace with recommended oil. Refer to Hydraulic Oil Table
System overheating	Oil viscosity too high	Drain system and replace with recommended oil. Refer to Hydraulic Oil Table
	Main relief set too high	Adjust relief valve to proper pressure
	Hydraulic system too low	Replenish oil as necessary
Pump not delivering oil	Defective pump or motor	Repair or replace motor
System pressure too low	Main relief valve set too low	Reset as required
	Hydraulic pump not functioning properly	Repair or replace pump
	Leak in component, line or fitting	Repair or replace component, line or fitting
	Scored valve spool; scored cylinder	Replace valve; replace cylinder
System(s) operate erratically	Sticking or binding valve cartridge, piston rod, etc.	Clean, repair or replace components as necessary
	Hydraulic oil not at operating temperature	Allow oil sufficient time to warm up



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Figure 3-1. Hydraulic Schematic - (2033E3/2046E3/2646E3/2658E3)

SECTION 3 - TROUBLESHOOTING

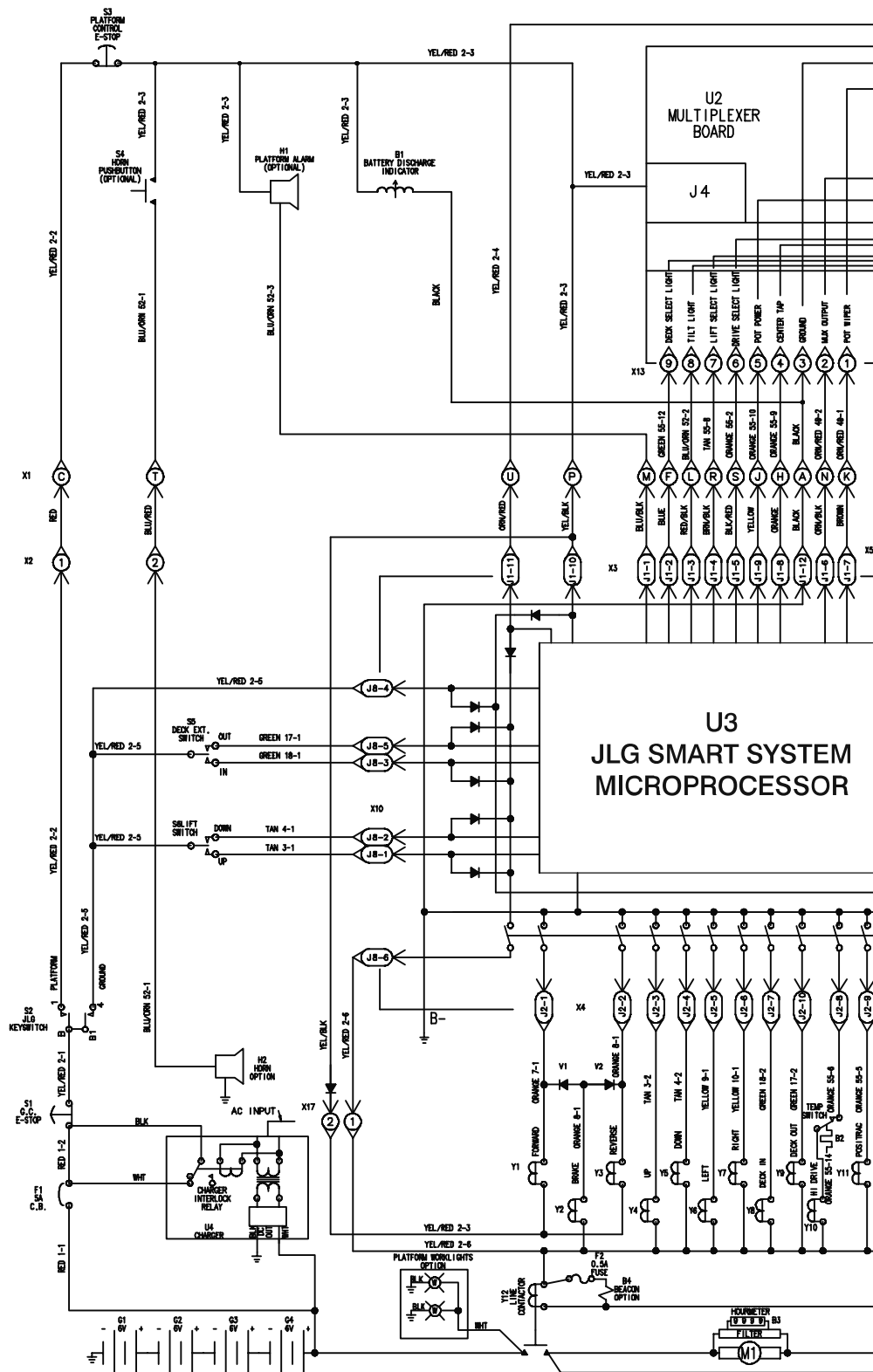


Figure 3-2. Electrical Schematic - Sheet 1 of 2

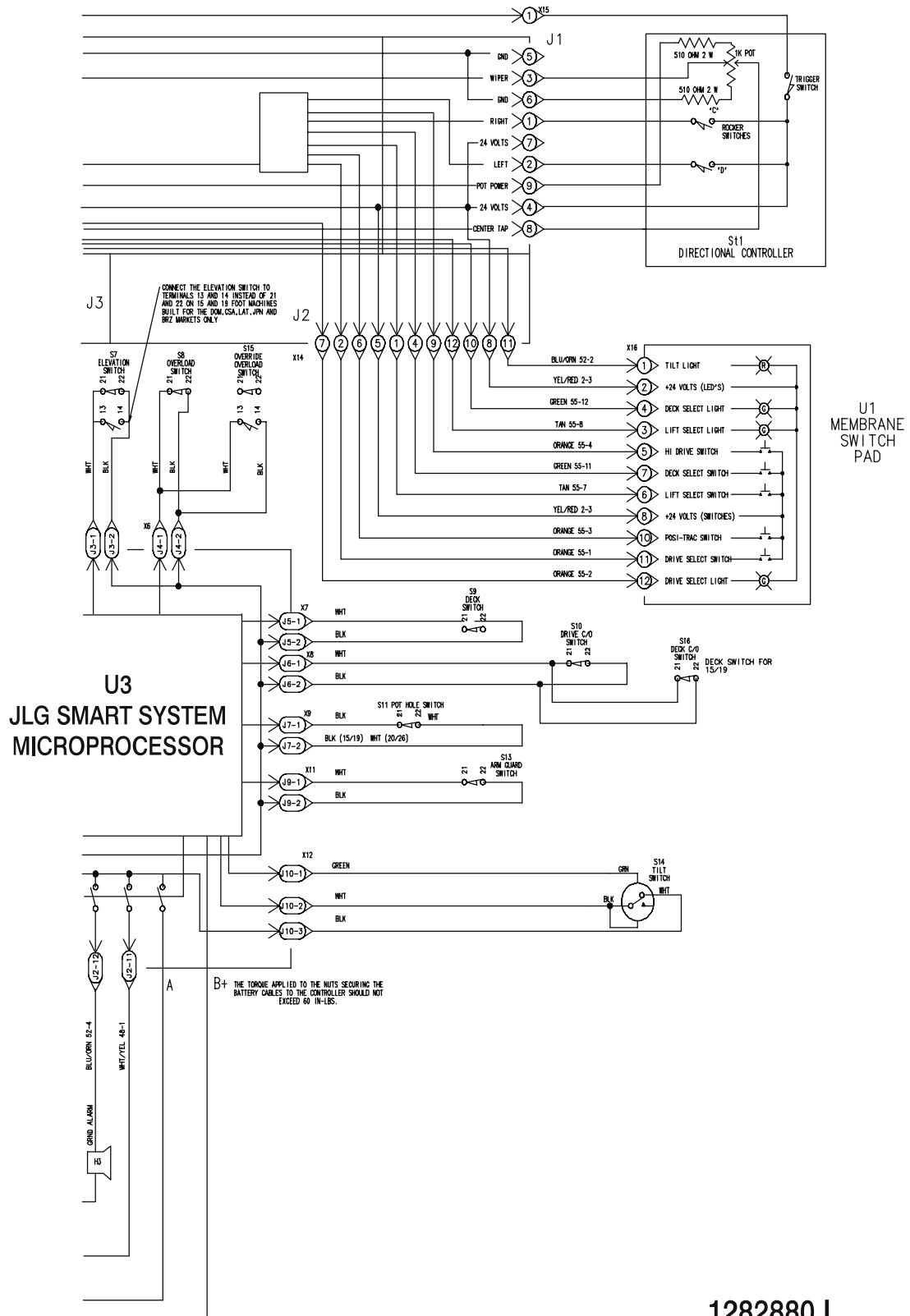


Figure 3-3. Electrical Schematic - Sheet 2 of 2

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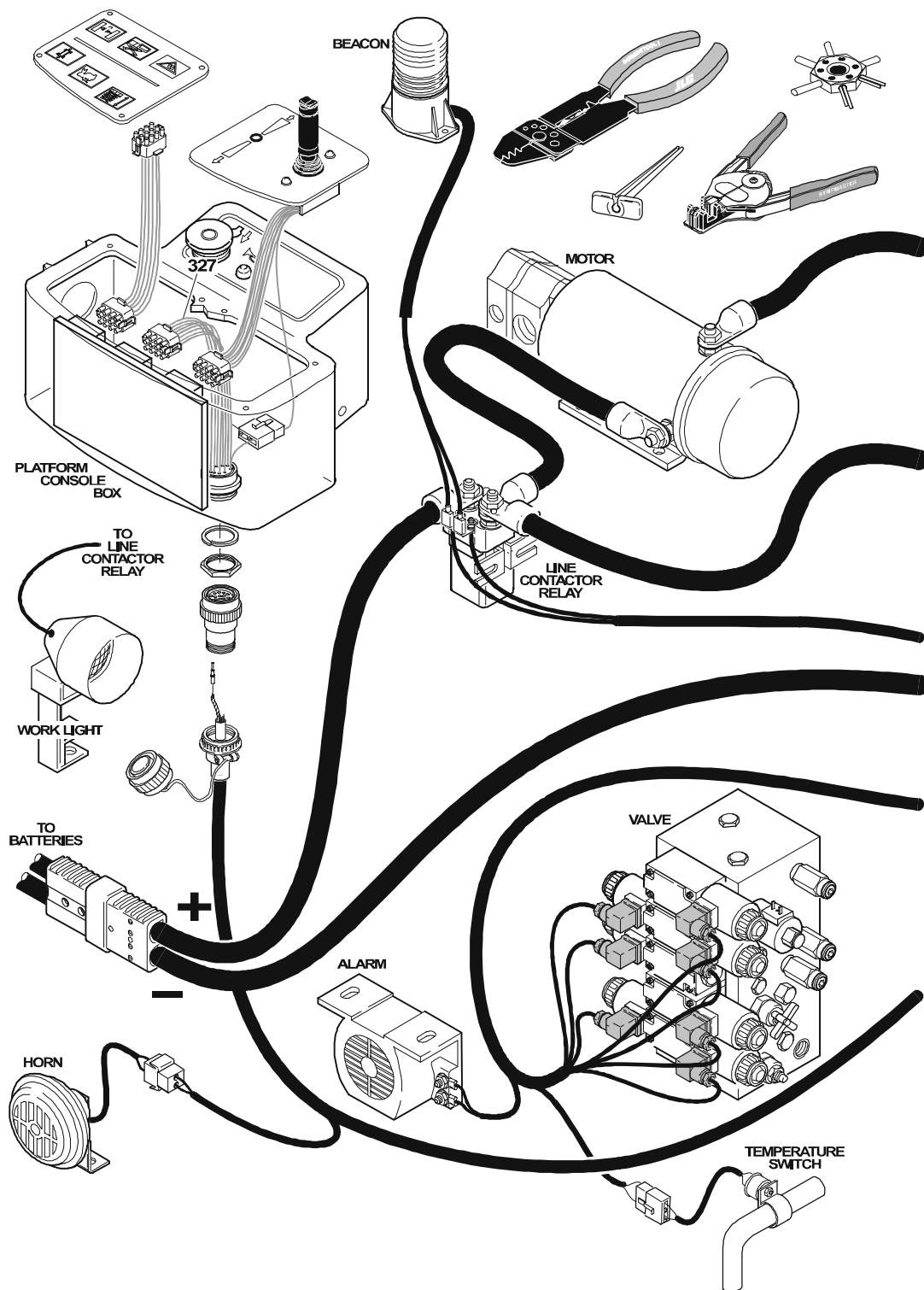


Figure 3-4. Electrical Components Installation - Sheet 1

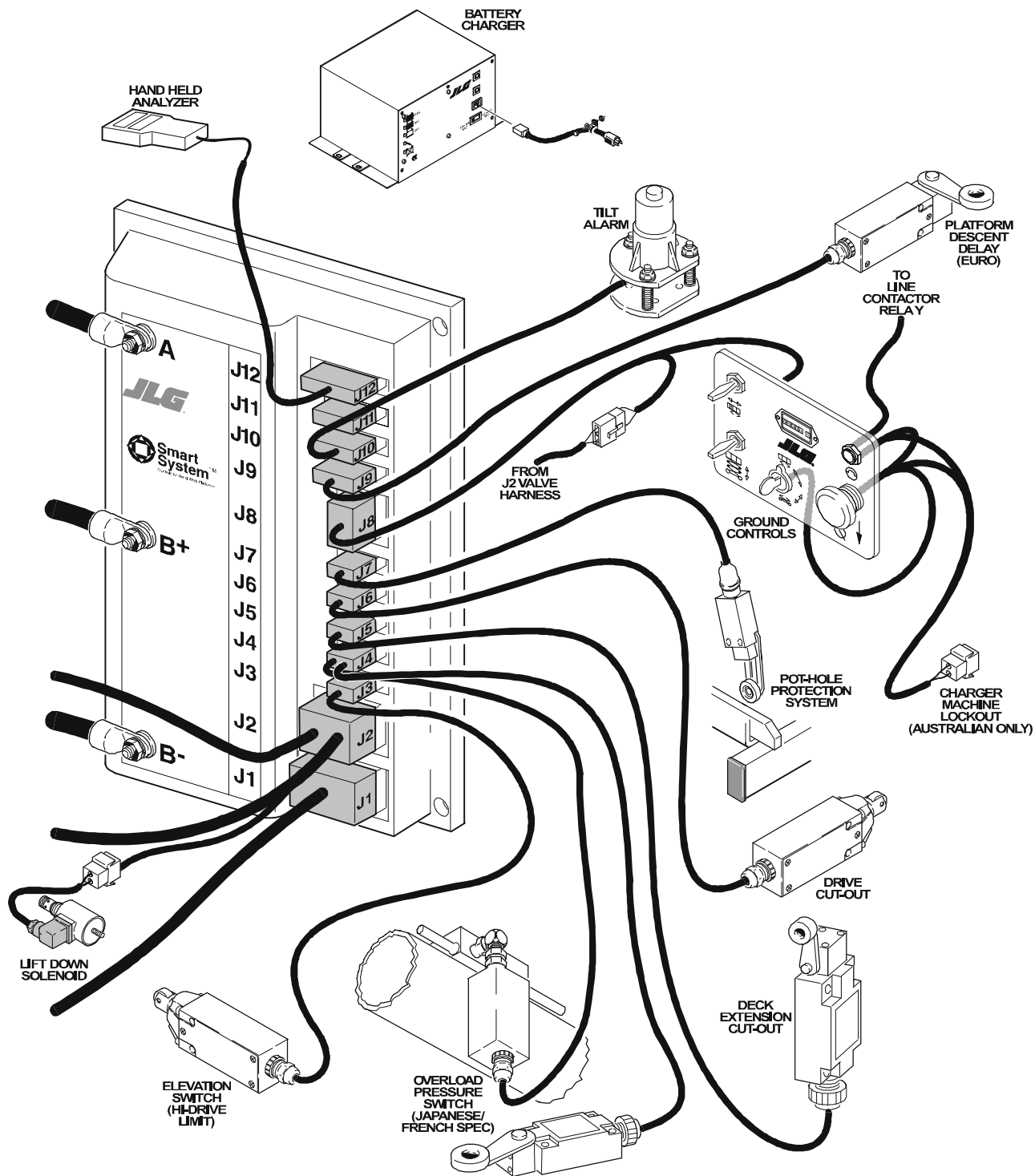


Figure 3-5. Electrical Components Installation - Sheet 2

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Corporate Office
JLG Industries, Inc.

1 JLG Drive
McConnellsburg PA. 17233-9533
USA

Phone: (717) 485-5161
Customer Support Toll Free: (877) 554-5438
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
