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Service and Maintenance Manual

Models
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E300AJP

PVC 2001

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SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A GENERAL

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

⚠ WARNING

MODIFICATION OR ALTERATION OF A MEWP SHALL BE MADE ONLY WITH WRITTEN PERMISSION FROM THE MANUFACTURER.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

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

⚠ WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBILITY OF THE OWNER/OPERATOR.

B HYDRAULIC SYSTEM SAFETY

It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

Do not use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks. Wear gloves to help protect hands from spraying fluid.

C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION COULD RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- USE ONLY REPLACEMENT PARTS OR COMPONENTS THAT ARE APPROVED BY JLG. TO BE CONSIDERED APPROVED, REPLACEMENT PARTS OR COMPONENTS MUST BE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN 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.

REVISON LOG

Original Issue	A - October 16, 2019

SECTION NO.	TITLE	PAGE NO.

SECTION A - INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A General . . . A-1
B Hydraulic System Safety . . . A-1
C Maintenance . . . A-1

SECTION 1 - SPECIFICATIONS

1.1 Operating Specifications . . . 1-1
Machine Specification E300AJ . . . 1-1
Machine Specification E300AJP . . . 1-1
1.2 Capacities . . . 1-1
1.3 Tires . . . 1-1
1.4 Dimensional Data . . . 1-2
1.5 Lubrication Specifications . . . 1-2
Hydraulic Oil . . . 1-2
1.6 Critical Stability Weights . . . 1-4
1.7 Major Component Weights . . . 1-4
1.8 Operator Maintenance . . . 1-6
1.9 Thread Locking Compound . . . 1-8
1.10 Torque Charts . . . 1-9
SAE Fastener Torque Chart . . . 1-9
Metric Fastener Torque Chart . . . 1-15

SECTION 2 - GENERAL

2.1 Machine Preparation, Inspection, and Maintenance . . . 2-1
General . . . 2-1
Preparation, Inspection, and Maintenance . . . 2-1
Pre-Start Inspection . . . 2-1
Pre-Delivery Inspection and Frequent Inspection . . . 2-1
Annual Machine Inspection . . . 2-1
Preventative Maintenance . . . 2-1
2.2 Service and Guidelines . . . 2-2
General . . . 2-2
Safety and Workmanship . . . 2-2
Cleanliness . . . 2-2
Components Removal and Installation . . . 2-2
Component Disassembly and Assembly . . . 2-3
Pressure-Fit Parts . . . 2-3
Bearings . . . 2-3
Gaskets . . . 2-3
Bolt Usage and Torque Application . . . 2-3
Hydraulic Lines and Electrical Wiring . . . 2-3
Hydraulic System . . . 2-3
Lubrication . . . 2-4
Battery . . . 2-4
Lubrication and Servicing . . . 2-4
2.3 Lubrication and Information . . . 2-4
Hydraulic System . . . 2-4
Hydraulic Oil . . . 2-4
Changing Hydraulic Oil . . . 2-4
Lubrication Specifications . . . 2-4
2.4 Cylinder Drift . . . 2-5
Theory . . . 2-5
Cylinder Leakage Test . . . 2-5
Cylinder Thermal Drift . . . 2-5
2.5 Pins and Composite Bearing Repair Guidelines . . . 2-6

SECTION NO.	TITLE	PAGE NO.
2.6	Welding on JLG Equipment	2-6
	Do the Following When Welding on JLG Equipment	2-6
	DO NOT Do the Following When Welding on JLG Equipment	2-6
SECTION 3	**- CHASSIS & TURNTABLE**	
3.1	Tires & Wheels	3-1
	Tire Damage	3-1
	Tire Replacement	3-1
	Wheel and Tire Replacement	3-1
	Wheel Installation	3-1
3.2	Spindle	3-2
	Setting Wheel Bearing End Play	3-2
	Specifications	3-2
	Checking	3-2
	Greasing Requirements	3-2
3.3	Tilt Sensor	3-7
3.4	Speed Sensor	3-7
3.5	Drive Hub	3-11
	Roll and Leak Testing	3-11
	Tightening and Torquing Bolts	3-11
	Main Disassembly	3-12
	Output Carrier Disassembly	3-14
	Input Carrier Disassembly	3-16
	Hub Spindle Disassembly	3-17
	Cover Disassembly	3-18
	Input Carrier Assembly	3-19
	Output Planet Gear Assembly	3-19
	Output Carrier Assembly	3-20
	Hub Spindle Assembly	3-20
	Cover Assembly	3-21
	Main Assembly	3-21
3.6	Drive Motor	3-25
	Removal	3-25
	Disassembly	3-25
	Inspection	3-25
	Assembly	3-26
	Installation	3-26
3.7	Swing Drive	3-29
	Disassembly	3-29
	Assembly	3-30
3.8	Swing Motor	3-32
	Preparation Before Disassembly	3-35
	Disassembly and Inspection	3-35
	Assembly	3-42
	One Piece Stator Construction	3-48
	Two Piece Stator Construction	3-49
	Final Checks	3-49
	Installation Torque	3-49
3.9	Swing Bearing	3-50
	Turntable Bearing Mounting Bolt Condition Check	3-50
	Wear Tolerance	3-50
	Replacement of Swing Bearing	3-53
	Swing Bearing Torque Value	3-55
3.10	Battery Maintenance and Charging	3-56
	Battery Maintenance, Quarterly	3-56
	Battery Charging, Daily	3-56

SECTION NO.	TITLE	PAGE NO.
3.11	Battery Charger	3-57
	Operating Instructions	3-57
	Maintenance Instructions	3-58
	Battery Charger Fault Codes	3-58
	Excessive Battery Watering Requirements or Strong Sulphur (Rotten Egg) Smell	3-62
	Instructions for using the Delta-Q QuiQ Programmer CTQuiQ Programming Kit	3-63
	Checking/Changing the Battery Charger Algorithm	3-64
3.12	Chassis Tilt Indicator System	3-65
3.13	Drive Orientation System	3-65
3.14	Hoods	3-66

SECTION 4 - BOOM & PLATFORM

4.1	Platform Control Enable System	4-1
4.2	Function Speed Control System	4-1
4.3	Transport Position Interlock System	4-1
4.4	Above Elevation (Above Horizontal) Cutout System	4-1
4.5	Platform Load Control System	4-1
4.6	Positive Opening Switch Systems	4-1
4.7	Platform	4-2
	Support Removal	4-2
	Support Installation	4-3
4.8	Boom Maintenance	4-6
	Removal of the Main Boom	4-6
	Disassembly of the Main Boom	4-6
	Inspection	4-8
	Assembly of the Main Boom	4-8
	Installation of the Main Boom	4-9
4.9	Wear Pads	4-19
4.10	Tilt Sensor Check	4-19
4.11	Boom Limit Switches	4-19
4.12	Boom Cleanliness Guidelines	4-21
4.13	Foot Switch Adjustment	4-21
4.14	Articulating Jib Boom	4-22
	Removal	4-22
	Disassembly	4-22
	Inspection	4-22
	Assembly	4-23
	Installation	4-23
4.15	Boom Synchronizing Procedure	4-23
4.16	Rotary Actuator	4-24
	Theory Of Operation	4-24
	Tools Required for Assembly/Disassembly	4-24
	Disassembly	4-27
	Inspection	4-30
	Assembly	4-31
	Installing Counterbalance Valve	4-35
	Greasing Thrust Washers	4-36
	Testing the Actuator	4-36
	Installation and Bleeding	4-37
	Troubleshooting	4-38
4.17	Powertrack Maintenance	4-39
	Removing a Link	4-39
	Installing a New Link	4-42
	Replacing Fixed End Brackets	4-47
	Replacing Moving End Brackets	4-49

SECTION NO.	TITLE	PAGE NO.

4.18 Skyguard 4-51
Operation 4-51
Function Test 4-51
Diagnostics & Troubleshooting 4-52

SECTION 5 - BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 Lubricating O-Rings in the Hydraulic System 5-1
Cup and Brush 5-1
Dip Method 5-2
Spray Method 5-2
Brush-on Method 5-2
5.2 Hydraulic Connection Assembly and Torque Specification 5-3
Tapered Thread Types 5-3
Straight Thread Types, Tube and Hose Connections 5-3
Straight Thread Types, Port Connections 5-4
Flange Connection Types 5-4
Tightening Methods 5-4
Assembly and Torque Specifications 5-5
Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections 5-6
Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections 5-7
Assembly Instructions for 37° (JIC) Flare Fittings 5-8
Assembly Instructions for 45° SAE Flare Fittings 5-12
Assembly Instructions for O-Ring Face Seal (ORFS) Fittings 5-14
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS) 5-16
Assembly Instructions for Bulkhead (BH) Fittings 5-18
Assembly Instructions for O-Ring Boss (ORB) Fittings 5-22
Assembly Instructions for Adjustable Port End Metric (MFF) Fittings 5-30
Assembly Instructions for Metric ISO 6149 (MPP) Port Assembly Stud Ends 5-38
Assembly instructions for Adjustable Port End (BSPP) Fittings 5-40
Assembly Instructions for Flange Connections: (FL61 and FL62) 5-48
Double Wrench Method 5-51
FFWR and TFFT Methods 5-52
Adjustable Stud End Assembly 5-52
O-ring Installation (Replacement) 5-53
5.3 Hydraulic Cylinders 5-54
Platform Level Cylinder 5-54
Jib Lift Cylinder 5-59
Main Boom Lift Cylinder 5-64
Master Cylinder 5-69
Tower Boom Lift Cylinder 5-74
Steer Cylinder 5-79
Telescope Cylinder 5-84
5.4 Cylinder Removal And Installation 5-89
Main Boom Lift Cylinder Removal 5-89
Main Boom Lift Cylinder Installation 5-89
Main Boom Telescope Cylinder Removal 5-90
Main Boom Telescope Cylinder Installation 5-91
Phase Check Cartridge 5-91
5.5 Pressure Setting Procedure 5-92
Adjustments made at the Main Valve Bank 5-92
Adjustments made at the Boom Function Valve Bank 5-94
5.6 Initial Hydraulic Pump Start-up Procedure 5-103
Procedure 5-103
5.7 Hydraulic Schematics 5-106

SECTION NO.	TITLE	PAGE NO.

SECTION 6 - JLG CONTROL SYSTEM

6.1 JLG Control System Analyzer Kit Instructions 6-1
Introduction 6-1
To Connect the JLG Control System Analyzer. 6-2
Using the Analyzer 6-2
Changing the Access Level of the Hand Held Analyzer. 6-3
Adjusting Parameters Using the Hand Held Analyzer 6-4
Machine Setup 6-5
Level Vehicle Description 6-5
6.2 Machine Personality Settings 6-13
6.3 Machine Orientation When performing test 6-22
Test Notes 6-23
Help Descriptions and Fault Flash Codes 6-33
Analyzer Diagnostics Menu Structure 6-34
System Self Test 6-40
6.4 Calibrating Steer 6-45
6.5 Calibrating Tilt Sensor 6-47
6.6 Calibrating Load Sensing 6-48

SECTION 7 - BASIC ELECTRICAL INFORMATION & SCHEMATICS

7.1 General 7-1
7.2 Multimeter Basics 7-1
Grounding 7-1
Backprobing 7-1
Min/Max 7-1
Polarity 7-1
Scale. 7-1
Voltage Measurement 7-1
Resistance Measurement 7-2
Continuity Measurement 7-2
Current Measurement 7-3
7.3 Checking Switches 7-3
Basic Check 7-3
Limit Switches 7-3
Automatic Switches 7-4
Switch Wiring - Low Side, High Side 7-4
7.4 Applying Silicone Dielectric Compound to Electrical Connections. 7-4
7.5 Dielectric Grease Application 7-5
Installation. 7-5
AMP Mate-N-Lok 7-5
AMP Faston 7-5
AMP Micro-Fit. 7-5
AMP Mini Fit Jr 7-5
Mini Fit Sr 7-6
DIN Connectors 7-6
Exceptions 7-6
7.6 AMP Connector 7-7
Applying Silicone Dielectric Compound to AMP Connectors 7-7
Assembly 7-7
Disassembly 7-9
Wedge Lock 7-9
Service - Voltage Reading 7-9
7.7 DEUTSCH Connectors 7-11
DT/DTP Series Assembly. 7-11
DT/DTP Series Disassembly 7-11
HD30/HDP20 Series Assembly 7-12
HD30/HDP20 Series Disassembly 7-12

SECTION NO.	TITLE	PAGE NO.
7.8	Wiring Harness Connector Labels	7-13
	Connector Labels	7-13
	Component Labels	7-13
7.9	Electrical Harness	7-15
7.10	Electrical Schematics	7-72

FIGURE NO.	TITLE	PAGE NO.
1-1.	Maintenance and Lubrication Diagram	1-5
2-1.	Hydraulic Oil Operation Chart	2-10
3-1.	Spindle Assembly	3-3
3-2.	Chassis Component Location	3-4
3-3.	Steering Installation	3-5
3-4.	Drive Components	3-6
3-5.	Frame Mounted Electrical Connection	3-7
3-6.	Relay	3-8
3-7.	System Fuses	3-8
3-8.	Brake Fuses	3-9
3-9.	Drive Fuses	3-10
3-10.	Main Assembly - Sheet 1 of 2	3-12
3-11.	Main Assembly - Sheet 2 of 2	3-13
3-12.	Output Carrier	3-14
3-13.	Planet Gear	3-15
3-14.	Input Carrier	3-16
3-15.	Hub Spindle	3-17
3-16.	Cover Assembly	3-18
3-17.	Drive Hub - Sheet 1 of 2	3-22
3-18.	Drive Hub - Sheet 2 of 2	3-23
3-19.	Cup Pressing Tool	3-24
3-20.	Cup Pressing Tool	3-24
3-21.	Drive Motor	3-27
3-22.	Swing Components	3-28
3-23.	Swing Drive - Exploded View	3-31
3-24.	Swing Motor - Cutaway	3-32
3-25.	Swing Motor - Exploded View	3-34
3-26.	Swing Bearing Feeler Gauge Check	3-50
3-27.	Swing Bearing Tolerance Boom Placement	3-51
3-28.	Swing Bearing Tolerance Boom Placement	3-52
3-29.	Swing Bearing Tolerance Measuring Point	3-53
3-30.	Swing Bearing Torque Sequence	3-55
3-31.	Battery Charger	3-59
3-32.	Battery Boxes	3-60
3-33.	QuiQ Programming Kit	3-63
3-34.	Hoods	3-66
3-35.	Drive Orientation Switch	3-67
3-36.	Counterweight	3-68
4-1.	Location of Components Platform Support	4-2
4-2.	Platform Support Torque Values	4-5
4-3.	Boom Assembly	4-7
4-4.	Boom Lubrication Instructions	4-9
4-5.	Power Track Hoses	4-10
4-6.	Clamp Block Installation	4-11
4-7.	Boom Thread Locking Compound Location	4-12
4-8.	Boom Torque Values	4-13
4-9.	Lower Boom	4-14
4-10.	Lower Boom Thread Locking Compound Location	4-15
4-11.	Lower Boom Torque Values	4-16
4-12.	AJP Jib	4-17
4-13.	AJP Jib Torque Values	4-18
4-14.	Wear Pad Thickness	4-19
4-15.	Boom Limit Switches	4-20
4-16.	Location of Components - Articulating Jib Boom	4-22
4-17.	Rotary Actuator (Exploded View)	4-25
4-18.	Rotator - Assembly Drawing	4-26
4-19.	Rotator Counterbalance Valve	4-35

FIGURE NO.	TITLE	PAGE NO.
5-1.	NPTF Thread	5-3
5-2.	BSPT Thread	5-3
5-3.	JIC Thread	5-3
5-4.	SAE Thread	5-3
5-5.	ORFS Thread	5-3
5-6.	MTBL-MBTS Thread	5-3
5-7.	Bulkhead Thread	5-3
5-8.	ORB-MPP Thread	5-4
5-9.	MFF-BSPP Thread	5-4
5-10.	ORB-MPP Thread	5-4
5-11.	Torque Wrench Angle	5-5
5-12.	Double Wrench Method	5-51
5-13.	FFWR Method	5-52
5-14.	Adjustable Stud End Assembly	5-53
5-15.	Cylinder Barrel Support	5-54
5-16.	Cylinder Rod Support	5-54
5-17.	Platform Level Cylinder	5-55
5-18.	Composite Bearing Installation	5-57
5-19.	Rod Seal Installation	5-57
5-20.	Cylinder Head Seal Installation	5-57
5-21.	Wiper Seal Installation	5-58
5-22.	Installation of Head Seal Kit	5-58
5-23.	Piston Seal Kit Installation	5-58
5-24.	Cylinder Barrel Support	5-59
5-25.	Cylinder Rod Support	5-59
5-26.	Jib Lift Cylinder	5-60
5-27.	Composite Bearing Installation	5-62
5-28.	Rod Seal Installation	5-62
5-29.	Cylinder Head Seal Installation	5-62
5-30.	Wiper Seal Installation	5-63
5-31.	Installation of Head Seal Kit	5-63
5-32.	Piston Seal Kit Installation	5-63
5-33.	Cylinder Barrel Support	5-64
5-34.	Cylinder Rod Support	5-64
5-35.	Main Boom Lift Cylinder	5-65
5-36.	Composite Bearing Installation	5-67
5-37.	Rod Seal Installation	5-67
5-38.	Cylinder Head Seal Installation	5-67
5-39.	Wiper Seal Installation	5-68
5-40.	Installation of Head Seal Kit	5-68
5-41.	Piston Seal Kit Installation	5-68
5-42.	Cylinder Barrel Support	5-69
5-43.	Cylinder Rod Support	5-69
5-44.	Master Cylinder	5-70
5-45.	Composite Bearing Installation	5-72
5-46.	Rod Seal Installation	5-72
5-47.	Cylinder Head Seal Installation	5-72
5-48.	Wiper Seal Installation	5-73
5-49.	Installation of Head Seal Kit	5-73
5-50.	Piston Seal Kit Installation	5-73
5-51.	Cylinder Barrel Support	5-74
5-52.	Cylinder Rod Support	5-74
5-53.	Tower Boom Cylinder	5-75
5-54.	Composite Bearing Installation	5-77
5-55.	Rod Seal Installation	5-77
5-56.	Cylinder Head Seal Installation	5-77
5-57.	Wiper Seal Installation	5-78

FIGURE NO.	TITLE	PAGE NO.

5-58.	Installation of Head Seal Kit	5-78
5-59.	Piston Seal Kit Installation	5-78
5-60.	Cylinder Barrel Support	5-79
5-61.	Cylinder Rod Support	5-79
5-62.	Steer Cylinder	5-80
5-63.	Rod Seal Installation	5-82
5-64.	Cylinder Head Seal Installation	5-82
5-65.	Wiper Seal Installation	5-82
5-66.	Installation of Head Seal Kit	5-82
5-67.	Piston Seal Kit Installation	5-83
5-68.	Cylinder Barrel Support	5-84
5-69.	Cylinder Rod Support	5-84
5-70.	Telescope Cylinder	5-85
5-71.	Composite Bearing Installation	5-87
5-72.	Rod Seal Installation	5-87
5-73.	Cylinder Head Seal Installation	5-87
5-74.	Wiper Seal Installation	5-88
5-75.	Installation of Head Seal Kit	5-88
5-76.	Piston Seal Kit Installation	5-88
5-77.	Main Boom Lift Cylinder Removal	5-89
5-78.	Main Telescope Cylinder Removal	5-90
5-79.	Main Control Valve - Sheet 1 of 2	5-98
5-80.	Main Control Valve - Sheet 2 of 2	5-99
5-81.	Boom Function Valve - Sheet 1 of 2	5-100
5-82.	Boom Function Valve - Sheet 2 of 2	5-101
5-83.	Hydraulic Components Location	5-102
5-84.	Hydraulic Schematic (E300AJP) - Sheet 1 of 4	5-106
5-85.	Hydraulic Schematic (E300AJP) - Sheet 2 of 4	5-107
5-86.	Hydraulic Schematic (E300AJ) - Sheet 3 of 4	5-108
5-87.	Hydraulic Schematic (E300AJ) - Sheet 4 of 4	5-109
6-1.	Hand Held Analyzer	6-1
6-2.	Analyzer Flow Chart, Version P1.10 - Sheet 1 of 5	6-17
6-3.	Analyzer Flow Chart, Version P1.10 - Sheet 2 of 5	6-18
6-4.	Analyzer Flow Chart, Version P1.10 - Sheet 3 of 5	6-19
6-5.	Analyzer Flow Chart, Version P1.10 - Sheet 4 of 5	6-20
6-6.	Analyzer Flow Chart, Version P1.10 - Sheet 5 of 5	6-21
6-7.	Control Module Location	6-24
6-8.	Analyzer Connecting Points	6-25
6-9.	Platform Control Module - Sheet 1 of 2	6-26
6-10.	Platform Control Module - Sheet 2 of 2	6-27
6-11.	Power Module - LH	6-28
6-12.	Power Module - RH	6-29
6-13.	Ground Control Module - Sheet 1 of 3	6-30
6-14.	Ground Control Module - Sheet 2 of 3	6-31
6-15.	Ground Control Module - Sheet 3 of 3	6-32
7-1.	Voltage Measurement (DC)	7-1
7-2.	Resistance Measurement	7-2
7-3.	Continuity Measurement	7-2
7-4.	Current Measurement (DC)	7-3
7-5.	Connector Assembly Figure 1	7-7
7-6.	AMP Connector	7-7
7-7.	Connector Assembly Figure 2	7-8
7-8.	Connector Assembly Figure 3	7-8
7-9.	Connector Assembly Figure 4	7-8
7-10.	Connector Disassembly	7-9
7-11.	Connector Installation	7-10
7-12.	DT/DTP Contact Installation	7-11

FIGURE NO.	TITLE	PAGE NO.
7-13.	DT/DTP Contact Removal	7-11
7-14.	HD/HDP Contact Installation	7-12
7-15.	HD/HDP Locking Contacts Into Position	7-12
7-16.	HD/HDP Contact Removal	7-12
7-17.	HD/HDP Unlocking Contacts	7-12
7-18.	Platform Console Harness - Sheet 1 of 5	7-15
7-19.	Platform Console Harness - Sheet 2 of 5	7-16
7-20.	Platform Console Harness - Sheet 3 of 5	7-20
7-21.	Platform Console Harness - Sheet 4 of 5	7-22
7-22.	Platform Console Harness - Sheet 5 of 5	7-27
7-23.	Load Sensing System Harness (LSS) - Sheet 1 of 2	7-28
7-24.	Load Sensing System Harness (LSS) - Sheet 2 of 2	7-29
7-25.	Main Valve Harness - Sheet 1 of 3	7-30
7-26.	Main Valve Harness - Sheet 2 of 3	7-31
7-27.	Main Valve Harness - Sheet 3 of 3	7-32
7-28.	Boom Valve Harness - Sheet 1 of 2	7-34
7-29.	Boom Valve Harness - Sheet 2 of 2	7-35
7-30.	Turntable Harness - Sheet 1 of 4	7-37
7-31.	Turntable Harness - Sheet 2 of 4	7-38
7-32.	Turntable Harness - Sheet 3 of 4	7-44
7-33.	Turntable Harness - Sheet 4 of 4	7-47
7-34.	Amber Beacon Harness	7-48
7-35.	Ground Panel Harness - Sheet 1 of 3	7-50
7-36.	Ground Panel Harness - Sheet 2 of 3	7-51
7-37.	Ground Panel Harness - Sheet 3 of 3	7-52
7-38.	Chassis Traction Harness - Sheet 1 of 3	7-54
7-39.	Chassis Traction Harness - Sheet 2 of 3	7-55
7-40.	Chassis Traction Harness - Sheet 3 of 3	7-56
7-41.	Chassis Traction to Turntable Harness	7-58
7-42.	Steering Sensor Harness	7-59
7-43.	Inverter IGN Harness	7-60
7-44.	Platform Work Light Harness	7-62
7-45.	SkyGuard Harness - Sheet 1 of 2	7-64
7-46.	SkyGuard Harness - Sheet 2 of 2	7-65
7-47.	Security Lock Harness - Sheet 1 of 2	7-66
7-48.	Security Lock Harness - Sheet 2 of 2	7-67
7-49.	Skyguard (Bar) 6 Pin Harness	7-68
7-50.	Eboom Clearsky CAN Harness	7-70
7-51.	Electrical Schematic - Sheet 1 of 14	7-74
7-52.	Electrical Schematic - Sheet 2 of 14	7-75
7-53.	Electrical Schematic - Sheet 3 of 14	7-76
7-54.	Electrical Schematic - Sheet 4 of 14	7-77
7-55.	Electrical Schematic - Sheet 5 of 14	7-78
7-56.	Electrical Schematic - Sheet 6 of 14	7-79
7-57.	Electrical Schematic - Sheet 7 of 14	7-80
7-58.	Electrical Schematic - Sheet 8 of 14	7-81
7-59.	Electrical Schematic - Sheet 9 of 14	7-82
7-60.	Electrical Schematic - Sheet 10 of 14	7-83
7-61.	Electrical Schematic - Sheet 11 of 14	7-84
7-62.	Electrical Schematic - Sheet 12 of 14	7-85
7-63.	Electrical Schematic - Sheet 13 of 14	7-86
7-64.	Electrical Schematic - Sheet 14 of 14	7-87

TABLE NO.	TITLE	PAGE NO.
1-1	Dimensional Data - E300AJ	1-2
1-2	Dimensional Data - E300AJP	1-2
1-3	Mobil DTE 11M Specs	1-3
1-4	Mobil DTE 10 Excel 15 Specs	1-3
1-5	Mobilfluid 424 Specs	1-3
1-6	Mobil EAL 224H Specs	1-3
1-7	Mobil EAL Envirosyn H Specs	1-3
1-8	Quintolubric 888-46	1-3
1-9	Lubrication Specifications	1-6
2-1	Inspection and Maintenance	2-2
2-2	Cylinder Drift	2-5
2-3	Inspection and Preventive Maintenance Schedule	2-7
3-1	Wheel Torque Chart	3-2
3-2	Swing Motor Troubleshooting	3-33
3-3	Battery Charger Fault Codes (Delta-Q)	3-58
3-4	Battery Algorithms	3-64
4-1	Troubleshooting	4-38
4-2	SkyGuard Function Table	4-52
5-1	NPTF Pipe Thread	5-6
5-2	BSPT Pipe Thread	5-7
5-3	37° Flare (JIC) Thread - Steel	5-9
5-4	37° Flare (JIC) Thread - Aluminum/Brass	5-10
5-5	45° Flare (SAE) - Steel	5-13
5-6	45° Flare (SAE) - Aluminum/Brass	5-13
5-7	O-ring Face Seal (ORFS) - Steel	5-14
5-8	O-ring Face Seal (ORFS) - Aluminum/Brass	5-15
5-9	DIN 24°Cone (MBTL & MBTS)	5-17
5-10	Bulkhead Fittings (BH) - INCH	5-19
5-11	Bulkhead Fittings (BH) - METRIC	5-20
5-12	O-ring Boss (ORB) - Table 1 of 6	5-23
5-13	O-ring Boss (ORB) - Table 2 of 6	5-24
5-14	O-ring Boss (ORB) - Table 3 of 6	5-25
5-15	O-ring Boss (ORB) - Table 4 of 6	5-26
5-16	O-ring Boss (ORB) - Table 5 of 6	5-27
5-17	O-ring Boss (ORB) - Table 6 of 6	5-28
5-18	Metric Flat Face Port (MFF) - L Series - Table 1 of 3	5-31
5-19	Metric Flat Face Port (MFF) - L Series - Table 2 of 3	5-32
5-20	Metric Flat Face Port (MFF) - L Series - Table 3 of 3	5-33
5-21	Metric Flat Face Port (MFF) - S Series - Table 1 of 3	5-34
5-22	Metric Flat Face Port (MFF) - S Series - Table 2 of 3	5-35
5-23	Metric Flat Face Port (MFF) - S Series - Table 3 of 3	5-36
5-24	Metric Pipe Parallel O-Ring Boss (MPP)	5-39
5-25	British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3	5-41
5-26	British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3	5-42
5-27	British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3	5-43
5-28	British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3	5-44
5-29	British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3	5-45
5-30	British Standard Parallel Pipe Port (BSPP) - S Series - Table 3 of 3	5-46
5-31	Flange Code (FL61 & FL62) -Inch Fasteners	5-49
5-32	Flange Code (FL61 & FL62) - Metric Fasteners	5-50
5-33	Main Valve Torque	5-99
5-2	Boom Function Valve Torques	5-101
6-1	Analyzer Abbreviations	6-6
6-2	Machine Configuration Programming Information - Version P1.10	6-8
6-3	Machine Configuration Programming Settings - Version P1.10	6-12
6-4	Personality Ranges/Defaults - Version P1.10	6-13
6-5	Function Speeds	6-23

TABLE NO.	TITLE	PAGE NO.
6-6	Machine Setup Descriptions	6-33
6-7	JLG Control System Flash Codes	6-33
6-8	DIAGNOSTICS - Menu Descriptions	6-34
6-9	System Test Descriptions	6-40
6-10	System Test Messages	6-41
6-11	Diagnostic Trouble Codes	6-51
7-1	Wiring Harness Connector Labels	7-14

SECTION 1. SPECIFICATIONS

1.1 OPERATING SPECIFICATIONS

Machine Specification E300AJ

Maximum Work Load (Capacity) ANSI Markets Unrestricted:	500 lb (227 kg)
Maximum Work Load (Capacity) CE & Australia Markets Unrestricted:	500 lb (230 kg)
Maximum Travel Grade, Stowed Position (Gradeability)	25%
Maximum Travel Grade Stowed Position (Side Slope)	3 degrees
Ground Bearing Pressure - Maximum	170 psi (11.95 kg/cm^2)
Maximum System Voltage	48V DC
Battery Life per Charge High Speed Reduced Speed	 8.7 hours 11.1 hours
Gross Machine Weight - Approximate	15060 lb (6831 kg)
Drive Speed Maximum Reduced Elevated	 4.5 mph (7.2 kph) 2.7 mph (4.3 kph) 0.3 mph (0.48 kph)
Battery Recharge Time	14 Hours from Full Discharge
Maximum Main Relief Hydraulic Pressure	3000 psi (207 bar)

Machine Specification E300AJP

Maximum Work Load (Capacity) ANSI Markets Unrestricted:	500 lb (227 kg)
Maximum Work Load (Capacity) CE & Australia Markets Unrestricted:	500 lb (230 kg)
Maximum Travel Grade, Stowed Position (Gradeability)	25%
Maximum Travel Grade Stowed Position (Side Slope)	3 degrees
Ground Bearing Pressure - Maximum	170 psi (11.95 kg/cm^2)
Maximum System Voltage	48 VDC
Battery Life per Charge High Speed Reduced Speed	 8.7 hours 11.1 hours
Gross Machine Weight - Approximate	15400 lb (6985 kg)
Drive Speed Maximum Reduced Elevated	 4.5 mph (7.2 kph) 2.7 mph (4.3 kph) 0.3 mph (0.48 kph)
Battery Recharge Time	14 Hours from Full Discharge
Maximum Main Relief Hydraulic Pressure	3000 psi (207 bar)

1.2 CAPACITIES

Hydraulic Oil Tank	2.9 Gal. (11 L) 2.1 Gal. (8 L) to Full Mark
Drive Hub*	25.5 oz. (0.75 L)(1/2 Full)
*Drive hubs should be one half full of lubricant.	

1.3 TIRES

Size	25x7x12
Maximum Tire Load	8200 lb (3719 kg)
Type	Solid Non-Marking

1.4 DIMENSIONAL DATA

Table 1-1. Dimensional Data - E300AJ

Turning Radius (Inside)	5 ft. (1.52 m)
Turning Radius (Outside)	10 ft. 2 in. (3.1 m)
Machine Height (Stowed)	6 ft. 7 in. (2.01 m))
Machine Length (Stowed)	18 ft. 2 in. (5.54 m)
Up and Over Platform Height	13 ft. 2 in. (4.01 m)
Horizontal Reach Up and Over	20 ft. 3 in. (6.17 m)
Machine Width	4 ft. (1.22 m)
Wheel Base	5 ft. 5 in. (1.65 m)
Platform Height	30 ft. 2 in. (9.19m))
Ground Clearance	4 in. (10 cm)
Occupied Floor Area	30 ft^2 (2.8 m^2)

Table 1-2. Dimensional Data - E300AJP

Turning Radius (Inside)	5 ft. (1.52 m)
Turning Radius (Outside)	10 ft. 2 in. (3.1 m)
Machine Height (Stowed)	6 ft. 7 in. (2.01 m))
Machine Length (Stowed)	18ft. 10 in. (5.74 m)
Up and Over Platform Height	13 ft. 2 in. (4.01 m)
Horizontal Reach Up and Over	20 ft. 1 in. (6.12 m)
Machine Width	4 ft. (1.22 m)
Wheel Base	5 ft. 5 in. (1.65 m)
Platform Height	29 ft. 5 in. (8.97 m)
Ground Clearance	4 in. (10 cm)
Occupied Floor Area	30 ft^2 (2.8 m^2)

1.5 LUBRICATION SPECIFICATIONS

Refer to Section 1.8, Operator Maintenance, for specific lubrication procedures.

Hydraulic Oil

Hydraulic System Operating Temperature Range	S.A.E. Viscosity Grade
+0° to +180° F (-18° to +83° C)	10W
+0° to +210° F (-18° to +99° C)	10W-20, 10W-30
+50° to +210° F (+10° to +99° C)	20W-20

NOTE: *Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service.*

NOTE: *Machines may be equipped with Biodegradable Hydraulic Fluid (VEG) and non-toxic hydraulic oil. This is vegetable oil based and possesses the same antiwear and rust protection characteristics as mineral oils, but will not adversely affect the ground water or the environment when spilled or leaked in small amounts. Biodegradable Hydraulic Fluid (VEG) has a viscosity of 34 cSt at 40° C. and viscosity index of 213. The operating temperature range of this oil is -18° C. to +83° C.*

NOTE: *Aside from JLG recommendations, it is not advisable to mix oils of different brands or types. They may not contain the same required additives or be of comparable viscosities.*

NOTE: *When temperatures remain consistently below 20 degrees F. (-7 degrees C.), JLG Industries recommends the use of Premier Hydraulic Fluid (VG 15).*

Table 1-3. Mobil DTE 11M Specs

ISO Viscosity Grade	#15
Gravity, API	31.9
Pour Point, Max	-40°F (-40°C)
Flash Point, Min	330°F (166°C)
Viscosity	
at 40° C	15 cSt
at 100° C	4.1 cSt
at 100° F	80 SUS
at 210° F	43 SUS
at -30° F	3.200 cP
Viscosity Index	140

Table 1-4. Mobil DTE 10 Excel 15 Specs

ISO Viscosity Grade	#15
Pour Point, Max	-65°F (-54°C)
Flash Point, Min.	360°F (182°C)
Viscosity	
at 40° C	15.8 cSt
at 100° C	4.07 cSt
at 100° F	15.8 cSt
at 212° F	4.07 cSt
Viscosity Index	168

Table 1-5. Mobilfluid 424 Specs

SAE Grade	10W30
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min	442°F (228°C)
Viscosity	
Brookfield, at -18°C	2700 cP
at 40° C	55 cSt
at 100° C	9.3 cSt
Viscosity Index	152

Table 1-6. Mobil EAL 224H Specs

Type	Biodegradable Vegetable Oil
ISO Viscosity Grade	32/46
Specific Gravity	0.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min	428°F (220°C)
Operating Temperature	0 to 180°F (-17 to 162°C)
Weight	7.64 lb per gal. (0.9 kg per liter)
Viscosity	
at 40° C	37 cS
at 100° C	8.4 cSt
Viscosity Index	213
NOTE: *Must be stored above 32°F (0°C)*	

Table 1-7. Mobil EAL Envirosyn H Specs

Type	Synthetic Biodegradable
ISO Viscosity Grade	32
Specific Gravity	0.950
Pour Point, Max	-59°F (-51°C)
Flash Point, Min	514°F (268°C)
Viscosity	
at 40° C	33.1 cSt
at 100° C	6.36 cSt
Viscosity Index	147

Table 1-8. Quintolubric 888-46

Density	0.92 g/cm^2 @ 15°C (59°F)
Pour Point	<-22°F (<-30°C)
Flash Point	572°F (300°C)
Fire Point	680°F (360°C)
Auto Ignition Temperature	>842°F (>450°C)
Viscosity	
at 0° C (32°F)	320 cSt
at 20° C (68°F)	109 cSt
at 40° C (104°F)	47.5 cSt
at 100° C (212°F)	9.5 cSt
Viscosity Index	190

1.6 CRITICAL STABILITY WEIGHTS

WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY, SUCH AS BATTERIES OR TIRES, WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION. DO NOT MODIFY THE MEWP IN ANY WAY TO AFFECT STABILITY.

Component	LB	KG.
Counterweight (AJ)	6188	2807
Counterweight (AJP)	6348	2880
Tire and Wheel	120	54.4
Platform (including console)	169	78
Battery (minimum each) - 305AH	87	39.5
Battery (minimum each) - 305AH (AGM)	108	49
Battery (minimum each) - 375AH & UL	110	50

1.7 MAJOR COMPONENT WEIGHTS

Component	LB	KG.
Platform and Support	215	97.5
Upper Boom Complete	450	204
Mid Boom Complete	419	190
Lower Boom Complete	419	190
Upper Lift Cylinder	97	44
Mid Lift Cylinder	60	27
Lower Lift Cylinder	130	59
Master Cylinder	405	184
Platform Level Cylinder	432	196
Telescope Cylinder	103	47
Upper Upright	222	101
Lower Upright	93	42
Turntable	948	430
Battery Box (incl. batteries)	600	272
Chassis (w/ pneu. tires)	4295	1948
Chassis (w/ foam-filled tires)	4695	2130
Counterweight (AJ)	6188	2807
Counterweight (AJP)	6348	2880
Machine Complete	15400	6985

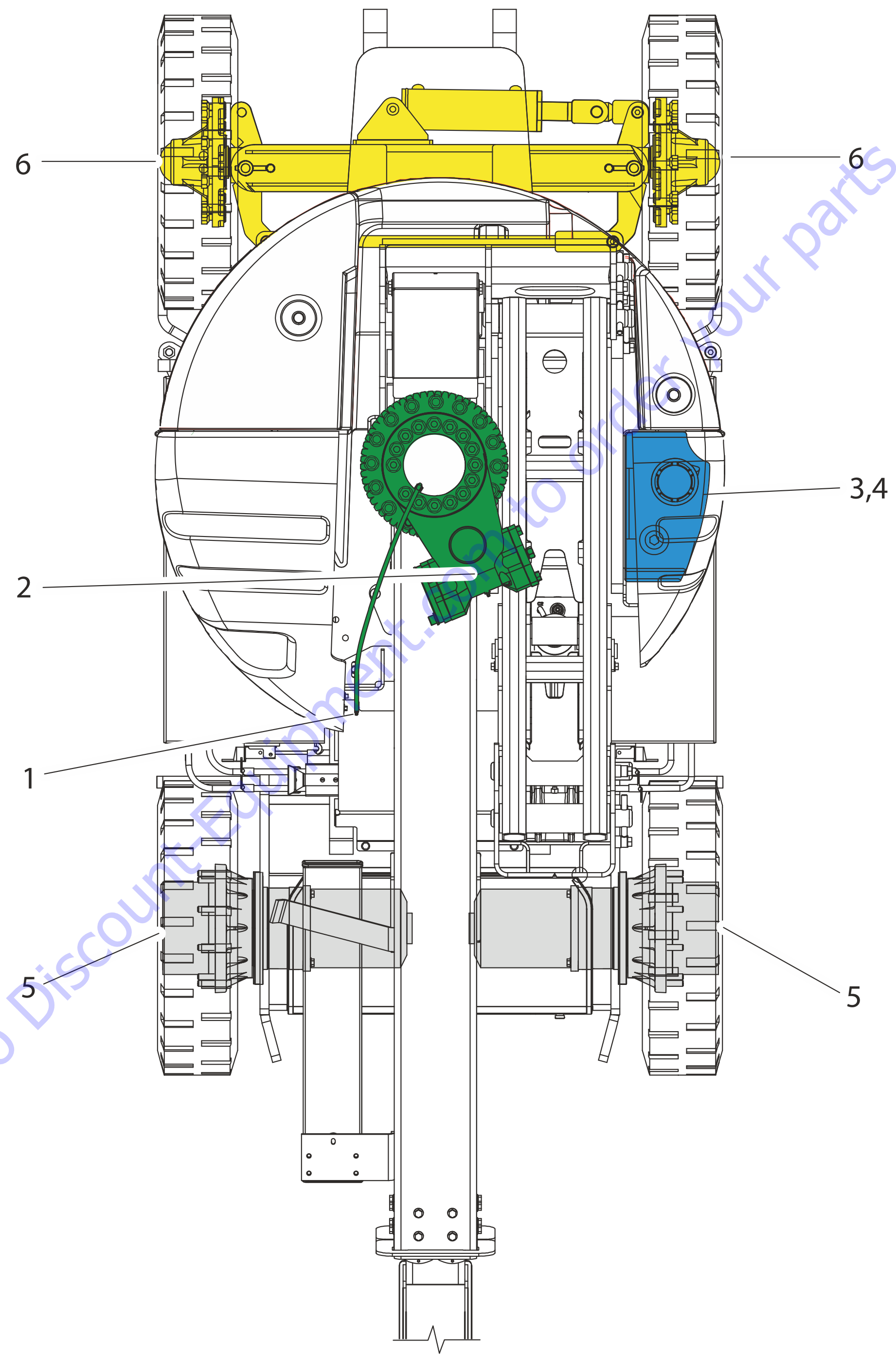


Figure 1-1. Maintenance and Lubrication Diagram

1.8 OPERATOR MAINTENANCE

NOTE: *The following numbers correspond to those in Figure 1-1., Maintenance and Lubrication Diagram.*

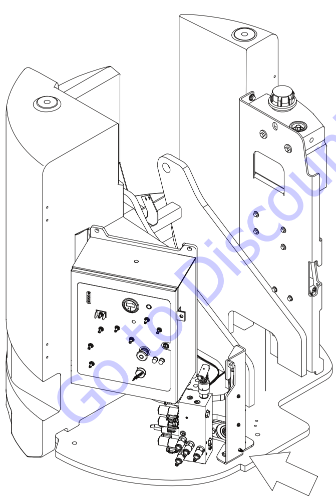
Table 1-9. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities; and being of extreme pressure type (Timken OK 40 pounds minimum).
EPGL	Extreme Pressure Gear Lube (oil) meeting API Service Classification GL-5 or Mil-Spec Mil-L-2105.
HO	Hydraulic Oil. Premier Hydraulic Fluid (VG 15)
BG*	Bearing Grease (JLG Part No. 3020029) Mobilith SHA 460
*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.	

NOTICE

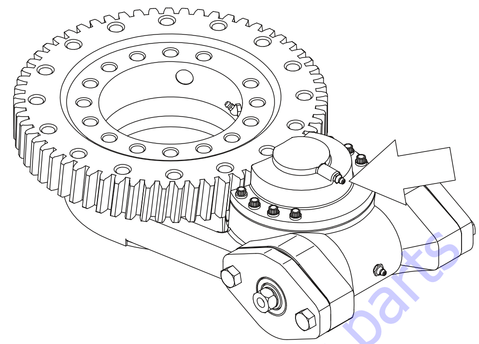
LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

1. Swing Bearing

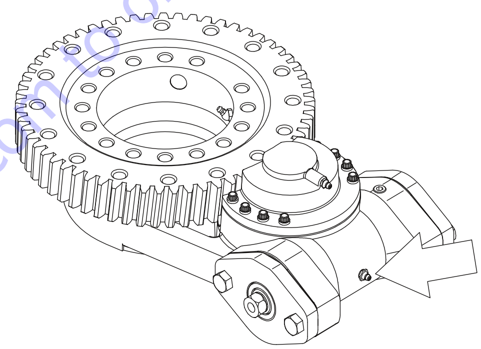


Lube Point(s) - Remote Fitting
Capacity - A/R
Lube - BG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply grease and rotate in 90 degree intervals until bearing is completely lubricated.

2. Swing Bearing/Worm Gear Teeth



Lube Point(s) - Grease Fittings
Capacity - A/R
Lube - BG
Interval - A/R

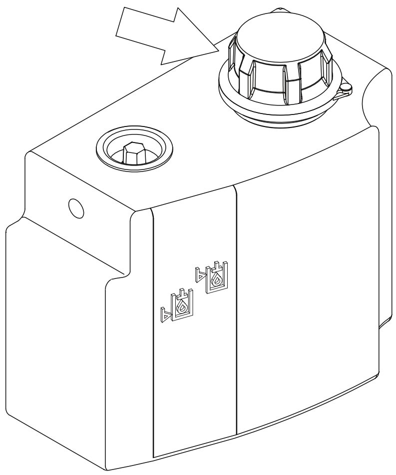


Lube Point(s) - Grease Fitting
Capacity - A/R
Lube - Mobile SHC 007
Interval - A/R

CAUTION

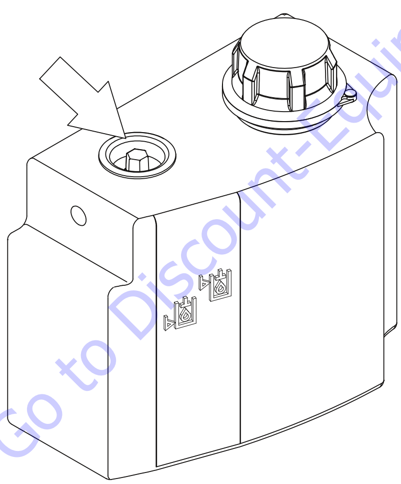
DO NOT OVER GREASE BEARINGS. OVER GREASING BEARINGS WILL RESULT IN BLOWING OUTER SEAL IN HOUSING.

3. Hydraulic Tank



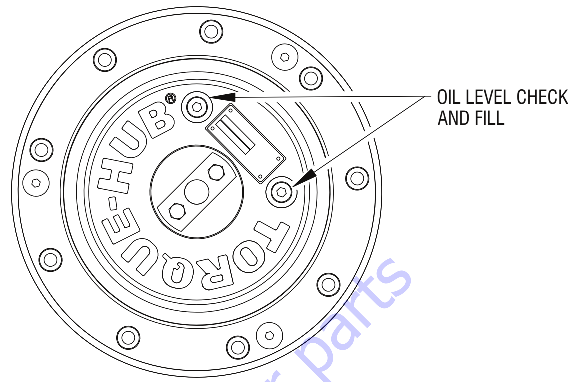
Lube Point(s) - Fill Cap
Capacity -2.9 Gal. (11 L), 2.1 Gal. (8 L) to Full Mark
Lube - HO
Interval - Check Level daily; Change every 2 years or 1200 hours of operation.
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

4. Hydraulic Return Filter



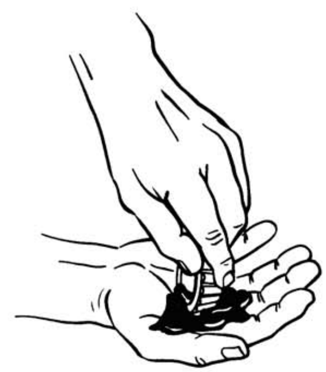
Interval - Change after first 50 hrs. and every 6 months or 300 hrs. thereafter.
Comments - Under certain conditions, it may be necessary to replace the hydraulic filter on a more frequent basis.

5. Wheel Drive Hub



Lube Point(s) - Level/Fill Plug
Capacity - 25.5 oz. (0.75 L)(1/2 Full)
Lube - EPGL
Interval - Check level every 3 months or 150 hrs of operation; change every 2 years or 1200 hours of operation.

6. Wheel Bearing



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

1.9 THREAD LOCKING COMPOUND

JLG PN	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™ 121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™ 122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™ 140	High Strength (Red)
0100071	262™	Vibra-TITE™ 131	Medium - High Strength (Red)

NOTE: *Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.*

1.10 TORQUE CHARTS

SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)											
SAE GRADE 5 BOLTS & GRADE 2 NUTS											
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 111)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

5000059K

SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)											
SOCKET HEAD CAPSCREWS											
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*											
SOCKET HEAD CAPSCREWS											
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lube)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAPSCREWS M3 - M5*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.20	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

5000059K

Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

5000059K

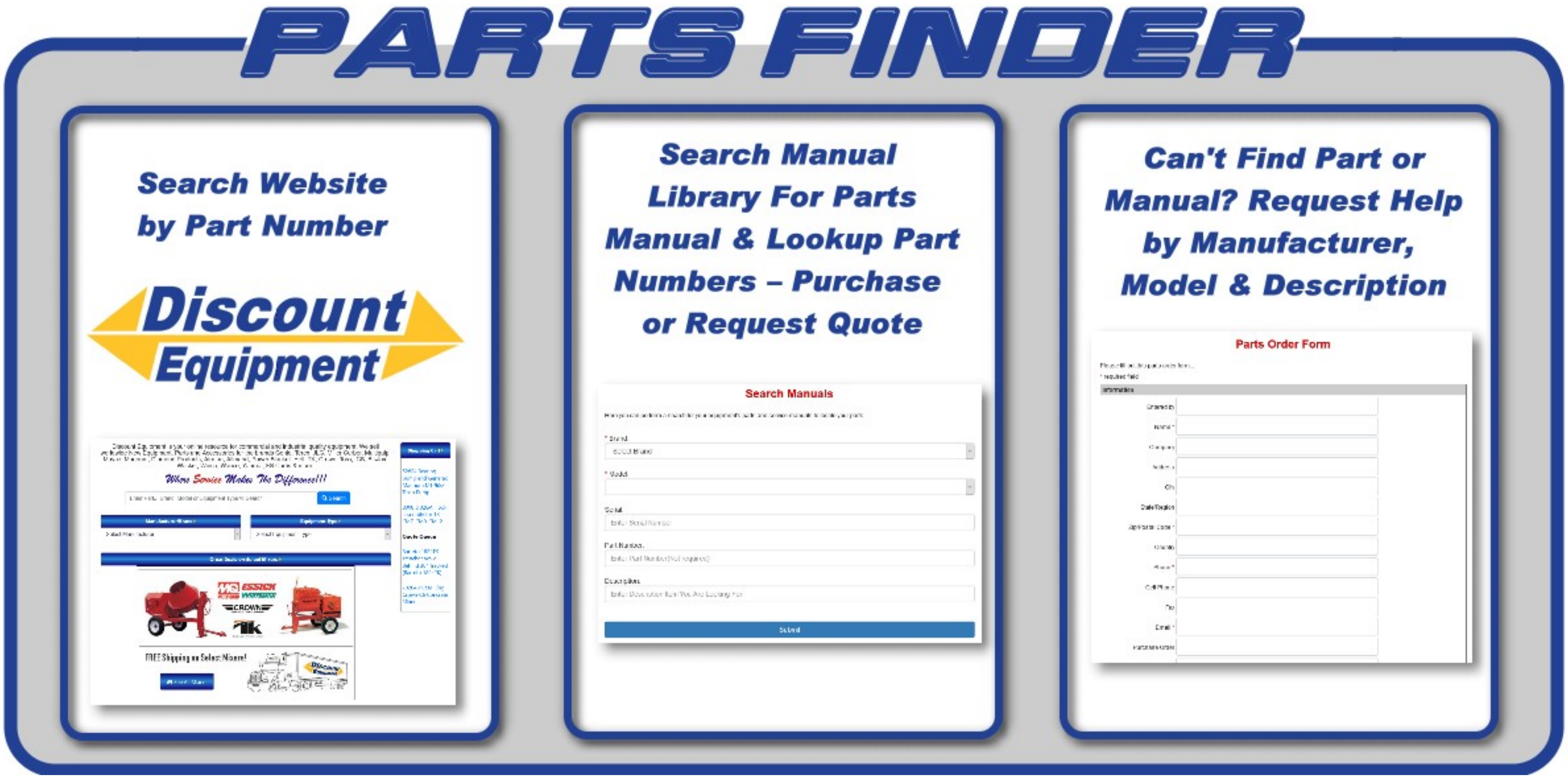
Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAPSCREWS M6 AND ABOVE*						
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K=0.17	Torque (Lube or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18	Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NOTES:
1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS

5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.



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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service. With proper care, maintenance, and inspections performed per JLG's recommendations, and with any and all discrepancies corrected, this product will be fit for continued use.

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

Components Removal and Installation

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

Component Disassembly and Assembly

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

Pressure-Fit Parts

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

Bearings

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

Gaskets

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

Bolt Usage and Torque Application

NOTICE

SELF LOCKING FASTENERS, SUCH AS NYLON INSERT AND THREAD DEFORMING LOCKNUTS, ARE NOT INTENDED TO BE REINSTALLED AFTER REMOVAL.

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

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

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

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

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

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

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

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

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

Hydraulic Oil

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

2. JLG recommends Premier Hydraulic Fluid (VG 15), which has an SAE viscosity of 10W and a viscosity index of 140.

NOTE: *Start-up of hydraulic system with oil temperatures below -20 degrees F (-29 degrees C) is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -20 degrees F (-29 degrees C).*

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils.

2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.

3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise, regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Section 1 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDER DRIFT

Theory

When a hydraulic cylinder is supporting a load, cylinder drift may occur as a result of any of the circumstances below:

- Normal leakage of load holding valves or malfunction of load holding valves. See Cylinder Leakage Test and Table 2-2, Cylinder Drift below for evaluation.
- Damaged or worn piston seals.
- Normal thermal expansion or contraction of the hydraulic oil within cylinders (See Cylinder Thermal Drift below).

The first two circumstances may result in cylinder movement due to oil leaking out of the cylinder externally or by leaking back to tank or due to oil leaking internally from one cylinder chamber to the other.

Thermal expansion or contraction of oil in hydraulic cylinders is a normal occurrence and does not result in oil leaking out of the cylinder or leaking internally from one cylinder chamber to the other. Thermal expansion or contraction is the tendency for materials to change size in response to a change in temperature.

Cylinder Leakage Test

Cylinder oil must be at stabilized ambient temperature before beginning this test.

Measure drift at cylinder rod with a calibrated dial indicator.

In an area free of obstructions, cylinder must have load applied and appropriately positioned to detect drift.

Cylinder leakage is acceptable if it passes this test.

Table 2-2. Cylinder Drift

Cylinder Bore Diameter		Max. Acceptable Drift in 10 Minutes	
inches	mm	inches	mm
3	76.2	0.026	0.66
3.5	89	0.019	0.48
4	101.6	0.015	0.38
5	127	0.009	0.22
6	152.4	0.006	0.15
7	177.8	0.005	0.13
8	203.2	0.004	0.10
9	228.6	0.003	0.08

NOTE: *This information is based on 6 drops per minute cylinder leakage.*

Cylinder Thermal Drift

The oil in all hydraulic cylinders will expand or contract due to thermal effects over time and may result in changes to the boom and/or platform position while the machine is stationary. These effects occur as the cylinder oil changes temperature, usually from a higher oil temperature as it cools and approaches the ambient air temperature. Results of these effects are related to several factors including cylinder length and change in temperature over the time the cylinder remains stationary.

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   a. Excessive sloppiness in joints.
   b. Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
   a. Frayed or separated fibers on the liner surface.
   b. Cracked or damaged liner backing.
   c. Bearings that have moved or spun in their housing.
   d. Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
   a. Detectable wear in the bearing area.
   b. Flaking, pealing, scoring, or scratches on the pin surface.
   c. Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
   a. Housing should be blown out to remove all dirt and debris. Bearings and bearing housings must be free of all contamination.
   b. Bearing/pins should be cleaned with a solvent to remove all grease and oil. Filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).
   c. Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

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

Do the Following When Welding on JLG Equipment

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

DO NOT Do the Following When Welding on JLG Equipment

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

NOTICE

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

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery[1] or Frequent[2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Boom Assembly		
Boom Weldments	1, 2	1, 2
Hose/Cable Carrier Installations	1, 2	1, 2
Pivot Pins and Pin Retainers	1, 2	1, 2
Sheaves, Sheave Pins	1, 2	1, 2
Bearings	1, 2	1, 2
Wear Pads	1, 2	1, 2
Covers or Shields	1, 2	1, 2
Extend/Retract Chain or Cable Systems[4]	1, 2	1, 2
Power Tracks/Hose Cable Installation	1,2,4	1,2,4
Platform Assembly		
Railing	2	2
Gate	1, 2, 3	1, 2, 3
Floor	2	2
Rotator	1, 2, 3, 4	1, 2, 3, 4
Bevel Washer	1,2,5,7	1,2,5,7
Platform	1,2	1,2
Lanyard Anchorage Point	1, 2, 6	1, 2, 6
Turntable Assembly		
Swing Bearing or Worm Gear	1[50], 2[50]	1[50], 2[50]
Oil Coupling	4	4
Swing Drive System	1, 4	1, 4
Turntable Lock	1, 2, 3	1, 2, 3
Hood, Hood Props, Hood Latches	3	3
Chassis Assembly		
Tires	1, 2	1, 2
Wheel Nuts/Bolts	1[50]	1[50]
Wheel Bearings	1, 2	1, 2
Oscillating Axle/Lockout Cylinder Systems	3	3
Extendable Axle Systems	3	3
Steer Components	1, 2, 3	1, 2, 3
Spindle Thrust Bearing/Washers	3	3
Drive Hubs	1, 4	1, 4

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery[1] or Frequent [2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Functions/Controls		
Platform Controls return to neutral/off when released	1, 3, 6, 9	1, 3, 6, 9
Ground Controls return to neutral/off when released	1, 3, 6, 9	1, 3, 6, 9
Function Control Locks, Enclosures, Guards, Boot or Detents	1, 3, 9	1, 3, 9
Footswitch	1, 3, 9	1, 3, 9
Emergency Stop Switches (Ground & Platform) arrest all platform movement	1, 3, 6	1, 3, 6
Function Limit or Cutout Switch Systems	1, 3, 9	1, 3, 9
Capacity Indicator	1, 3, 9	1, 3, 9
Drive Brakes	1, 3, 9	1, 3, 9
Swing Brakes	1, 3, 9	1, 3, 9
Synchronization and Sequence system	1,3,9	1,3,9
Auxiliary Power	1, 3, 9	1, 3, 9
Power System		
Batteries	1, 2	1, 2
Battery fluid level correct	4	4
Battery Charger	1,2, 3	1,2, 3
Motors free of damage	2	4
All electrical connections tight, free of frays and corrosion	1, 2	1, 2
Hydraulic/Electric System		
Hydraulic Pumps	1, 2, 4	1, 2, 4
Hydraulic Cylinders	1, 2, 4, 5	1, 2, 4, 5
Cylinder Attachment Pins and Pin Retainers	1, 2	1, 2
Hydraulic Hoses, Lines, and Fittings	1, 2, 4	1, 2, 4
Hydraulic Reservoir, Cap, and Breather	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Hydraulic Filter(s)	1, 4, 5	1, 4, 5
Hydraulic Fluid	4, 5	4, 5
Electrical Connections	1, 2	1, 2
Instruments, Gauges, Switches, Lights, Horn		1, 3
General		
All Decals/Placards Installed, Secure, Legible	9	9
Annual Machine Inspection Due		9
No Unauthorized Modifications or Additions	9	9
All Relevant Safety Publications Incorporated	9	9
General Structural Condition and Welds	2	2
All Fasteners, Pins, Shields, and Covers	1, 2	1, 2
Function Test of All Systems	9	9

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	Inspections	
	Pre-Delivery[1] or Frequent [2] (Quarterly) Inspection	Annual[3] (Yearly) Inspection
Paint and Appearance	5	5
Stamp Inspection Date on Frame		9
Notify JLG of Machine Ownership		9
AEM Handbook	9	9

Footnotes:

[1] Prior to each sale, lease, or delivery

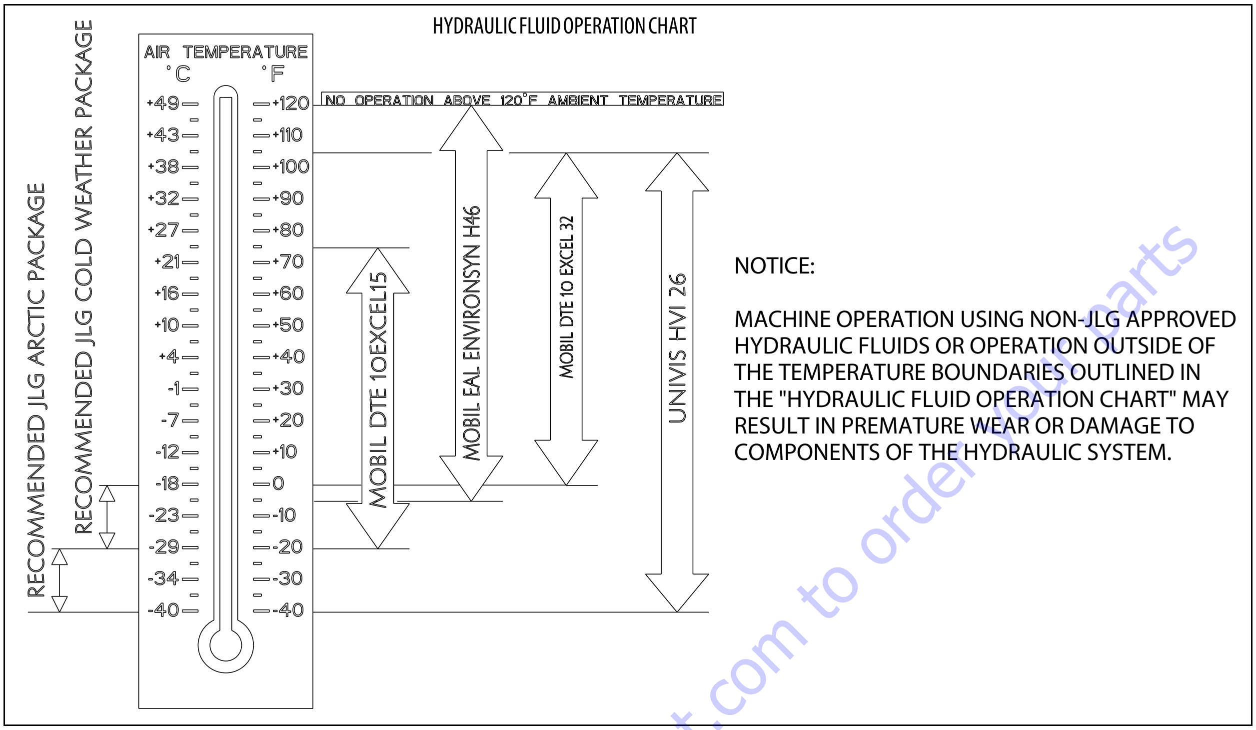
[2] In service for 3 months; Out of service for 3 months or more; Purchased used

[3] Annually, no later than 13 months from the date of the prior inspection, Includes all daily and quarterly inspections, mandated by regulating body

[4] Replace every 12 years or 7,000 hours

[50] Indicates a 50 hour interval required to perform task after initial use of machine. This only occurs once in machine life

Performance Codes:
1 - Check for proper and secure: installation, adjustment, or torque
2 - Visual inspection for damage: (cracks, corrosion, abrasions, distortion, excessive wear, broken welds, gouges, chafing and threads showing)
3 - Proper operation
4 - Check for proper sealing, signs of leakage and fluid level
5 - Clean and free of debris
6 - Decals installed and legible
7 - Check for proper tolerances, routing, and lubrication
8 - Fully Charged
9 - Verify/Perform



Fluid	Properties		Base					Classification		
Description	Visc @ 40 C	Visc Index	Mineral Oils	Vegetable Oils	Synthetic	Synthetic Polyol Esters	Water Glycol	Readilly Biodegradeable*	Virtually Non-toxic**	Fire Resistant***
Mobil DTE 10Excel32	32	141	X							
UNIVIS HVI 26	26	376	X							
Mobil EAL Env H 46	46	145			X			X	X	
Mobil DTE 10EXCEL15	15	168	X							

* Readily biodegradable classification indicates one of the following:
CO2 Conversion > 60% per EPA 560/6-82-2
CO2 Conversion > 80% per CEC-L-33-A-93
** Virtually Non-toxic classification indicates an LC50 > 5000 ppm per OECD 203
*** Fire Resistant classification indicates Factory Mutual Research Corp. (FMRC) Approval

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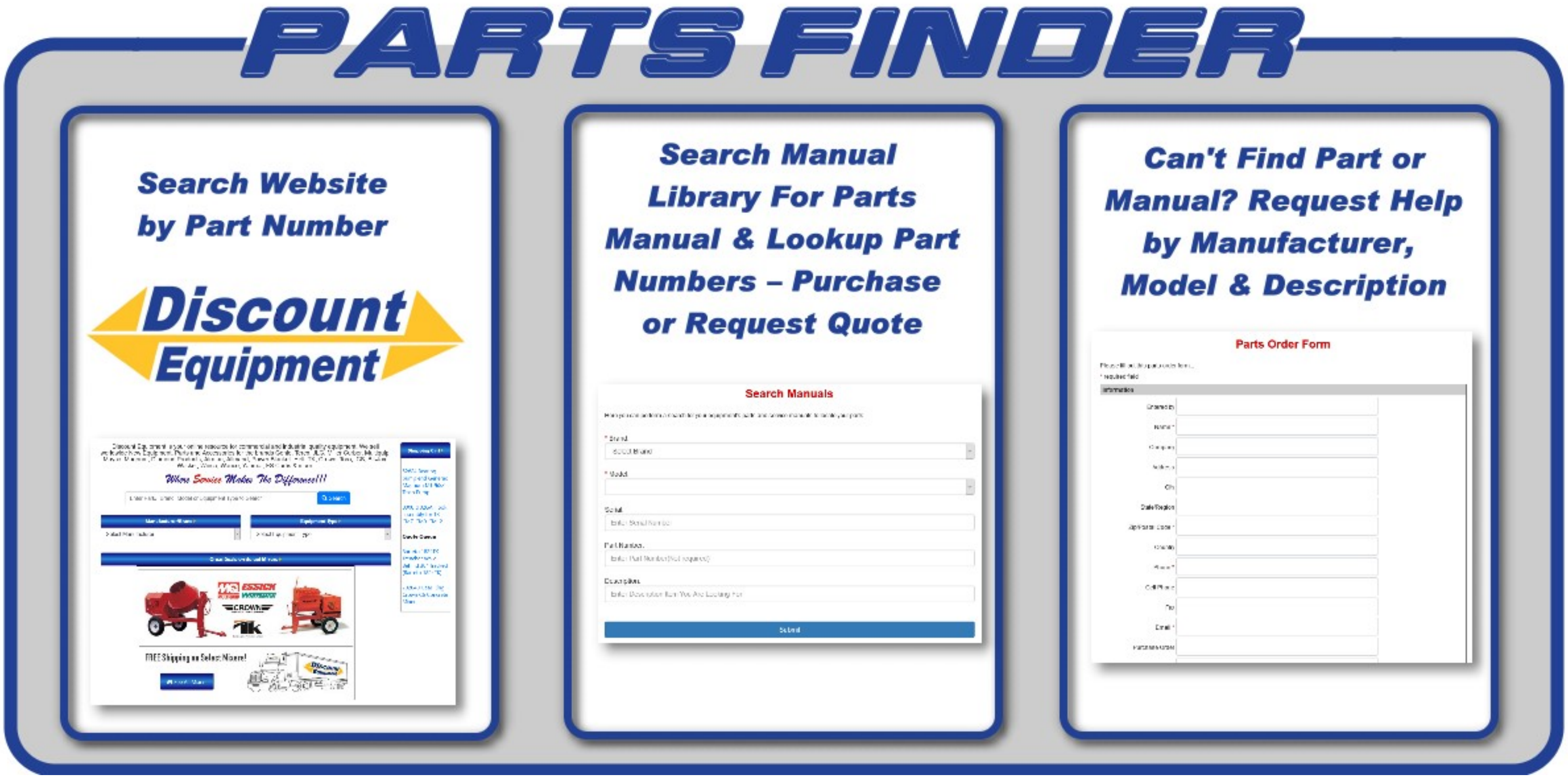
Figure 2-1. Hydraulic Oil Operation Chart



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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Damage

For polyurethane foam filled tires, JLG Industries, Inc. recommends that when any of the following are discovered, measures must be taken to remove the JLG product from service immediately and arrangements must be made for replacement of the tire or tire assembly.

- A smooth, even cut through the cord plies which exceeds 3 inches (7.5 cm) in total length
- Any tears or rips (ragged edges) in the cord plies which exceeds 1 inch (2.5 cm) in any direction
- Any punctures which exceed 1 inch in diameter
- Any damage to the bead area cords of the tire

If a tire is damaged but is within the above noted criteria, the tire must be inspected on a daily basis to insure the damage has not propagated beyond the allowable criteria.

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. Please refer to the JLG Parts Manual for the part number of the approved tires for a particular machine model. If not using a JLG approved replacement tire, we recommend that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original
- Tire tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load)

Unless specifically approved by JLG Industries Inc. do not replace a foam filled or ballast filled tire assembly with a pneumatic tire. Due to size variations between tire brands, both tires on the same axle should be the same.

Wheel and Tire Replacement

The rims installed on each product model have been designed for stability requirements which consist of track width, and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in an unsafe condition regarding stability.

Wheel Installation

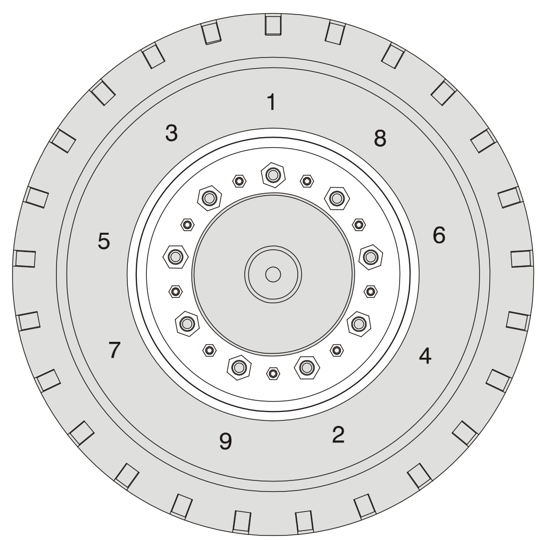
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

WHEEL NUTS MUST BE INSTALLED AND MAINTAINED AT THE PROPER TORQUE TO PREVENT LOOSE WHEELS, BROKEN STUDS, AND POSSIBLE DANGEROUS SEPARATION OF WHEEL FROM THE AXLE. BE SURE TO USE ONLY THE NUTS MATCHED TO THE CONE ANGLE OF THE WHEEL.

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-tightening will result in breaking the studs or permanently deforming the mounting stud holes in the wheels. The proper procedure for attaching wheels is as follows:

1. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.
2. Tighten nuts in the following sequence:



3. The tightening of the nuts should be done in stages. Following the recommended sequence, tighten nuts per wheel torque chart.

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
40 ft. lbs. (55 Nm)	95 ft. lbs. (130 Nm)	170 ft. lbs. (230 Nm)

4. Wheel nuts should be torqued after first 50 hours of operation and after each wheel removal. Check the torque after the first 10 miles, 25 miles, and again at 50 miles. Check periodically thereafter.

3.2 SPINDLE

Setting Wheel Bearing End Play

NOTICE

BE SURE NOT TO OVER-TIGHTEN THE SPINDLE NUT.

1. Tighten the spindle nut to assure the bearings are properly seated.

2. Loosen the spindle nut completely until the nut can be turned by hand.

3. Tighten the spindle nut by hand using a socket without rotating the hub.

4. If the cotter pin can be assembled with the spindle nut finger tight, insert cotter pin without backing the nut off. If the cotter pin cannot be assembled with the spindle nut hand tight, tighten the spindle nut to the nearest available slot and insert cotter pin. If more than ½ of the cotter pin hole in the spindle can be seen in a slot, back nut off to nearest slot and insert pin.

5. Check the unit for end play by moving the hub up & down parallel along the centerline of the spindle. If you can feel excessive end play (over the 0.010" [0.25 mm] specification), recheck the nut to see what is causing the excessive end play. Keep in mind that there can be some movement and still be within the 0.010" (0.25 mm) maximum specification. If there is no way of getting the excessive end play out by using your fingers, a socket or wrench may have to be used to set the end play.

6. The units should be checked visually to make sure the cotter pins are installed and that the correct components have been used. Each unit must also be checked for the proper feel to make sure there isn't excessive end play and the hubs turn freely.

7. Insert the dust cap and check to make sure the cotter pin is not going to interfere. Cap must be pressed all the way down. The unit should be checked again to assure it spins freely after the dust cap is installed.

Specifications

The end play specification is 0.001"/0.010" (0.025/0.254 mm) for all units.

Checking

The end play is checked by clamping the spindle in a fixture or vise and moving the hub parallel to the spindle centerline without rocking the hub. If the end play is set properly the following should apply:

1. Hub should rotate freely when spun by hand.

2. The hub should not be noticeably loose when moved parallel with spindle centerline.

Greasing Requirements

Hub assemblies shall have grease packed in the bearings via an appropriate greasing spindle or by hand. In either method, the bearing must be greased so the grease is forced thru the entire bearing cavity and thru the rollers of both inner and outer bearings.

Dust or grease caps used shall have grease applied to the inside of the cap.

The bearing cavity shall be filled 50 - 80% full of grease on all applications.

Dust or grease caps shall also be filled 10-20% full of grease on all applications prior to final assembly.

Visually verify that grease has flowed through all rollers of the inner and outer bearings.

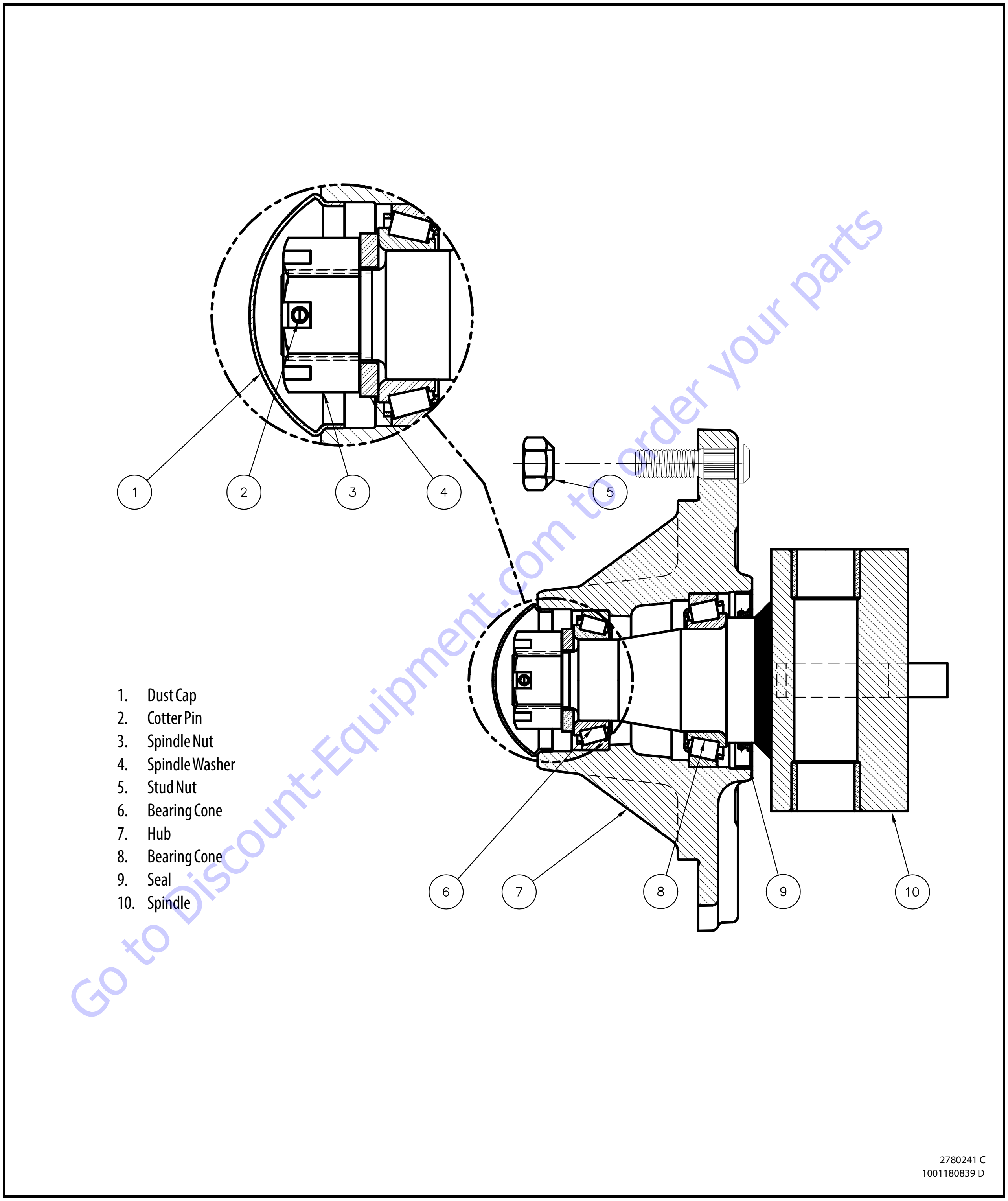
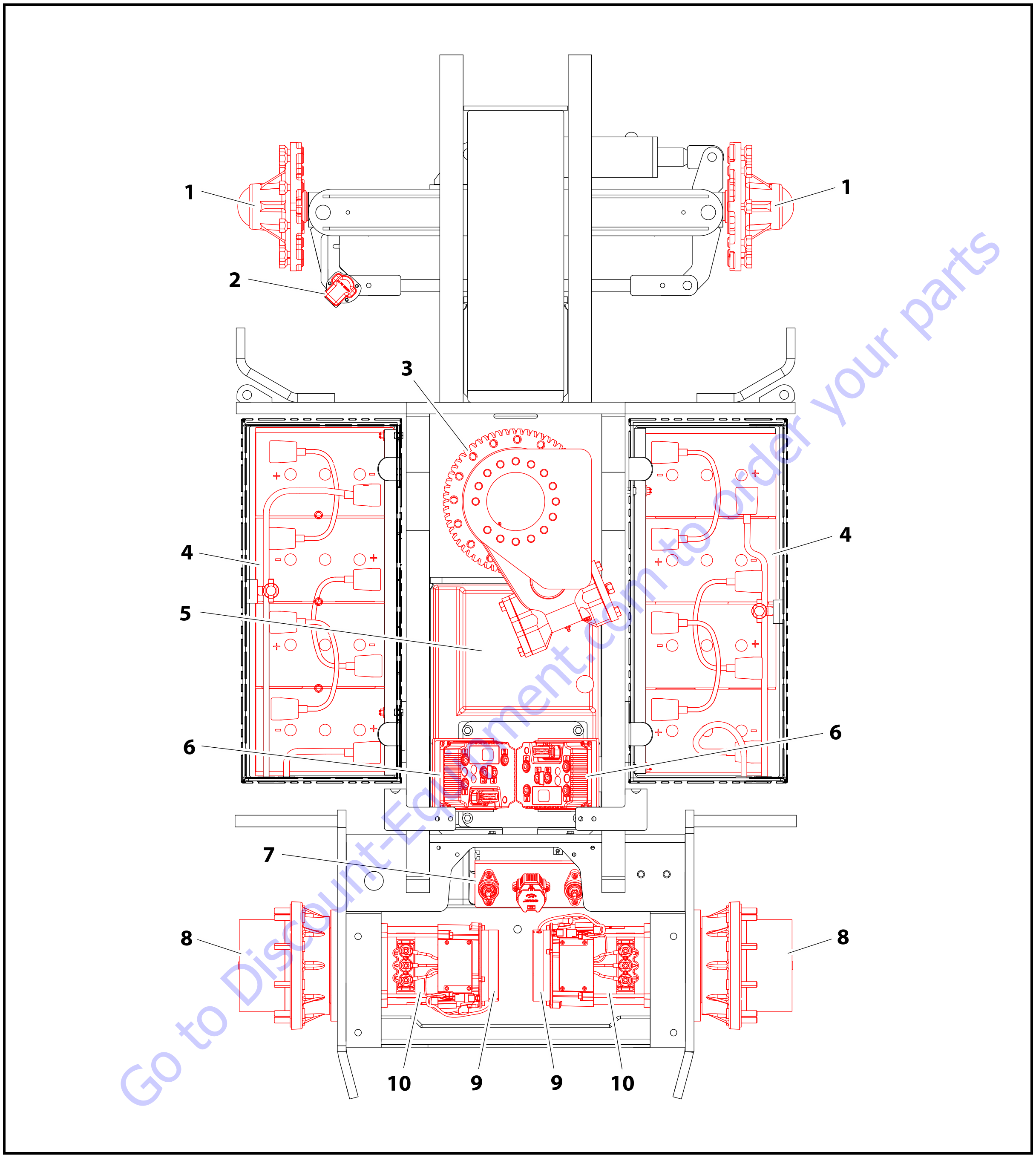
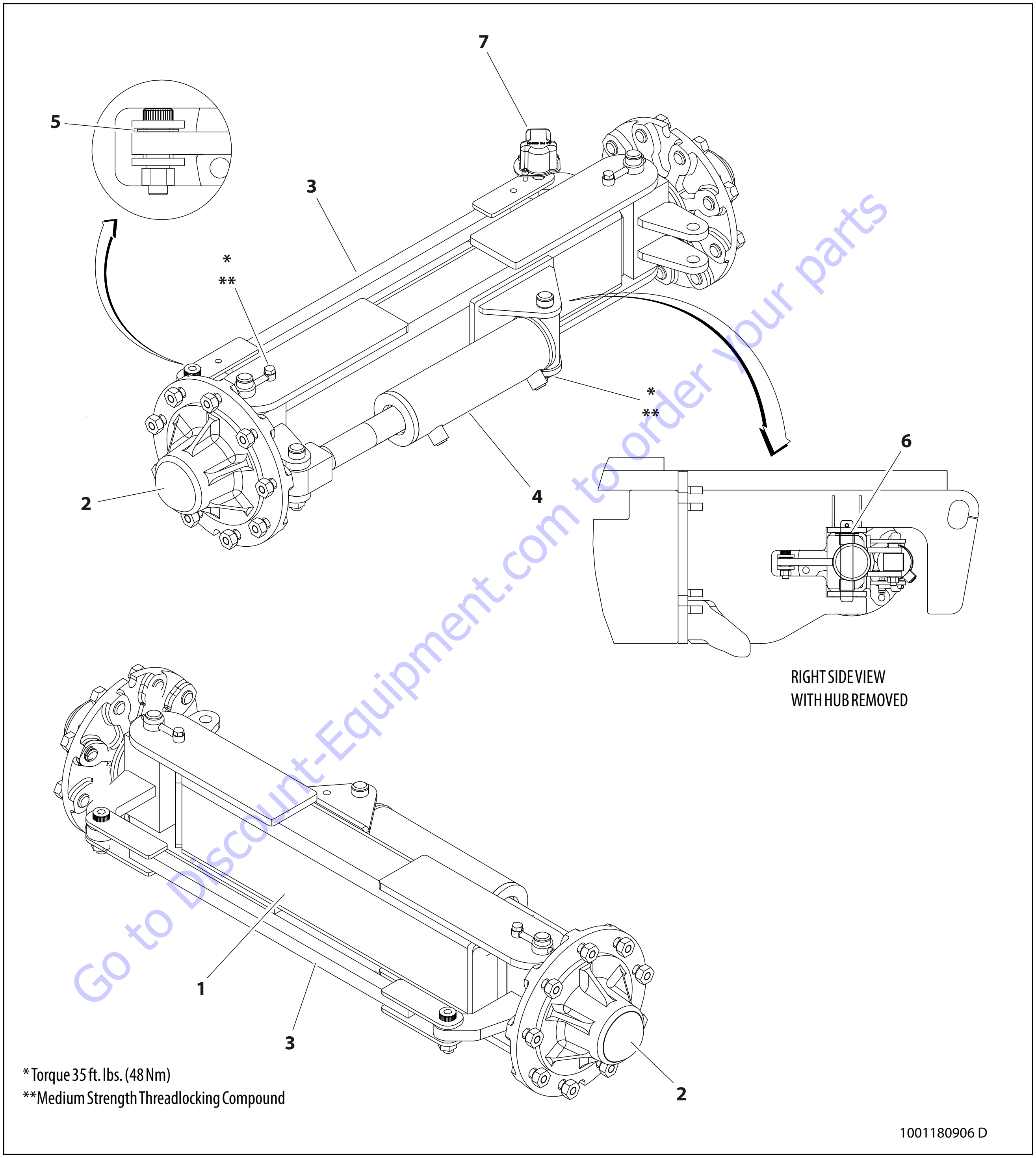


Figure 3-1. Spindle Assembly



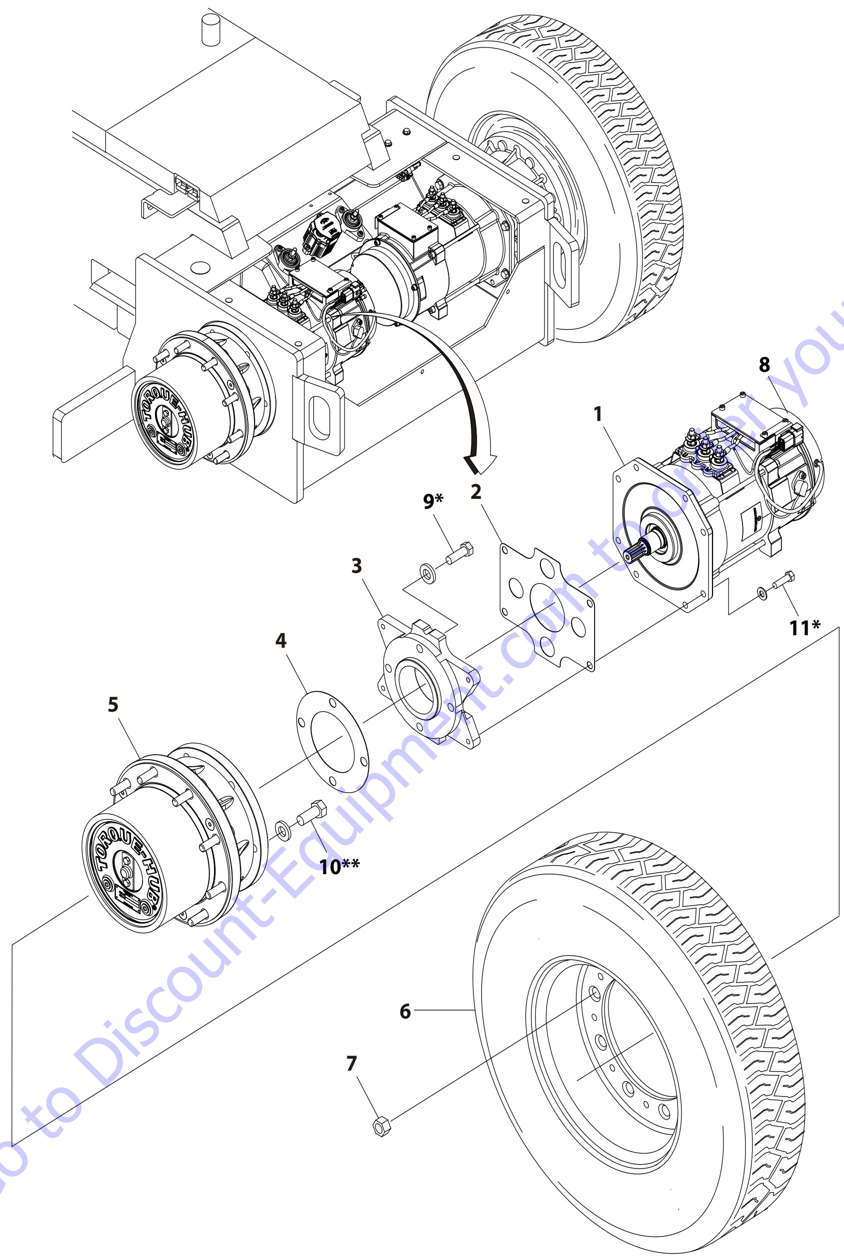
1. Spindle Assembly
2. Steer Angle Sensor
3. Swing Bearing
4. Battery
5. Hydraulic Tank
6. Drive Module
7. Electrical Assembly
8. Drive Hub
9. Drive Brake
10. Drive Motor

Figure 3-2. Chassis Component Location



1. Axle Assembly	3. Tie Rod	5. Thrust Washer	7. Sensor Switch
2. Spindle Assembly	4. Steer Cylinder	6. Thrust Bearing	

Figure 3-3. Steering Installation



* Apply Medium Strength Threadlocking Compound
**Apply High Strength Threadlocking Compound and Torque to 190 ft. lbs. (260 Nm)
Note: Before installing brake and motor, apply a light coat of grease to the splined shafts

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1.	Drive Motor	4.	Hub Seal	7.	Lug Nut	10.	Bolt
2.	Motor Seal	5.	Drive Hub	8.	Drive Brake	11.	Bolt
3.	Motor Adapter	6.	Tire & Wheel	9.	Bolt		

Figure 3-4. Drive Components

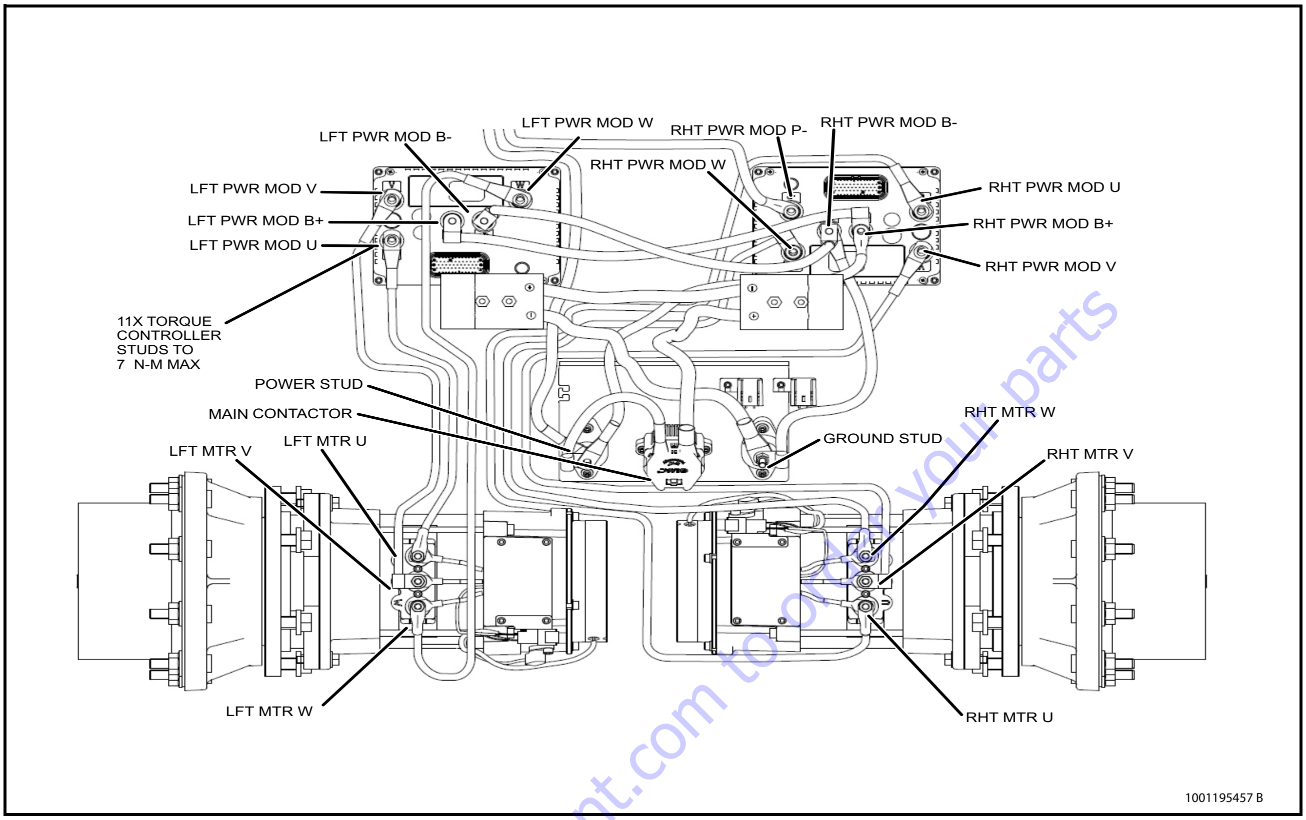


Figure 3-5. Frame Mounted Electrical Connection

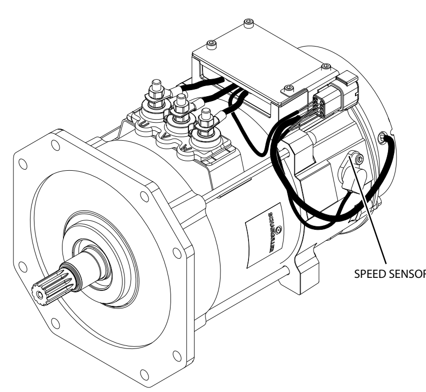
3.3 TILT SENSOR

When installing a new tilt sensor, always ensure that it is calibrated using the JLG Control System analyzer before operating the machine. Refer to Section 6, JLG Control System Analyzer. For Tilt Sensor calibration refer toSection 6.5, Calibrating Tilt Sensor.

⚠ WARNING

TO ASSURE PROPER OPERATION, THE MACHINE MUST BE LEVEL WHEN INSTALLING AND CALIBRATING A NEW TILT SENSOR.

3.4 SPEED SENSOR



For proper drive operation, the speed sensors must be properly installed and adjusted. The sensor operates on a leading pulse to show direction. If installed wrong, the sensor will not be able to sense the proper direction.

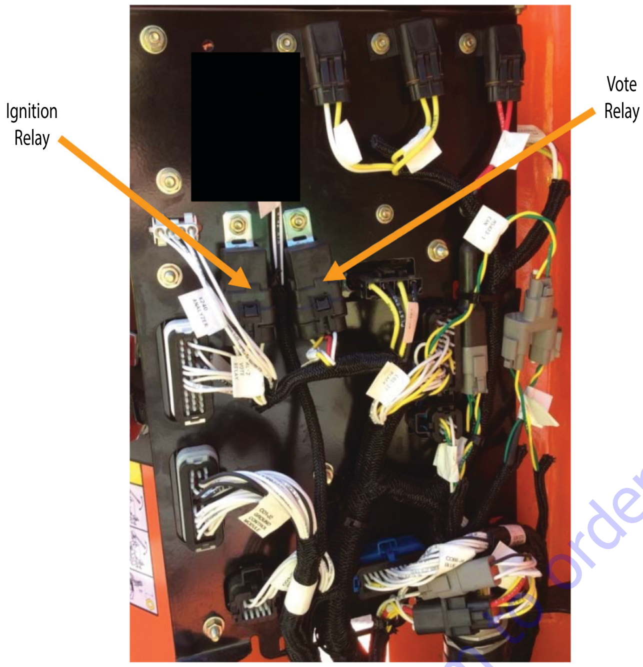


Figure 3-6. Relay

Figure 3-7. System Fuses

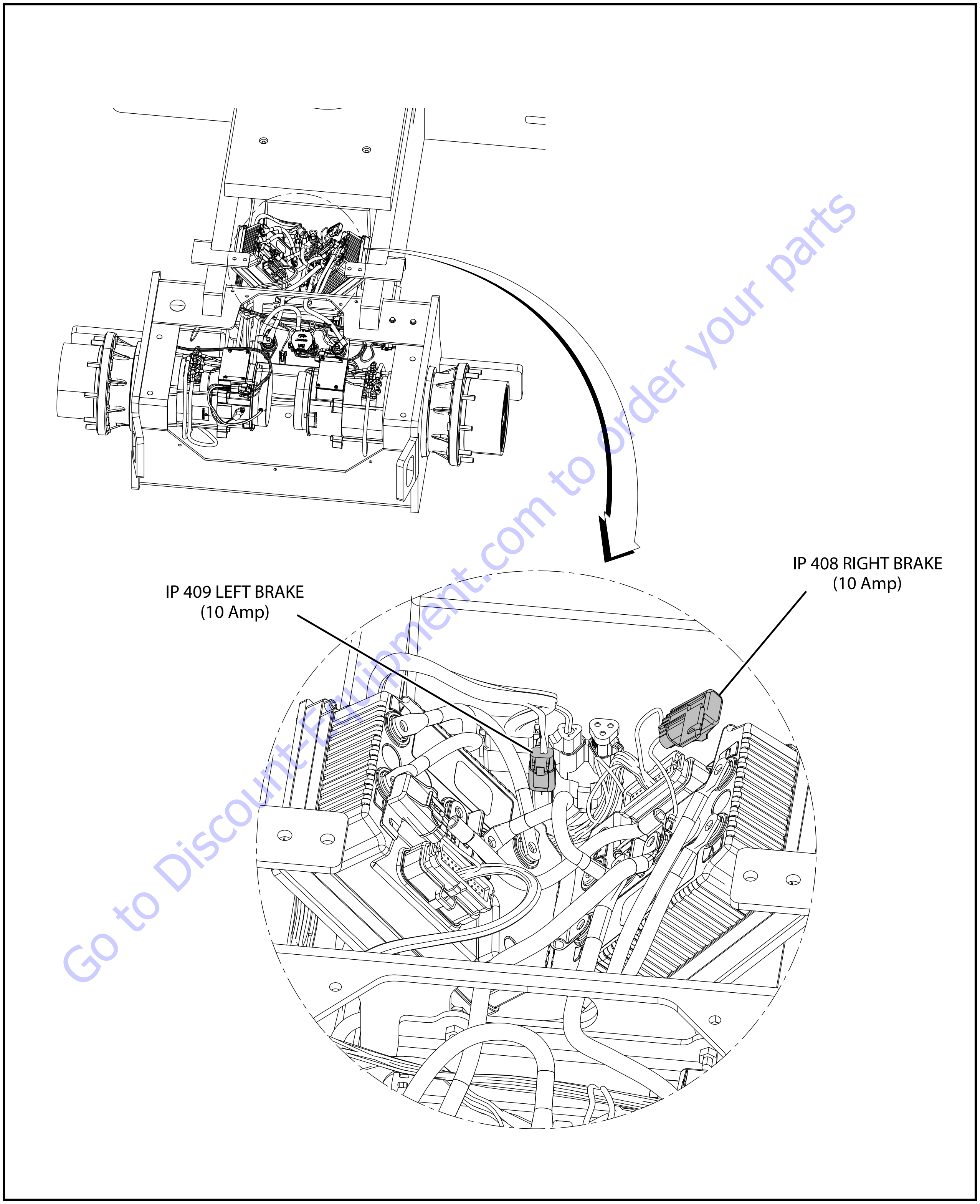


Figure 3-8. Brake Fuses

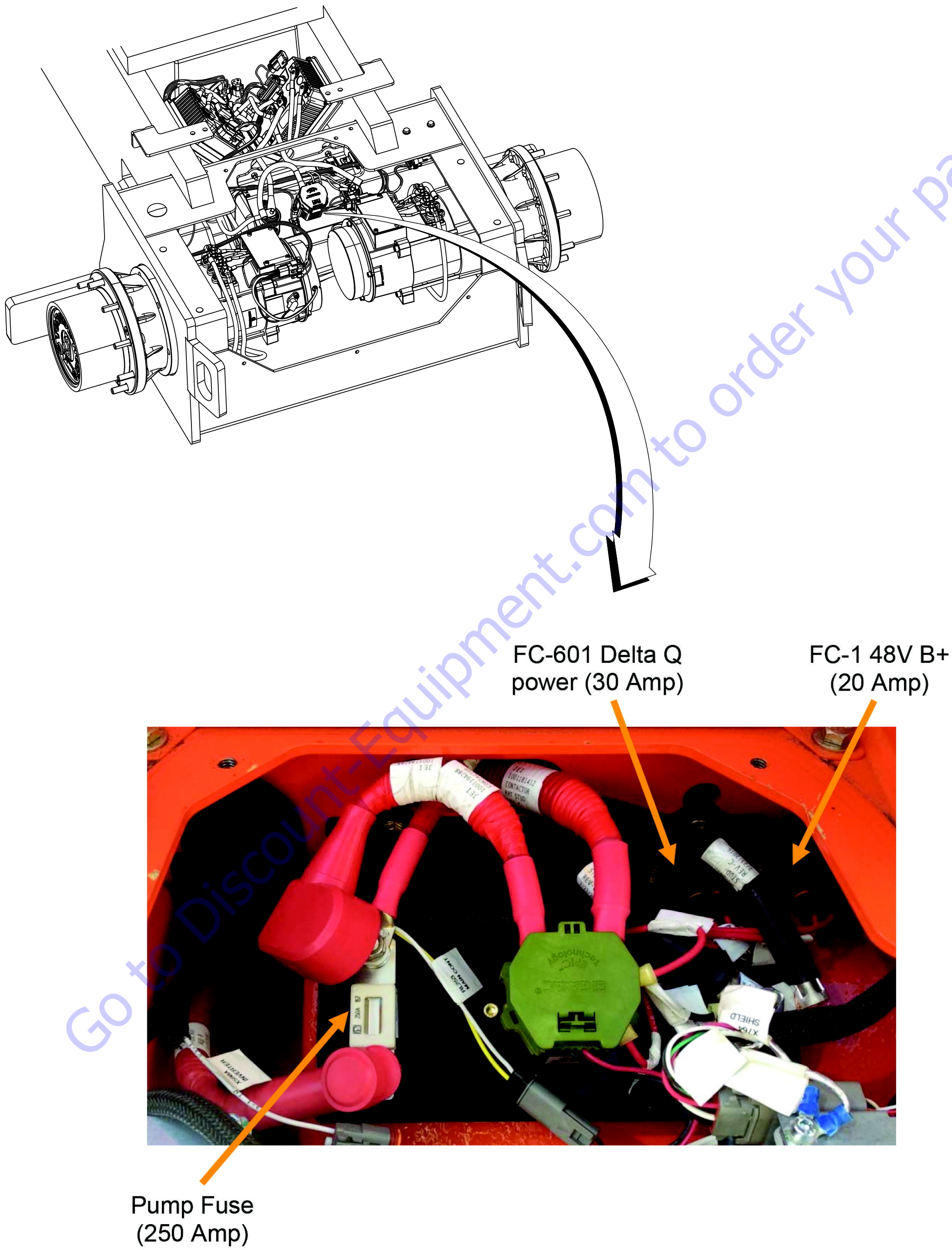


Figure 3-9. Drive Fuses

3.5 DRIVE HUB

Roll and Leak Testing

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

NOTE: *The brake must be released before performing the roll test. This can be accomplished by either pressure testing using the Brake Leak Test procedure below or by tightening the 12 bolts into the piston through the end plate.*

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

Roll Test

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

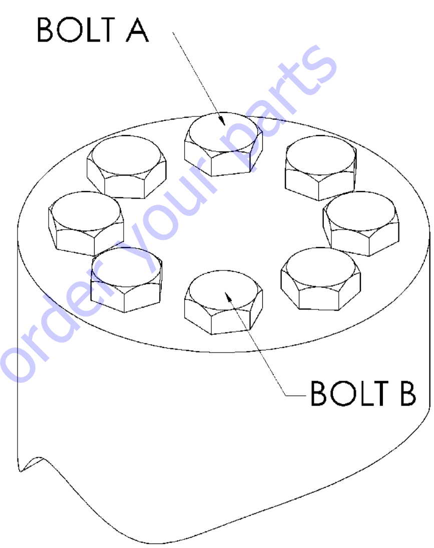
Leak Test (Main Unit)

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

Tightening and Torquing Bolts

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

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



1. Tighten (but do not torque) bolt “A” until snug.
2. Go to the opposite side of the bolt circle and tighten bolt “B” until equally snug.
3. Crisscross around the bolt circle and tighten remaining bolts.
4. Now use a torque wrench to apply the specified torque to bolt “A”.
5. Using the same sequence, crisscross around the bolt circle and apply an equal torque to the remaining bolts.

Main Disassembly

NOTE: *Refer to Figure 3-10., Main Assembly - Sheet 1 of 2, and Figure 3-11., Main Assembly - Sheet 2 of 2,*

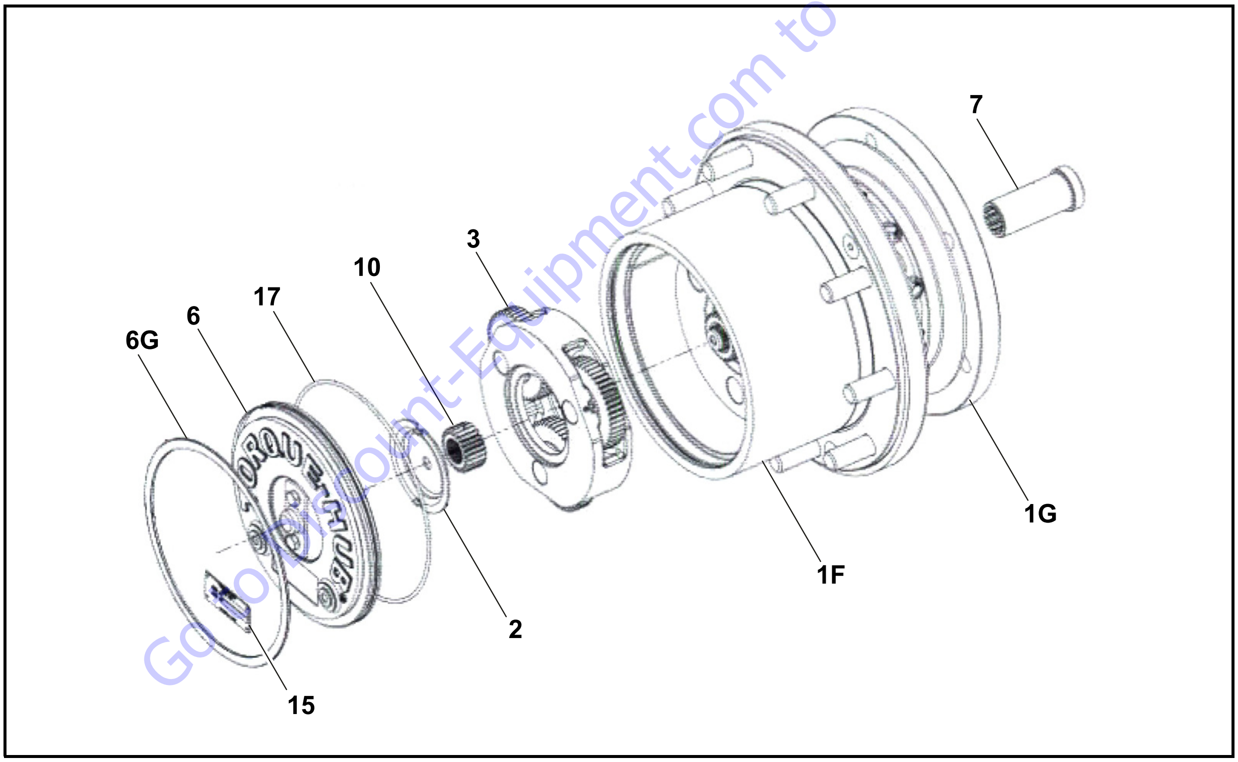
1. Perform Roll Check and Leak Check if applicable prior to disassembling the unit.
2. Drain oil from unit. Note the condition and volume of the oil.
3. Remove Coupling (7) from Spindle End first.
4. Remove Retaining Ring (6G) by prying the open end of Retaining Ring out of the groove in the Ring Gear (1F) with a screwdriver, then grasp the loose end with pliers and pull the Retaining Ring completely out of the groove.
5. Remove the Cover Subassembly (6) from the unit. The unit can be carefully pressurized with air to pop the cover out of the unit. Washer (2) may have to be removed separately because of the loose attachment.
6. Remove the First Stage Sun Gear (10) if applicable.

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

7. Remove the Input Carrier Sub-assembly (3).
8. Remove the Second Stage Sun Gear (11).
9. Remove the Input Shaft (9).

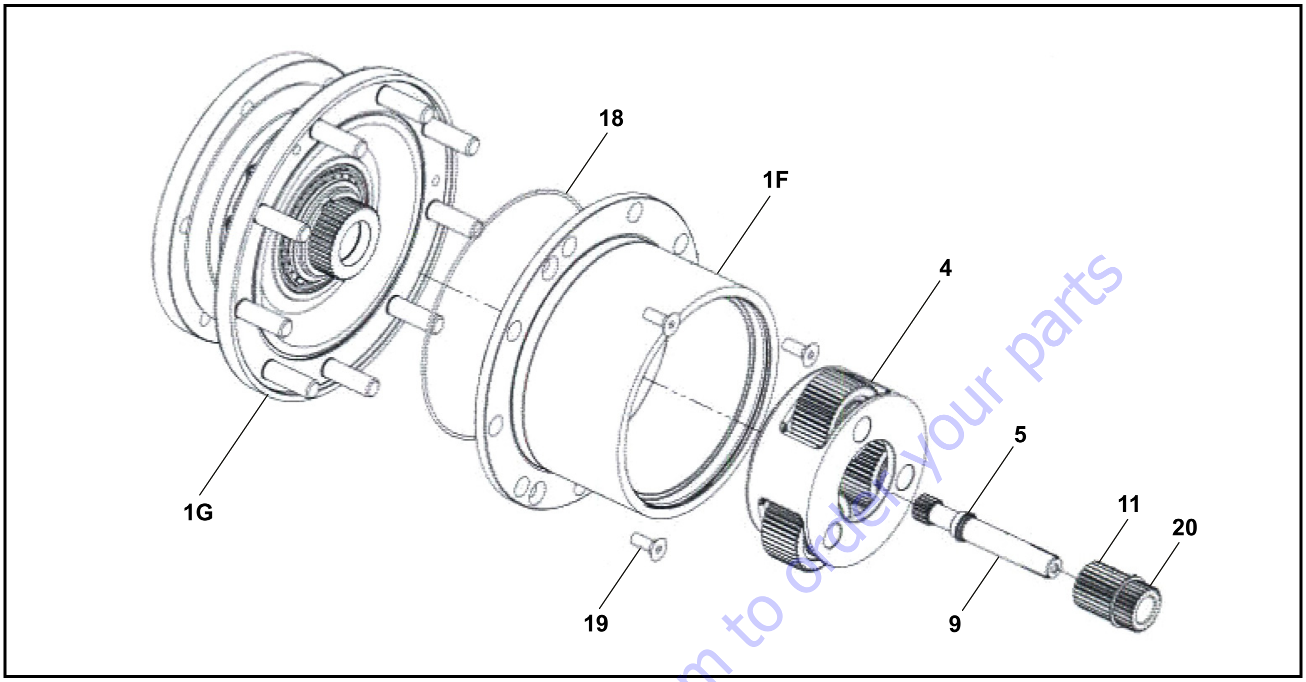
NOTE: *On units with a ratio 48:1, the Sun Gear (11) and the Input Shaft (9) will need to be removed together.*

10. Remove the Output Stage Carrier Sub-assembly (4).
11. Loosen and remove the three Flat Head Bolts (19) that retain the Ring Gear (1F) to the Housing (1G).
12. Lift the Ring Gear (1F) off of the Housing (1G).
13. Remove the O-Ring (18) from between the Housing (1G) and the Ring Gear (1F).



1F Ring Gear	7 Coupling
1G Housing	9 Input Shaft
2 Washer	10 First Stage Sun Gear
3 Input carrier Subassembly	11 Second Stage Sun Gear
4. Output carrier Subassembly	18 O-ring
8 Cover Assembly	19 Flat Head Bolt

Figure 3-10. Main Assembly - Sheet 1 of 2



1F Ring Gear	9 Input Shaft
1G Housing	10 First Stage Sun Gear
4 Output Carrier Subassembly	11 Second Stage Sun Gear
5 Retaining Ring	18 O-ring
6 Cover Assembly	19 Flat Head Bolt
6G Retaining Ring	20 Retaining Ring

Figure 3-11. Main Assembly - Sheet 2 of 2

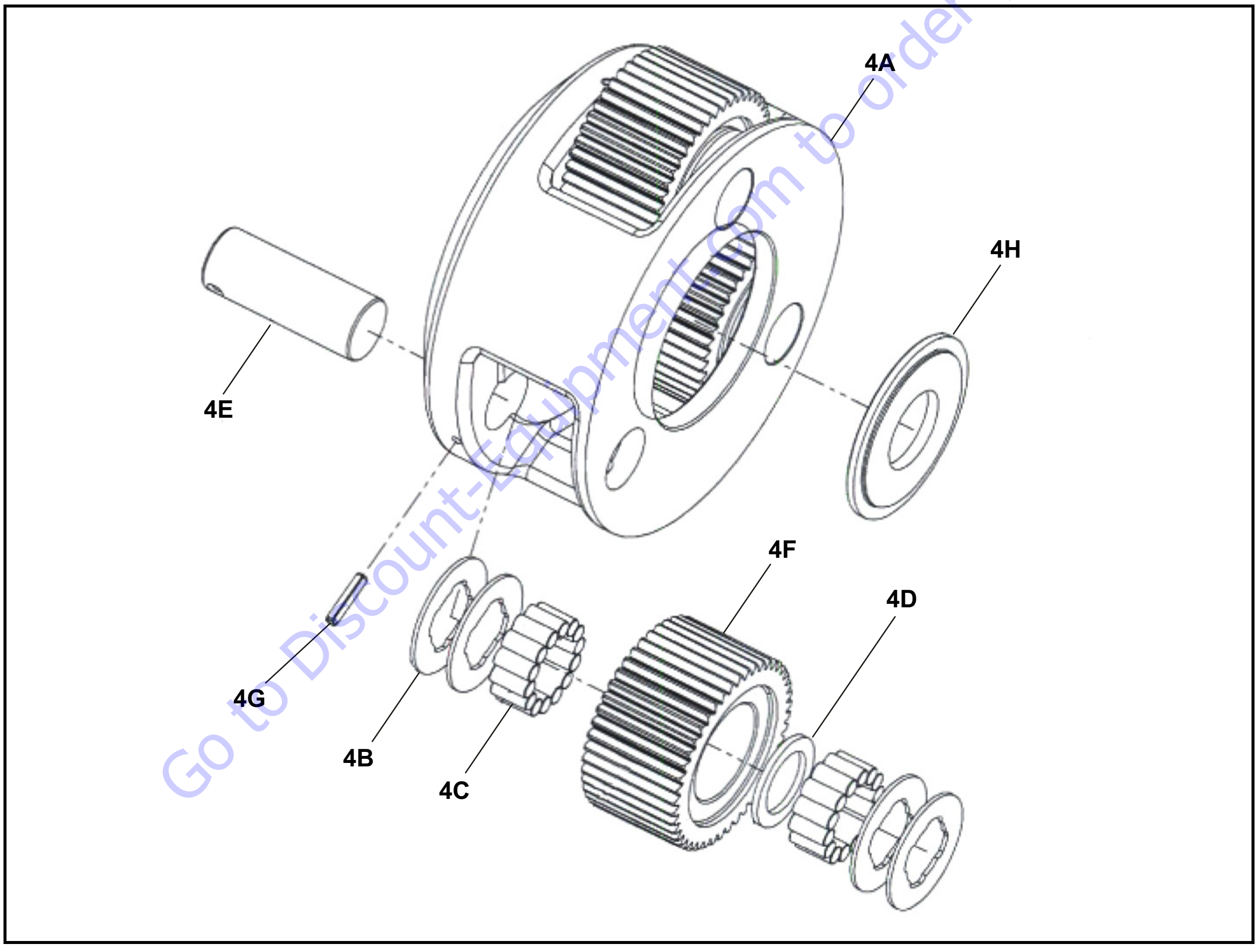
Output Carrier Disassembly

NOTE: *Refer to Figure 3-12., Output Carrier, and Figure 3-13., Planet Gear.*

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

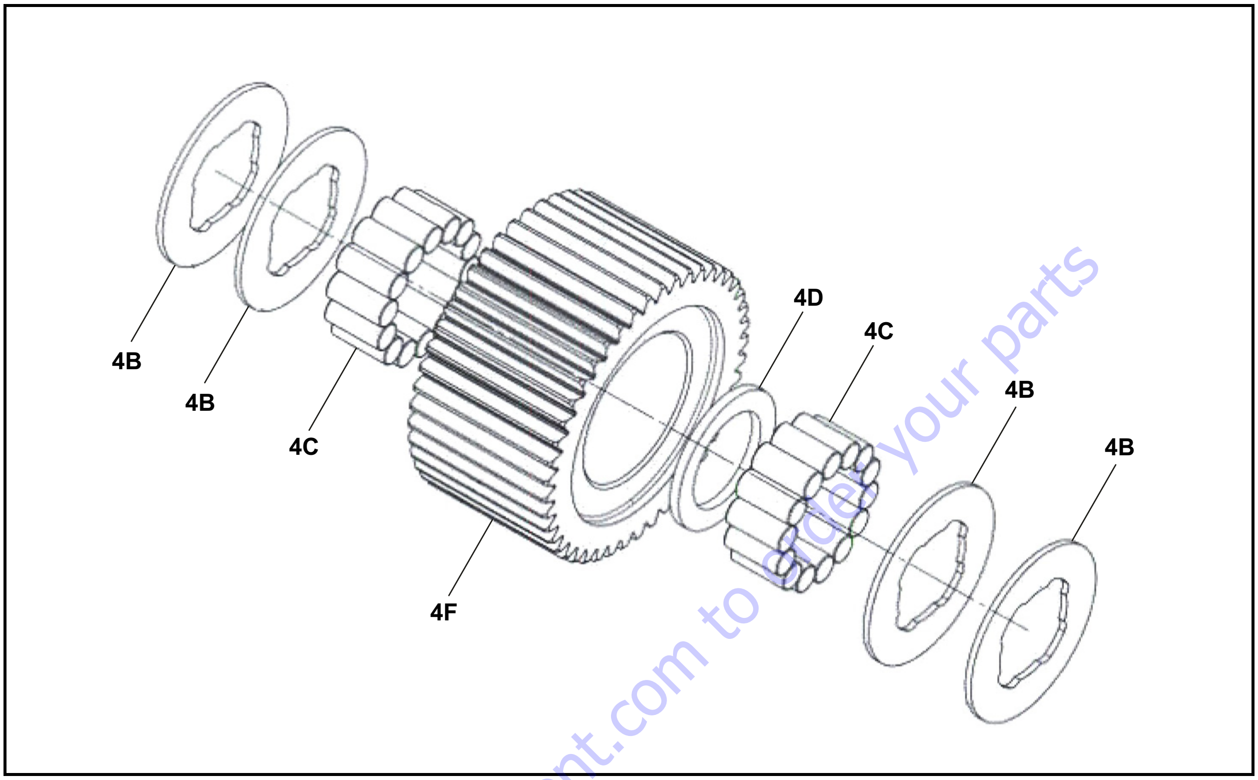
NOTE: *The Roll Pins (4G) should not be reused when reassembling the unit.*

4. Slide the Planet Gear Sub-assembly (4) out of the Output Carrier (4A) being careful to not drop the Needle Bearings (4C) in the process.
5. Remove 4 Thrust Washers (4B), 28 Needle Rollers (4C) and the Thrust Spacer (4D) from the Second Stage Planet Gear (4F).
6. Repeat Steps 1 though 5 for the remaining two Planet Gears (4F).
7. Remove the Thrust Washer (4H) from the counterbore in the Output Carrier (4A).



4A Output Carrier	4E Planet Shaft
4B Thrust Washer	4F Planet Gear
4C Needle Bearing	4G Roll Pin
4D Thrust Spacer	4H Thrust Washer

Figure 3-12. Output Carrier



4B Thrust Washer
4C Needle Bearing
4D Thrust Spacer
4F Planet Gear

Figure 3-13. Planet Gear

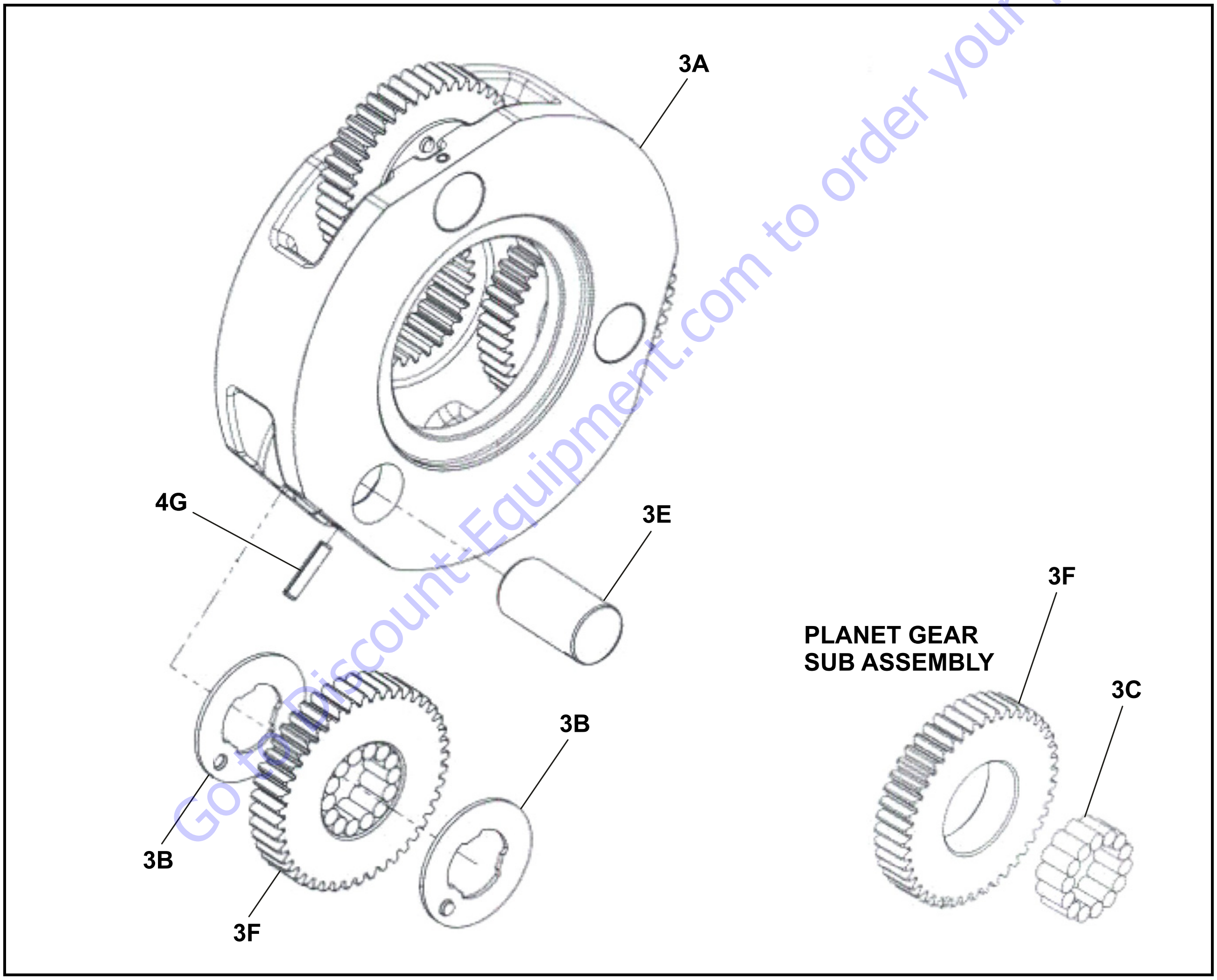
Input Carrier Disassembly

NOTE: *Refer to Figure 3-14., Input Carrier*

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

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

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



3A Carrier
3B Thrust Washer
3C Needle Bearing
3E Planet Shaft
3F Planet Gear
4G Roll Pin

Figure 3-14. Input Carrier

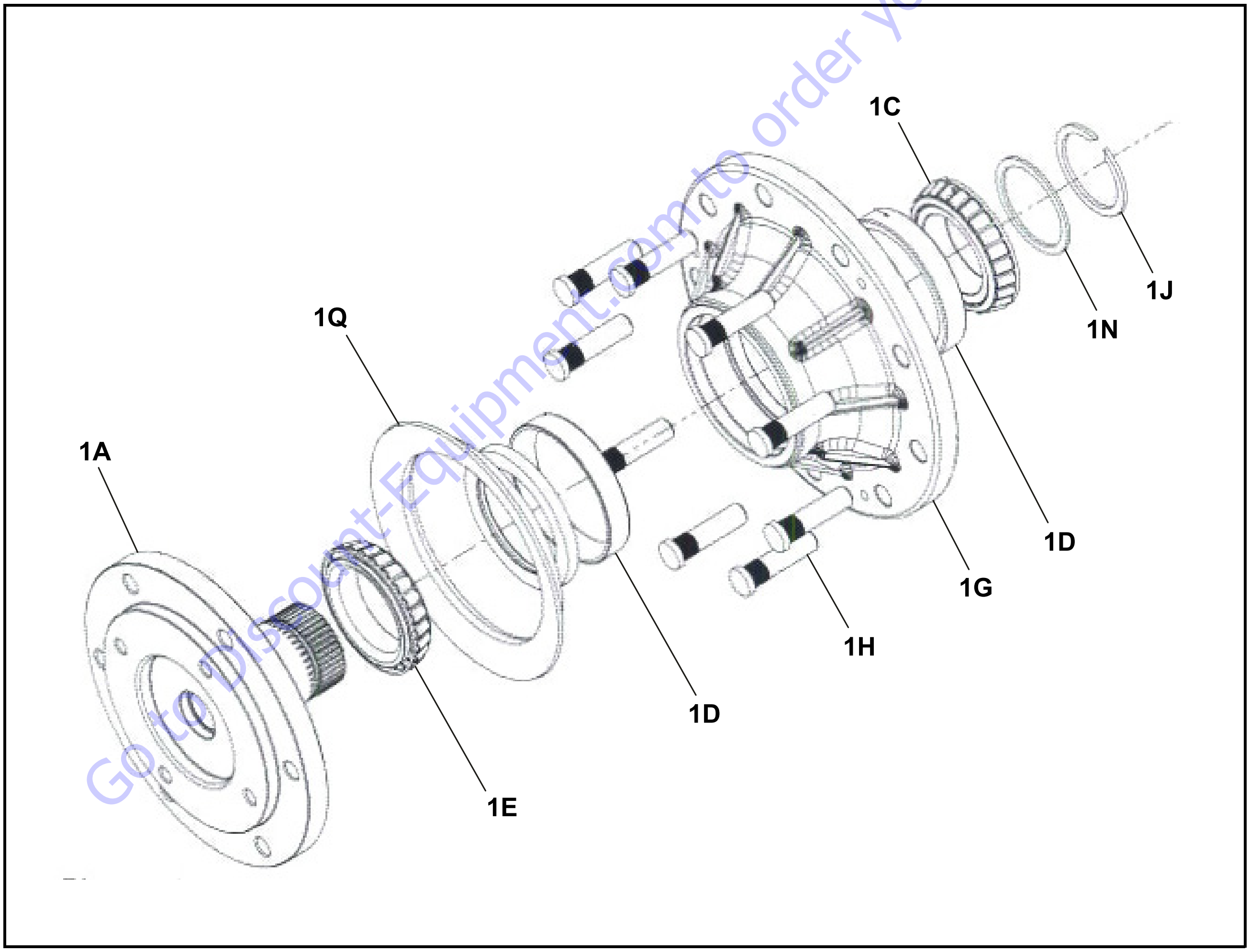
Hub Spindle Disassembly

NOTE: *Refer to Figure 3-15., Hub Spindle.*

1. Place unit on bench with Spindle (1A) end down.
2. Remove Retaining Ring (1J) with appropriate tool.
3. Remove Spacer (1N).
4. Remove Bearing Cone (1C) from Bearing Cup (1D) in Hub (1G).
5. Lift Hub (1G) off of Spindle (1A). Remove Boot Seal (1Q) from Hub (1G) if applicable.
6. If necessary, press 9 Studs (1H) out of Hub (1G). Locate Hub (1G) on Seal (1B) end.
7. Remove Seal (1B) from Hub (1G).

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

8. Remove Bearing Cone (1E) from Hub (1G).
9. Using a soft steel rod, knock both Bearing Cups (1D) out of Hub (1G).



1A Spindle	1H Stud
1D Tapered Bearing Cup	1J Retaining Ring
1E Tapered Bearing Cone	1N Spacer
1G Hub {Housing)	1Q Seal Boot

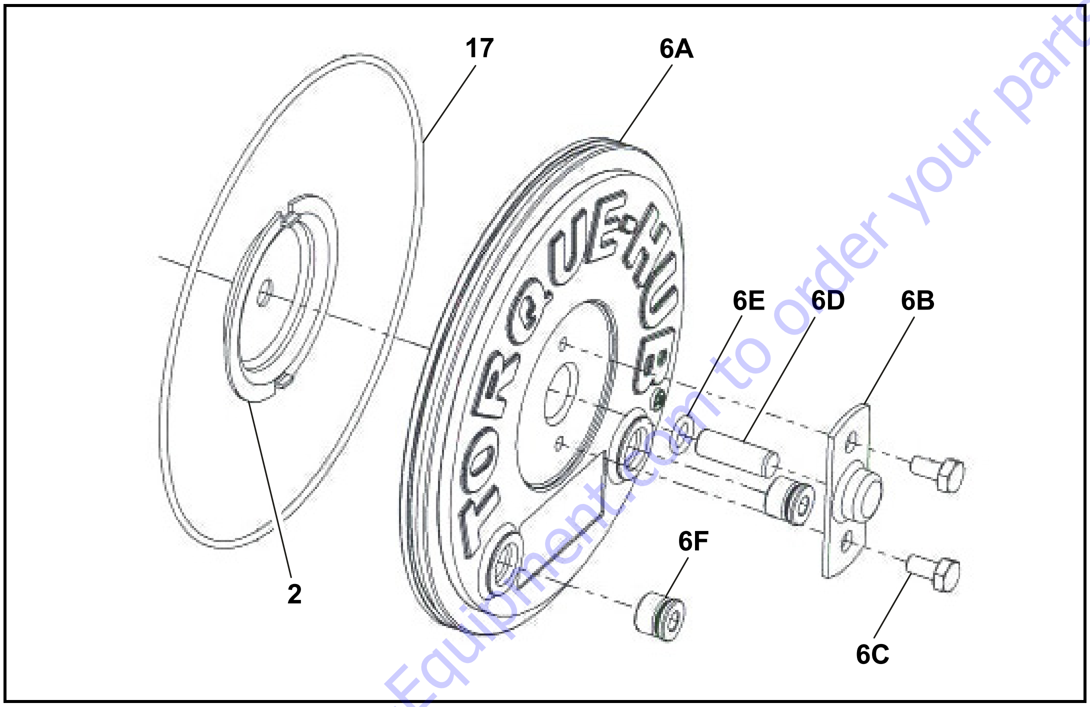
Figure 3-15. Hub Spindle

Cover Disassembly

NOTE: *Refer to Figure 3-16., Cover Assembly.*

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

NOTE: *For reassembling unit, please refer to the exploded views in the disassembly sections.*



2 Thrust Spacer	6D Disengage Rod
6A Cover	6E O-ring
6B Disengage Cap	6F Pipe Plug
6C Bolt	17 O-ring

Figure 3-16. Cover Assembly

Input Carrier Assembly

NOTE: *Refer to Figure 3-14., Input Carrier.*

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

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

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

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

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

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

Output Planet Gear Assembly

NOTE: *Refer to Figure 3-13., Planet Gear.*

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

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

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

Output Carrier Assembly

NOTE: *Refer to Figure 3-12., Output Carrier.*

1. Place Thrust Washer (4H) into counterbore of Carrier (4A). BE SURE the small diameter side of Washer (4H) facing planet gear side.
2. Place Planet Gear Sub-assembly (4) into Carrier (4A). Visually align the planet gear bore with one of the planet shaft holes on the Carrier (4A).
3. Insert a Planet Shaft (4E) into the planet shaft hole described in Step 2 on Carrier (4A). The end of the planet shaft that does NOT have the roll pin hole should be inserted into the Carrier (4A) FIRST.
4. Now insert Planet Shaft (4E) through the first set of Thrust Washers (4B), Planet gear, then the second set of Thrust Washers (4B). Use an alignment punch or similar tool to align roll pin holes on Carrier (4A) and Planet Shaft (4E).

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

5. Drive Roll Pin (4G) down into the aligned roll pin holes. Pin should be flush with 0D of Carrier (4A).
6. Repeat Steps 1-5 for the installation of the two remaining Planet Gears (4F).

Hub Spindle Assembly

NOTE: *Refer to Figure 3-15., Hub Spindle.*

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

1. Place Hub (1G) into pressing base. Press nine Studs (1H) into Hub.

NOTE: *Use enough pressure to press in studs. Don't use excessively high pressure to press in studs or hub may crack.*

NOTE: *Spray a generous amount of oil on bearings during installation.*

2. Press Bearing Cup (1D) into hub using appropriate pressing tool. Refer Figure 3-19. or Figure 3-20.
3. Turn hub over and press Bearing Cup (1D) into hub using appropriate pressing tool. Refer Figure 3-19. or Figure 3-20.
4. Place Bearing Cone (1E), into Bearing Cup (1D).
5. Grease Seal (1B) lip and press seal into Hub (1G) using appropriate tool until seal is flush with end of hub.
6. Press Seal Boot (1Q) onto Hub (1G) if required. Turn Hub (1G) over and lower onto Spindle (1A).
7. Install Bearing Cone (1C) into Bearing Cup (1D).
8. Place Bearing Spacer (1N) on top of Bearing Cone (1C).
9. Using appropriate tool, install Retaining Ring (1J) into Spindle (1A) groove. Make sure ring is completely seated in groove.

NOTE: *Extra bearing pre-load caused by using tool in Step #9 must be removed. This should be done by placing a tool (NOT THE SAME TOOL USED IN STEP #9) on the end of the spindle, and then striking the tool with a piece of barstock. This should be adequate to remove any additional bearing pre-load.*

Cover Assembly

NOTE: *Refer to Figure 3-16., Cover Assembly.*

1. Grease O-Ring (6E) and insert into internal groove in Cover (6A).
2. Assemble Disengage Cap (6B) onto Cover (6A) using two Hex Head Bolts (6C). Torque bolts to 70-80 in. lbs. (8-9 Nm).
3. Insert Disengage Rod (6D) into hole in Cover (6A) until it touches the inside of the Disengage Cap (6B).

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

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

Main Assembly

NOTE: *Refer to Figure 3-10., Main Assembly - Sheet 1 of 2 and Figure 3-11., Main Assembly - Sheet 2 of 2.*

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

1. Place Hub-Spindle Sub-Assembly on the bench.
2. Grease O-Ring (18) and place it into groove of Hub (1G).
3. Place Ring Gear (1F) onto Hub (1G). Align the three shipping Capscrew Holes on Hub (1G) and Ring Gear (1F).
4. Install three shipping Capscrews (19) into ring gear and hub. Torque them to 15-20 ft. lbs. (20-27 Nm).

NOTE: *The output carrier sub- assembly does not need timed with the spindle splines.*

5. Place Output Carrier Sub-Assembly (4) into mesh with Spindle (1A) splines.
6. Place External Retaining Ring (5) over 13T spline to the retaining groove on Input Shaft (9).

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

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

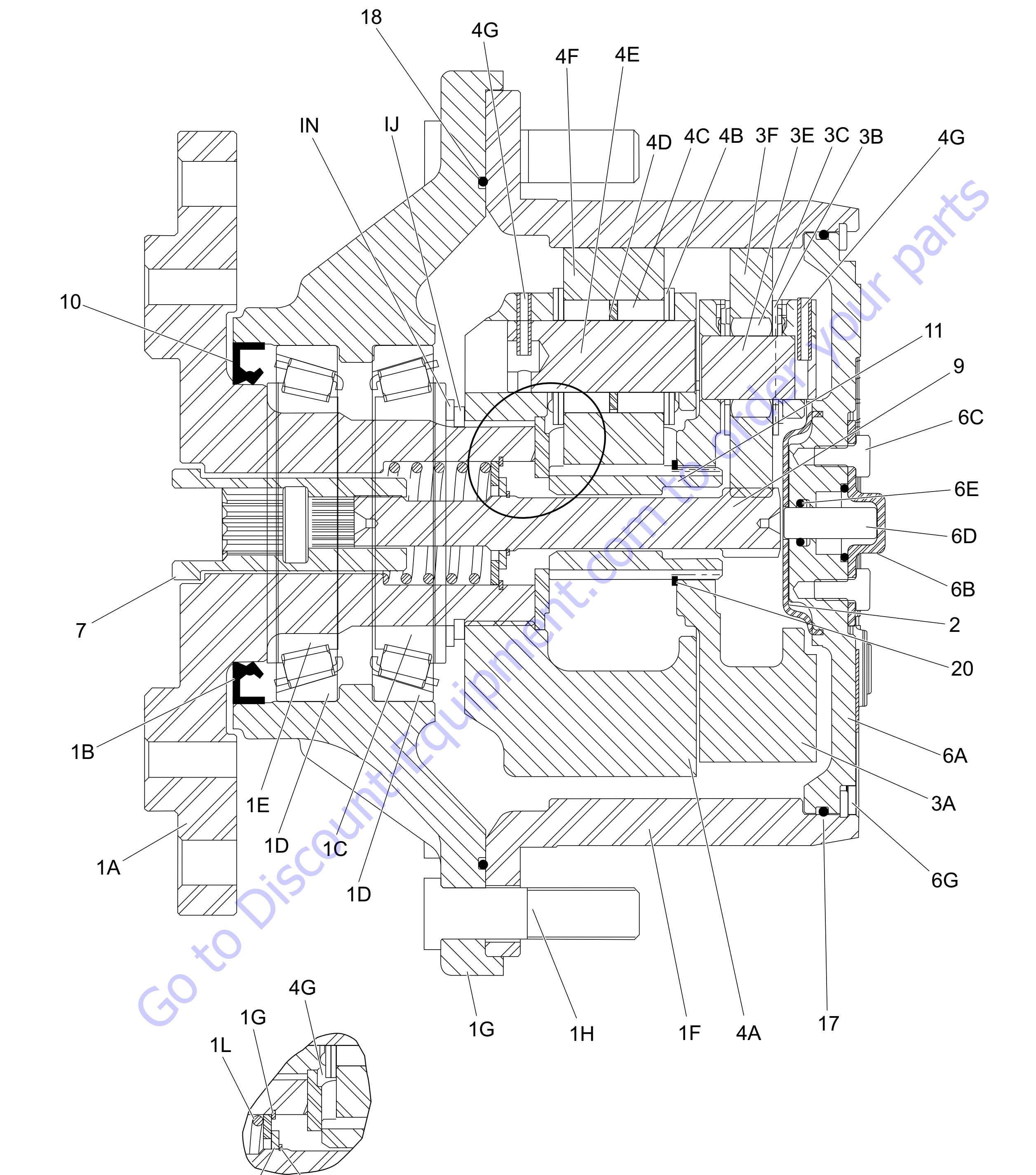


Figure 3-17. Drive Hub - Sheet 1 of 2

1A Spindle	1K Retaining Ring	3F Planet Gear	5 Retaining Ring	9 Input Shaft
1B Lip Seal	1L Spring	4A Output Carrier	6A Cover	10 Input Sun Gear
1C Tapered Bearing Cone	1M Thrust Washer	4B Thrust Washer	6B Disengage Cap	11 Output Sun Gear
1D Tapered Bearing Cup	1Q Seal Boot	4C Needle Bearing	6C Bolt	15 ID Plate
1E Tapered Bearing Cone	2 Thrust Spacer	4D Thrust Spacer	6D Dowel Pin	16 Drive Screw
1F Ring Gear	3A Input carrier	4E Planet Shaft	6E O-ring	17 O-ring
1G Hub (Housing)	3B Thrust Washer	4F Planet Gear	6F Pipe Plug	18 O-ring
1H Stud	3C Needle Bearing	4G Roll Pin	6G Retaining Ring	19 Bolt
1J Retaining Ring	3E Planet Shaft	4H Thrust Washer	7 Coupling	20 Retaining Ring

Figure 3-18. Drive Hub - Sheet 2 of 2

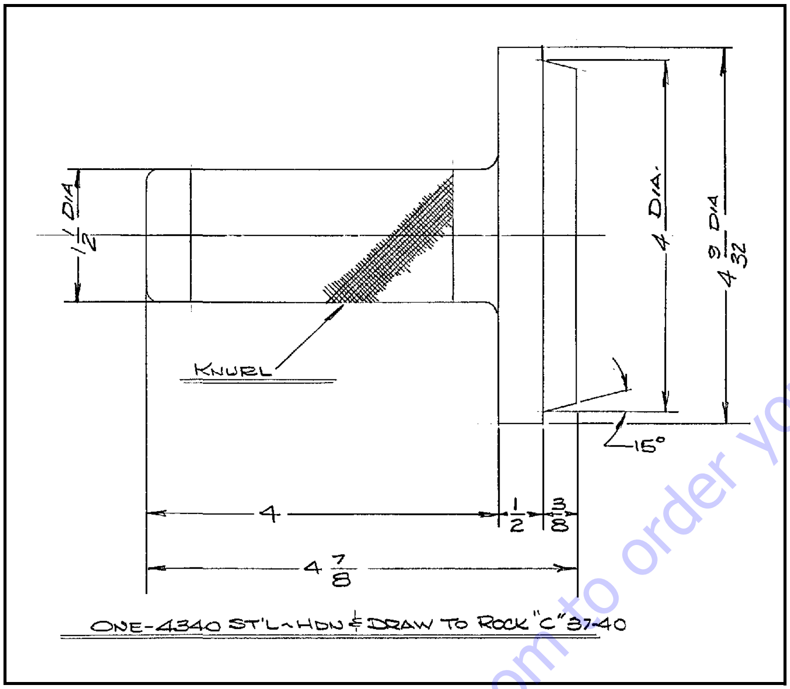


Figure 3-19. Cup Pressing Tool

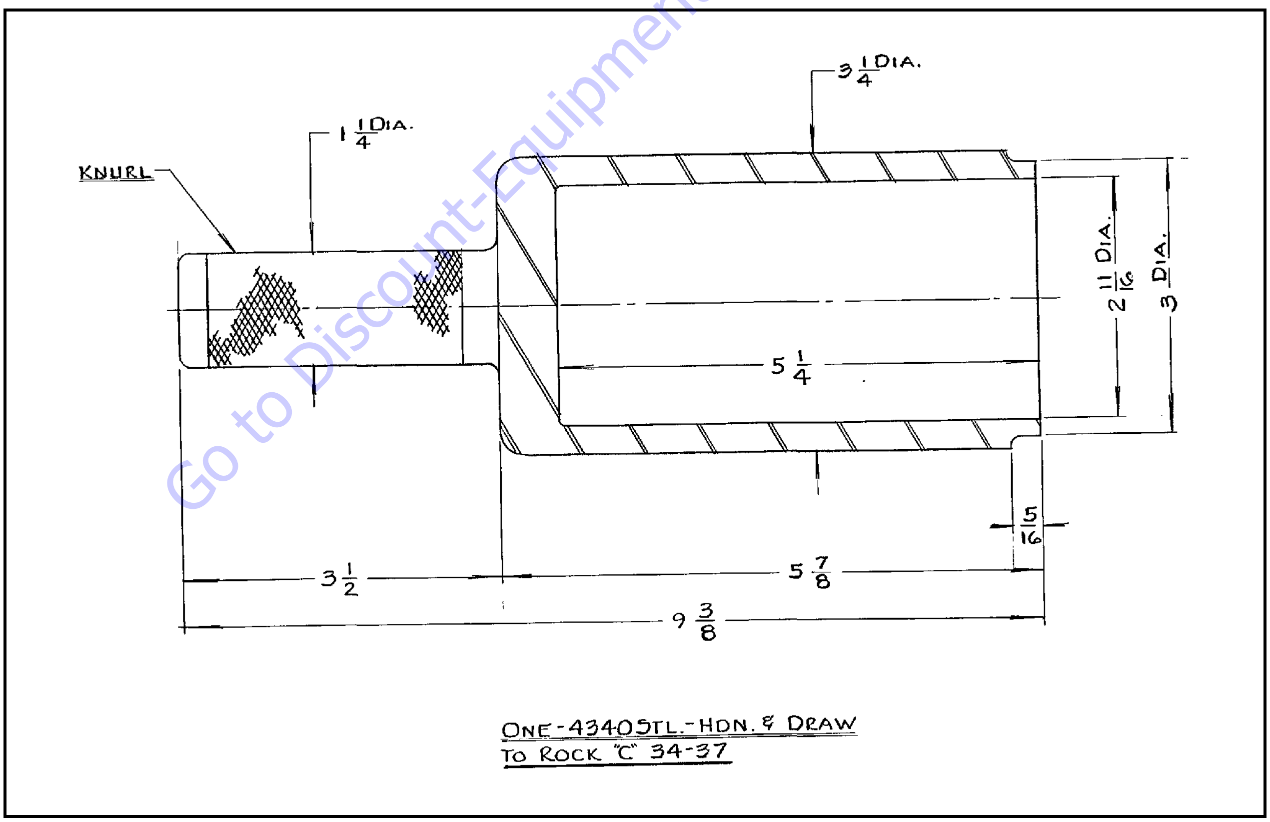


Figure 3-20. Cup Pressing Tool

3.6 DRIVE MOTOR

Removal

1. Place machine on the firm level surface.
2. Disconnect the battery power and all electrical connections from the drive motor.

NOTE: *The drive motor weighs approximately 95 lb (43 kg).*

3. Use suitable lifting device to support the drive motor.
4. Remove four bolts attached drive motor to the frame.
5. Remove the motor from machine and place in a clean work area.
6. Clean the motor for dirt. Remove rust or corrosion from coupling shaft.

Disassembly

NOTE: *Refer to Figure 3-21., Drive Motor.*

1. Place the motor in a soft jawed vice, with coupling shaft from motor pointing down and the vise jaws clamping firmly to the sides of the end shield (8).

⚠ WARNING

IF THE MOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. Remove the three nuts (4) and relevant washers (5) from the terminal board (3).
3. Remove the terminal board (3) from the terminal base (6).
4. Remove the screws (7). Make sure that the screws are not damage.
5. Remove four screw (35) that attach the drive brake (36) onto the drive motor. Remove the drive brake.
6. Remove the terminal base (6) from the stator (2).
7. Remove the temperature sensor (27) from the stator (2).
8. Remove the screws (22) from the retaining plate (23).
9. Remove the retaining plate (23) from the cover (21).
10. Remove the cover (21) from the shield end (18).
11. Remove the seals (20) and (19).
12. Disconnect the connector (34) from the sensor (13).
13. Remove the sensor (13) from shield end.
14. Remove four screws (26) attached to the drive end plate (8).
15. Remove end plate and shield end.
16. Remove the Shaft Seal (10). To avoid damaging the shaft during removal, install a large sheet metal screw into the chuck of a slide hammer. Drive the screw into the seal surface and use the slide hammer to pull the seal.
17. Remove Washer (12), O-ring (9) and Bearing from Stator (2).
18. Remove the retainer clips (31) and (30).
19. Remove the Bearing (24), O-ring (28) and retainer clip (25).
20. Use mallet to remove the Gear (33) and remove Gear Key (32) from the Rotor (29).
21. Remove the rotor (29) from the stator (2).
22. Remove the stator (2).
23. Keep all parts in a clean work area.

Inspection

Inspect the new seal, the motor housing seal bore, and the sealing area on the shaft for rust, wear, and contamination. Polish the shaft and clean the housing if necessary.

Assembly

NOTE: *Refer to Figure 3-21., Drive Motor.*

1. Install the rotor (29) into the stator (2).
2. Install the gear key (32) on to the rotor shaft.
3. Align the gear notch with key and install the gear (33) on to the rotor shaft.
4. Install the bearing (24), o-ring (28) and retainer clip (25).
5. Install the retainer clips (31) and (30).
6. Install washer (12), o-ring (9) and bearing into the stator (2).
7. Install the shaft seal (10).
8. Attach four bolts to secure the drive end plate with the shield end.
9. Connect the connector (34) to the sensor (13).
10. Install the sensor (13) to the shield end.
11. Install the seals (20) and (19).
12. Install the cover (21) onto the shield end (18).
13. Install the retaining plate (23) onto the cover (21).
14. Attach the bolts (22) to secure the retaining plate (23).
15. Attach the temperature sensor (27) to the stator (2).
16. Install the terminal base (6) onto the stator (2).
17. Install the screws (7).
18. Install the terminal board (3) onto the terminal base (6).
19. Attach the three nuts (4) and relevant washers (5) to the terminal board (3).
20. Install the drive brake (36) onto the drive motor.
21. Attach the screws (35) to the drive brake (36).

Installation

NOTE: *The drive motor weighs approximately 95 lb (43 kg).*

22. Use suitable lifting device to support the drive motor.
23. Install the drive motor to the machine.

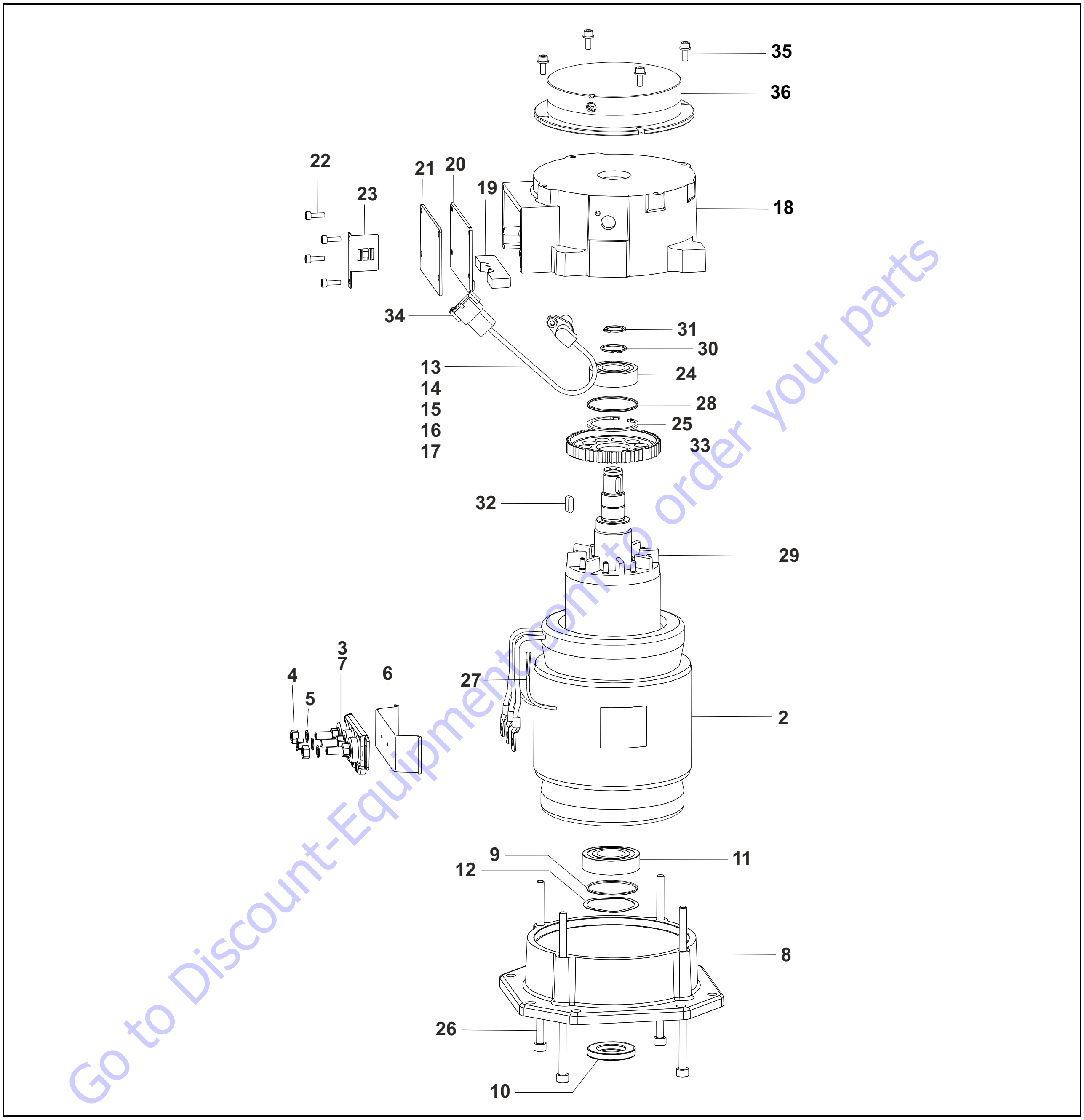
⚠ CAUTION

INCORRECT SHAFT ALIGNMENT MAY RESULT IN DAMAGE TO DRIVE SHAFT, BEARINGS, OR SEAL WHICH CAN CAUSE EXTERNAL OIL LEAKAGE.

24. Make sure that the pump shaft is properly aligned.
25. Use the four bolts and attach the drive motor to the machine. Tighten the bolts to torque 35 ft. lbs. (48 Nm).

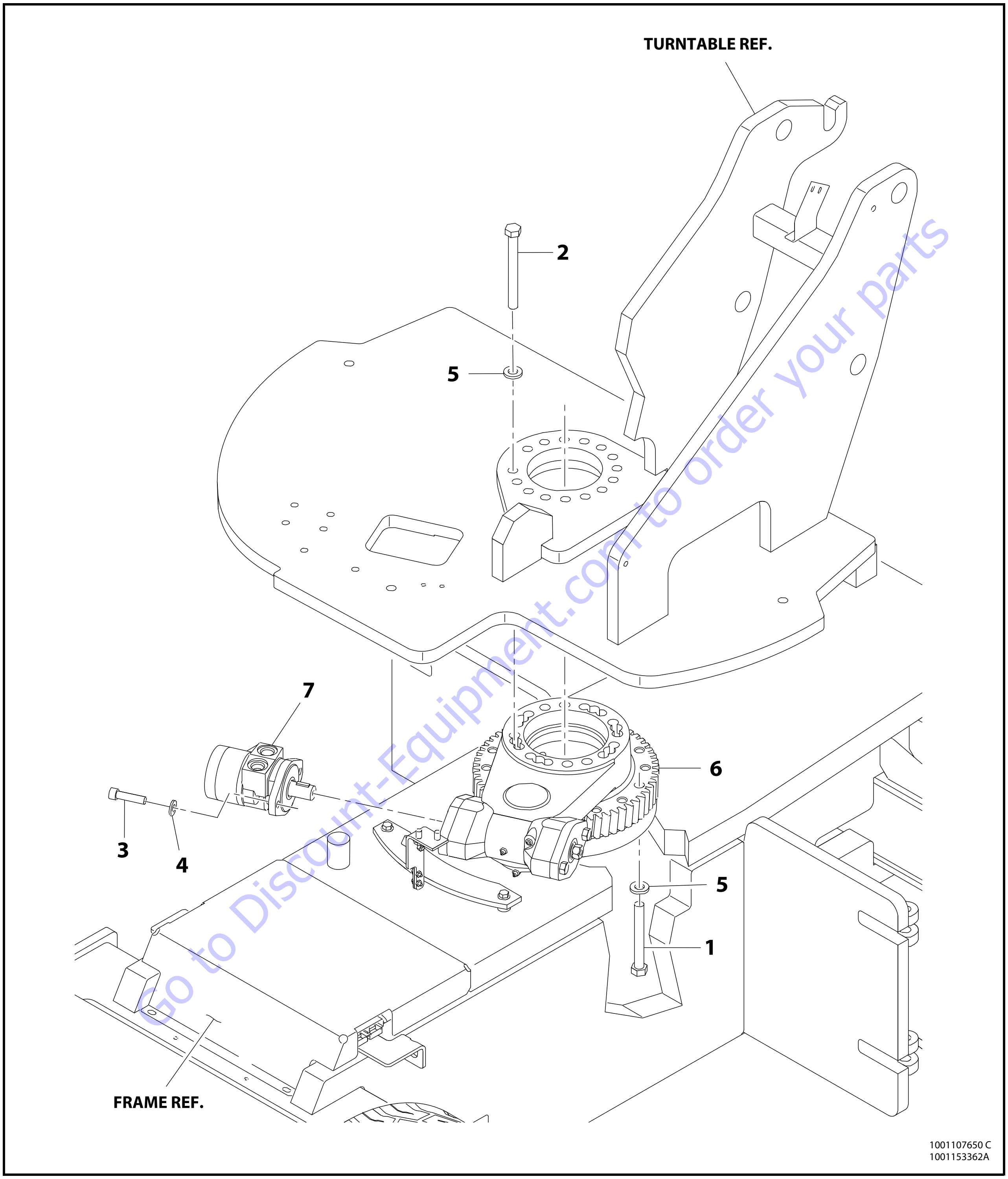
NOTE: *Apply Medium Strength Threadlocking Compound to bolts before installation.*

26. Install drive brake on to the drive motor.
27. Reconnect all electrical connections to the drive motor.
28. Start the machine and check the motor for proper functioning.



1.	Not Included	10.	Shaft Seal	19.	Seal	28.	O-Ring
2.	Stator	11.	Bearing	20.	Seal	29.	Rotor
3.	Terminal Board	12.	Washer	21.	Cover	30.	Retainer Clip
4.	Nut	13.	Sensor	22.	Screw	31.	Retainer Clip
5.	Washer	14.	Screw	23.	Retaining Plate	32.	Key
6.	Terminal Base	15.	Wedge	24.	Bearing	33.	Gear
7.	Screw	16.	Connector	25.	Retainer Clip	34.	Connector
8.	Drive End Plate	17.	Male Pin	26.	Screw	35.	Screw
9.	O-Ring	18.	End Shield	27.	Temperature Sensor	36.	Drive Brake

Figure 3-21. Drive Motor



1. Bolt	3. Bolt	5. Washer	7. Swing Motor
2. Bolt	4. Washer	6. Swing Bearing	

Figure 3-22. Swing Components

3.7 SWING DRIVE

NOTE: *The swing drive must be removed from the machine to be serviced.*

The swing drive has five major components; the housing, worm, worm gear, output pinion, and gear/pinion cap.

Tools required:

- Hydraulic Press
- 5/16" 12 point socket
- 7/16" socket
- 3/4" socket
- Torque Wrench (80 ft. lbs.)
- Steel Hammer
- Soft Face Hammer
- Bearing Puller (External And Internal)
- Large Flat Blade Screw Driver

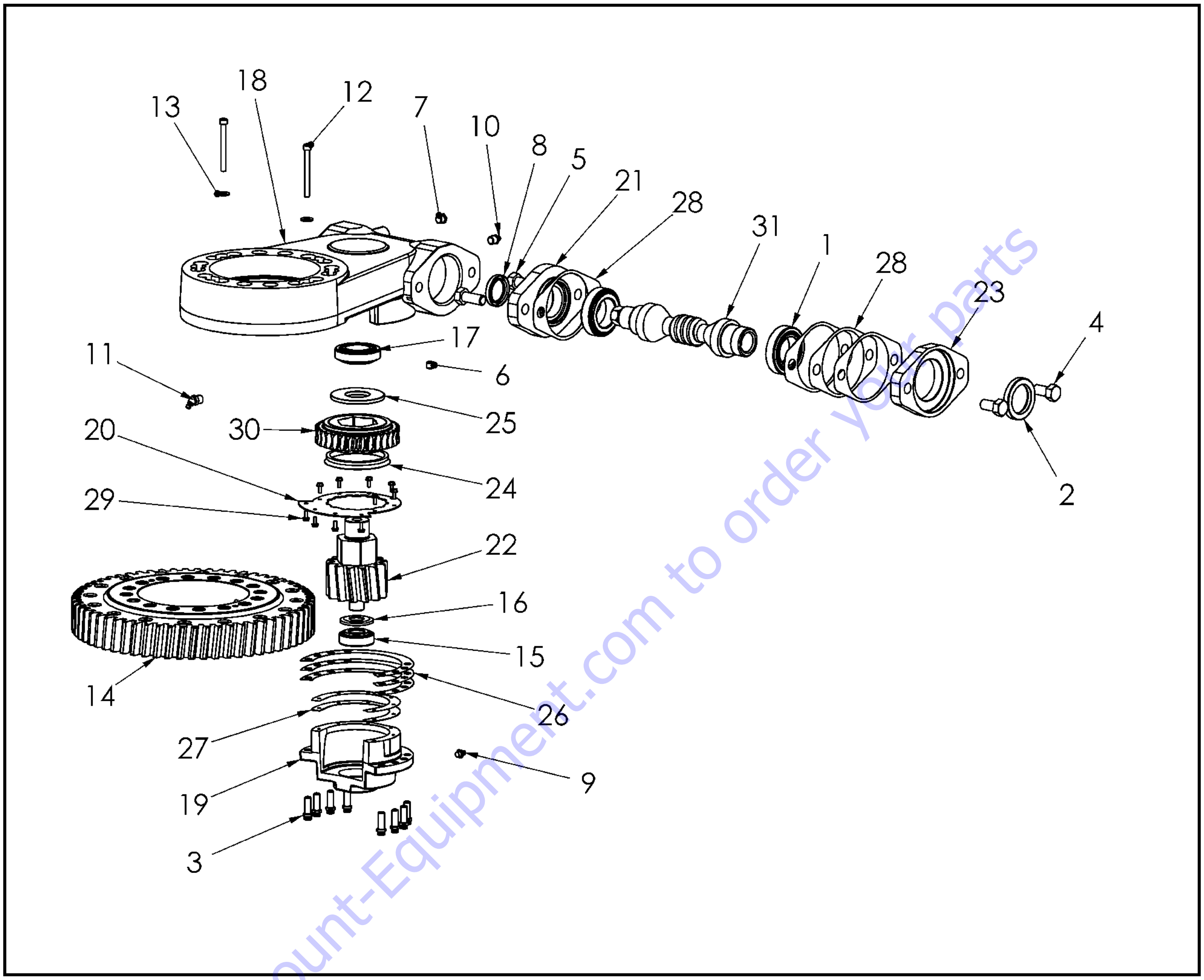
NOTE: *Also needed are a shim and seal kit, 3/4" steel rod at least 10" long, Threadlocking Compound#515, Mobil SHC 007 grease (available as SW007GK), Mobil SHC 460 grease, Medium Strength Threadlocking Compound for bolts and any other parts that may be worn out.*

Disassembly

1. Remove the slew ring (14) by removing the two 1/4" bolts (12) and washers (13) that hold the slew ring to the housing.
2. Remove four #6 machine screws (29) that are located on cover plate (20) immediately in front of Pinion (22).
3. Remove eight 5/16" 12 point capscrews (3) from gear/pinion cap (19). Pry the cap from the housing. The cover plate (20) will come off with cap. Note where sealant is on Cover and plate so when assembling sealant can be applied in the same place. Note number and color of shims (26) between the cap and housing. Remove six small screws (29) from cover plate. Pry the cover plate (20) from cap (19) and discard the cover plate. Note the number and color of shims between cover plate and cap.
4. Remove the Pinion and Gear assembly (15, 16, 17, 22, 24, 25, 30) from the housing. The assembly lifts directly upward from the housing.
5. Using a press, disassemble the pinion and gear assembly. Support the worm gear (30) on the press with the pinion (22) down allowing room for pinion to be pressed out of gear. Press pinion out of bearing (17) spacer (25) and worm gear (30) Pressing on end of pinion. Remove face seal (24) from face of worm gear (30). Note how the seal is assembled.
6. Remove the bearing (15) and Nilos Ring (16) from the pinion (22) using an external bearing puller or press.
7. Remove the motor and motor adapter (23) and shims (28).
8. Remove 1/2” bolts (5) from the Worm Cap (21) using 3/4" socket. Remove the shim (28) and seal (8) and discard.
9. Remove the worm (31) from the housing (18) by pushing it from the motor end using steel rod and a hammer. The bearing cup (1) on the hex end of the worm will be forced out of the housing. Once the bearing cup (1) has come out of housing, use a soft hammer to tap the worm on the hex end to remove the other bearing cup (1) out the other end of housing.
10. Remove both bearings (1) from the worm (31) using external bearing puller or press.
11. The bearing cup (17) can be removed from the housing (18) by lifting it out (this is not a press fit just a close slip fit).
12. The bearing cup (15) can be removed from the cap (19) using a small pry bar, or by welding a small bead of weld on the internal diameter of cup, this is a press fit.

Assembly

1. Press the bearing cup (15) into the cap (19).
2. Place the bearing cup (17) into the housing (18).
3. Put the face seal (24) onto the hub of the worm gear (30) with the flap of the seal pointing away from gear.
4. Place the worm gear (30) onto the press with the face seal up and press the pinion (22) into the worm gear. Place the Nilos Ring (16) onto the pinion so the cup shape is up and press the bearing (15) onto the pinion tight to the Nilos Ring.
5. Turn the assembly over and place the spacer (25) on the pinion against the gear hub so the large chamfer on the I.D. of spacer is against the bronze gear. Press the bearing (17) onto the pinion tight to the spacer and gear.
6. Place the pinion/gear assembly into the housing. Place the gear cap (19) and shims (26) over the gear/pinion assembly to achieve a slight preload on the pinion bearings. Remove the cap and shims and set the shims aside. Install a new cover plate (20) onto the cap using 6 screws (29) and shims (27) equal to or close to equal to the total thickness of shims set aside during Disassembly. Apply sealant (Threadlocking Compound#515) to both sides of each of these shims and tighten the screws taking care not to twist these screws off. Clean extra sealant from the surfaces of the cover plate. Apply a small amount of grease to this flap. Set this assembly to the side.
7. Install the bearing (1) on the bore end of the worm (31) only. This is almost a slip fit, may have to be lightly tapped with soft hammer.
8. Install the worm (31) into the housing (18), hex end first.
9. On the bore end of the worm, install the bearing cup (1) into the worm bore of the housing. Also on the bore end of worm (31), install the motor adapter (23) and 1 shim (28 yellow) to the housing using 1/2-13 x 1" bolts (4) and sealant. Torque to 75 ft.lbs. (101.5 Nm). These bolts will be replaced with motor bolts when the motor is mounted.
10. Install the bearing cone (1) on the hex end of the worm (31). Place a bearing cup (1) over the bearing and lightly tap the cup into the bore using a soft hammer.
11. Install the worm cap (21) using proper shims (28) to achieve 0.000 to 0.001" (0.000 to 0.025 mm) end play. Apply Medium Strength Threadlocking Compound to end of 1/2-13 x 1.25" grade 5 bolts (5) and Threadlocking Compound#515 sealant to shims. Torque the bolts to 75 ft.lbs. (101.5 Nm).
12. Place the pinion/gear assembly into the housing so the gear teeth mesh with the worm gear teeth. The worm or gear set may have to be turned by hand to achieve this.
13. Apply Threadlocking Compound#515 to surfaces of the housing where the cap assembly will touch. This includes the vertical surfaces.
14. Place the gear cap assembly and shims set aside in step 6, over the pinion assembly.
15. Apply Medium Strength Threadlocking Compound to the end of eight 5/16” 12 point screws (3) and torque to 20 ft.lbs. (27 Nm).
16. Install 4 small screws (29) through the cover plate (20) and into the housing (18). Tighten the screws taking care not the twist the screws off.
17. Install the seal (8) in the worm cap at the hex end of the worm.
18. Install the slew ring (14) using two 1/4" bolts (12) and washers (13). Adjust backlash with the pinion to 0.008/0.012" (0.203/0.304 mm) and torque bolts to 10 ft.lbs. (13.5 Nm).
19. Fill the unit with SHC 007 grease (available as SW007GK) and grease the pinion bearing (15) thru the fitting (9) with Mobil SHC 460 grease.



1. Bearing	9. Grease Fitting	17. Bearing	25. Spacer
2. Oil Seal	10. Grease Fitting	18. Housing	26. Shim
3. Capscrew	11. Grease Fitting	19. Gear/Pinion Cap	27. Shim
4. Bolt	12. Bolt	20. Cover Plate	28. Shim
5. Bolt	13. Washer	21. Worm Cap	29. Machine Screw
6. Plug	14. Slew Ring	22. Pinion	30. Worm Gear
7. Pressure Vent	15. Bearing	23. Motor Adapter	31. Worm
8. Seal	16. Ring	24. Face Seal	

Figure 3-23. Swing Drive - Exploded View

3.8 SWING MOTOR

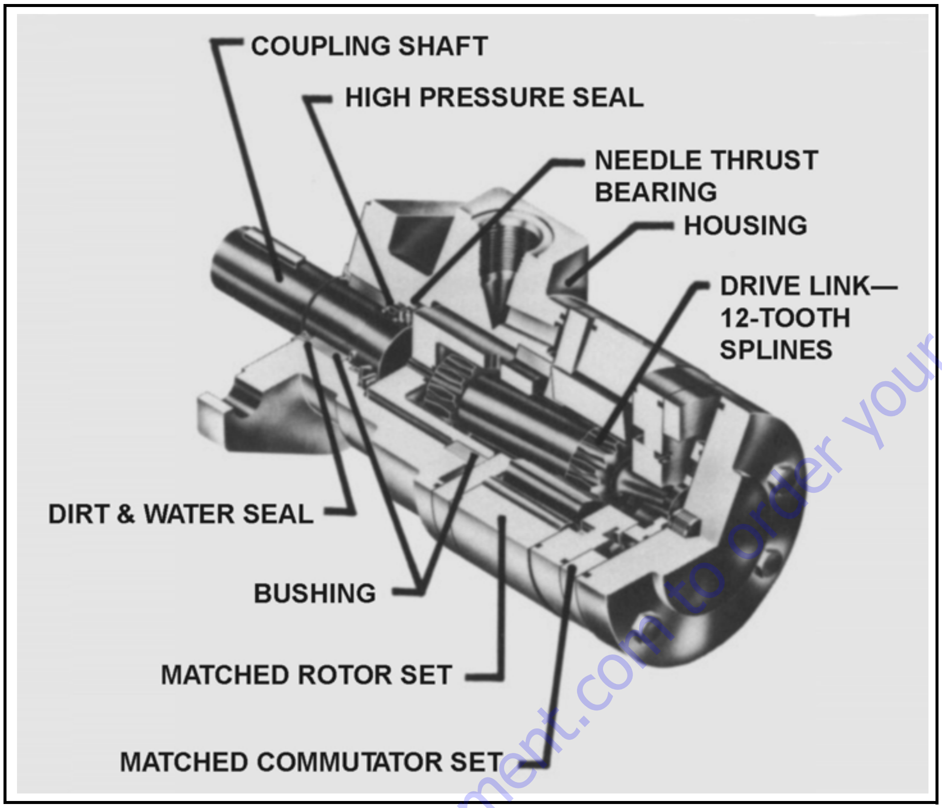


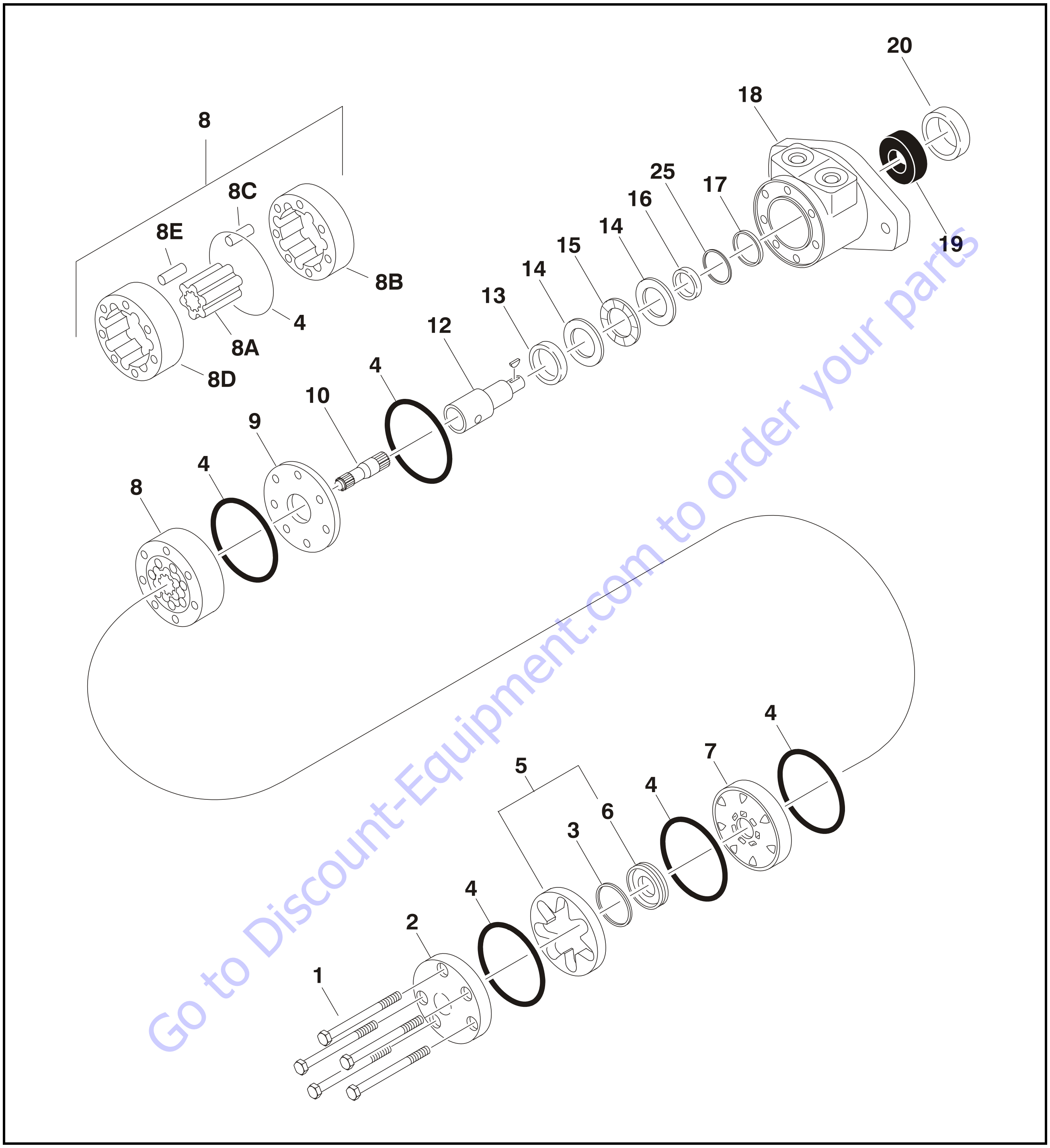
Figure 3-24. Swing Motor - Cutaway

CAUTION

IF THE HYDRAULIC SYSTEM FLUID BECOMES OVERHEATED [IN EXCESS OF 200°F (93.3°C)], SEALS IN THE SYSTEM CAN SHRINK, HARDEN OR CRACK, THUS LOSING THEIR SEALING ABILITY.

Table 3-2. Swing Motor Troubleshooting

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged.	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (4) deteriorated by excess heat.	Replace oil seal rings by disassembling unit.
	3. Special bolt (1, 1 A, 1B or 1C) loose or its sealing area deteriorated by corrosion.	(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged.	Replace seal. Disassembly of motor unit necessary.
	5. Worn coupling shaft (12) and internal seal (16).	Replace coupling shaft and seal by disassembling unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	Replace worn rotor set by disassembling unit.
	3. Severely worn or damaged internal splines.	Replace rotor set, drive link and coupling shaft by disassembling unit.
	4. Excessive heat.	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to motor unit.	Locate source and eliminate cause.



1. Bolt	6. Commutator Ring	8C. Stator Vane	12. Coupling Shaft	17. Backup Ring	22. Not Used
2. End Cover	7. Manifold	8D. Stator Half	13. Inner Bushing	18. Housing	23. Not Used
3. Seal Ring	8. Rotor Set	9. Wear Plate	14. Thrust Washer	19. Outer Bushing	24. Not Used
4. Seal Ring	8A. Rotor	10. Drive Link	15. Thrust Bearing	20. Dirt & Water Seal	25. Backup Washer
5. Commutator	8B. Stator Half	11. Thrust Bearing	16. Seal	21. Not Used	

Figure 3-25. Swing Motor - Exploded View

Preparation Before Disassembly

- Before you disassemble the motor unit or any of its components read this entire section. It provides important information on parts and procedures you will need to know to service the motor.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the motor. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings and immediately plug port holes and fluid lines.
- Remove the motor from system, drain it of fluid and take it to a clean work surface.
- Clean and dry the motor before you start to disassemble the unit.
- As you disassemble the motor clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

⚠ WARNING

PETROLEUM-BASE SOLVENTS ARE FLAMMABLE. BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

⚠ WARNING

WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

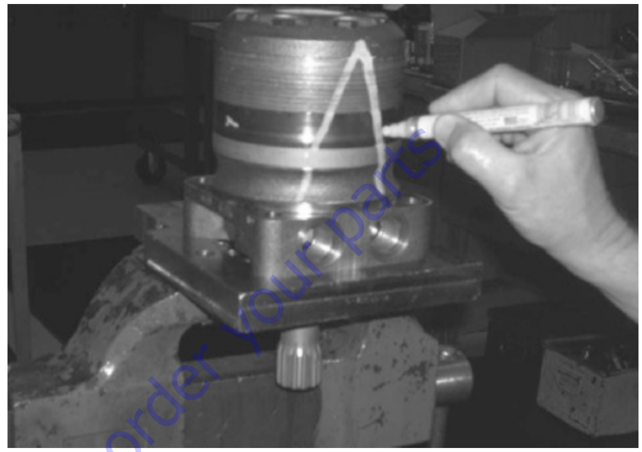
⚠ CAUTION

NEVER STEAM OR HIGH PRESSURE WASH HYDRAULIC COMPONENTS. DO NOT FORCE OR ABUSE CLOSELY FITTED PARTS.

- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the motor. Replace all seals, seal rings and any damaged or worn parts with OEM approved service parts.

Disassembly and Inspection

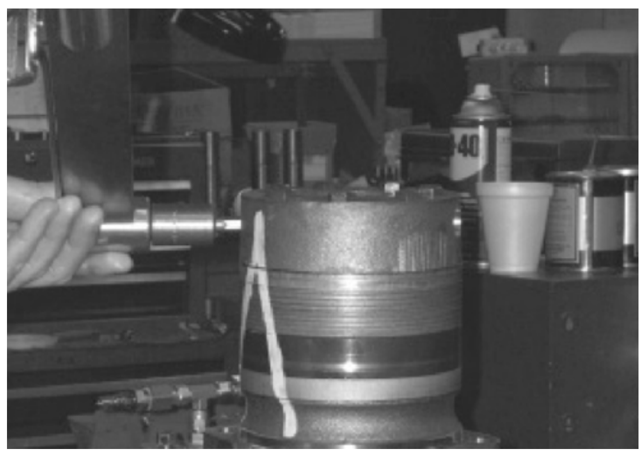
1. Place the motor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings if applicable.

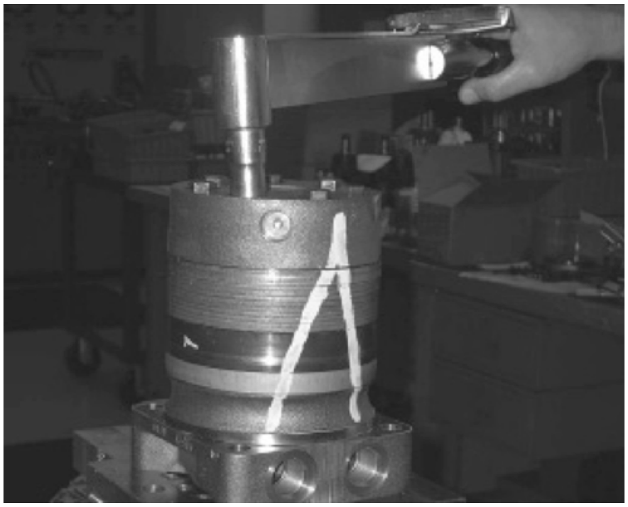


⚠ WARNING

IF THE MOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. Scribe an alignment mark down and across the motor components from end cover (2) to housing (18) to facilitate reassembly orientation where required.





3. Remove the special ring head bolts (1) using an appropriate 1/2 or 9/16 inch size socket. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts.

4. Remove end cover assembly (2) and seal ring (4). Discard seal ring.

5. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary.

NOTE: *A polished pattern (not scratches) on the cover from rotation of the commutator (5) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.*

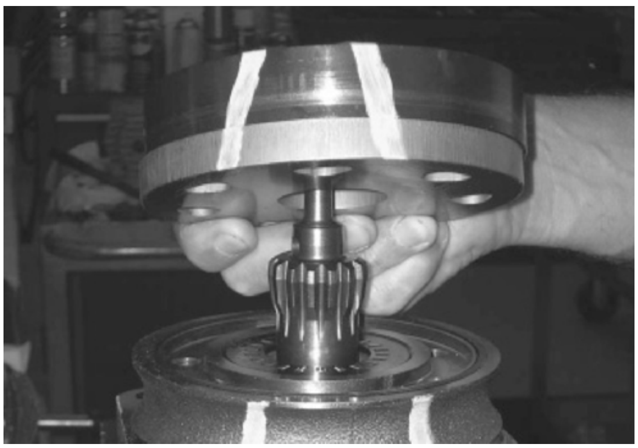
6. Remove commutator ring (6). Inspect commutator ring for cracks, or burrs.

7. Remove commutator (5) and seal ring (3) Remove seal ring from commutator, using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator for cracks or burrs, wear, scoring, spalling or brinelling. If any of these conditions exist, replace commutator and commutator ring as a matched set.

8. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.

NOTE: *The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.*

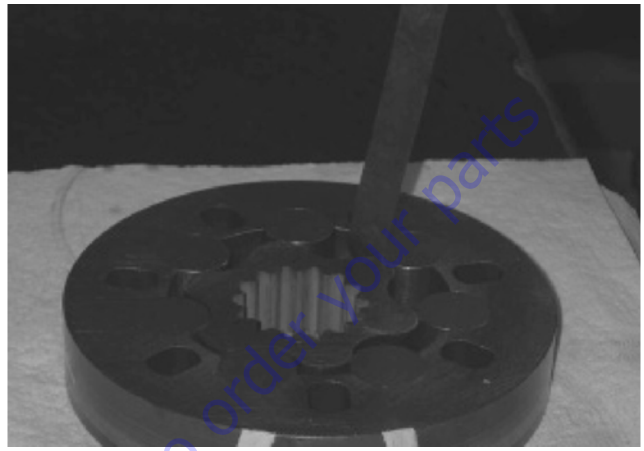
9. Remove rotor set (8) and wearplate (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane to stator contact surfaces. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor and wearplate. Inspect the rotor set in its assembled form for nicks, scoring, or spalling on any surface and for broken or worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wearplate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wearplate.



NOTE: *The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal will ensure correct reassembly of rotor into stator and rotor set into motor. Marking all rotor components and mating spline components for exact repositioning at assembly will ensure maximum wear life and performance of rotor set and motor.*

NOTE: *A polished pattern on the wear plate from rotor rotation is normal.*

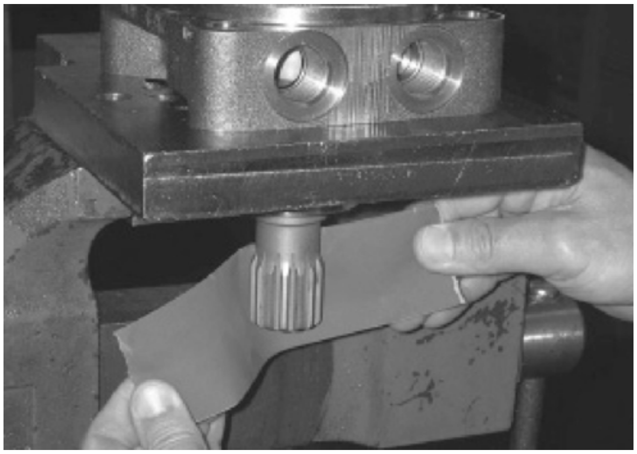
10. Place rotor set (8) and wear plate (9) on a flat surface and center rotor in stator such that two rotor lobes (180 degrees apart) and a roller vane centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than 0.005 inches (0.13 mm) of clearance, replace rotor set.



NOTE: *If rotor set (8) has two stator halves and two sets of seven vanes as shown, check the rotor lobe to roller vane clearance at both ends of rotor.*

11. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. Remove and discard seal ring (4) from housing (18).

12. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used.



13. Remove coupling shaft (12), by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. Replace coupling shaft if any of these conditions exist.

NOTE: *Minor shaft wear in seal area is permissible. If wear exceeds 0.020 inches (0.51 mm) diametrically, replace coupling shaft.*

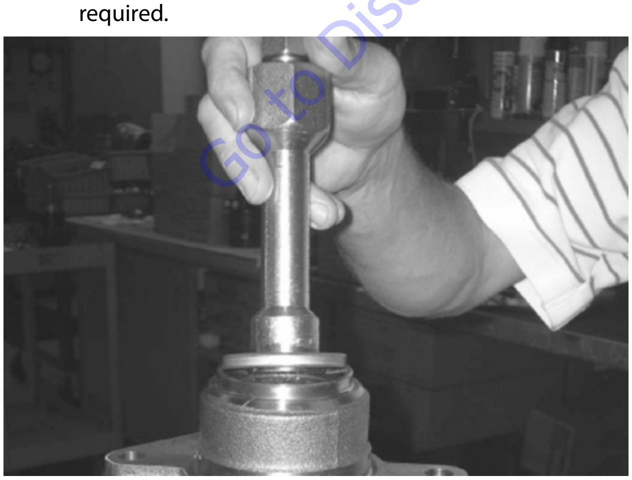
NOTE: *A slight "polish" is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.*

14. Remove and discard seal ring (4) from housing (18).

15. Remove thrust bearing (15) and thrust washer (14). Inspect for wear, brinelling, corrosion and a full complement of retained rollers.

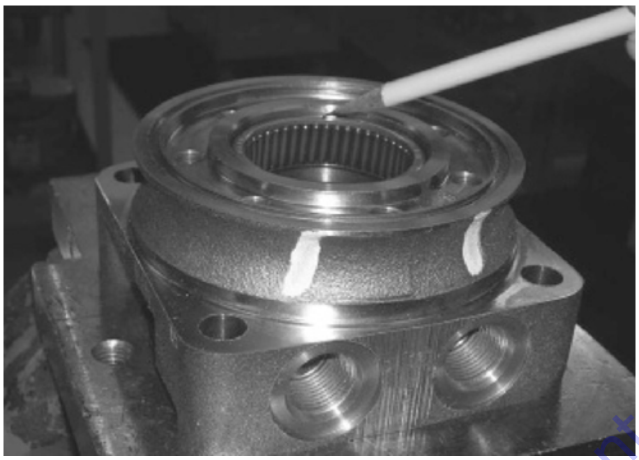
16. Remove seal (16) and backup ring (17) from housing (18) and backup washer (25). Discard both.

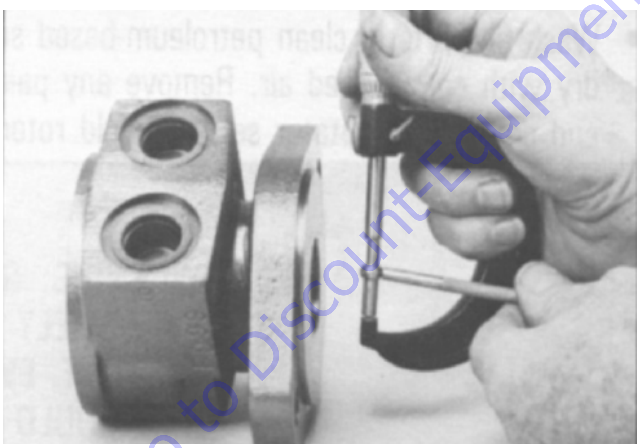
17. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller is required.



18. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly.

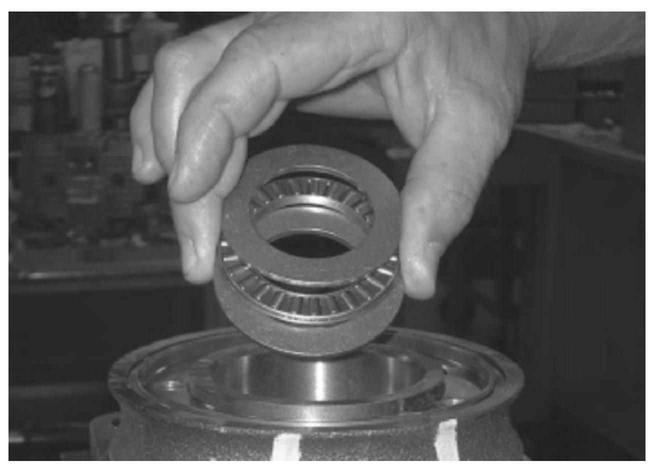
19. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and thrust washers must be free of brinelling and corrosion. The bushing (19) or (13) to coupling shaft diameter clearance must not exceed 0.010 inch (0.025 mm). A bearing, bushing, or thrust washer that does not pass inspection must be replaced. If the housing has passed this inspection the disassembly of the motor is completed.





NOTE: *The depth or location of bearing/bushing (13) in relation to the housing wear plate surface and the depth or location of bearing/bushing (19) in relation to the beginning of bearing/bushing counterbore should be measured and noted before removing the bearings/bushings. This will facilitate the correct reassembly of new bearings/bushings.*

20. If the bearings, bushing or thrust washers must be replaced use a suitable size bearing puller to remove bearing/bushings (19) and (13) from housing (18) without damaging the housing. Remove thrust washers (14) and thrust bearing (15) if they were previously retained in the housing by bearing (13).



Assembly

Replace all seals and seal rings with new ones each time you reassemble the motor unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE: *Unless otherwise indicated, do not oil or grease parts before assembly.*

Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, commutator set, manifold rotor set, wear plate and housing and from port and sealing areas.

⚠ WARNING

SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

⚠ WARNING

WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

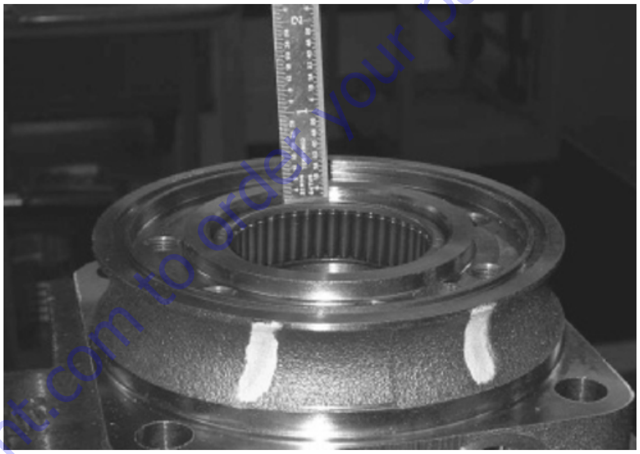
1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a new outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using the appropriate sized bearing mandrel as described which will control the bearing/ bushing depth.

   The housing requires the use of bearing mandrel to press bearing/ bushing (19) into the housing to a required depth of 0.151/0.161 inches (3.84/4.09 mm) from the end of the bearing counterbore.

NOTE: *Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing/ bushing is not cocked when pressing a bearing/bushing into the housing.*

⚠ CAUTION

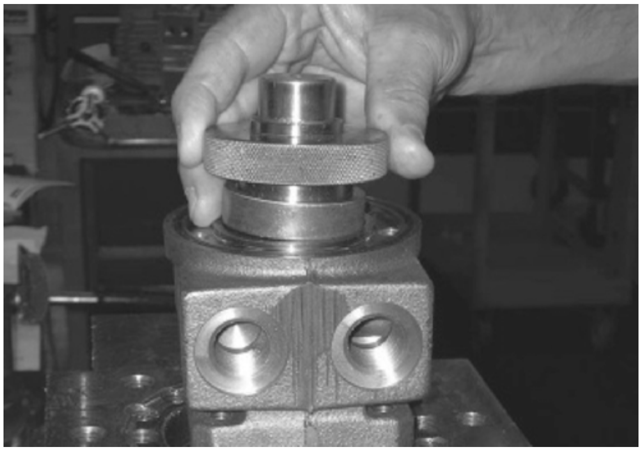
IF A BEARING MANDREL IS NOT AVAILABLE AND ALTERNATE METHODS ARE USED TO PRESS IN BEARING/BUSHING (13) AND (19) THE BEARING/BUSHING DEPTHS SPECIFIED MUST BE ACHIEVED TO INSURE ADEQUATE BEARING SUPPORT AND CORRECT RELATIONSHIP TO ADJACENT COMPONENTS WHEN ASSEMBLED.



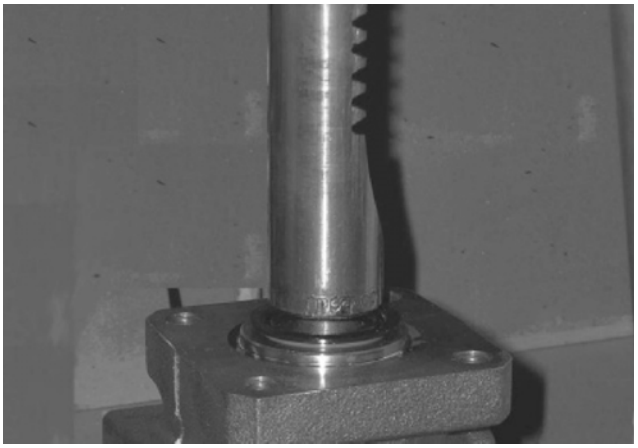
⚠ CAUTION

BECAUSE THE BEARING/BUSHINGS (13) AND (19) HAVE A PRESS FIT INTO THE HOUSING THEY MUST BE DISCARDED WHEN REMOVED. THEY MUST NOT BE REUSED.

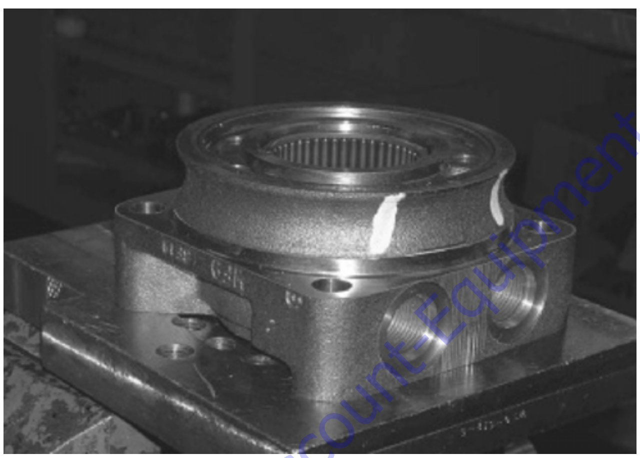
2. The inner housing bearing/bushing (13) can now be pressed into its counterbore in housing (18) flush to 0.03 inch (0.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19).



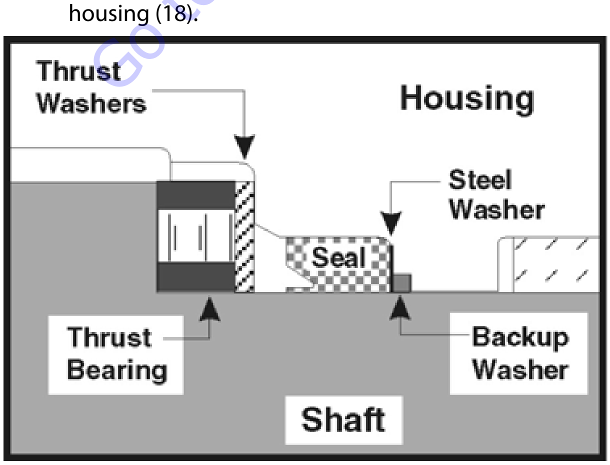
3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore. The dirt and water seal (20) must be pressed in until its' flange is flush against the housing.



4. Place housing (18) assembly into a soft jawed vise with the coupling shaft bore down, clamping against the mounting flange.



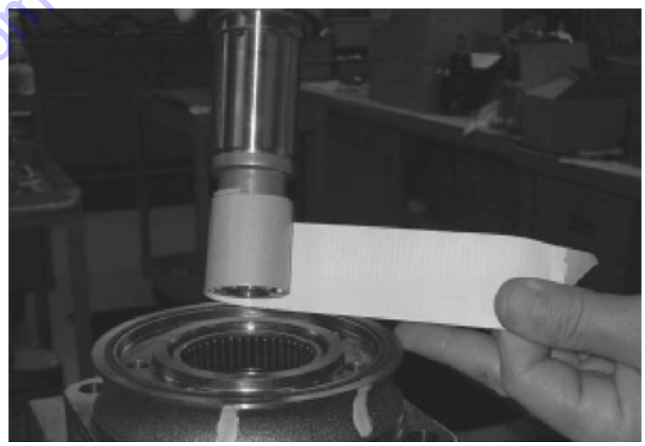
5. Assemble a new backup ring (17), new backup washer (25) and new seal (16) with the seal lip facing toward the inside of the motor, into their respective counterbores in housing (18).



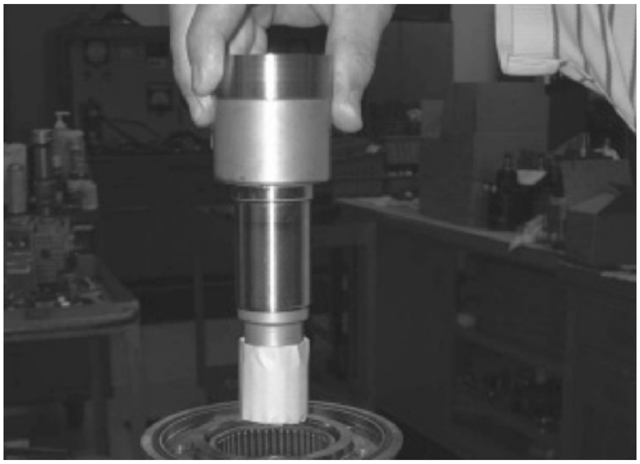
6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the motor.

NOTE: *The motor requires one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust bearing.*

7. Apply masking tape around splines or keyway on shaft (12) to prevent damage to seal.



8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15).

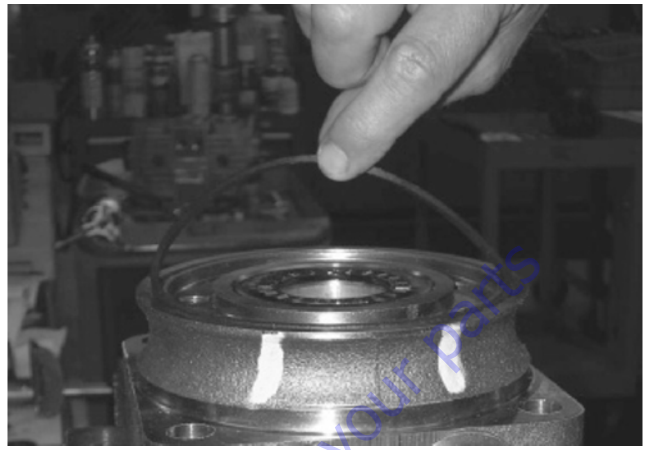


CAUTION

THE OUTER BEARING (19) IS NOT LUBRICATED BY THE SYSTEM'S HYDRAULIC FLUID. BE SURE IT IS THOROUGHLY PACKED WITH THE RECOMMENDED GREASE.

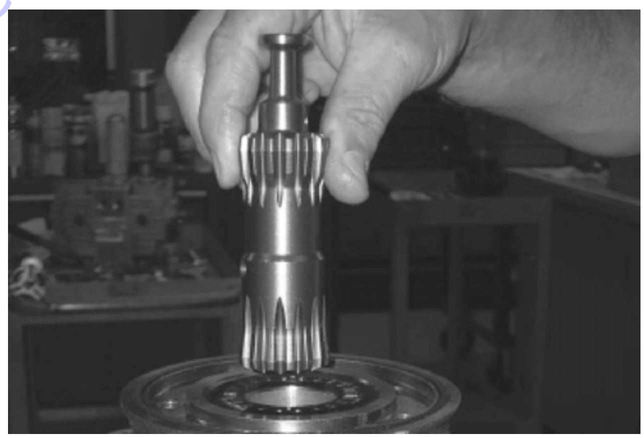
NOTE: *The coupling shaft (12) will be flush or just below the housing wear surface when properly seated while the coupling shaft (12). The coupling shaft must rotate smoothly on the thrust bearing package.*

9. Apply a small amount of clean grease to a new seal ring (4) and insert it into the housing (18) seal ring groove.



NOTE: *One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF 2A bolts as required that are over 0.5 inch (12.7 mm) longer than the bolts (1) used in the motor.*

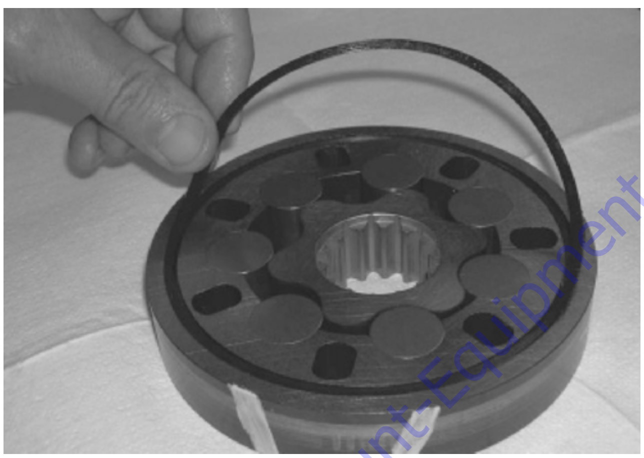
10. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines.



NOTE: *Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.*

11. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18).

12. Apply a small amount of clean grease to a new seal ring (4) and assemble it into the seal ring groove on the wear plate side of the rotor set stator.



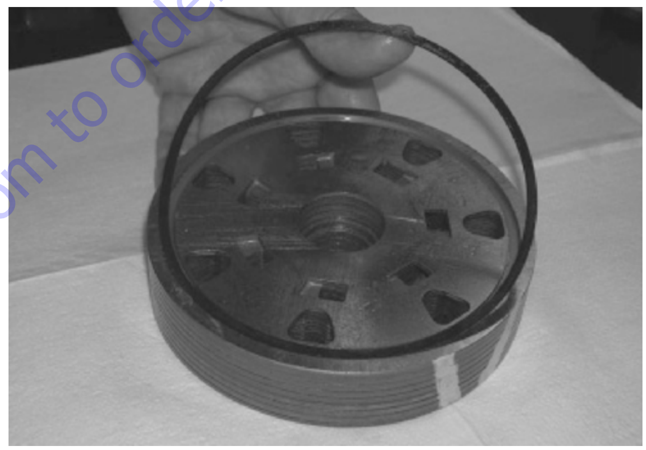
13. Install the assembled rotor set (8) onto wear plate (9) with rotor counterbore and seal ring side down and the splines into mesh with the drive link splines.

NOTE: *It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.*

NOTE: *If necessary, go to the appropriate, "Rotor Set Component Assembly Procedure."*

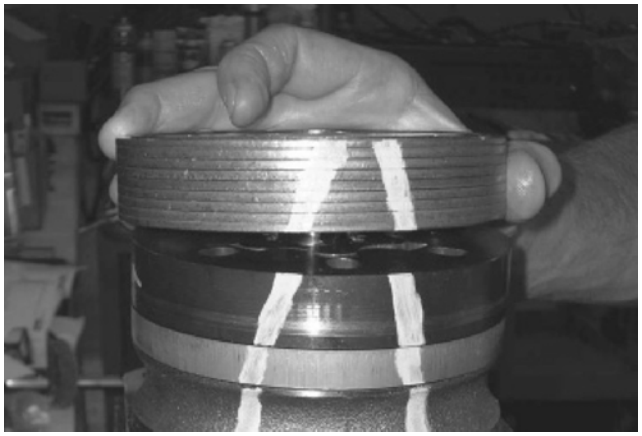
NOTE: *The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set seal ring groove faces toward the wear plate (9).*

14. Apply clean grease to a new seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7).

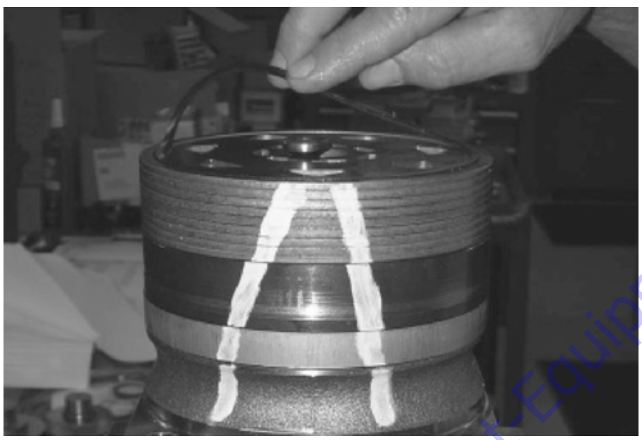


NOTE: *The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.*

15. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.

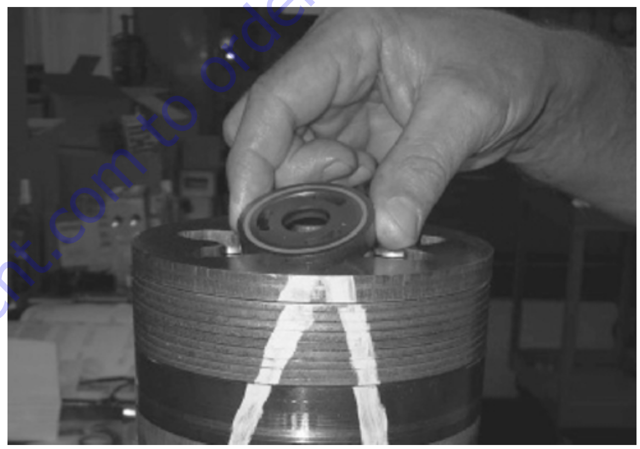


16. Apply grease to a new seal ring (4) and insert it in the seal ring groove exposed on the manifold.

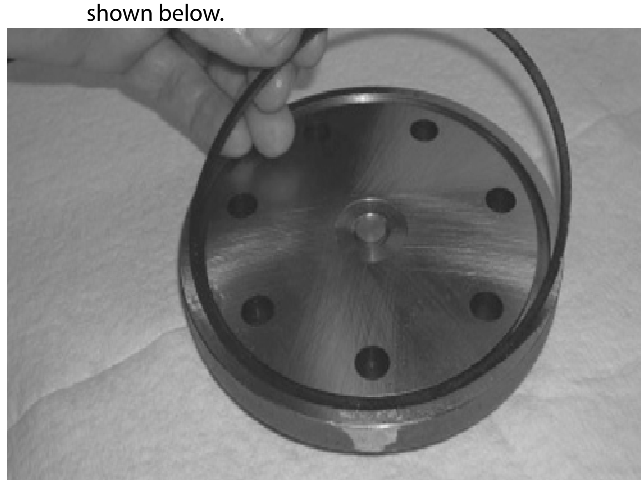


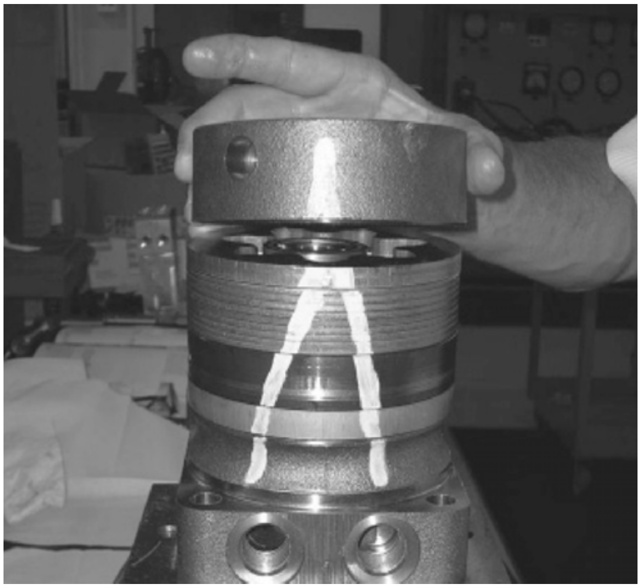
17. Assemble the commutator ring (6) over alignment studs onto the manifold.

18. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up.



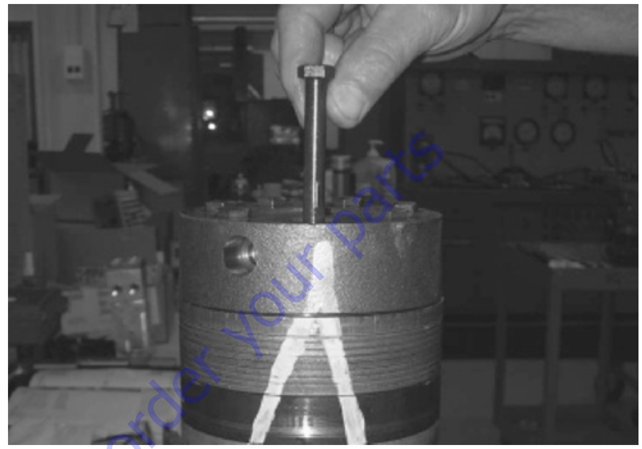
19. Assemble a new seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship to housing port bosses is shown below.

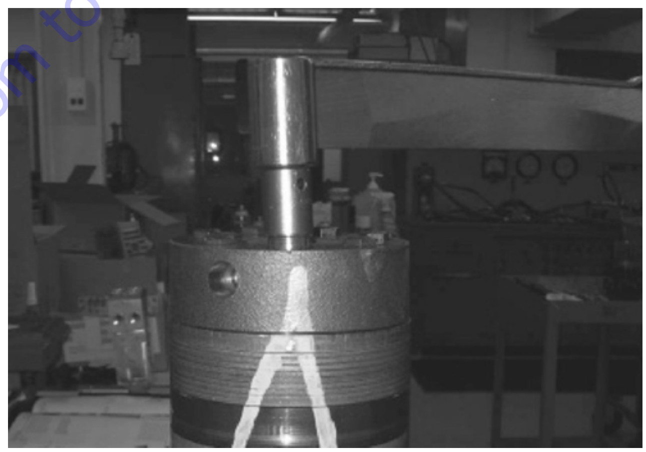


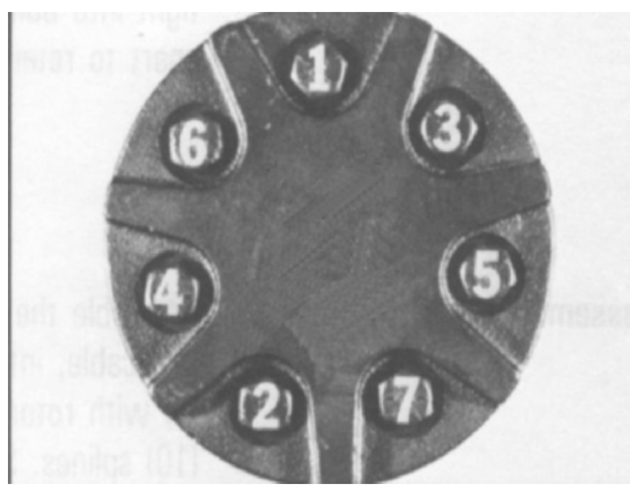


NOTE: *If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.*

20. Assemble the bolts (1) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 25-30 ft. lbs. (34-41 Nm).







One Piece Stator Construction

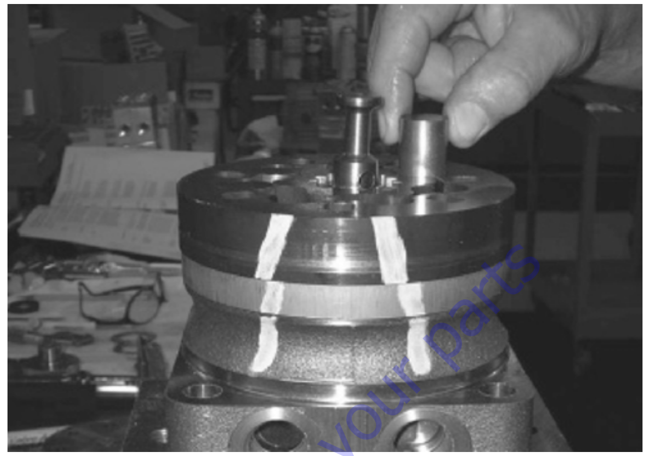
A disassembled rotor stator and vanes that cannot be readily assembled by hand can be assembled by the following procedures.

1. Place stator onto wear plate (9) with seal ring (4) side down, after following assembly procedures 1 through 13. Be sure the seal ring is in place.

2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate and housing bolt holes and turn two bolts (1) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

3. Assemble the rotor, counterbore down if applicable, into stator, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

4. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.



CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

6. Remove the two assembled bolts (1) if used to retain stator and wear plate.

Go to assembly procedure #15, to continue assembly.

Two Piece Stator Construction

A disassembled rotor set (8) that cannot be readily assembled by hand and has a two piece stator can be assembled by the following procedures.

1. Place stator half onto wear plate (9) with seal ring (4) side down, after following motor assembly procedures 1 through 13. Be sure the seal ring is in place.
2. Align stator bolt holes with wear plate and housing bolts and turn two alignment studs finger tight into bolt holes approximately 180 degrees apart to retain stator half and wear plate stationary.
3. Assemble rotor, counterbore down if applicable, into stator half, and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

NOTE: *Use any marking you applied to rotor set components to reassemble the components in their original relationship to ensure ultimate wear life and performance.*

4. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.

⚠ CAUTION

EXCESSIVE FORCE USED TO PUSH THE ROTOR VANES INTO PLACE COULD SHEAR OFF THE COATING APPLIED TO THE STATOR VANE POCKETS.

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator half, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.
6. Place second stator half on a fl at surface with seal ring groove up. Apply a small amount of grease to a new seal ring (4) and assemble it into stator half ring groove.
7. Assemble the second stator half over the two alignment studs and rotor with seal ring side down onto the first stator half aligning any timing marks applied for this purpose.

⚠ CAUTION

IF THE STATOR HALF (8B) IS A DIFFERENT HEIGHT (THICKNESS) THAN STATOR HALF (8D) THE STATOR VANES (8C) OR (8E)OF THE SAME LENGTH (HEIGHT) AS THE STATOR HALF MUST BE REASSEMBLED IN THEIR RESPECTIVE STATOR HALF FOR THE ROTOR SET TO FUNCTION PROPERLY.

8. Assemble six vanes, or as many vanes that will readily assemble into the stator vane pockets.
9. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes into stator, creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

   Go to assembly procedure #15, to continue assembly.

Final Checks

1. Pressurize the motor with 100 psi. dry air or nitrogen and submerge in solvent to check for external leaks.
2. Check motor for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 Nm).
3. Pressure port with “A” cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with “B” cast under it is for counterclockwise coupling shaft rotation.
4. Use test stand if available, to check operation of the motor.

Installation Torque

When installing the swing motor onto the swing drive, apply High Strength Threadlocking Compound to the threads of the retaining bolts and torque to 85 ft. lbs. (115 Nm).

3.9 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

NOTE: *This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with High Strength Threadlocking Compound. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.*

1. Check the frame to bearing. Attach bolts as follows:
   a. Elevate the fully retracted boom to 70 degrees (full elevation).
   b. At the positions indicated on Figure 3-27., Swing Bearing Tolerance Boom Placement try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   c. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
   d. Swing the turntable 90 degrees, and check some selected bolts at the new position.
   e. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.
2. Check the turntable to bearing. Attach bolts as follows:
   a. Elevate the fully retracted boom to 70 degrees (full elevation).
   b. At the positions indicated on Figure 3-26., Swing Bearing Feeler Gauge Check try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
   c. Lower the boom to horizontal and fully extend the boom.
   d. At the position indicated on Figure 3-26., Swing Bearing Feeler Gauge Check try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

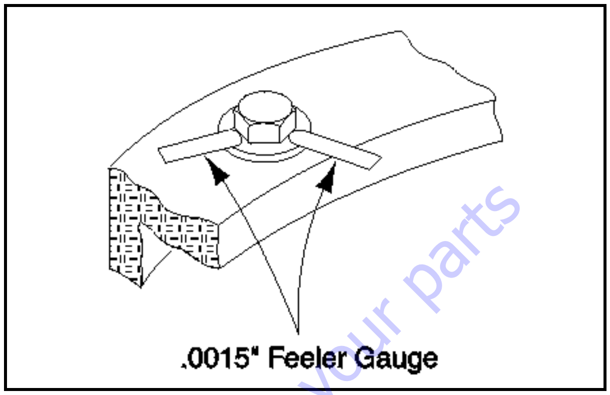


Figure 3-26. Swing Bearing Feeler Gauge Check

Wear Tolerance

1. With the boom positioned over the side of the machine, the Upper Boom horizontal with telescope fully extended and Tower Boom raised half way (approx 37°) (See Figure 3-27., Swing Bearing Tolerance Boom Placement), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. Figure 3-29., Swing Bearing Tolerance Measuring Point.

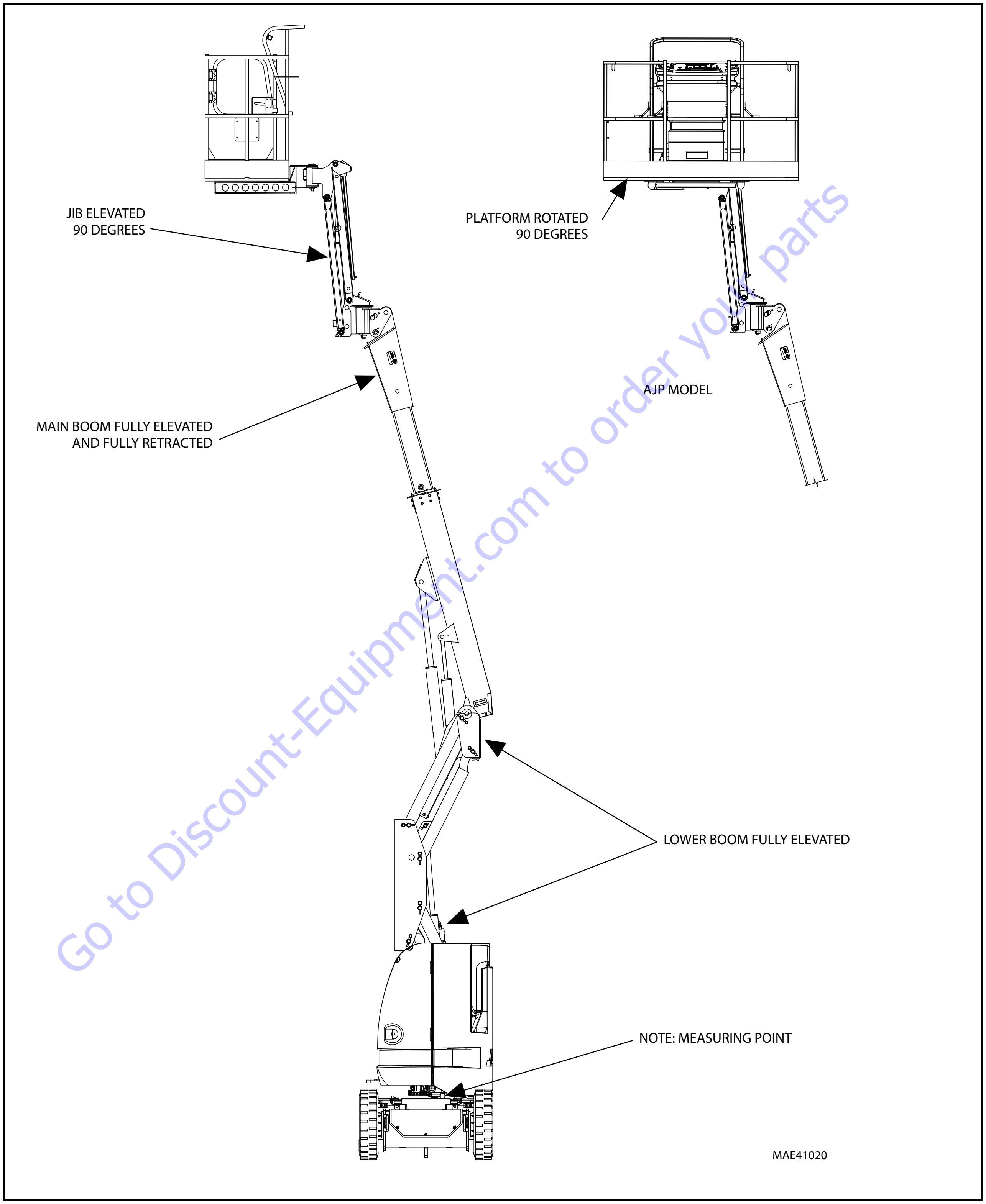


Figure 3-27. Swing Bearing Tolerance Boom Placement

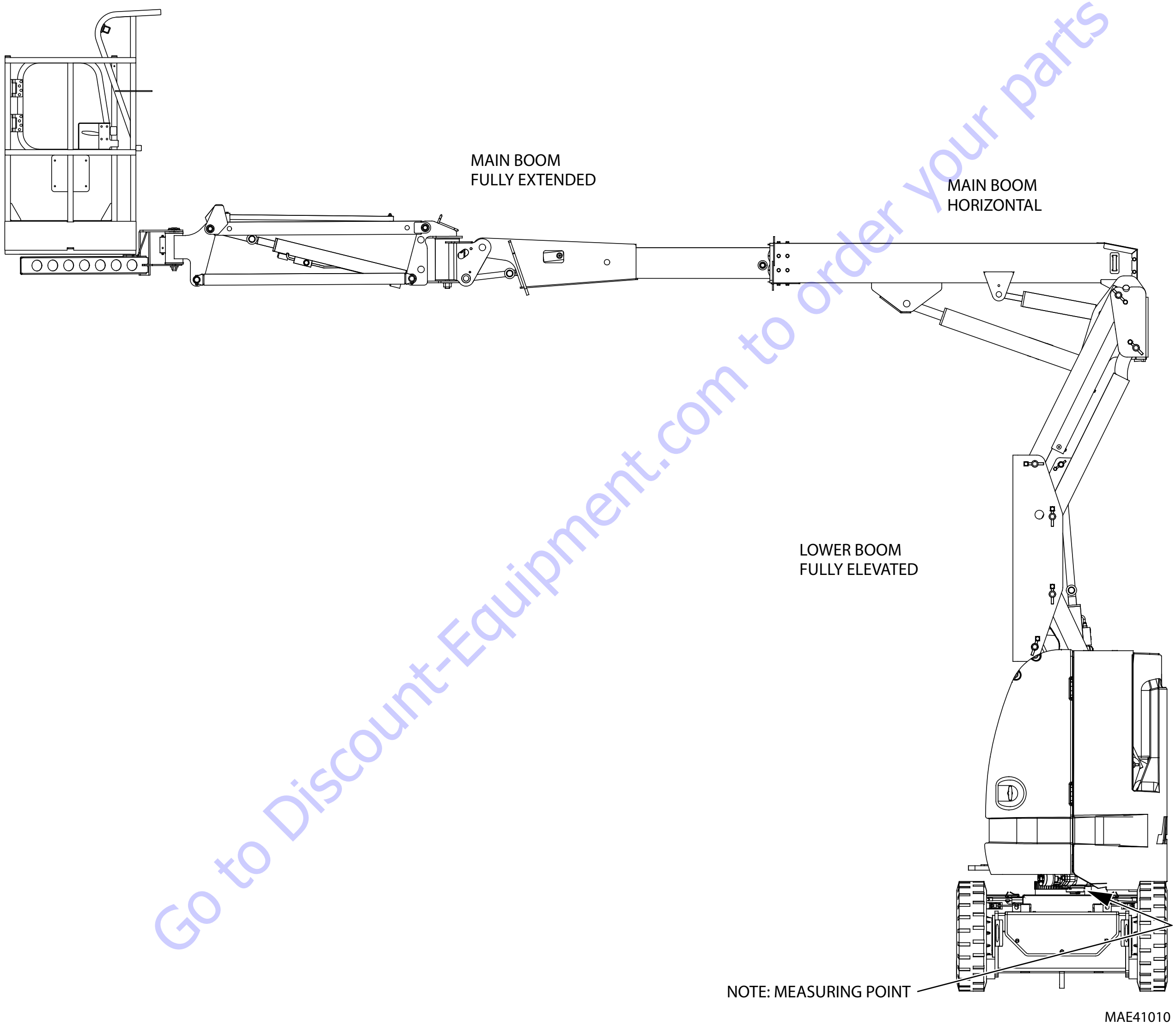


Figure 3-28. Swing Bearing Tolerance Boom Placement

2. At the same point, with the boom positioned over the side of the machine, the Upper Boom fully elevated and the Mid/Lower Boom fully elevated, Figure 3-27., Swing Bearing Tolerance Boom Placement using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable (See Figure 3-29., Swing Bearing Tolerance Measuring Point).

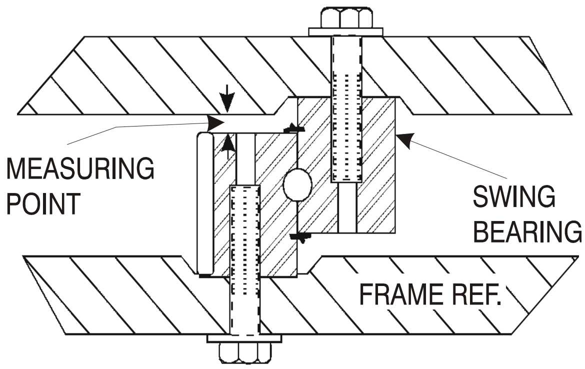


Figure 3-29. Swing Bearing Tolerance Measuring Point

3. If a difference greater than 0.057 in. (1.40 mm) is determined, the swing bearing should be replaced.

4. If a difference less than 0.057 in. (1.40 mm) is determined, and any of the following conditions exist, the bearing should be removed.

   a. Metal particles in the grease.
   b. Increased drive power.
   c. Noise.
   d. Rough rotation.

5. If bearing inspection shows no defects, reassemble bearing and return to service.

Replacement of Swing Bearing

1. Removal.

   a. Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.

   b. Tag and disconnect hydraulic lines running through center of turntable and frame. Use a suitable container to retain any residual hydraulic fluid. Cap lines and ports.

   c. Attach suitable overhead lifting equipment to the base of turntable weldment.

   d. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This will aid in aligning the bearing upon installation. Remove bolts, nuts and washers which attach the turntable to the bearing inner race. Discard nuts and bolts.

   e. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame mounted components.

   f. Carefully place the turntable on a suitably supported trestle.

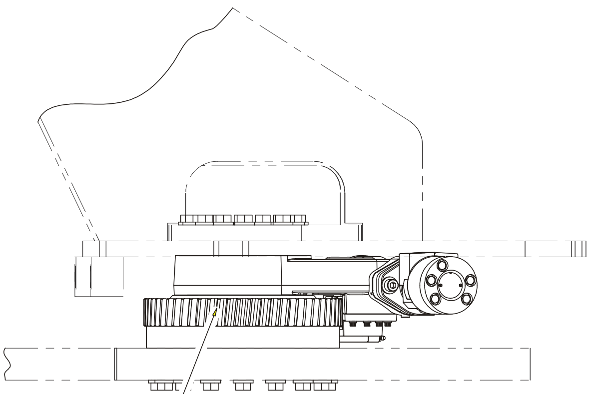
   g. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing and rotation box assembly from the frame; move to a clean, suitably supported work area.

   h. Remove the two capscrews securing the bearing to the rotation box to separate the two for inspection.

2. Installation.

   a. Install bearing to rotation box with two capscrews, so that fill plug of bearing is as close to gear as bolt pattern will allow. Do not tighten capscrews.

   b. Line up high spot (blue) of bearing with center tooth of worm gear. Set backlash to 0.008 - 0.010 inch (0.20 - 0.25 mm). Tighten capscrews as shown in Figure 3-30., Swing Bearing Torque Sequence.



   c. Apply Tribol Molub-Alloy 936 Open Gear Compound to bearing and worm gear teeth.

   d. Grease bearing with Mobilith SHC Bearing Grease. Grease fitting is on inside wall of inner race of bearing.‘

CAUTION

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED GRADE 8 BEARING NUTS AND BOLTS BE DISCARDED AND REPLACED WITH NEW NUTS AND BOLTS. SINCE THE SWING BEARING IS THE ONLY STRUCTURAL LINK BETWEEN THE FRAME AND TURNTABLE, IT IS IMPERATIVE THAT SUCH REPLACEMENT HARDWARE MEETS JLG SPECIFICATIONS. USE OF GENUINE JLG HARDWARE IS HIGHLY RECOMMENDED.

   e. Apply a light coating of High Strength Threadlocking Compound to the new bearing bolts and loosely install the bolts and washers through the frame and outer race of bearing.

NOTICE

IF COMPRESSED AIR OR ELECTRICALLY OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

   f. Following the torque sequence diagram shown in Figure 3-30., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 140 ft. lbs. (190 Nm). Then following the same sequence, tighten to a final torque of 190 ft. lbs. (260 Nm).

   g. Remove lifting equipment from bearing.

   h. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.

   i. Carefully lower the turntable onto the swing bearing. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable. If a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the turntable.

   j. Apply a light coating of High Strength Threadlocking Compound to the new bearing bolts and install through the turntable and inner race of bearing.

   k. Following the torque sequence shown in Figure 3-30., Swing Bearing Torque Sequence, tighten the bolts to an initial torque of 130 ft. lbs. (175 Nm). Then following the same sequence, tighten the bolts to 190 ft. lbs (260 Nm).

   l. Remove the lifting equipment.

   m. Route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.

   n. Using all applicable safety precautions, activate the hydraulic system and functionally check swing system for proper and safe operation.

Swing Bearing Torque Value

Install bolts with High Strength Threadlocking Compound - 190 ft. lbs. (260 Nm).

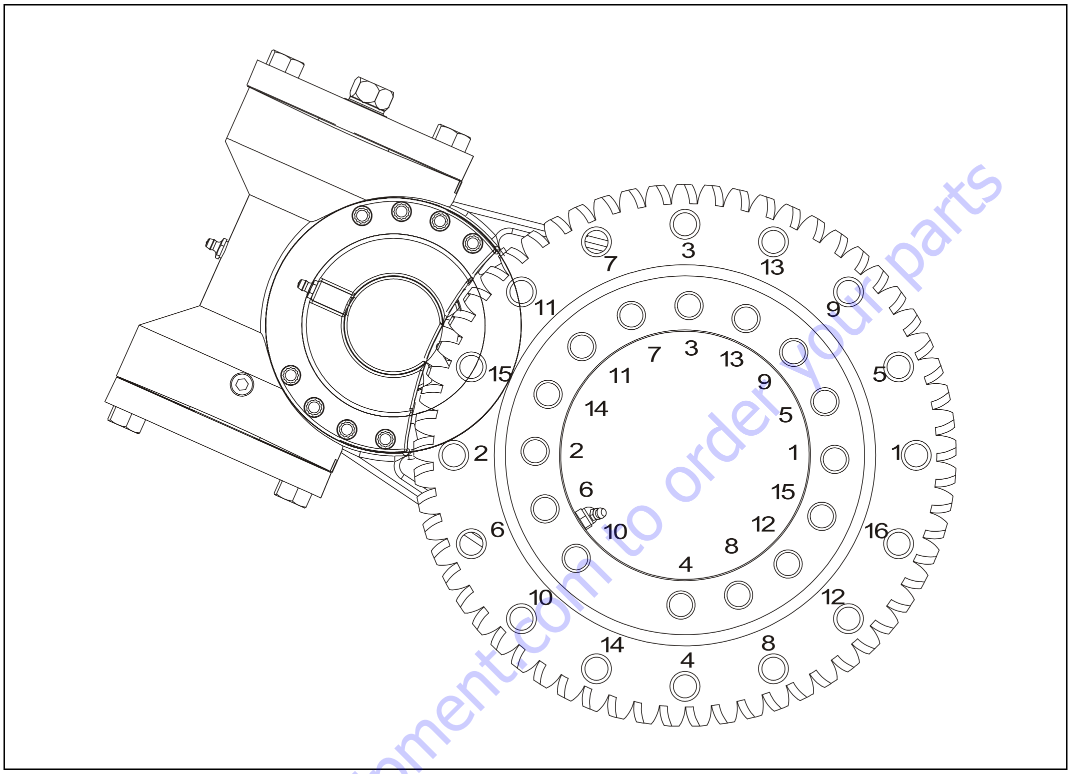


Figure 3-30. Swing Bearing Torque Sequence

3.10 BATTERY MAINTENANCE AND CHARGING

⚠ WARNING

TO AVOID INJURY FROM AN EXPLOSION, DO NOT SMOKE OR ALLOW SPARKS OR A FLAME NEAR BATTERY DURING SERVICING. ALWAYS WEAR EYE AND HAND PROTECTION WHEN SERVICING BATTERIES.

Battery Maintenance, Quarterly

1. Open battery compartment cover to allow access to battery terminals and vent caps.

⚠ CAUTION

WHEN ADDING WATER TO BATTERIES, ADD WATER UNTIL ELECTROLYTE COVERS PLATES. DO NOT CHARGE BATTERIES UNLESS ELECTROLYTE COVERS THE PLATES.

NOTE: *When adding distilled water to batteries, non-metallic containers and/or funnels must be used.*

To avoid electrolyte overflow, add distilled water to batteries after charging.

When adding water to the battery, fill only to level indicated or 3/8" (1cm) above separators.

2. Remove all vent caps and inspect electrolyte level of each cell. Electrolyte level should be to the ring approximately one inch from top of battery. Fill batteries with distilled water only. Replace and secure all vent caps.
3. Remove battery cables from each battery post one at a time, negative first. Clean cables with acid neutralizing solution (e.g. baking soda and water or ammonia) and wire brush. Replace cables and/or cable clamp bolts as required.
4. Clean battery post with wire brush then re-connect cable to post. Coat non-contact surfaces with mineral grease or petroleum jelly.
5. When all cables and terminal posts have been cleaned, ensure all cables are properly positioned and do not get pinched. Close battery compartment cover.
6. Start hydraulic system and ensure that it functions properly.

Battery Charging, Daily

NOTE: *To avoid excessive battery charging time, do not allow batteries to become completely discharged.*

NOTE: *To avoid electrolyte overflow, add distilled water to batteries after charging.*

NOTE: *When adding water to the battery, fill only to level indicated or 3/8" above separators.*

7. Charge batteries at the end of each work day, or when machine performance is significantly reduced due to batteries becoming discharged.
8. Charge batteries in accordance with the following procedure:

   a. Open battery compartment, and battery charger compartment covers.

⚠ WARNING

WHEN BATTERY CHARGER IS TO BE USED, CHARGING HARNESS MUST BE PLUGGED INTO A GROUNDED RECEPTACLE. IF RECEPTACLE IS NOT GROUNDED AND A MALFUNCTION SHOULD OCCUR, THE MACHINE COULD CAUSE SERIOUS ELECTRICAL SHOCK.

   b. Remove charging harness cable and connect to a receptacle or the correct voltage.

   c. Allow batteries to charge until 100% LED is illuminated.

NOTE: *When batteries are completely charged, disconnect charging harness cable from receptacle. Store charging harness cable.*

   d. Ensure battery cables are positioned and are not pinched. Close and secure all compartment doors.

3.11 BATTERY CHARGER

The battery charger utilizes a microprocessor to monitor battery condition and determine when to automatically start and stop charging. The 3-LED panel will light in sequence upon start up to indicate self-diagnostics, then display the proper battery level upon start of charging. It has failsafe protection to terminate charging if abnormal battery conditions exist and an abnormal light will light up. The charger restarts automatically if there is interruption of AC power. The charger will automatically sense AC input and operates within the range of 120 - 230 VAC, nominal. The charger is UL recognized. The charger will operate at either 50 or 60 Hz frequency. A drive interlock prevents driving while the battery charger is in operation.

NOTICE

JLG MACHINES EQUIPPED WITH DELTA Q BATTERY CHARGERS ARE DESIGNED FOR THE BEST PERFORMANCE WITH OEM FACTORY APPROVED BATTERIES.

APPROVED JLG REPLACEMENT BATTERIES ARE AVAILABLE THROUGH JLG'S AFTERMARKET PARTS DISTRIBUTION CENTERS OR JLG'S AFTERMARKET PROGRAMS. FOR ASSISTANCE WITH PROPER BATTERY REPLACEMENT, PLEASE CONTACT YOUR LOCAL JLG SUPPORT OFFICE.

BATTERIES APPROVED BY JLG HAVE BEEN TESTED FOR COMPATIBILITY WITH THE ALGORITHM PROGRAMMING OF THE DELTA Q BATTERY CHARGER TO OPTIMIZE BATTERY LIFE AND MACHINE C YCLE TIMES. THE USE OF NON APPROVED BATTERIES IN YOUR JLG EQUIPMENT MAY RESULT IN PERFORMANCE ISSUES OR BATTERY CHARGER FAULT CODES. JLG ASSUMES NO RESPONSIBILITY FOR SERVICE OR PERFORMANCE ISSUES ARISING FROM THE USE OF NON APPROVED BATTERIES.

⚠ WARNING

LEAD ACID BATTERIES MAY GENERATE EXPLOSIVE HYDROGEN GAS DURING NORMAL OPERATION. KEEP SPARKS, FLAMES, AND SMOKING MATERIALS AWAY FROM BATTERIES. PROVIDE ADEQUATE VENTILATION DURING CHARGING. NEVER CHARGE A FROZEN BATTERY. STUDY ALL BATTERY MANUFACTURERS' SPECIFIC PRECAUTIONS SUCH AS RECOMMENDED RATES OF CHARGE AND REMOVING OR NOT REMOVING CELL CAPS WHILE CHARGING.

⚠ WARNING

RISK OF ELECTRIC SHOCK. CONNECT CHARGER POWER CORD TO AN OUTLET THAT HAS BEEN PROPERLY INSTALLED AND GROUNDED IN ACCORDANCE WITH ALL LOCAL CODES AND ORDINANCES. A GROUNDED OUTLET IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK - DO NOT USE GROUND ADAPTERS OR MODIFY PLUG. DO NOT TOUCH UNINSULATED PORTION OF OUTPUT CONNECTOR OR UNINSULATED BATTERY TERMINAL. DISCONNECT THE AC SUPPLY BEFORE MAKING OR BREAKING THE CONNECTIONS TO THE BATTERY WHILE CHARGING. DO NOT OPEN OR DISASSEMBLE CHARGER. DO NOT OPERATE CHARGER IF THE AC SUPPLY CORD IS DAMAGED OR IF THE CHARGER HAS RECEIVED A SHARP BLOW, BEEN DROPPED, OR OTHERWISE DAMAGED IN ANY WAY - REFER ALL REPAIR WORK TO QUALIFIED PERSONNEL. NOT FOR USE BY CHILDREN.

Operating Instructions

NOTICE

ALWAYS USE A GROUNDED OUTLET. WHEN USING AN EXTENSION CORD, AVOID EXCESSIVE VOLTAGE DROPS BY USING A GROUNDED 3-WIRE 12 AWG CORD.

1. The charger will automatically turn on and go through a short self-test. All LED's will flash in an up-down sequence for two seconds. The yellow "Charging" LED will turn on and a trickle current will be applied until a minimum voltage is reached.
2. Once a minimum battery voltage of 2 volts per cell is detected, the charger will enter the constant-current charging stage and the yellow LED will remain on. The length of charge time will vary by input voltage and ambient temperature.
3. When the green "Charged" LED turns on, the batteries are completely charged. The charger may now be unplugged from AC power. If left plugged in, the charger will automatically restart a complete charge cycle if battery voltage drops below a minimum voltage or 30 days have elapsed.
4. If a fault occurred during charging, the red "Fault" LED will flash with a code corresponding to the error.

Maintenance Instructions

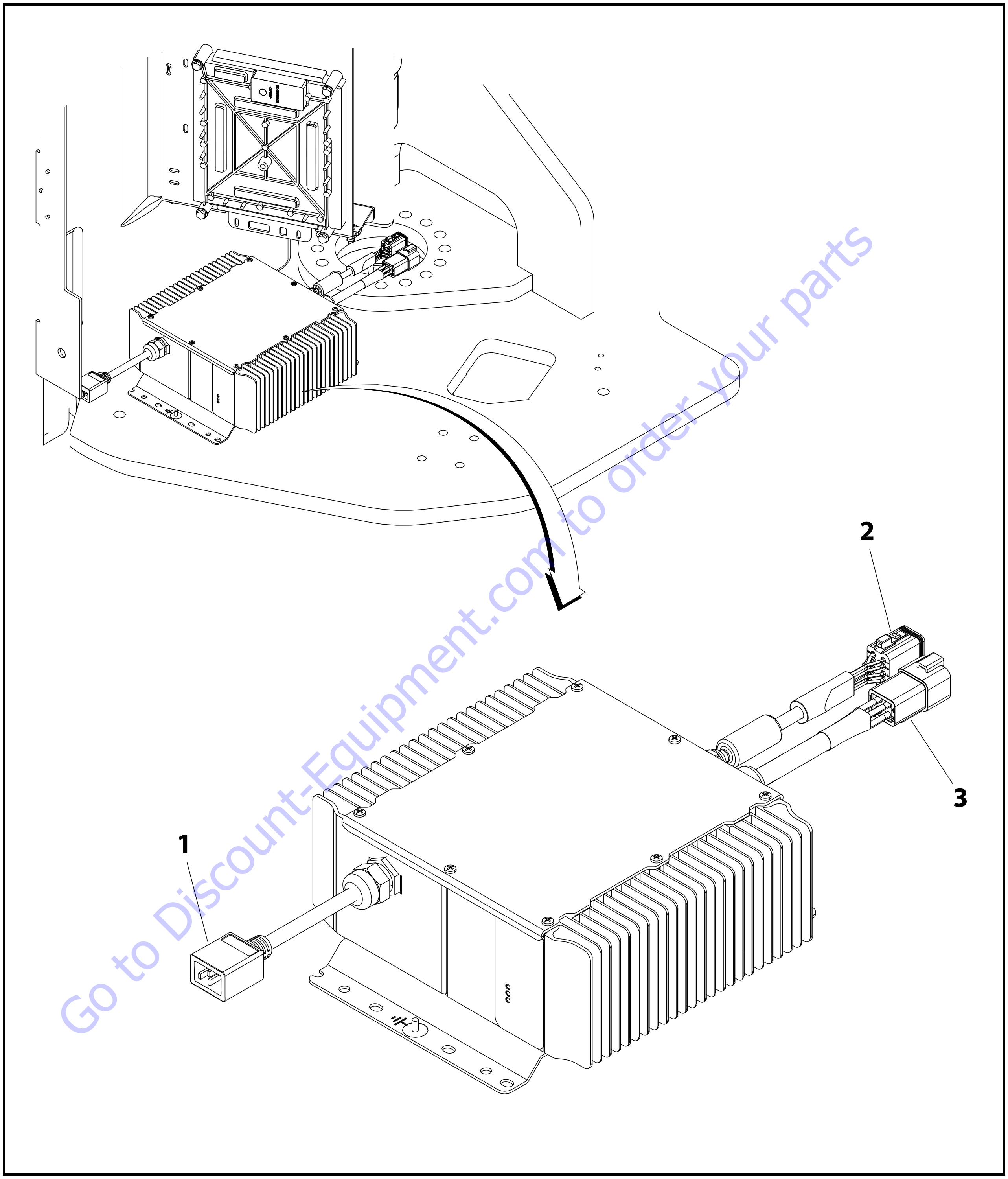
1. For flooded lead-acid batteries, regularly check water levels of each battery cell after charging and add distilled water as required to level specified by battery manufacturer. Follow the safety instructions recommended by the battery manufacturer.
2. Make sure charger connections to battery terminals are tight and clean.
3. Do not expose charger to oil or to direct heavy water spraying when cleaning vehicle.

Battery Charger Fault Codes

If a fault occurred during charging, the red "Fault" LED will flash with a code corresponding to the error. Refer to the table following for the flash codes and their removal.

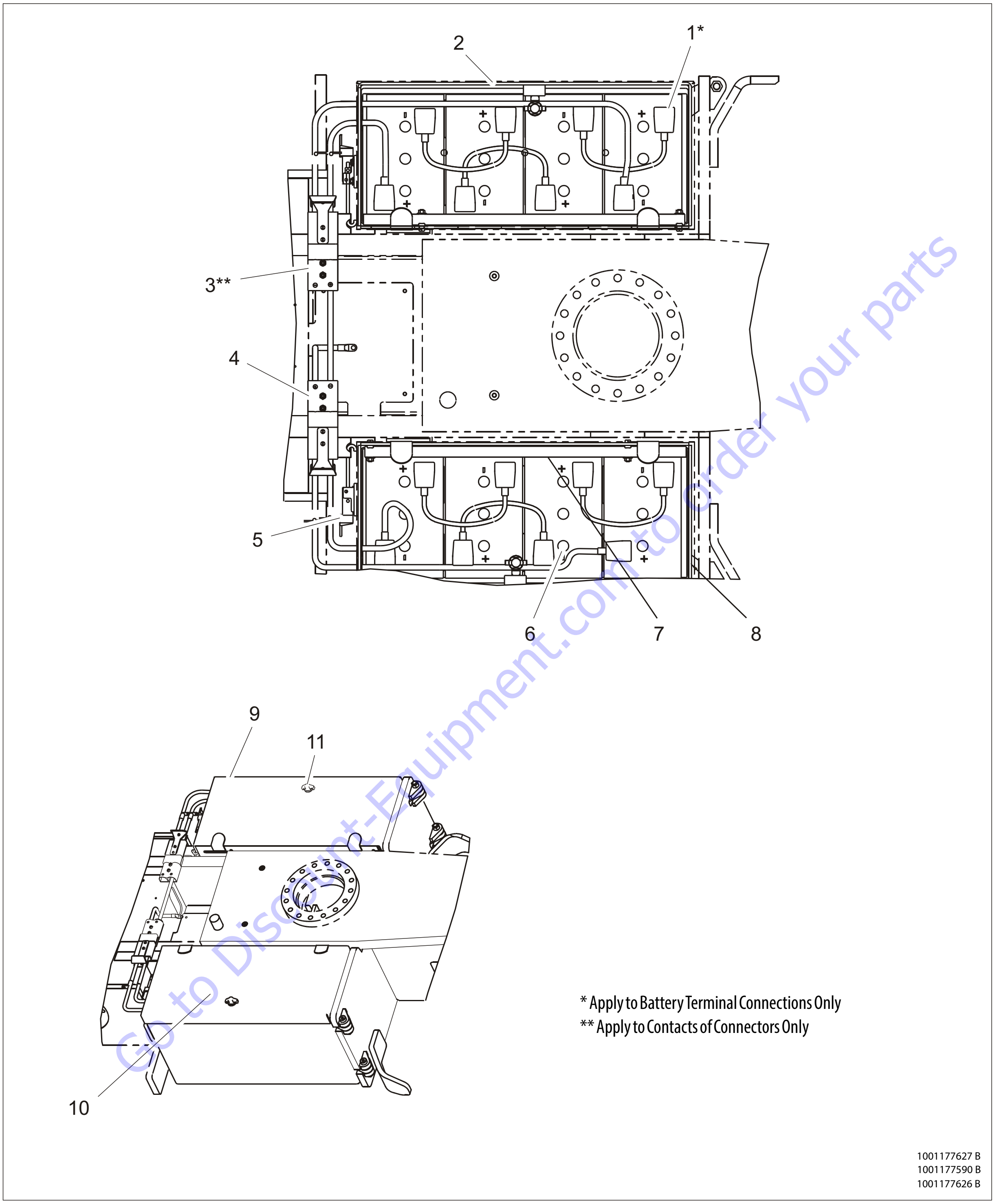
Table 3-3. Battery Charger Fault Codes (Delta-Q)

Flash(s)	Fault	Fault Removal
1	Battery voltage high	Auto-recover - Indicates a high battery pack voltage
2	Battery voltage low	Auto-recover - Indicates either a battery pack failure, battery pack not connected to charger or battery volts per cell is less than 0.5 VDC. Check the battery pack and connections
3	Charge time-out	Indicates the batteries did not charge in the allowed time. This could occur if the batteries are a larger capacity than the algorithm is intended for or if the batteries are damaged old or in poor condition.
4	Check battery	Indicates the batteries could not be trickle charged up to the minimum voltage per cell level required for the charge to be started.
5	Over-temperature	Auto-recover - indicates charger has shut down due to high internal temperature
6	QuiQ fault	Indicates that the battery will not accept charge current, or an internal fault has been detected in the charger. This fault will nearly always be set within the first 30 seconds of operation. Once it has been determined that the batteries and connections are not faulty and fault 6 is again displayed after interrupting AC power for at least 10 seconds, the charger must be brought to a qualified service depot.



1. AC Voltage - Input Cable
2. Battery Charge Signal Cable
3. DC Power Cable to Batteries

Figure 3-31. Battery Charger



1. Battery Terminal Grease
2. Left Battery Box
3. Dielectric Grease
4. Battery Connector
5. Draw Latch
6. Battery
7. Battery Hold Down
8. Right Battery Box
9. Left Cover
10. Right Cover
11. Latch

Figure 3-32. Battery Boxes

NO LIGHTS AT ALL

No Lights at all indicate that AC power to the charger is not connected or that the AC voltage is too low. It could also indicate an internal failure in the charger.

1. Check the connections to AC power. Check for AC voltage between 90 and 260 VAC at the charger.
2. If the AC voltage is verified to be correct at the connection to the charger, and the charger still displays no lights at all, return the charger for service.

FAULT LED FLASHING

The Fault LED flashes to indicate the microcontroller inside the battery charger has detected a fault. The fault detected is indicated by the number of flashes. Count the number of flashes to determine the fault.

With any battery system, the most common problem will be a faulty battery connection. Because of the high likelihood of a battery connection problem, it is always worthwhile to confirm that all connections are good before checking for any other problems.

[1 Flash] - High Battery Voltage

1. Indicates a high battery voltage. Check that the battery charger voltage is consistent with the battery pack voltage. The first two digits of the four digit model name indicate the battery voltage the charger supports.
2. Check for wiring errors.
3. This fault will automatically clear and the charger will restart charging when this problem is removed.
4. High battery voltage could also occur if there is another source charging the battery. Disconnect any other sources during charging.
5. If this problem does not clear after the battery voltage is confirmed to be less than 2.5V per cell, return the charger for service.

[2 Flashes] - Low Battery Voltage

1. Indicates either a battery failure, no battery connected, or a lower than expected battery voltage. check the battery and battery connections.
2. Check the nominal battery voltage. The first two digits of the four digit model name indicate the battery voltage the charger supports. Confirm that a nominal battery voltage is the same as the charger voltage.
3. This fault will clear automatically when the low battery voltage problem is rectified.
4. If this problem does not clear after the battery voltage is confirmed to be higher than 1.0V per cell and all connections are good, return the charger for service.

[3 Flashes] - Charge Timeout

Indicates the battery failed to charge within the allowed time. This could occur if the battery is of larger capacity than the algorithm is intended for. In unusual cases it could mean charger output is reduced due to high ambient temperature. It can also occur if the battery is damaged, old, or in poor condition.

1. Check the battery for damage such as shorted cells and insufficient water. Try the charger on a good battery.
2. If the same fault occurs on a good battery, check the connections on the battery and connection to AC, and the AC voltage itself.
3. Confirm that the nominal battery pack voltage is the same as the battery charger voltage.
4. This fault must be cleared manually by unplugging the AC, waiting 30 seconds and reconnecting the AC power.
5. If a charger displays this fault on a battery pack, and the pack is of questionable status, reset the charger by disconnecting AC for 30 seconds, and then reconnect the AC to start a new charge cycle. After a few charge cycles, this problem could stop occurring as the pack "recovers."

[4 Flashes] - Check Battery

This fault indicates the battery pack could not be trickle charged up to the minimum level required for the normal charge cycle to be started.

1. Check that none of the battery pack connections between modules are reversed or incorrectly connected.
2. Check that one or more cells in the battery are no shorted.
3. Confirm that the nominal battery pack voltage is the same as the battery charger voltage.
4. Try the charger on a good battery.
5. If this fault occurs, the battery is likely in poor condition. Try to recover the pack with a charger that can charge the individual cells - such as an automotive charger. Be sure to set this charger to the appropriate voltage - 6V per 6V battery, 12V per 12V string/battery.

[5 Flashes] - Over Temperature

This fault indicates the charger has become too hot during operation. Though not damanging to the charger, charge time will be extended significantly.

1. This fault indication will not clear automatically, but the charger will restart charging automatically when the temperature drops. The fault indicaiton must be cleared manually by unplugging the AC, waiting 30 seconds and reconnecting the AC power.
2. If possible, move the machine to a cooler location.
3. Confirm that dirt or mud is not blocking the cooling fins of the charger. Clean the charger. Rinse the charger with a low pressure hose if required. Do no use high pressure. Do not us a pressure washer.

[6 Flashes] - Over Load/Over Temperature

This fault indicates that the batteries will not accept charge current, or an internal fault has been detected in the charger. This fault will nearly always be set within the first 30 seconds of operation. If it occurs after the charger has started charging normally, be sure to make a note of it.

1. Remove excessive AC loads from inverter if installed.
2. Try to clear the fault by unplugging the AC, waiting 30 seconds and reconnecting the ac power.
3. Check all battery connections. Look for a high resistance connection.The most likely reason for this fault is a fault in the battery such as a bad battery connection, an open cell, or insufficient water.
4. This fault will occur if an internal fuse inside the charger blows. If the green wire is shorted to ground even momentarily, this fuse will blow. To check the fuse, measure with an ohmmeter between the green and red wires with the AC disconnected. If a short circuit is not measured, the fuse has blown. Return unit to a service depot to have this fuse replaced.
5. If this fault occurs after battery charging has started, confirm that AC power was not interrupted and that all battery connections are good.
6. If all battery connections are good, an internal fault has been detected and the charger must be brought to a qualified service depot.

Excessive Battery Watering Requirements or Strong Sulphur (Rotten Egg) Smell

These symptoms indicate over-charging or high battery temperature. These symptoms are unlikely to be caused by too high a charge current since the maximum charge current of the charger will be small compared to even a moderately sized battery pack. The most likely cause for this problem is incorrect charge algorithm setting and/or high ambient temperatures.

1. Confirm that the battery pack is not too small - usually > 50Ah.
2. Confirm that the nominal battery voltage matches the charger output voltage.
3. Confirm the correct battery charge algorithm. If the battery pack is new, the algorithm will need to be changed if the pack is not the same as the old one. for instructions on how to determine and change the battery charge algorithm see the following sub-section.
4. If the output voltage of the charger seems excessive, return the charger for service. Contact JLG to get the expected battery voltage settings for the charger in question. Be sure to have the charger's serial number and charge algorithm setting available when calling.

Instructions for using the Delta-Q QuiQ Programmer CTQuiQ Programming Kit

CONTENTS OF THE QUIQ PROGRAMMING KIT (JLG PART NUMBER: 2915230)

- QuiQ USB Interface Module
- QuiQ Programmer CT Installation CD
- USB Cable
- Wire Assembly
- QuiQ Programmer CT Instructions

Figure 3-33. QuiQ Programming Kit

With QuiQ Programmer CT you can:

- Add a battery charge algorithm
- Select a different algorithm for battery charging
- Delete a battery charge algorithm
- Upgrade the software in your QuiQ or QuiQ-dci charger
- View charge tracking data from charger
- Upload Charge Events to Delta-Q's Online Charge Event Database

INSTALLING QUIQ PROGRAMMER CT SOFTWARE AND DRIVERS

You will find the QuiQ Programmer CT application on the QuiQ Programmer CT installation CD. QuiQ Programmer CT requires a PC with a minimum of 512 MB of RAM, running 32-bit or 64-bit edition of Windows XP, Vista, or 7.

To install QuiQ Programmer CT Insert the QuiQ Programmer Installation CT CD into the CD or DVD drive of your PC (label must be facing up). If the setup application does not launch the QuiQ Programmer CT installer automatically (this will depend on your computer's security settings and configuration), click the Start button (or icon) on the taskbar; click My Computer; double click the drive labeled QuiQ Programmer CT; double click Setup.exe to launch the installer. You may also use Windows Explorer to navigate to Setup.exe. Then follow the instructions on your screen to complete the software installation.

NOTE: *If your computer is running Windows XP Professional 64-bit, you must install x64 .NET Framework 2.0 before installing QuiQ Programmer CT. You will find x64 .NET Framework 2.0 on the CD in the subfolder Net64Fx.Double click Net64Fx.exe to start installing the software.*

Checking/Changing the Battery Charger Algorithm

The charger is pre-loaded with programming algorithms for the specific batteries detailed in Table 3-4, Battery Algorithms.

NOTE: *Contact JLG if your specific battery model is not listed.*

Each time AC power is applied with the battery pack not connected, the charger enters an algorithm select/display mode for approximately 11 seconds. During this time, the current Algorithm # is indicated on the Yellow Charging LED. A single digit Algorithm # is indicated by the number of blinks separated by a pause. A two digit Algorithm # is indicated by the number of blinks for the first digit followed by a short pause, then the number of blinks for the second digit followed by a longer pause.

To check / change the charging algorithm:

1. Disconnect the charger positive connector from the battery pack. Apply AC power and after the LED test, the Algorithm # will display for 11 seconds.
2. To change the algorithm, touch the connector to the battery's positive terminal for 3 seconds during the 11 second display period and then remove. The Algorithm # will advance after 3 seconds. Repeat this procedure until the desired Algorithm # is displayed. A 30 second timeout is extended for every increment. Incrementing beyond the last Algorithm will recycle back to the first Algorithm. When the desired Algorithm is displayed, touch the charger connector to the battery positive terminal until the output relay makes a clicking noise (approx. 10 seconds). The algorithm is now in the permanent memory.
3. Remove the AC power from the charger and reconnect the charger's positive connector to the battery. It is recommended to check a newly changed algorithm by repeating the above steps 1 and 3.

Table 3-4. Battery Algorithms

Algorithm #	JLG PN	Battery Type	Proper Algorithm Setting
173	1001105091	US BATT 6V-305-S	73
173	0400055	US BATT L16	173
173	1001114782	DISCOVER EV 305A-A	43

3.12 CHASSIS TILT INDICATOR SYSTEM

The Chassis Tilt Indicator System measures the turntable angle with respect to level ground. The external tilt sensor is mounted in the chassis. The tilt sensors have six settings: 3.0° omni directional tilt, 4.0° omni directional tilt, and 5.0° omni directional tilt.

The 3.0° + DRV CUT setting is used for the purpose of warning the operator by means of the chassis tilt light in the platform display panel. Additionally, when used in conjunction with the Transport Position Interlock System or the Above Elevation Cutout System, the tilt sensor will cause an alarm to sound and automatically disable tele out, lift up, steer, and drive function in the current direction of operation. All other functions are placed in the creep speed mode, including drive in the opposite direction.

The 4.0° or 5.0° + DRV CUT setting is used for the purpose of warning the operator by means of the chassis tilt light in the platform display panel. Additionally, when used in conjunction with the Transport Position Interlock System or the Above Elevation Cutout System, the tilt sensor will cause an alarm to sound and automatically suspend all functions. When controls are reselected, tele out, lift up, steer, and drive functions will be disabled. All other functions are placed in the creep speed mode, including drive in the opposite direction.

The 3.0°, 4.0°, or 5.0° + CUT setting is used for the purpose of warning the operator by means of the chassis tilt light in the platform display panel. Additionally, when used in conjunction with the Transport Position Interlock System or the Above Elevation Cutout System, the tilt sensor will cause an alarm to sound and automatically suspend all functions. When controls are reselected, tele out, lift up, steer, and drive functions will be disabled. All other functions are placed in the creep speed mode.

The operator is responsible to prevent the machine from attaining an unstable position.

In order to maintain consistent speed, tilt angle and direction of travel on grade are used to adjust commanded speed. At 8° down slope, drive command is 10% of MAX. Travel up slope is not reduced. The control system responds to indicated angle readings 0.3 degree smaller than the required angles to account for calibration and sensor variation.

3.13 DRIVE ORIENTATION SYSTEM

The Drive Orientation System (DOS) is intended to indicate to the operator conditions that could make the direction of movement of the chassis different than the direction of movement of the drive/steer control handle. The system indicates to the operator the need to match the black and white directional arrows on the platform control panel to the arrows on the chassis. The system uses a proximity switch mounted under the turntable, a "target" mounted to the frame, an indicator light and an override switch on the platform display panel. The proximity switch trips when the turntable is swung +/- 28 degrees off center of the normal driving position. This occurs roughly when the boom is swung past a rear tire. When the turntable is in the normal drive position with the boom between the rear tires, no indications or interlocks are made.

When the machine is actively driving when the turntable is swung past the switch point, the system is ignored until drive/steer is released. When drive is initiated with the boom swung past the switch point, the DOS indicator will flash and the drive/steer functions will be disabled. The operator must engage the DOS override switch to enable Drive/steer (high drive will remain disabled). When the DOS is enabled, the DOS indicator will be illuminated continuously and a 3-second enable timer will be started and will continue for 3 seconds after the end the last drive/steer command. If the timer expires, the DOS override switch must be re-engaged to enable drive/steer.

3.14 HOODS

The right hood weighs 15 lb (6.8 kg) and the left hood weighs 10.3 lb (4.7 kg). See Figure 3-34., Hoods.

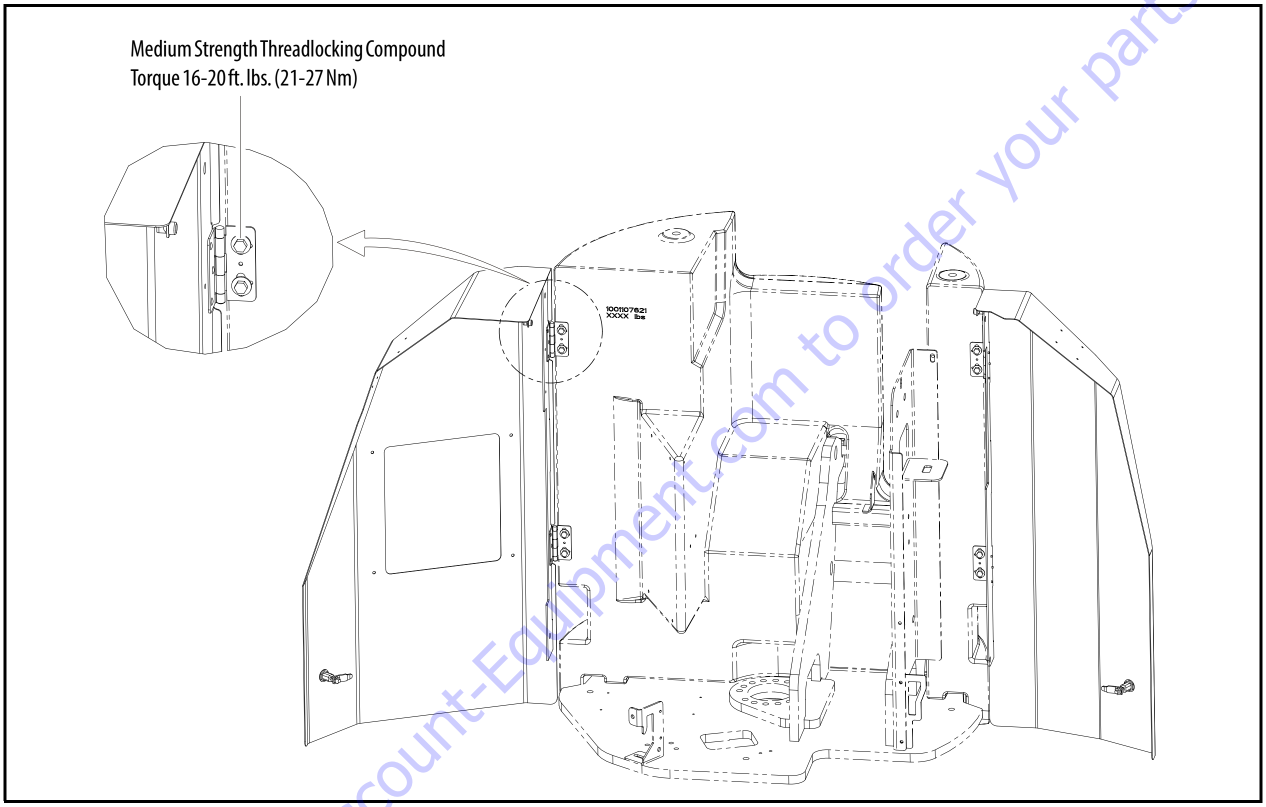


Figure 3-34. Hoods

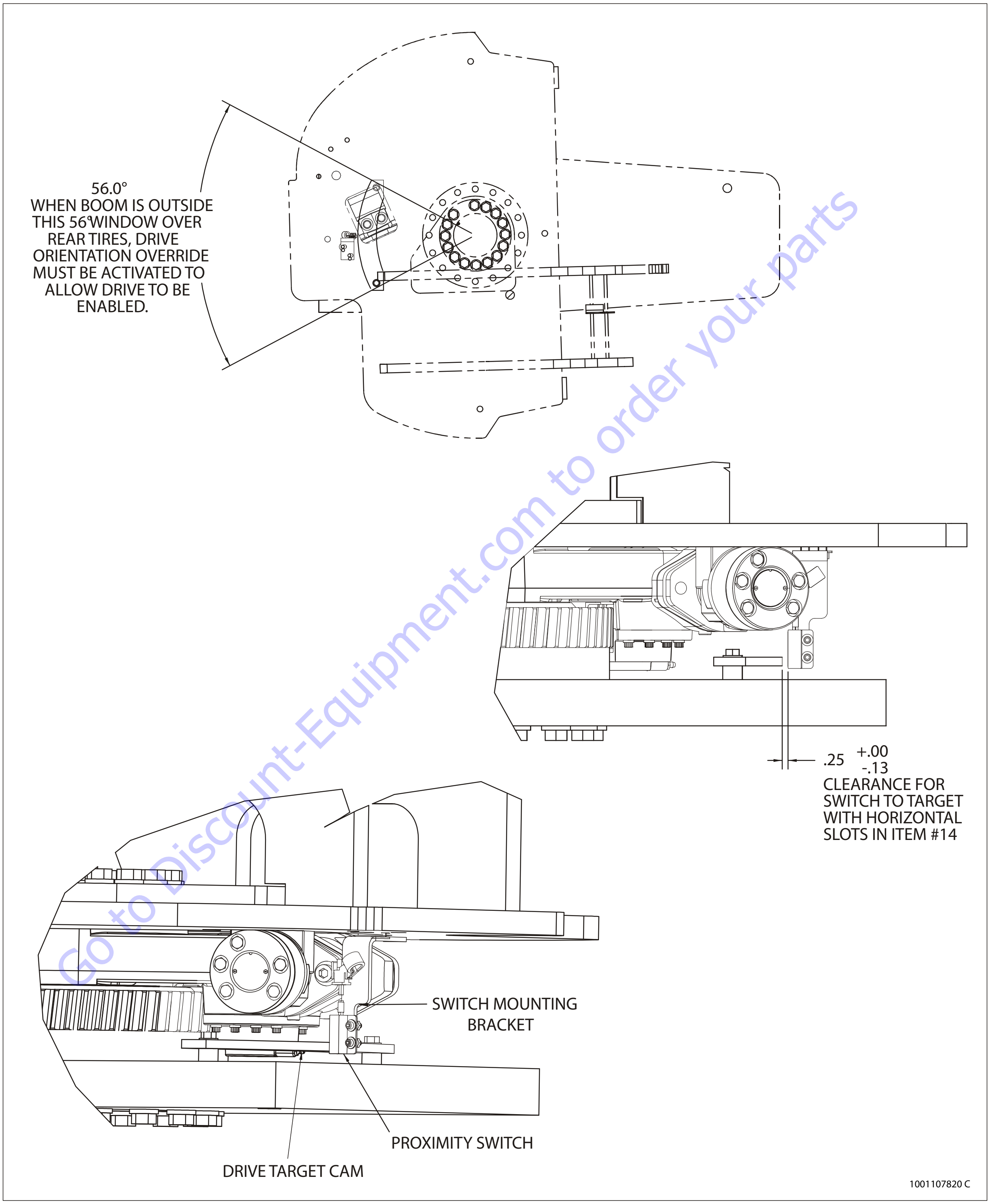


Figure 3-35. Drive Orientation Switch

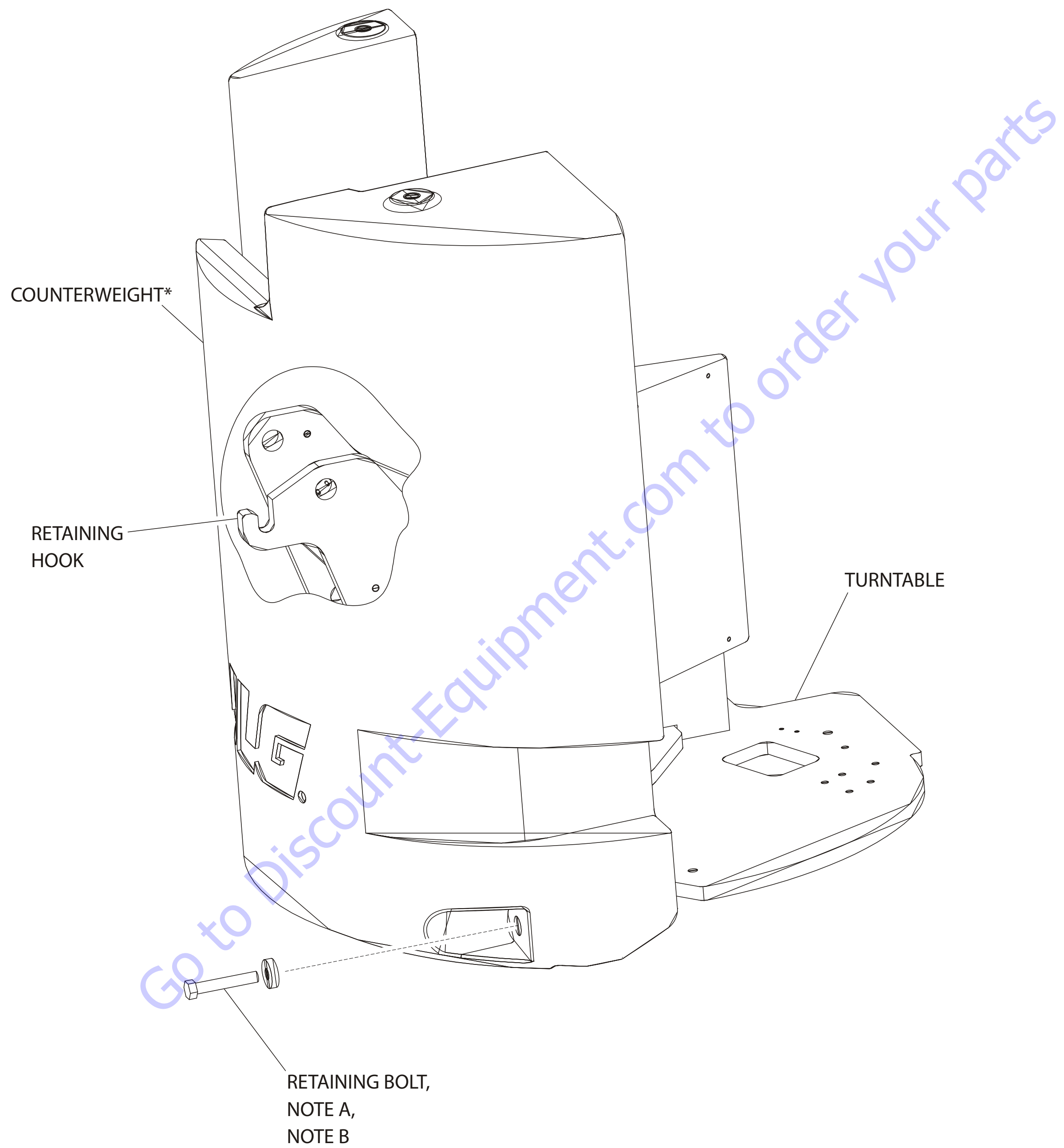


Figure 3-36. Counterweight

SECTION 4. BOOM & PLATFORM

4.1 PLATFORM CONTROL ENABLE SYSTEM

The platform controls make use of a time dependent enable circuit to limit the time availability of "live" or enabled controls. To operate any directional function, the footswitch must be depressed before activation of the function. When the footswitch is depressed, the controls are enabled and the operator has 7 seconds to operate any function. The controls will remain enabled as long as the operator continues to use any function and will remain enabled 7 seconds after the last function has been used. While the controls are "live", the enabled light will be illuminated in the platform display panel. When the time limit has been reached, the enabled light will turn off and the controls will be "dead" or disabled. To continue use of the machine the controls must be re-enabled to start the timer system over again. This is done by releasing all functions, then releasing and re-depressing the footswitch.

4.2 FUNCTION SPEED CONTROL SYSTEM

The function speed for the platform rotate, jib swing, jib lift, tower lift, and main telescope functions are controlled through a common variable speed control knob. This knob acts as an input to the control system allowing a smooth ramp up and controlled maximum output speed. Setting of ramp down is provided through the adjustable controller settings. The range of speeds for functions and ramp down are controlled through controller settings. Each function has its own personality settings allowing the characteristics of each function to be modified using the standard analyzer. Not all functions will respond the same to the changes in the function speed knob position.

4.3 TRANSPORT POSITION INTERLOCK SYSTEM

The transport position interlock system uses the "above elevation cutout system" switches to sense when the boom is out of the transport position. The main boom telescope can be in any position. The articulated jib may be in any position. Controls are simultaneously functional when the booms are within the transport position as on the standard machine. When the booms are outside of the transport position, the control functions are interlocked to prevent simultaneous operation of any boom function with drive/steer. The first function set to be operated in this mode, becomes the master function set. In other words, while operating drive/steer functions the boom functions are inoperable. Likewise, while operating boom functions drive/steer functions are inoperable. In addition to being an interlock, this system also disallows high speed operation while the booms are beyond the transport position. While in this position, the machine will respond in the same way as described in the Above Elevation Cutout System. As described in the Positive Opening Switch System, the "safe" condition of the machine is when the use of multiple function operation is allowed (at low boom angles).

4.4 ABOVE ELEVATION (ABOVE HORIZONTAL) CUTOUT SYSTEM

The above elevation cutout system uses a main boom angle switch and a tower boom angle switch to sense when the boom is raised substantially above horizontal. The articulated jib may be in any position. When "above elevation", the drive speed is restricted to elevated speed and the controller automatically restricts input voltage to motors to obtain this speed. Additionally, when used in conjunction with the "tilt indicator system", a tilt light will illuminate, and an alarm will sound at the platform control box. The machine is automatically disable drive functions and elevate functions. The operator is responsible to prevent the machine from attaining an unstable position. As described in the Positive Opening Switch System, the "safe" condition of the machine is when high engine and high speed is allowed (at low boom angles).

4.5 PLATFORM LOAD CONTROL SYSTEM

The Platform Load Sensing System (LSS) consists of single load cell and two linkages mounted to the platform rotator. The load cell includes a sealed circuit and is connected directly to a CAN-based platform control panel within the platform box. This system measures weight in the platform. When the capacity is exceeded, or when there is a fault in the system, the platform overload indicator will flash, the platform alarm will sound at the rate of 5 sec on / 2 sec off and all.

4.6 POSITIVE OPENING SWITCH SYSTEMS

Transport Position Interlock, and Above Elevation Systems use normally closed electrical switches with "positive opening" contacts. They are used in such a way that the switch contacts are physically broken to the open contact position when the machine is in the "unsafe" condition. When the machine is in the "safe" condition, the switch must be allowed to return to the closed contact state. This requires switch arm cams to be positioned in a way that the switch arm is actuated while the machine is in the "unsafe" condition and the switch arm is free while the machine is in the "safe" condition.

4.7 PLATFORM

Support Removal

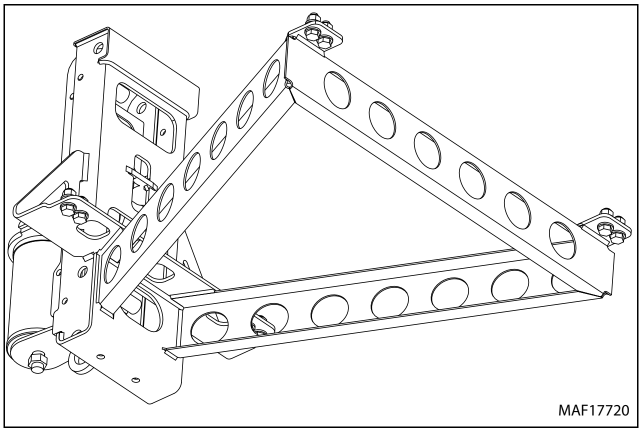
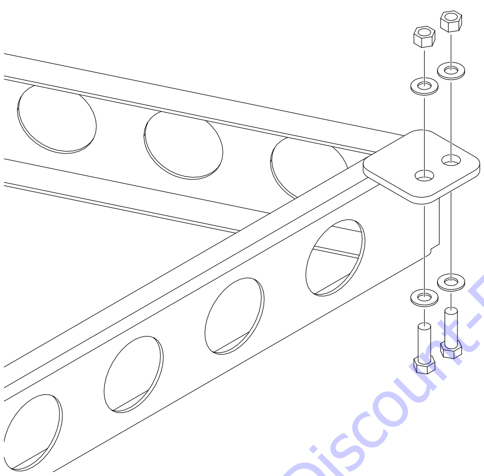


Figure 4-1. Location of Components Platform Support

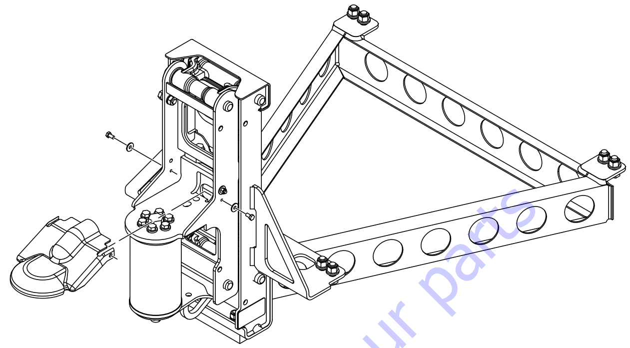
1. Disconnect electrical cables from control console.
2. Remove the bolts securing the platform to the platform support, then remove the platform.



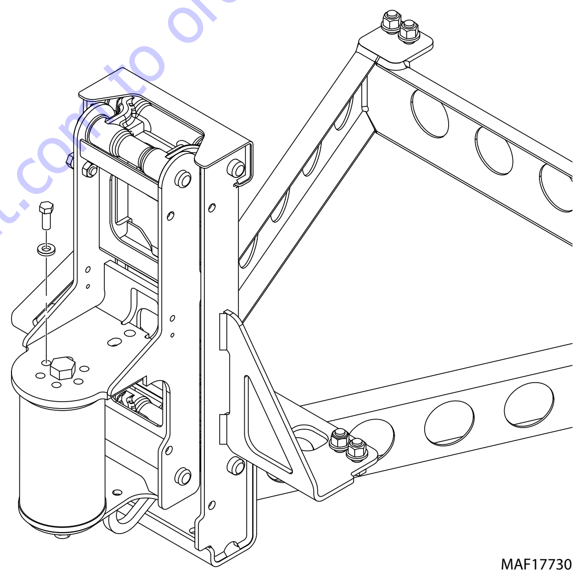
3. Using a suitable lifting device, support the platform support.

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

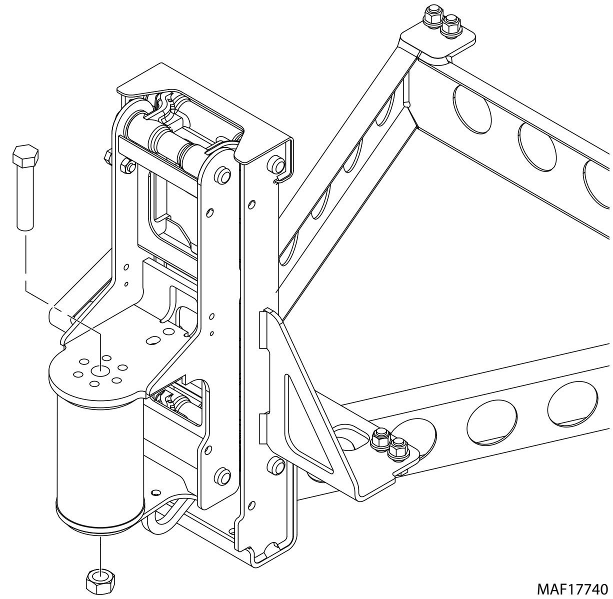
4. Remove the bolts and washer securing the platform support cover to the platform support. Remove platform support cover.



5. Remove the bolts and locknut securing the support to the rotator.



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



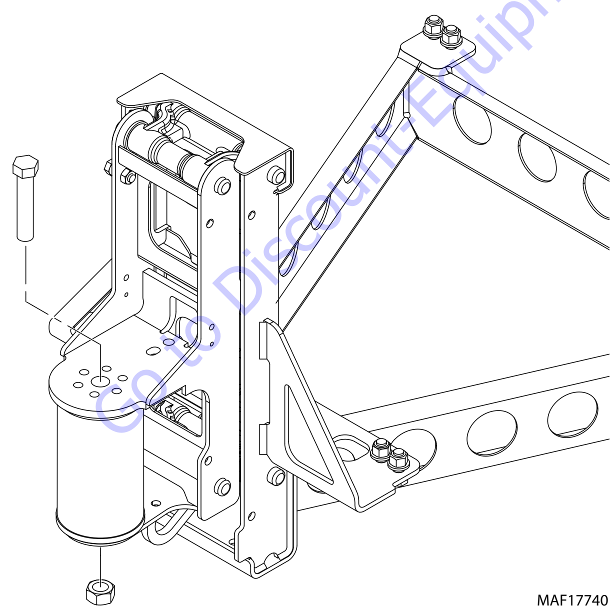
MAF17740

Support Installation

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

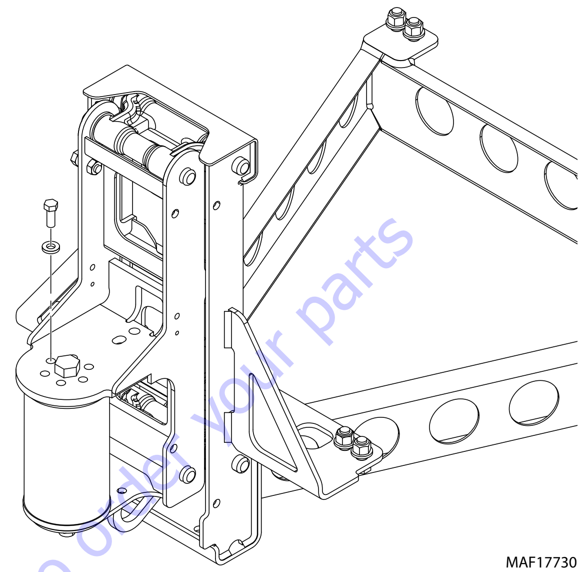
NOTE: *The platform support weighs approximately 77 lb (35 kg).*

2. Install the rotator center bolt.



MAF17740

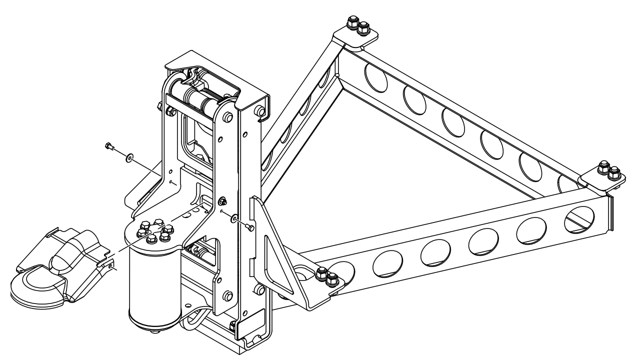
3. Apply Medium Strength Threadlocking Compound to the bolts and locknuts securing the support to the rotator and install the bolts and locknuts.



MAF17730

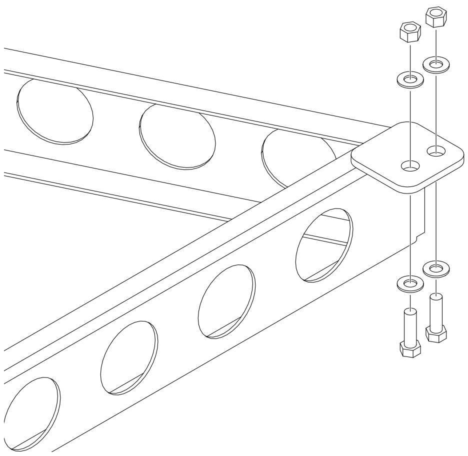
4. Torque the nut on the rotator center bolt to 250-270 ft. lbs. (339-366 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

5. Apply Medium Strength Threadlocking Compound to the bolts and washers securing platform support cover to the platform support.

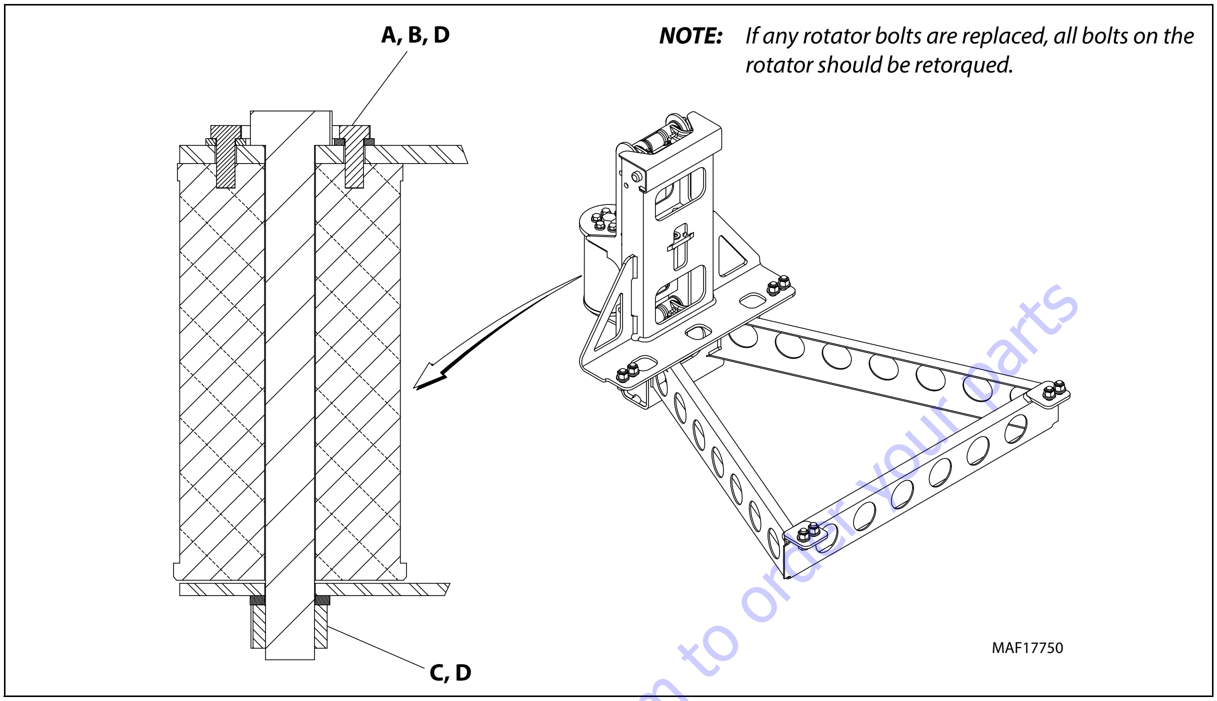


MAF17790

6. Position the platform on the platform support and install the bolts securing the platform to the platform support.



7. Connect the electrical cables to the platform control console



A Torque to 40 ft.lbs. (55 Nm)

B Medium Strength Threadlocking Compound

C Torque to 250-270 ft. lbs. (340-365 Nm)

D Check torque every 150 hours of operation

Figure 4-2. Platform Support Torque Values

4.8 BOOM MAINTENANCE

Removal of the Main Boom

NOTICE

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

1. Raise the boom to a horizontal position.
2. Place blocking in the tower boom for support and prevent it from lowering.

NOTE: *The jib/platform assembly weighs approximately 500 lb (230 kg).*

3. Support the weight of the jib/platform assembly using adequate lifting or blocking equipment.

NOTE: *The main boom assembly weighs approximately 475 lb (216 kg).*

4. Support the weight of the main boom with an adequate lifting device.
5. Tag and disconnect all electrical lines running to the platform.
6. Tag and disconnect all hydraulic lines running to the platform rotator, jib rotator (if equipped), and jib cylinder. Cap or plug all openings.
7. Remove the hose cover from the top of the jib and remove the hydraulic hoses from the jib.

NOTE: *When removing the retaining pin from the rod end of the level cylinder, make sure the cylinder is properly supported.*

8. Remove the retaining bolt, keeper, and pin that secures the level cylinder to the jib.
9. Remove the retaining bolt, keeper, and pin that secures the main boom to the jib.
10. Remove the jib and platform assembly from the boom.
11. Tag and disconnect the hydraulic lines running to the level cylinder. Cap or plug all openings.
12. Remove the cable cover from the side of the main boom.
13. Tag and disconnect all the hose/line couplings found behind the cable cover. Cap or plug all openings. Remove the clamp blocks securing the hoses/ lines.
14. Unbolt the power track from the boom and remove the power track and hoses/lines from the boom.
15. Remove the cover at the rear of the boom.
16. Tag and disconnect the hydraulic lines running to the telescope cylinder. Cap or plug all openings.

NOTE: *When removing the retaining pin from the rod end of the upper lift cylinder, make sure the cylinder is properly supported.*

17. Remove the retaining bolt, keeper, and pin that secures the upper lift cylinder rod end to the main boom.

NOTE: *When removing the retaining pin from the rod end of the master cylinder, make sure the cylinder is properly supported.*

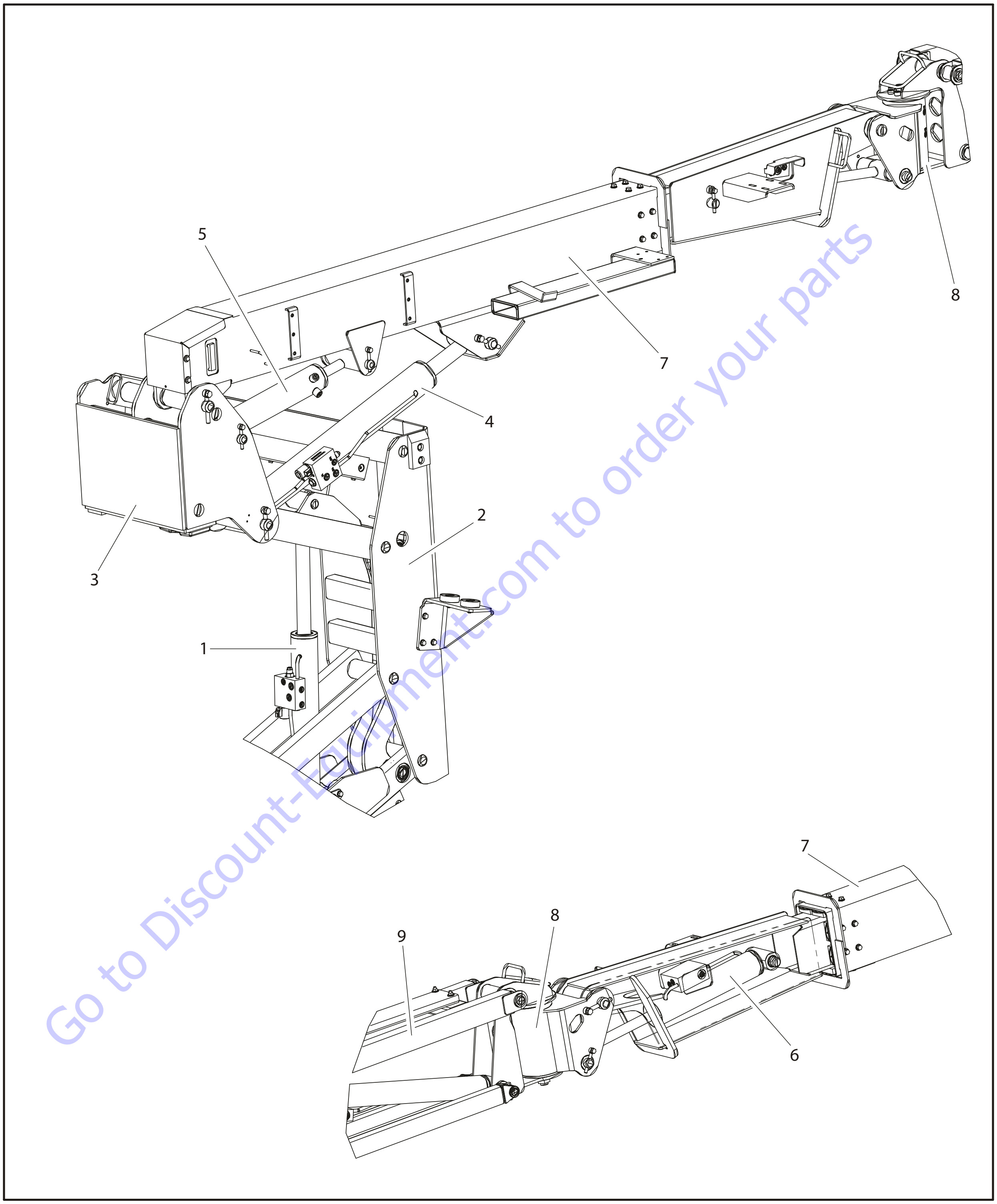
18. Remove the retaining bolt, keeper, and pin that secures the master cylinder rod end to the main boom.
19. Remove the retaining bolt, keeper, and pin that secures the main boom to the upper upright.
20. Remove the boom from the machine and place it on suitable blocking.

Disassembly of the Main Boom

1. Loosen the wear pad retaining bolts at the rear of fly boom section and remove the shims and wear pads noting the location and amount of shims to aid in reassembly.
2. Using a portable power source, attach hose to telescope cylinder port block. Using all applicable safety precautions, activate hydraulic system and extend cylinder to gain access to cylinder rod retaining pin. Shut down the portable power source.
3. 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 initial discharge, there should be no further leakage from the retract port. Cap or plug all openings.

NOTE: *When removing the retaining pin from the rod end of the telescope cylinder, make sure the cylinder is properly supported.*

4. Remove the retaining ring and pin securing the telescope cylinder rod end to the fly boom section.
5. Remove the bolts and washers securing telescope cylinder to the rear of the base boom section.



1. Tower Lift Cylinder
2. Tower Upright
3. Upper Upright
4. Upper Lift Cylinder
5. Master Cylinder
6. Platform Level Cylinder
7. Boom Assembly
8. Jib Rotator
9. Jib

Figure 4-3. Boom Assembly

NOTE: *The telescope cylinder weighs approximately 53 lb (24 kg).*

6. Using a suitable lifting device, remove telescope cylinder from the rear of the boom sections.
7. Remove hardware securing the front wear pads on base boom section, remove wear pads and shims, noting the location and amount of shims to aid in reassembly.

NOTE: *The fly boom section weighs approximately 188 lb (85 kg).*

8. Using a suitable lifting device, remove fly boom from boom section.

Inspection

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

Assembly of the Main Boom

1. Lubricate the boom sections as shown in Figure 4-4., Boom Lubrication Instructions.
2. Using Medium Strength Threadlocking Compound, install the bottom wear pads and shims as noted during disassembly on the rear of the fly section. Torque the retaining bolts to 41 ft. lbs. (55 Nm). Install the rest of the wear pads on the rear of the fly section but do not install the shims or torque them at this time.
3. Using an adequate lifting device, slide the fly boom section into the base boom section. Install the remaining shims on the rear of the fly section as noted during disassembly and torque the retaining bolts to 40 ft. lbs. (55 Nm). Pull the fly section out of the base section enough to install the pin that secures the telescope cylinder rod to the fly boom section.
4. Using Medium Strength Threadlocking Compound, install the front wear pads and shims as noted during disassembly on the base boom section. Torque the retaining bolts to 41 ft. lbs. (55 Nm).
5. Using an adequate lifting device, install the telescope cylinder into the boom assembly. It will aid assembly if the cylinder is extended to enable connection to the fly boom section.
6. Align the telescope cylinder rod end with the corresponding hole in the fly boom section. If necessary, attach a portable power supply to the cylinder to extend or retract the cylinder for alignment. Install the retaining pin and secure it in place with the retaining ring.
7. Using Medium Strength Threadlocking Compound, secure the rear of the telescope cylinder to the base boom section with the attaching bolts and washers. Torque the bolts 95 ft. lbs. (129 Nm).

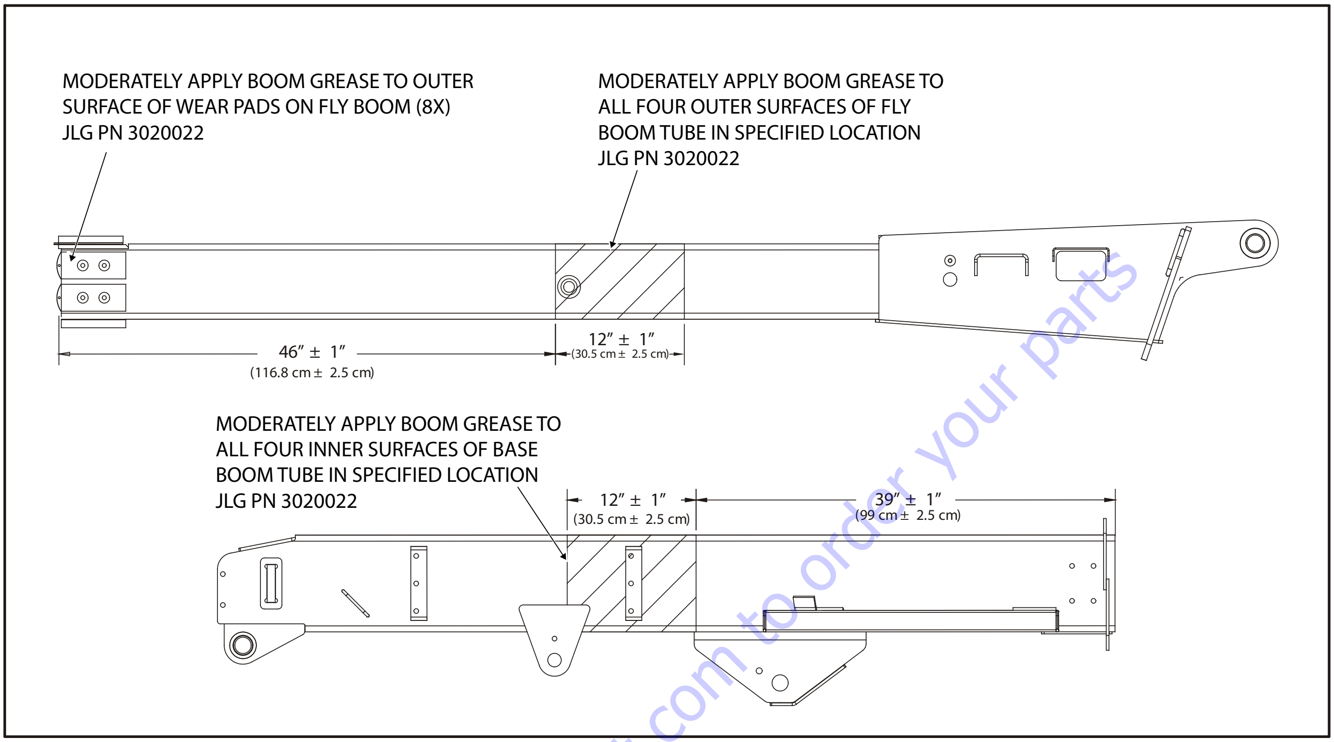


Figure 4-4. Boom Lubrication Instructions

Installation of the Main Boom

NOTE: *The main boom assembly weighs approximately 475 lb (216 kg).*

1. Using suitable lifting equipment, position boom assembly into the upper upright so the boom pivot holes in both the boom and upright are aligned.
2. Using Medium Strength Threadlocking Compound, install the retaining bolt, keeper, and pin that secures the main boom to the upper upright. Torque the retaining bolt to 85 ft.lbs. (116 Nm).
3. Using Medium Strength Threadlocking Compound, install the retaining bolt, keeper, and pin that secures the master cylinder rod end to the main boom. Torque the retaining bolt to 41 ft.lbs. (55 Nm).
4. Using Medium Strength Threadlocking Compound, install the retaining bolt, keeper, and pin that secures the upper lift cylinder rod end to the main boom. Torque the retaining bolts to 72 ft.lbs. (97 Nm).
5. Connect the hydraulic lines running to the telescope cylinder as tagged during removal.
6. Install the cover at the rear of the boom.
7. Install the power track and hoses/lines onto the boom support brackets and secure in place with the retaining hardware. Refer to,Figure 4-5., Power Track Hoses

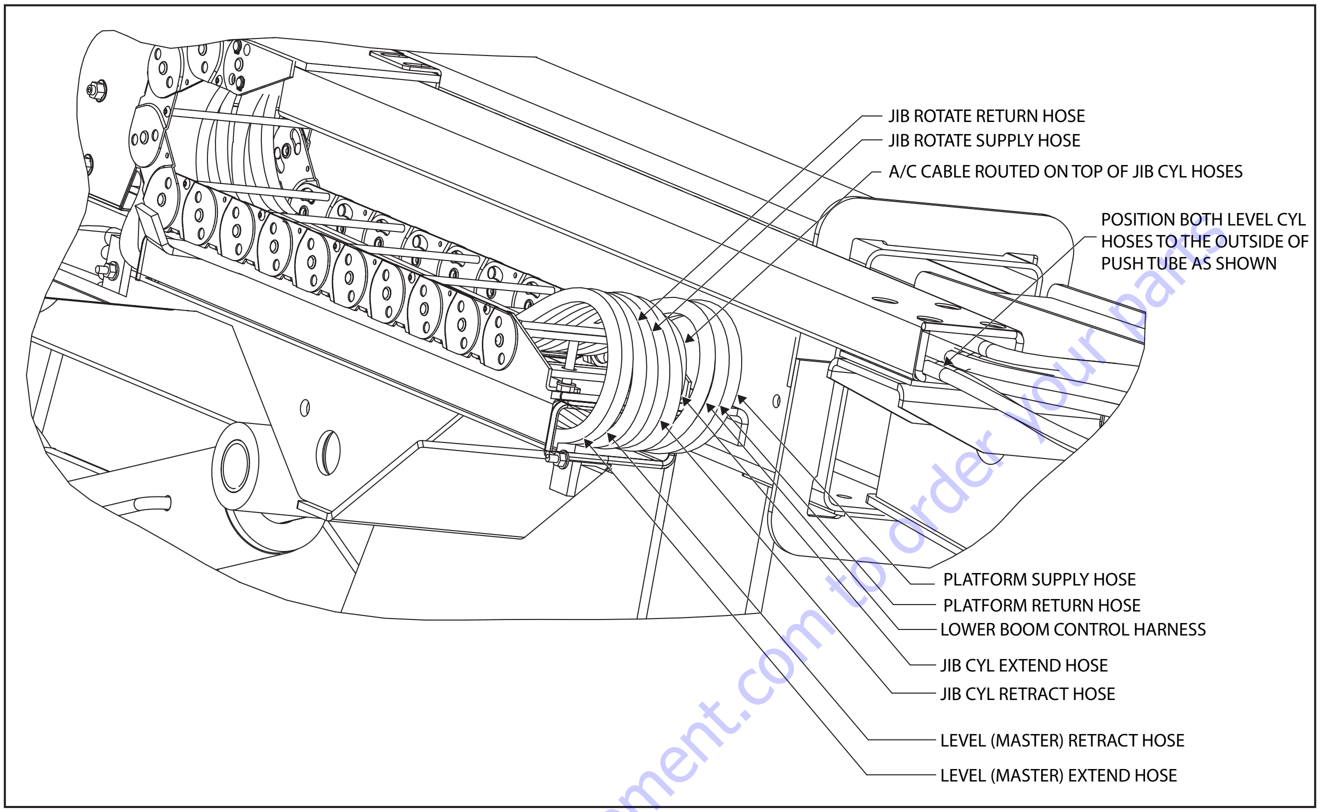


Figure 4-5. Power Track Hoses

8. Connect all the hose/line couplings on the side of the boom as tagged during removal. Install the clamp blocks securing the hoses/lines. Refer to Figure 4-6., Clamp Block Installation.
9. Install the cable cover onto the side of the main boom.
10. Connect the hydraulic lines running to the level cylinder as tagged during removal.
11. Align the jib and platform assembly with the attach points on the boom.
12. Using Medium Strength Threadlocking Compound, install the retaining bolt, keeper, and pin that secures the main boom to the jib. Torque the retaining bolt to 85 ft. lbs. (116 Nm).

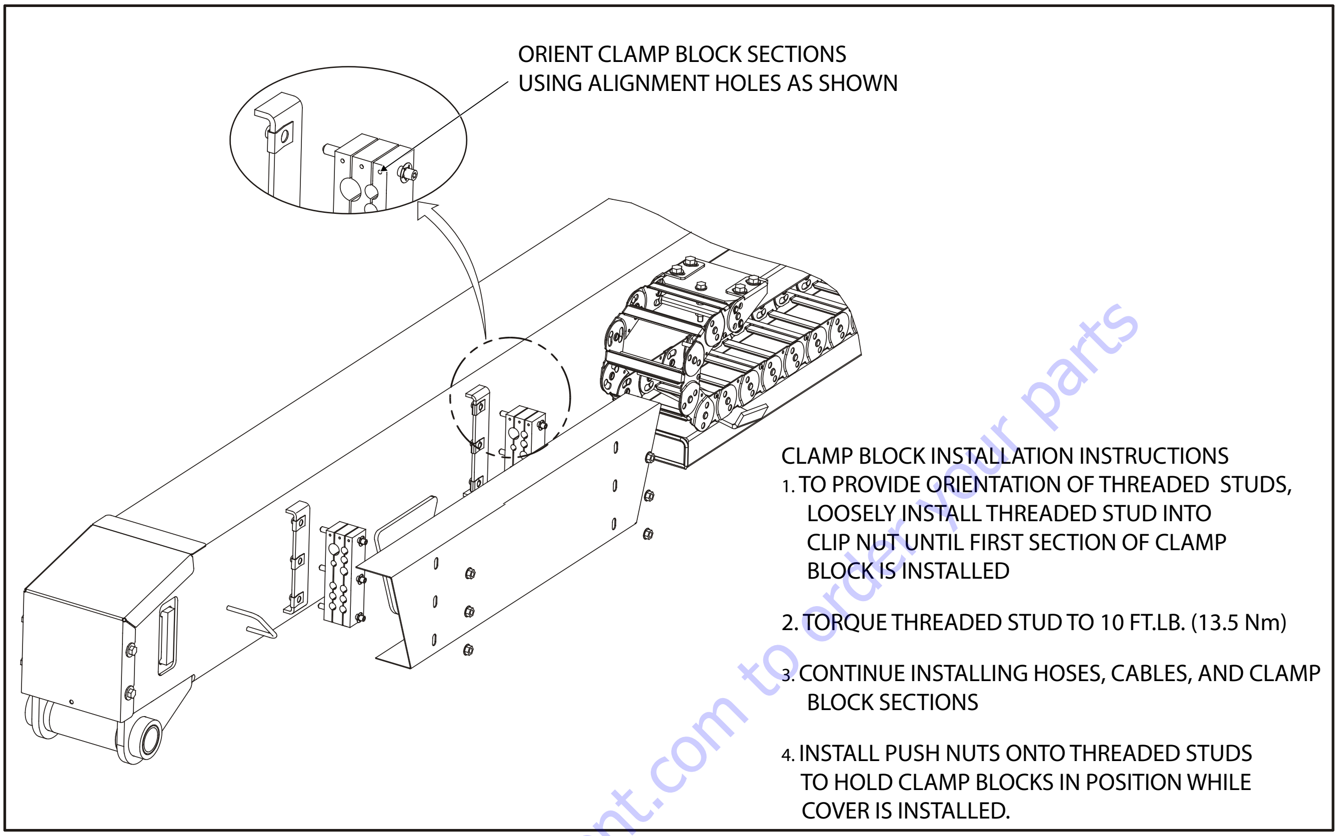
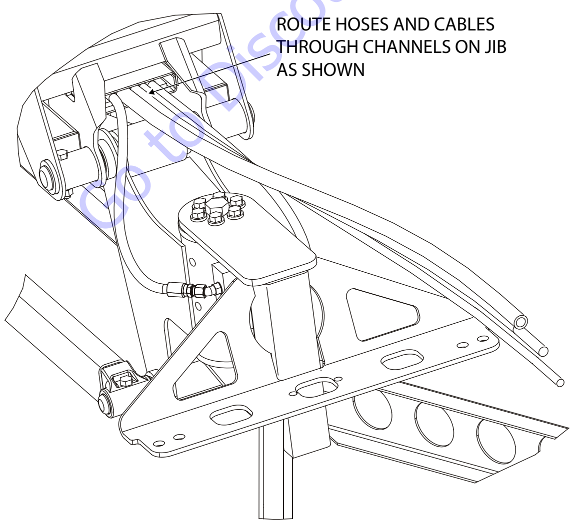


Figure 4-6. Clamp Block Installation

13. Using Medium Strength Threadlocking Compound, install the retaining bolt, keeper, and pin that secures the level cylinder to the jib. Torque the retaining bolt to 35 ft.lbs. (48 Nm).

14. Route the hydraulic hoses on top of the jib and install the hose cover.



15. Connect all hydraulic lines running to the plaform rotator, jib rotator (if equipped), and jib cylinder as tagged during removal.

16. Connect all electrical lines running to the platform as tagged during removal.

17. Using all safety precautions, operate machine systems and extend and retract boom for four or five cycles, checking for proper operation.

18. Shut down the machine and check for leakage.

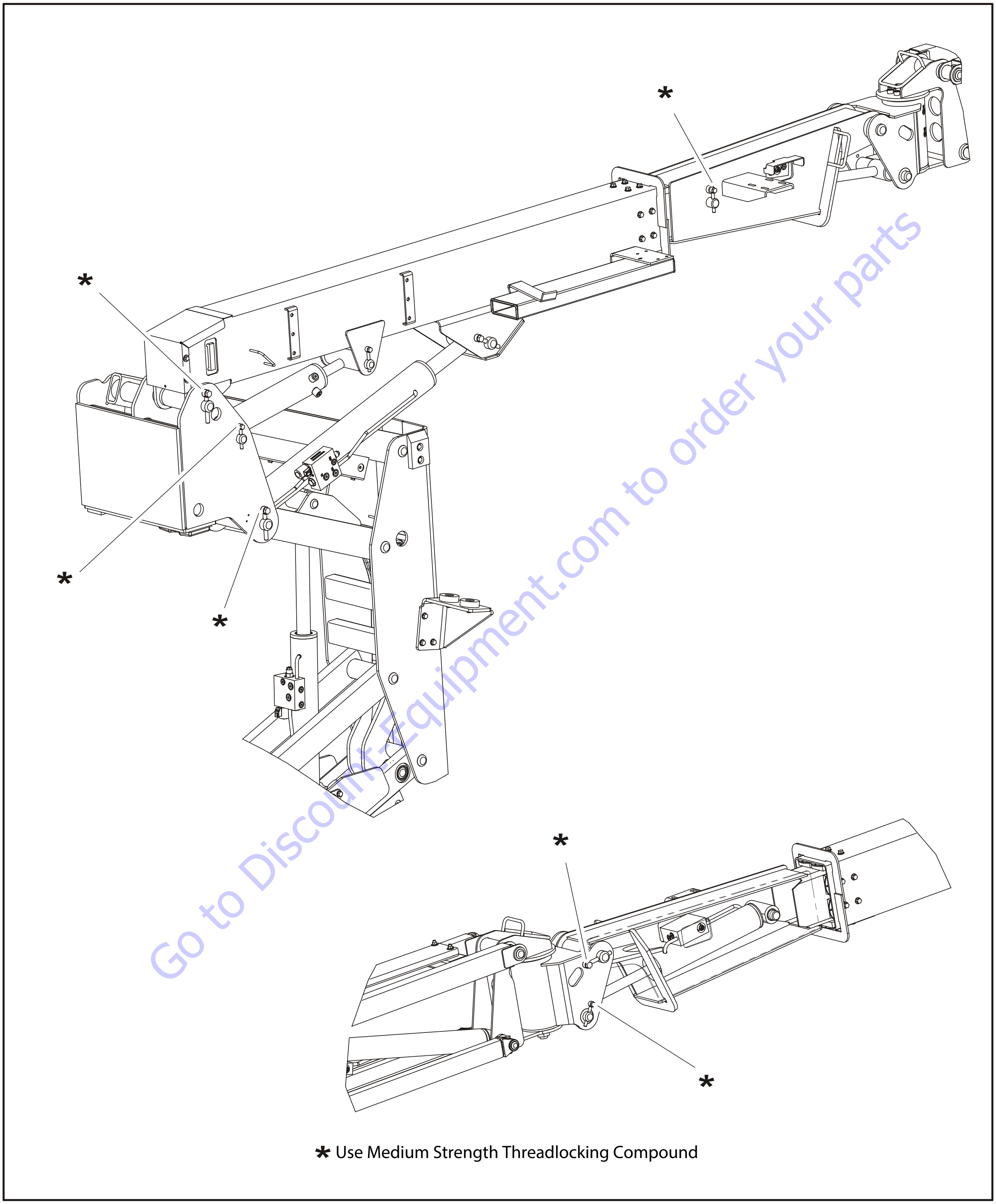


Figure 4-7. Boom Thread Locking Compound Location

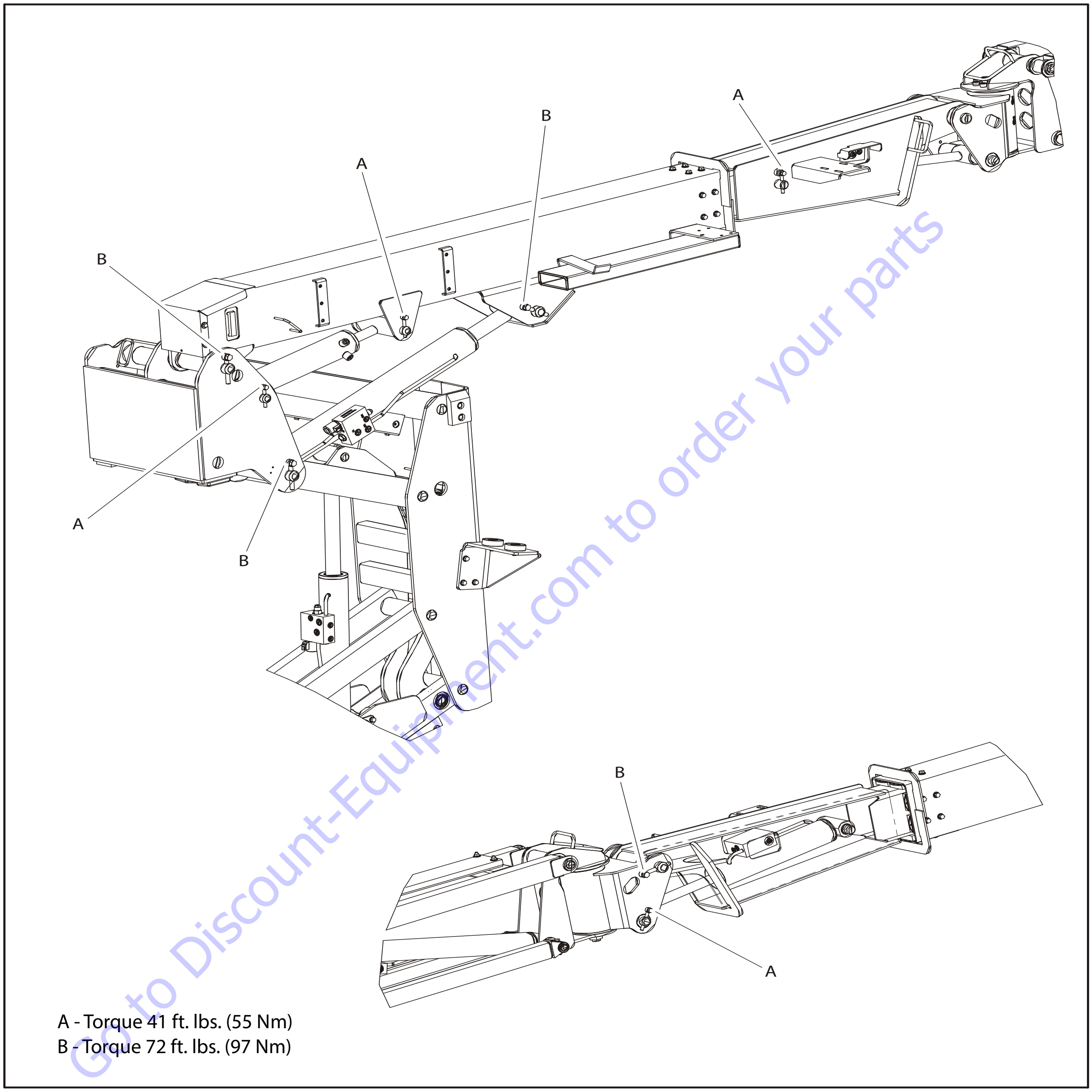
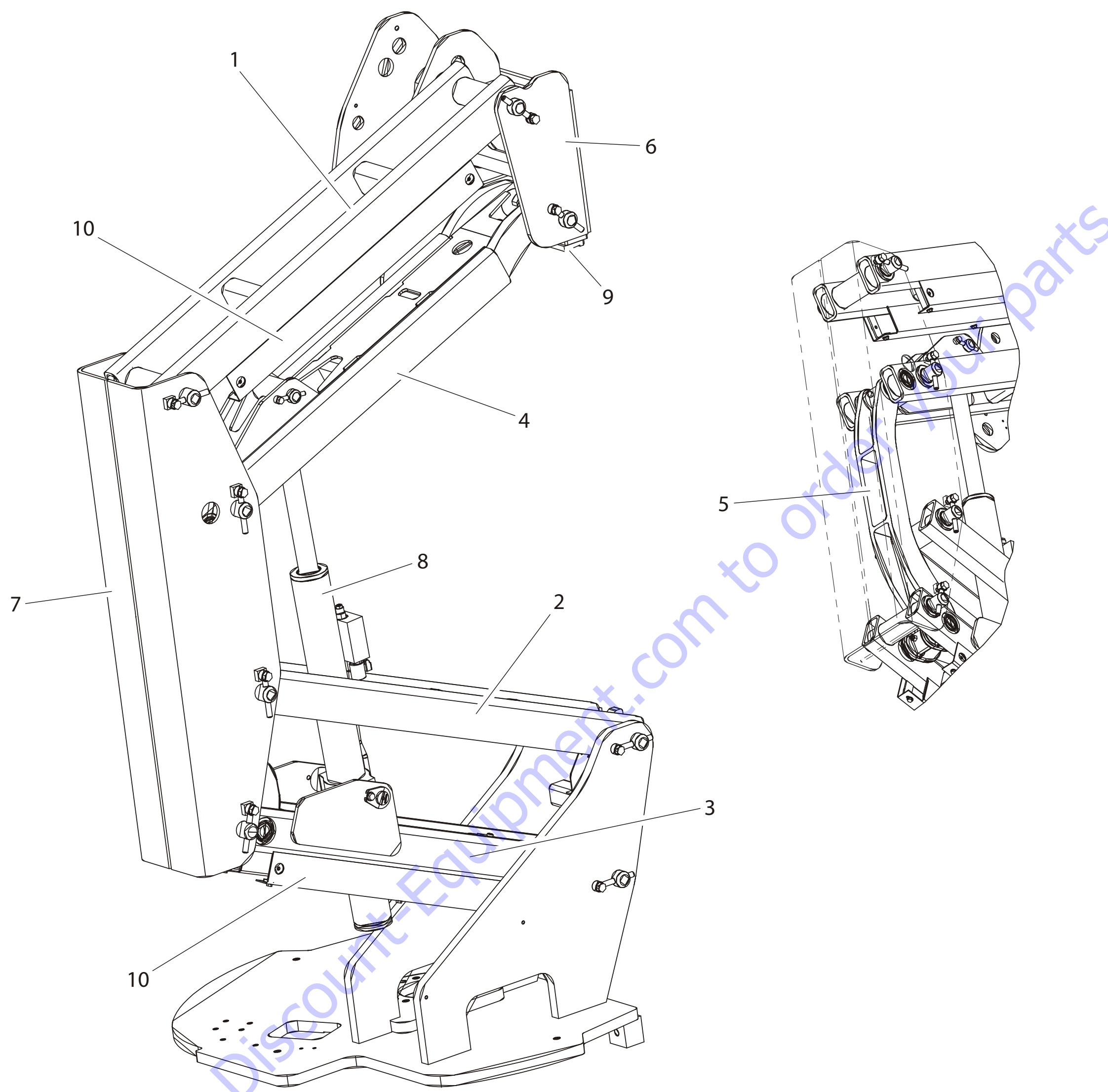


Figure 4-8. Boom Torque Values



1. Link
2. Level Link
3. Lower Boom
4. Mid Boom
5. Timing Link
6. Upper Upright Weldment
7. Tower Upright Weldment
8. Tower Lift Cylinder
9. Bumper
10. Hose Channel Protector

Figure 4-9. Lower Boom

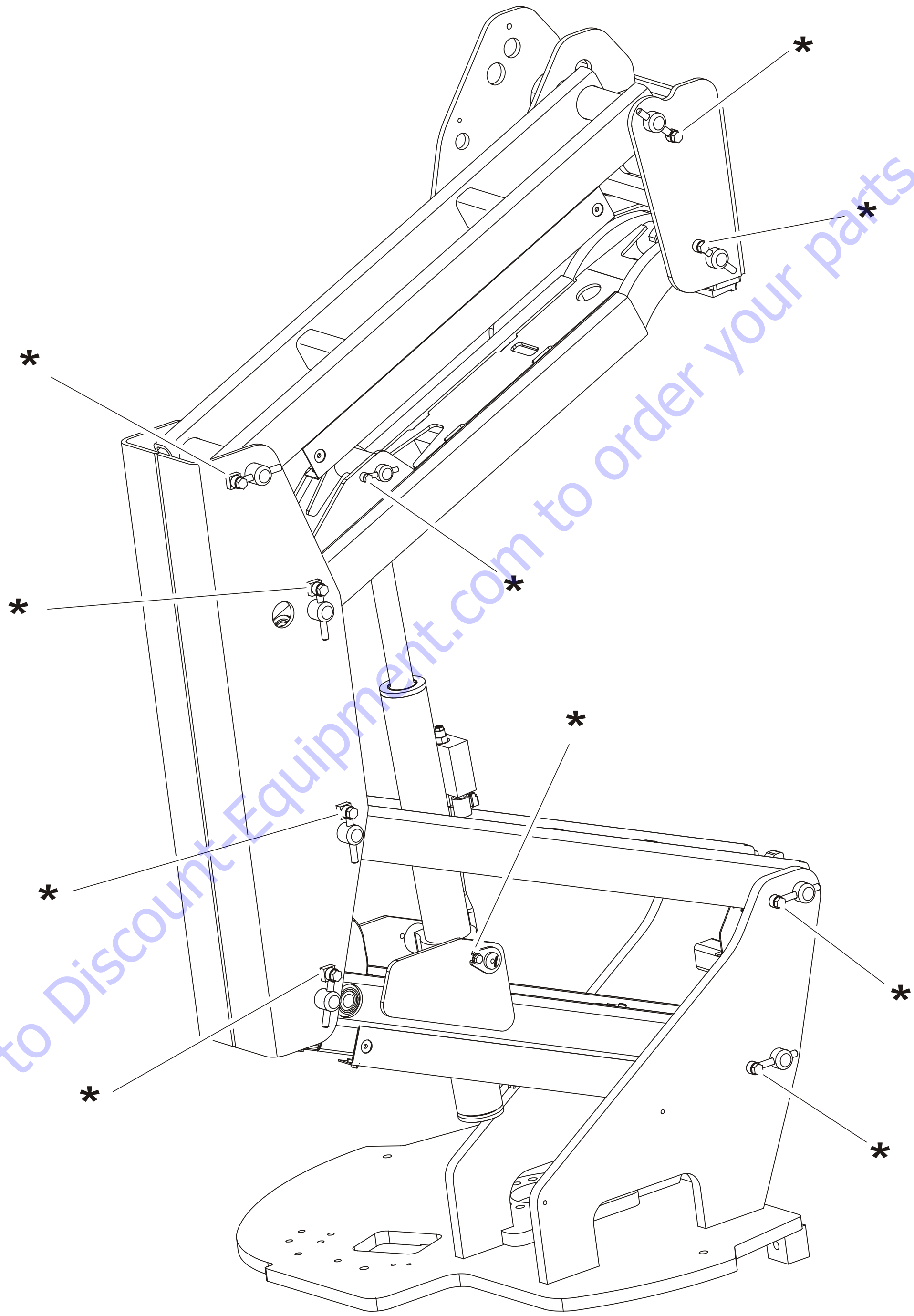


Figure 4-10. Lower Boom Thread Locking Compound Location

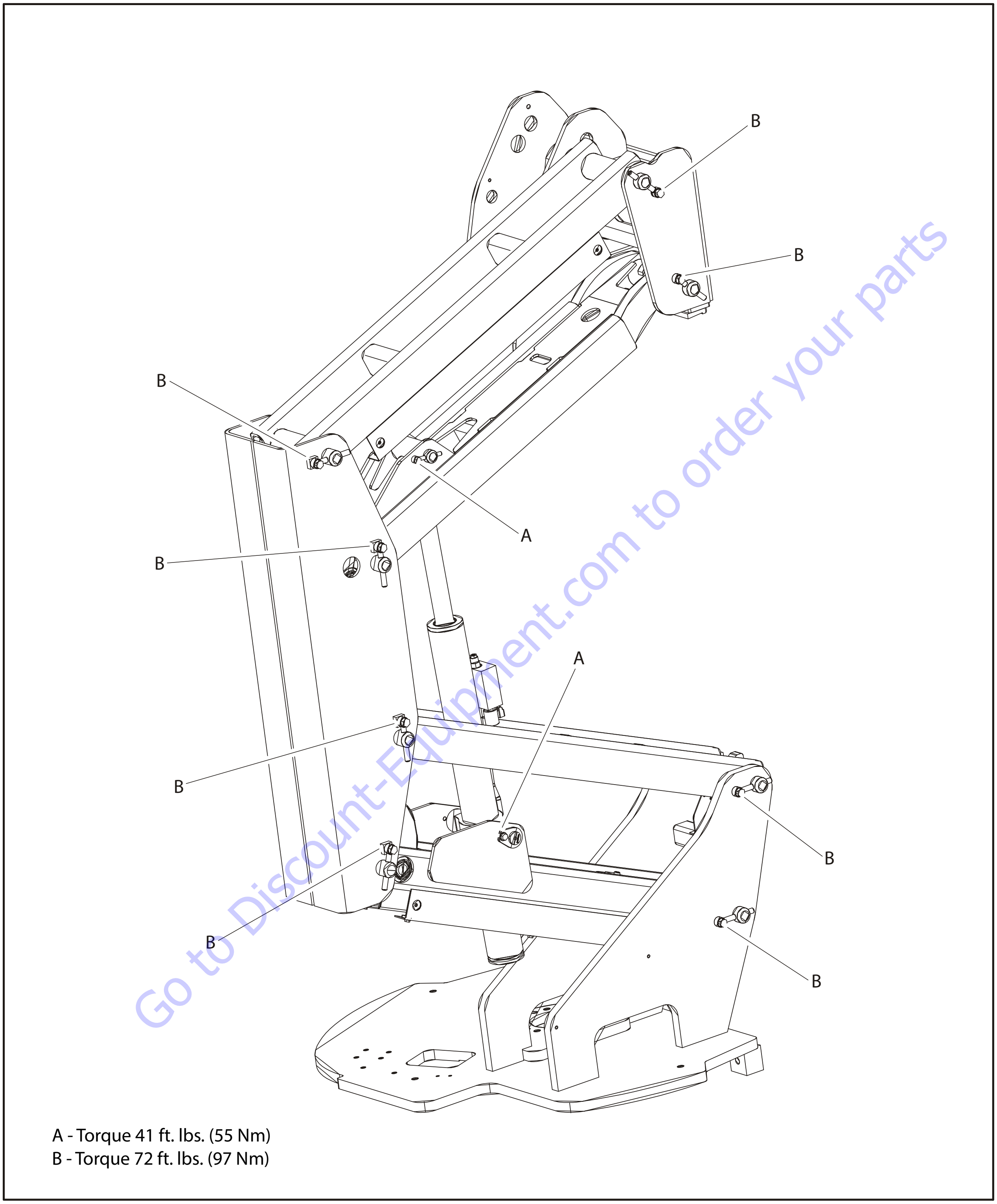


Figure 4-11. Lower Boom Torque Values

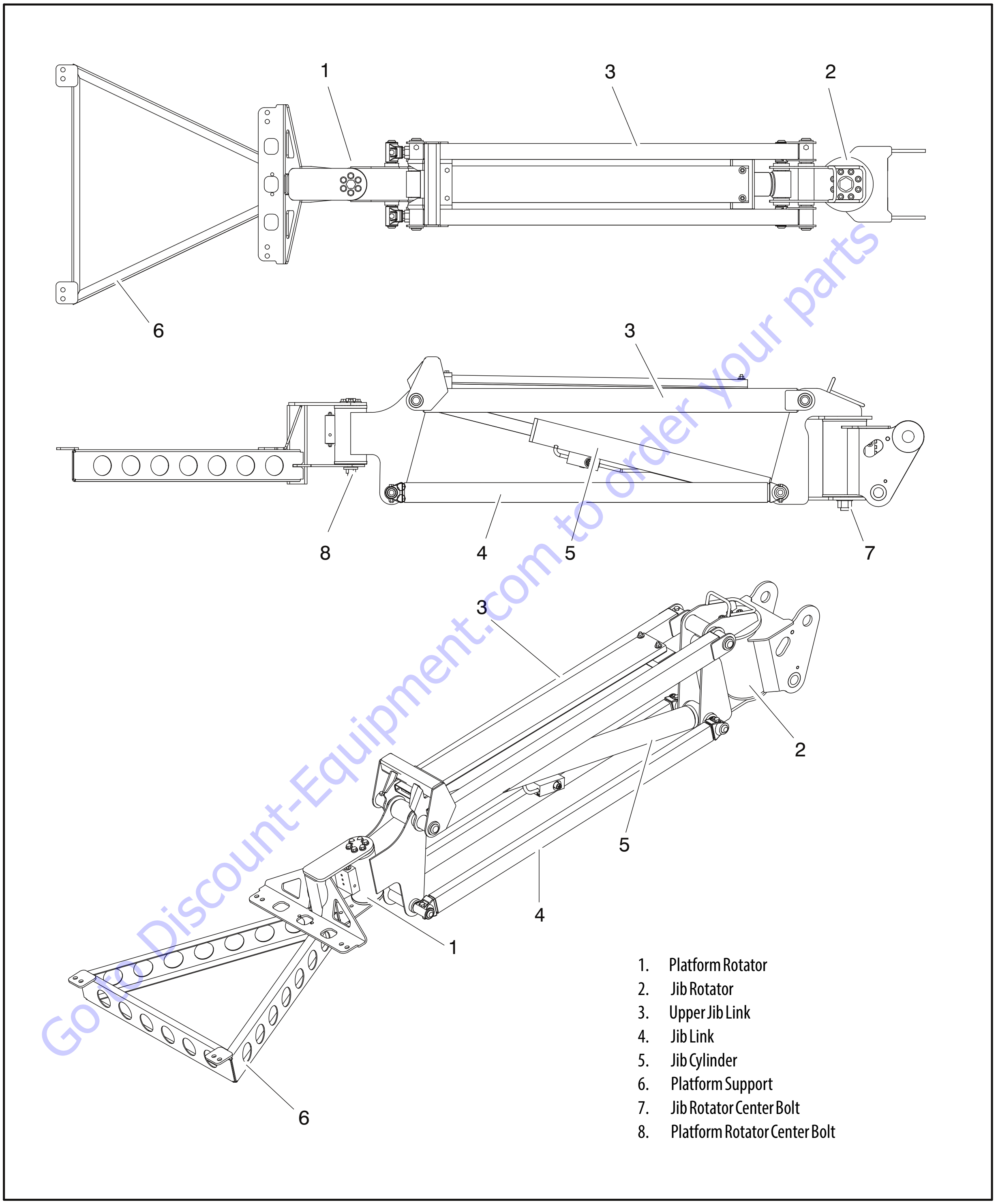
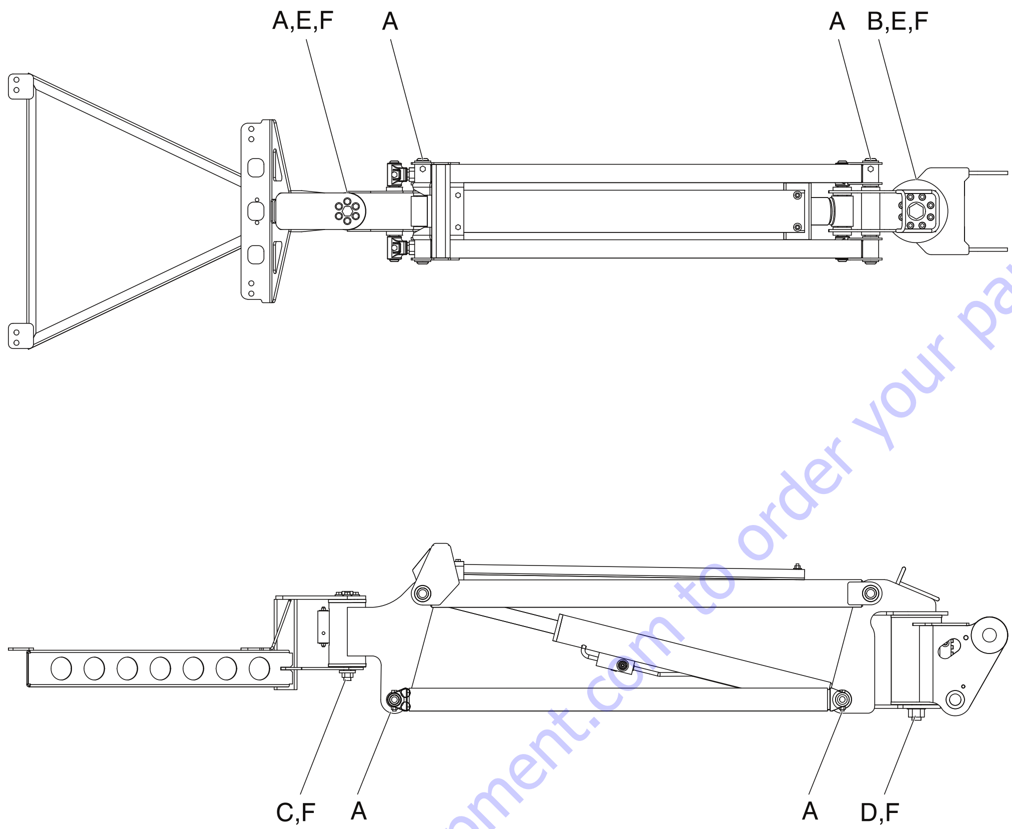


Figure 4-12. AJP Jib



NOTE: *If any rotator bolts are replaced, all bolts on the rotator should be retorqued.*

A - Torque to 35 ft. lbs. (48 Nm)
B - Torque to 85 ft. lbs. (115 Nm)
C - Torque to 250 ft. lbs. (339 Nm)
D - Torque to 480 ft. lbs. (650 Nm)
E - Medium Strength Threadlocking Compound
F - Check torque every 150 hours of operation

Figure 4-13. AJP Jib Torque Values

4.9 WEAR PADS

1. Shim up wear pads until snug to adjacent surface.
2. Replace wear pads when worn to thickness shown below.

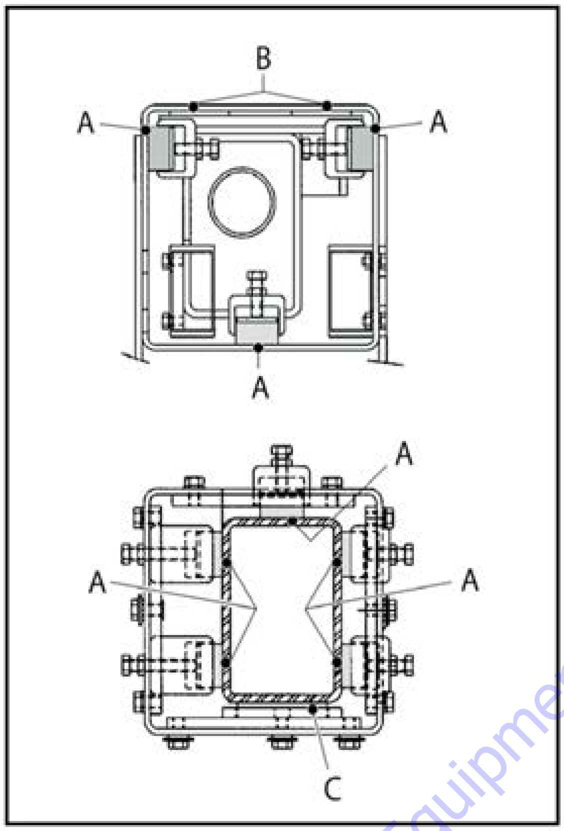


Figure 4-14. Wear Pad Thickness

3. Adjust wear pads as follows:
   a. Loosen jam nut on adjustment bolt, turn bolt CW until wear pad is snug to adjacent surface.
   b. After adjustments have been made, tighten the jam nuts on wear pad bolts.

4.10 TILT SENSOR CHECK

CAUTION

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

1. Check chassis out of level indicator light located on the platform control console by driving, with the machine in level position, up a suitable ramp of at least 6° slope. Check the out of level alarm, with the machine on the ramp, raise the upper boom until it is parallel with the chassis. DO NOT RAISE ABOVE THE PARALLEL POSITION. If the light does not illuminate, return the machine to a level surface, shut down the machine, and contact a qualified technician before resuming operation.
2. If necessary, verify the tilt sensor with the analyzer. Refer to Section 6.

4.11 BOOM LIMIT SWITCHES

Refer to Figure 4-15., Boom Limit Switches for adjustments to be made to the two Boom Limit Switches which bolt in place on the upright.

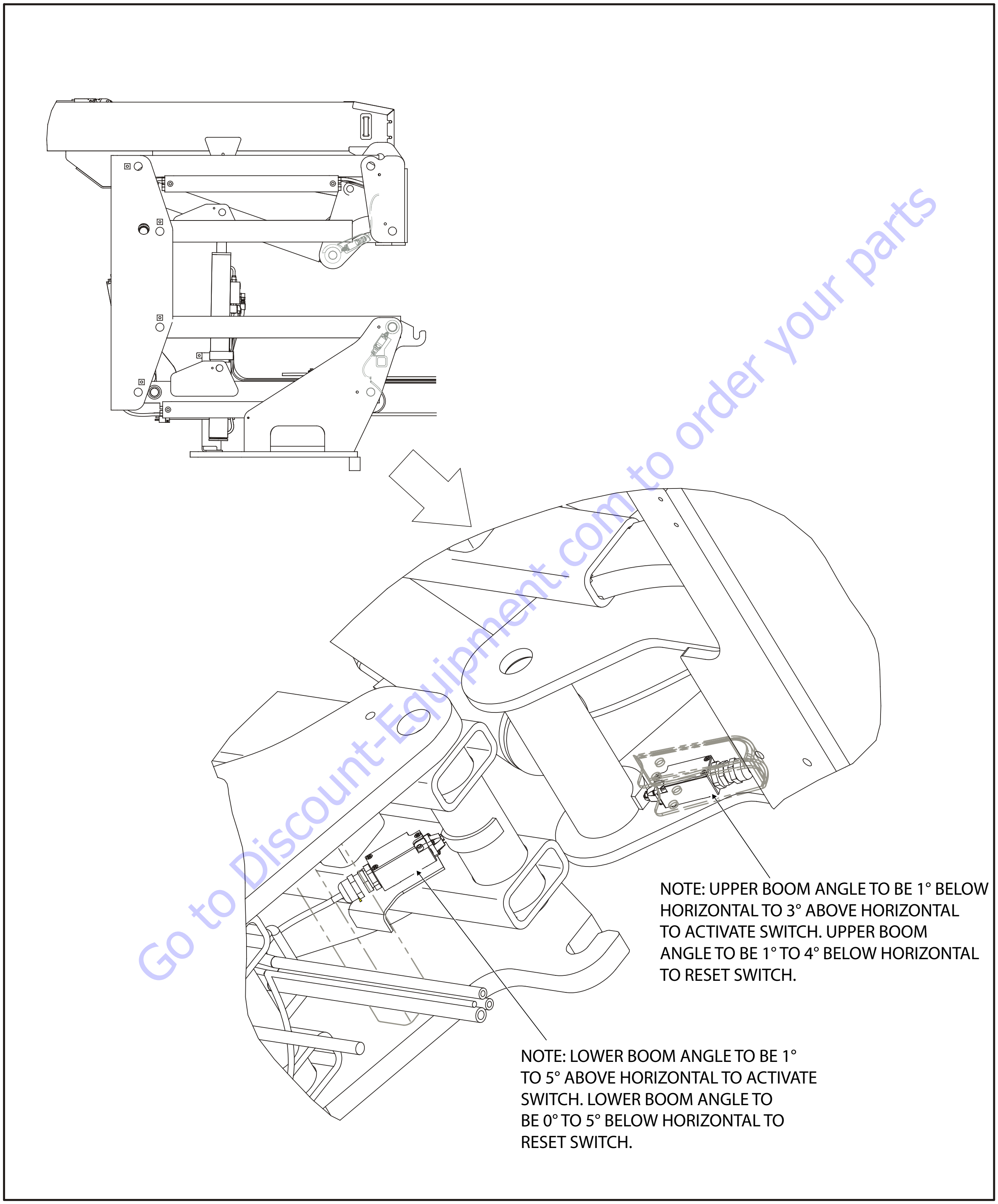


Figure 4-15. Boom Limit Switches

4.12 BOOM CLEANLINESS GUIDELINES

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

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.
3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no “puddling” of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.
5. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

4.13 FOOT SWITCH ADJUSTMENT

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

4.14 ARTICULATING JIB BOOM

Removal

1. For platform/support removal see platform/support removal diagram. See Section 4.7, Platform.
2. Position the articulating jib boom level with ground.
3. Remove mounting hardware from slave leveling cylinder pin #1. Using a suitable brass drift and hammer, remove the cylinder pin from articulating jib boom.

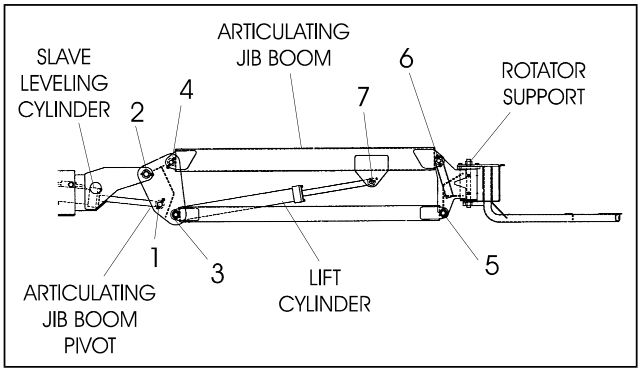


Figure 4-16. Location of Components - Articulating Jib Boom

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

Disassembly

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

Inspection

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

1. Inspect articulating fly boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
2. Inspect articulating fly boom pivot attach points for scoring, tapering and ovality, or other damage. Replace pins as necessary.
3. Inspect inner diameter of articulating fly boom pivot bearings for scoring, distortion, wear, or other damage. Replace bearings as necessary. (See Section 5, Cylinder Repair For Bearing Replacement).
4. Inspect lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
5. Inspect inner diameter of rotator attach point bearings for scoring, distortion, wear, or other damage. Replace bearing as necessary.
6. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
7. Inspect structural units of articulating jib boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

NOTE: *For location of components See Figure 4-16., Location of Components - Articulating Jib Boom.*

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

Installation

1. Align articulating jib boom pivot weldment with attach holes in fly boom assembly. Using a soft head mallet, install pivot pin #2 into fly boom assembly and secure with mounting hardware.
2. Align the slave leveling cylinder with attach holes in articulating jib boom pivot weldment. Using a soft head mallet, install slave leveling cylinder pin #1 into articulating jib boom pivot weldment and secure with mounting hardware.

4.15 BOOM SYNCHRONIZING PROCEDURE

If the Lower Boom assembly does not fully lower:

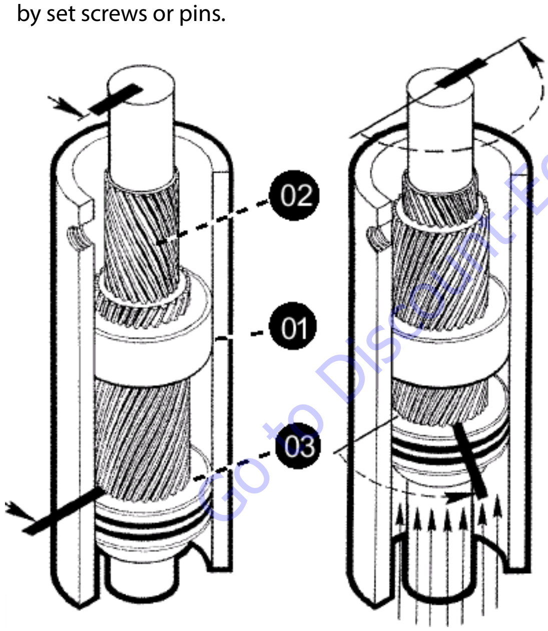
1. Remove all personnel from the platform.
2. Pull the red knob located under the main control valve.
3. From Ground Control, activate the lift control switch, raise Lower Boom 6 feet (1.8 m).
4. After raising Lower Boom, release the red knob.
5. Activate Lower Boom Down, fully lower boom.
6. Repeat steps 1 thru 5 if necessary.

4.16 ROTARY ACTUATOR

Theory Of Operation

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

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

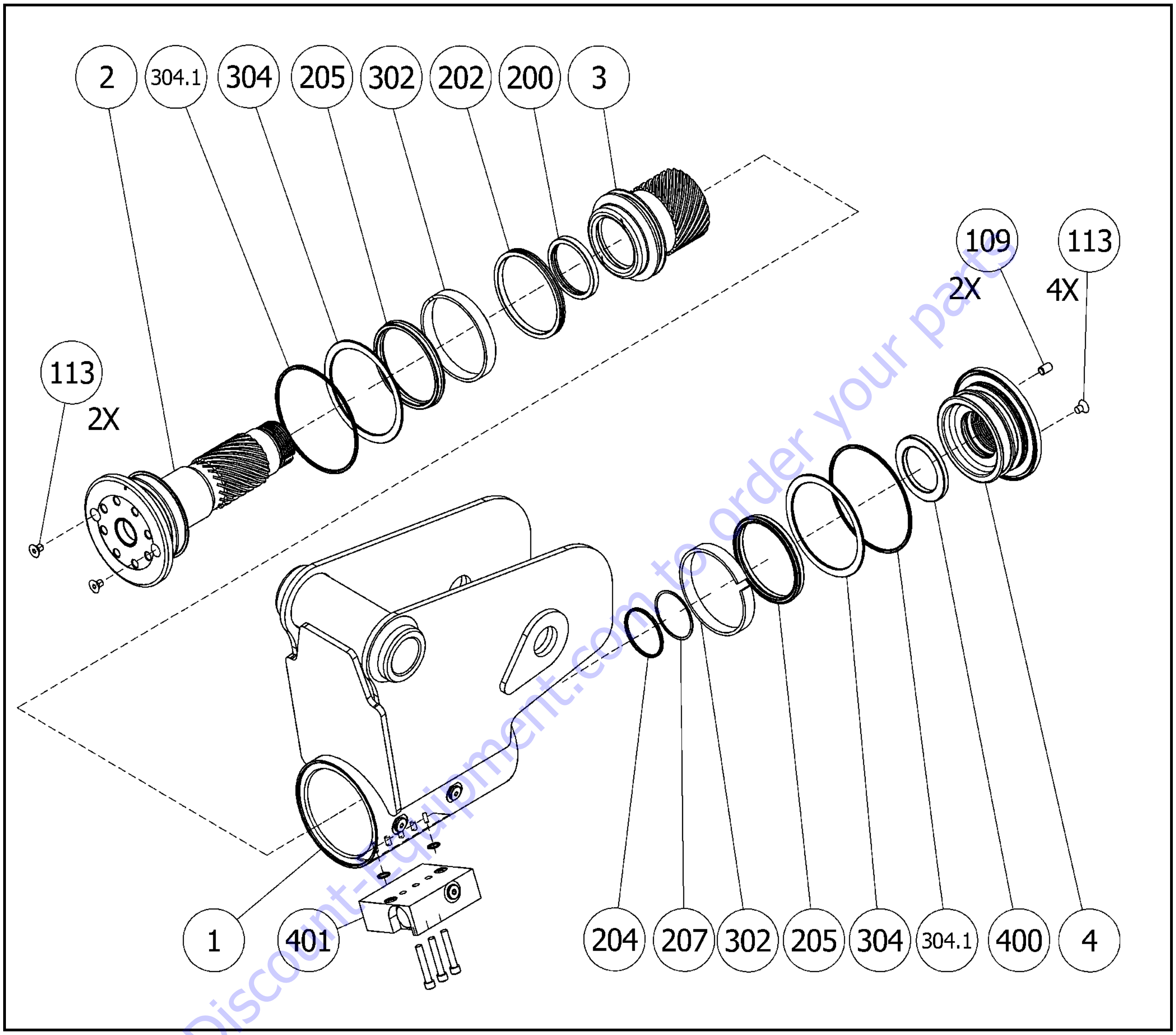


NOTE: *Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.*
As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.

Tools Required for Assembly/Disassembly

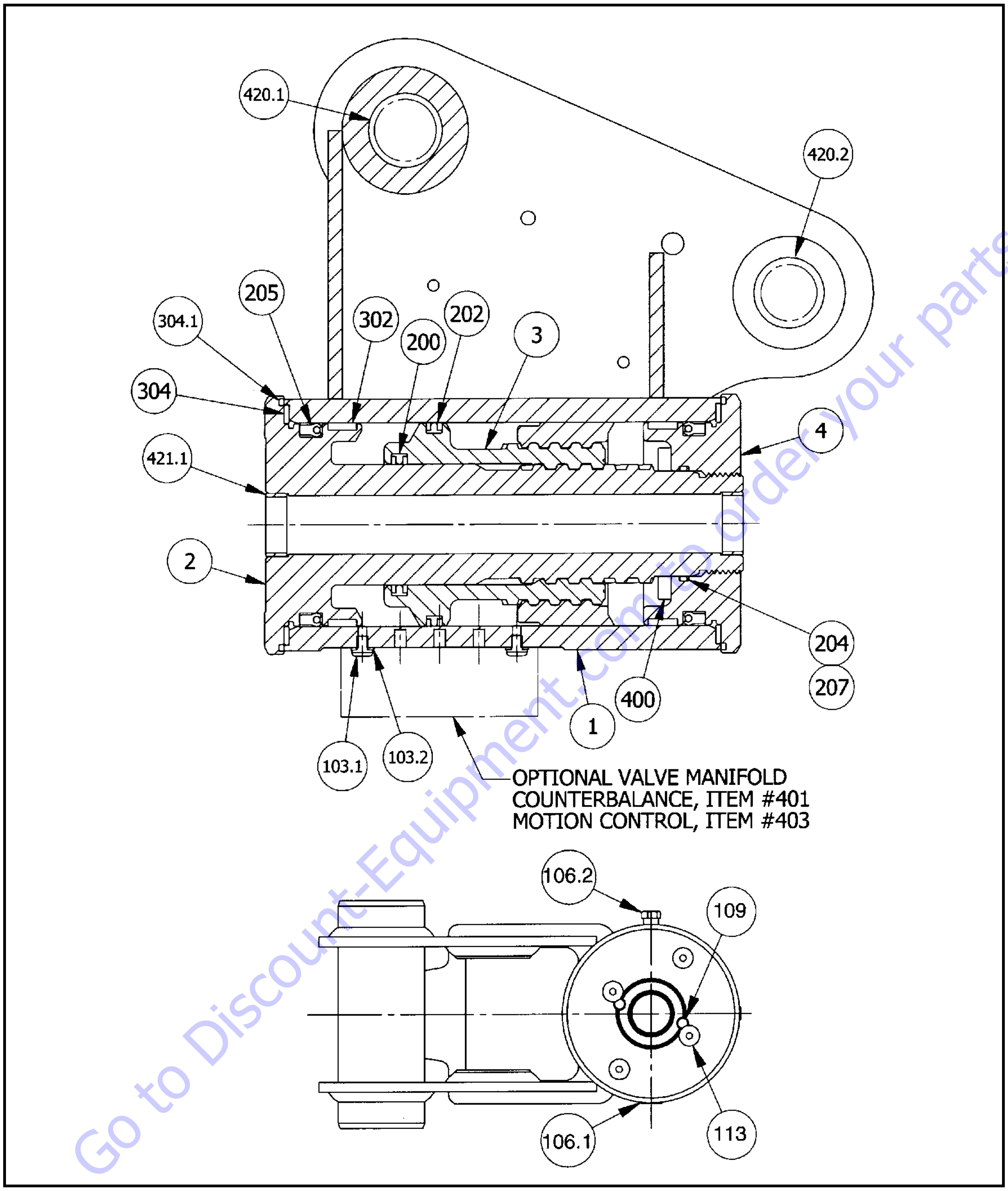
Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:

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



1. Housing	200. T-Seal	304. Thrust Washer
2. Shaft	202. T-Seal	304.1. Wiper Seal
3. Piston Sleeve	204. O-Ring	400. Stop Tube (Optional)
4. End Cap	205. Cup Seal	401. Counterbalance Valve
109. Lock Pin	207. Backup	
113. Capscrew	302. Wear Guide	

Figure 4-17. Rotary Actuator (Exploded View)



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

Figure 4-18. Rotator - Assembly Drawing

Disassembly

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

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

3. Remove the lock pins using an "Easy Out" (a size #2 is shown). If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm)todrill out the entire pin.

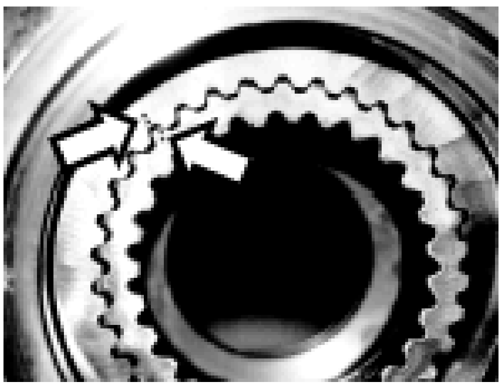
4. Install the end cap (4) removal tools provided with the Helac seal kit.

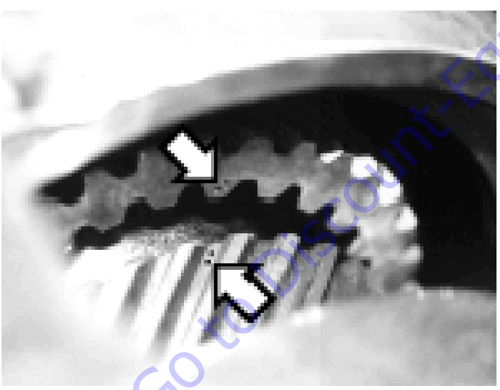
5. Using a metal bar, or something similar, un-screw the end cap (4) by turning it counterclock-wise.

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

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

8. Every actuator has timing marks for proper engagement.



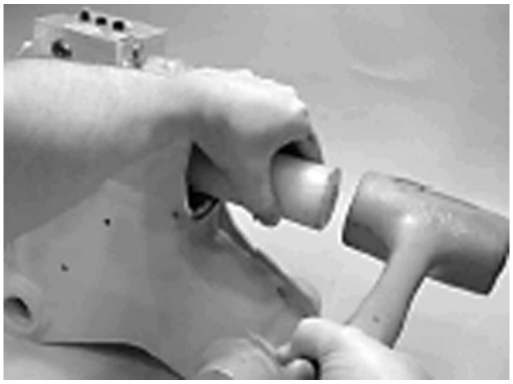


9. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.

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

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

12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is no damaged.



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

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

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

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

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

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

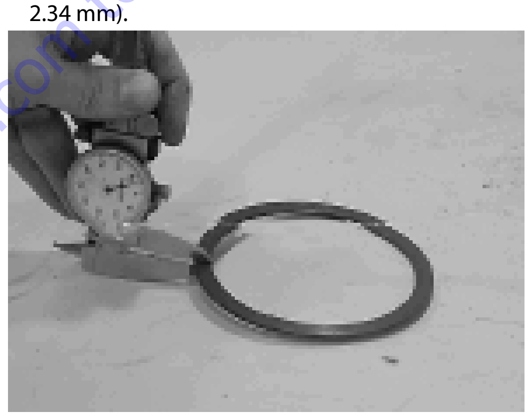
19. Remove the piston O.D. seal (202).

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

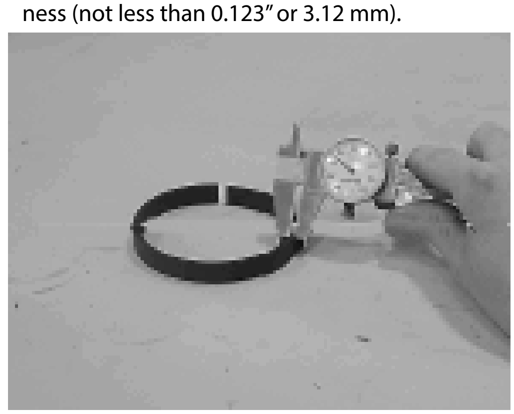
Inspection

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

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



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



Assembly

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

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

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

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

5. Install the wear guide (302) on the end cap (4) and shaft (2).

6. Install the inner T-seal (200) into the piston (3) using a circular motion. Install the outer T-seal (202) by stretching it around the groove in a circular motion. Each T-seal has 2 backup rings (see drawing for orientation).

7. Beginning with the inner seal (200) insert one end of b/u ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly. Repeat this step for the outer seal (202).

8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

9. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.

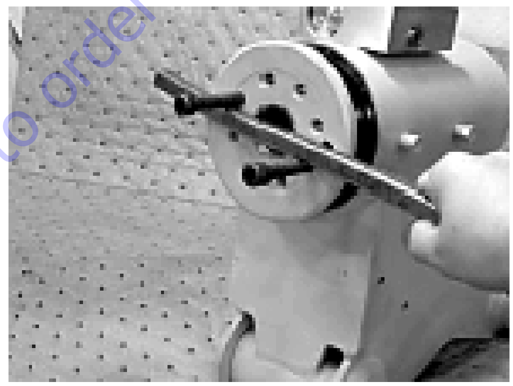
10. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.

11. Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.

12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.

13. Install 2 bolts in the threaded holes in the flange. Using a bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

14. Install the stop tube onto the shaft end. Stop tube is an available option to limit the rotation of an actuator.



15. Coat the threads on the end of the shaft with anti-seize grease to prevent galling.

16. Install the O-ring (204) and backup ring (207) into the inner seal groove on the end cap (4).

17. Thread the end cap (4) onto the shaft (2) end. Make sure the wear guide stays in place on the end cap as it is threaded into the housing (1).

18. Tighten the end cap (4). In most cases the original holes for the lock pins will line up.

19. Place the lock pins (109) provided in the Helac seal kit in the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.

20. Insert the set screws (113) over the lock pins. Tighten them to 25 in. lbs. (2.825 Nm).

Installing Counterbalance Valve

Refer to Figure 4-19., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Threadlocking Compound.
2. Make sure the new valve has the O-rings in the counterbores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. Medium Strength Threadlocking Compound should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-inch bolts 110 to 120 in. lbs. (12.4 to 13.5 Nm). Do not torque over 125 in. lbs. (14.1 Nm). Torque the 5/16-inch bolts 140 in. lbs. (15.8 Nm). Do not torque over 145 inch pounds (16.3 Nm).
5. Make sure the valve is seated against the housing valve flat. If it is raised up on any side or corner, remove the valve to determine what the obstruction is. If possible test this using hydraulic hand pump or electric test.

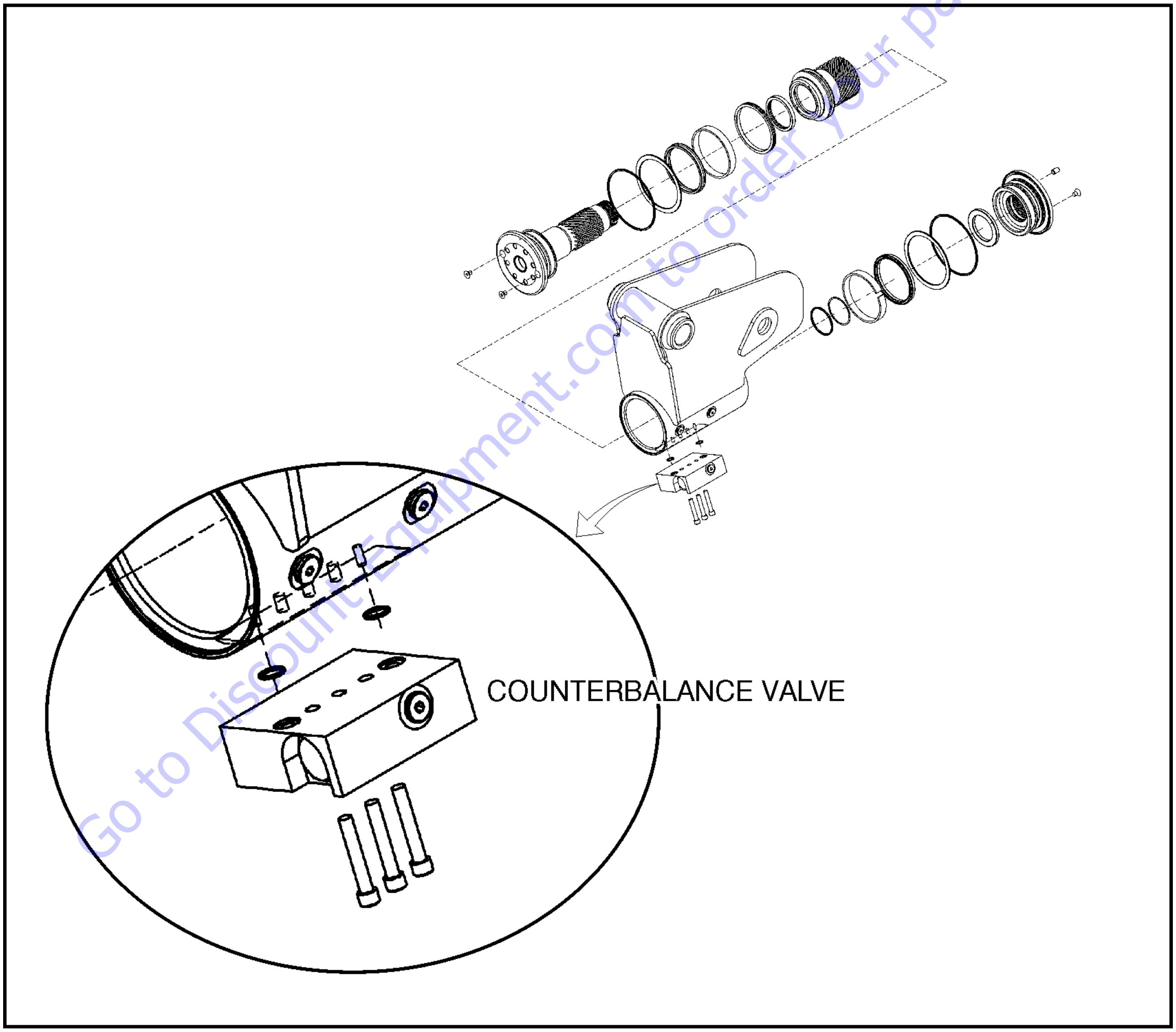


Figure 4-19. Rotator Counterbalance Valve

Greasing Thrust Washers

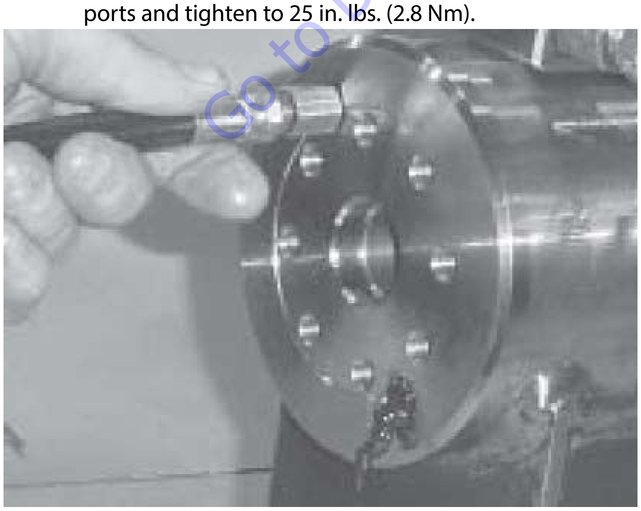
6. After the actuator is assembled but before it is put into service, the thrust washer area must be packed with Lithium grease.

7. There are two grease ports located on both the shaft flange and the end cap. They are plugged with capscrews (113) or set screws. Remove the grease port screws from the shaft flange and end cap. (See exploded view)

NOTICE

IF A HYDRAULIC TEST BENCH IS NOT AVAILABLE, THE ACTUATOR CAN BE ROTATED BY HAND, OPEN THE PRESSURE PORTS AND USE A PRY BAR WITH CAPSCREWS INSERTED INTO THE SHAFT FLANGE TO TURN THE SHAFT IN THE DESIRED DIRECTION.

8. Insert the tip of a grease gun into one port and apply grease to the shaft flange. Continue applying until grease flows from the opposite port. Cycle the actuator five times and apply grease again. Repeat this process on the end cap. Insert the capscrews into the grease ports and tighten to 25 in. lbs. (2.8 Nm).



Testing the Actuator

If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see Installation and Bleeding) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.

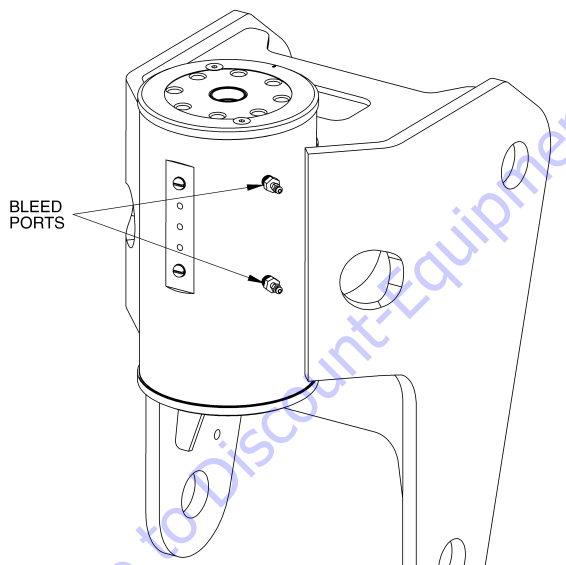
Installation and Bleeding

After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16" inside diameter x 5/16" outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.



TYPICAL CONFIGURATION OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.
3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.
4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

Troubleshooting

Table 4-1. Troubleshooting

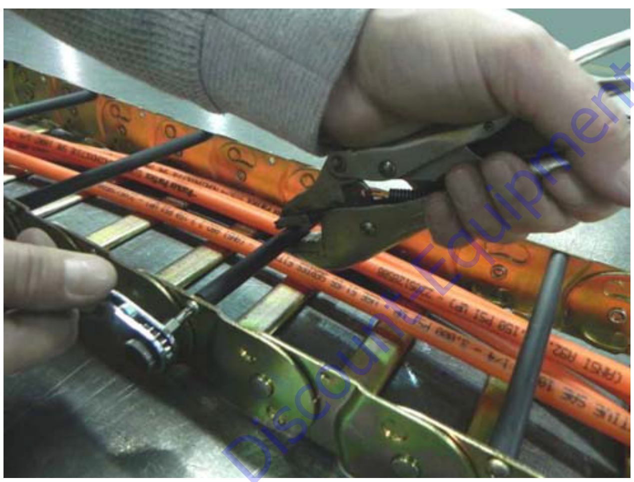
Problem	Cause	Solution
1. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks.
	c. Control or counterbalance valve has internal leak	c. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	d. Piston and/or shaft seal leak	d. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	e. Corrosion build-up on the thrust surfaces	e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed.
	f. Swollen seals and composite bearings caused by incompatible hydraulic fluid	f. Re-build the actuator. Use fluid that is compatible with seals and bearings.
2. Operation is erratic or not responsive	a. Air in actuator	a. Purge air from actuator. See bleeding procedures.
3. Shaft will not fully rotate	a. Twisted or chipped gear teeth	a. Check for gear binding. Actuator may not be able to be re-built and may need to be replaced. Damage could be a result of overload or shock.
	b. Port fittings are obstructing the piston	b. Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.
4. Selected position cannot be maintained	a. Control or counterbalance valve has internal leak	a. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	b. Piston and/or shaft seal leak	b. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	c. Air in actuator	c. Purge air from actuator. See bleeding procedures

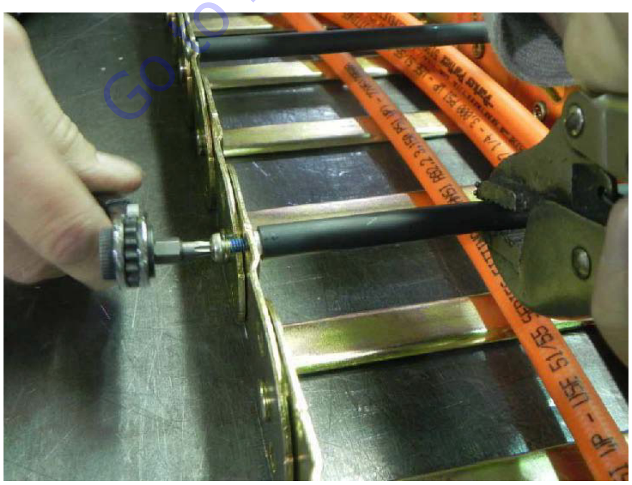
4.17 POWERTRACK MAINTENANCE

Removing a Link

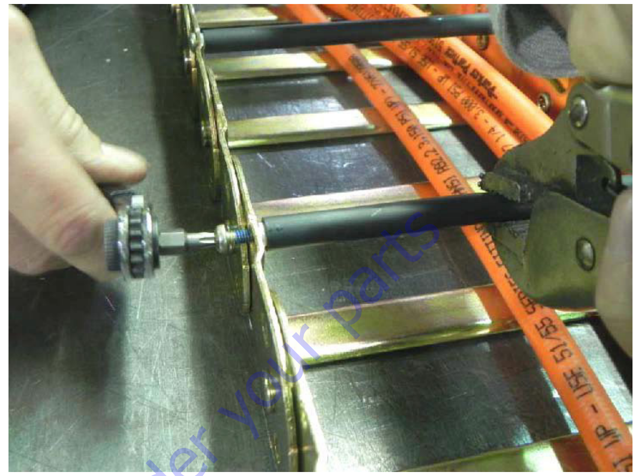
NOTE: *Hoses shown in the powertrack are for example only. Actual hose and cable arrangements will be different.*

1. Clamp the bar and poly roller tightly so they do not spin when removing the screw. With a small ¼" ratchet and a t-20 torx bit, remove the 8-32 x 0.500 screw from one side.

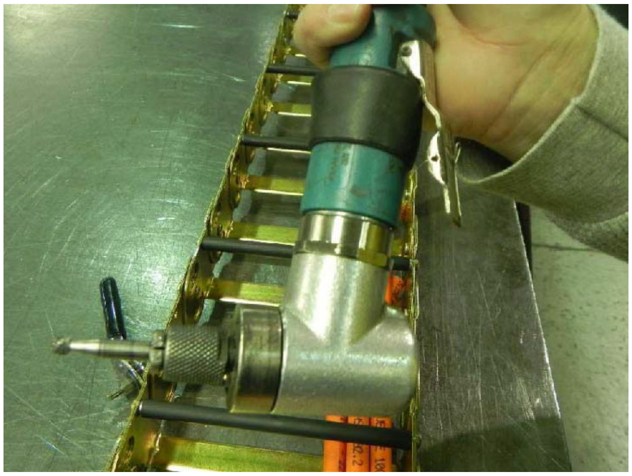


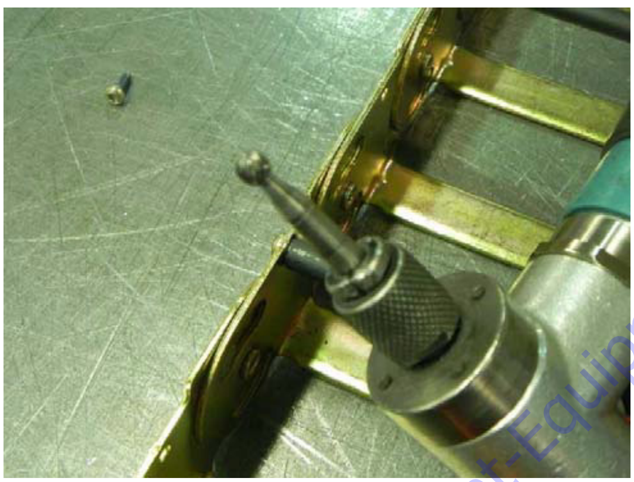


2. Repeat step 1 and remove the screw from the other side of track. Remove the bar/poly roller from the power-track. .



3. To remove a link, the rivets holding the links together must be removed. Use a right-angle pneumatic die grinder with a ¼" ball double cut bur attachment.

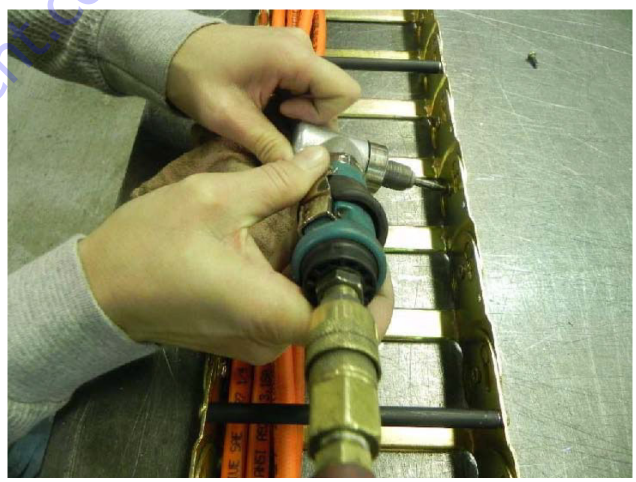




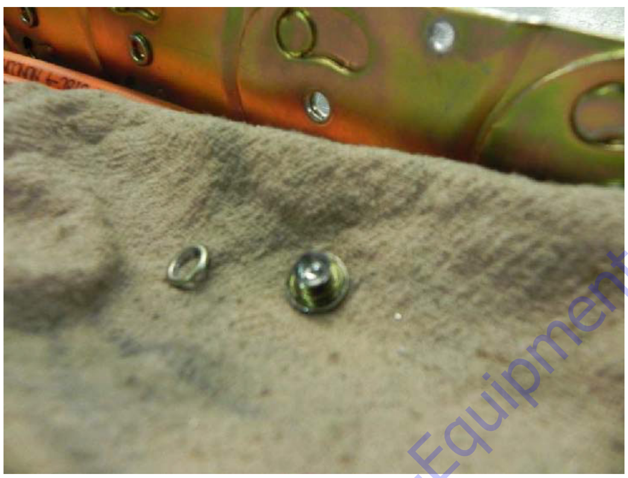
NOTICE

MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.

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

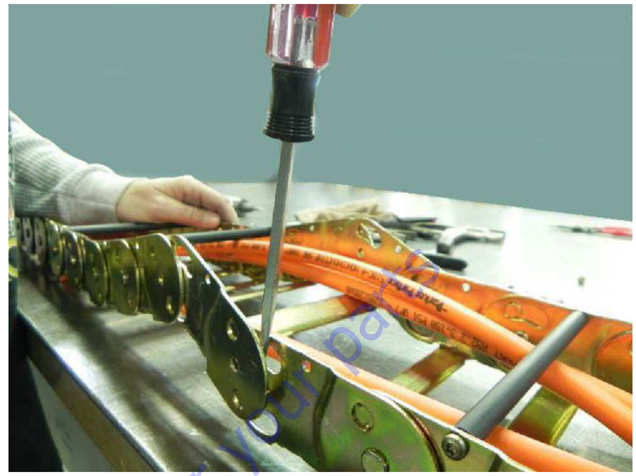


5. After grinding it may be neccesary to help the rivet out by using a center punch with a hammer.

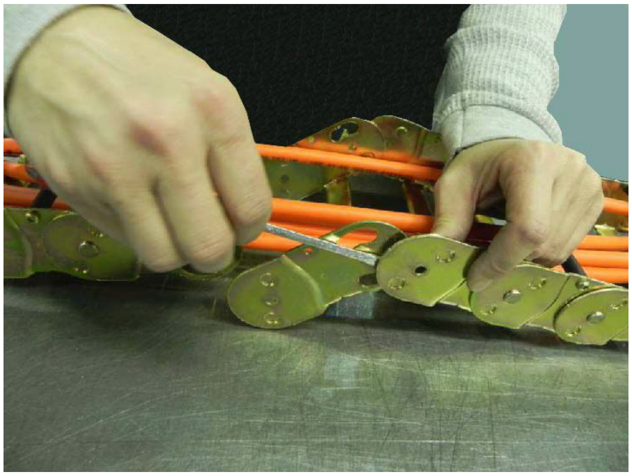


NOTE: *It may be necessary to loosen the fixed end brackets from the machine in order to twist and pull the track section enough to disconnect the links.*

6. Using a flat head screwdriver between the links, twist the screwdriver and pull the links apart.



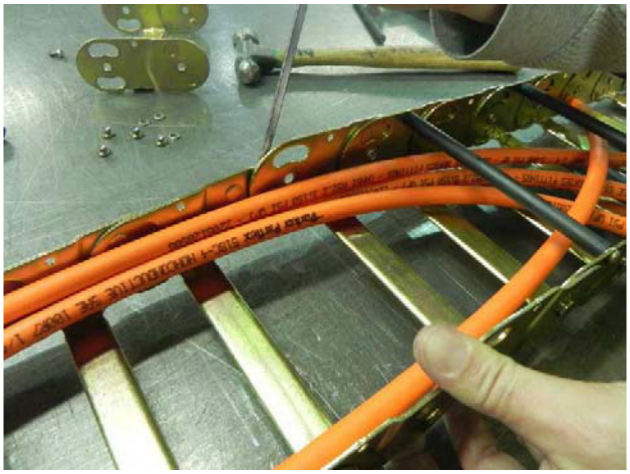
7. Remove the link from the other section of the power-track using a screwdriver.

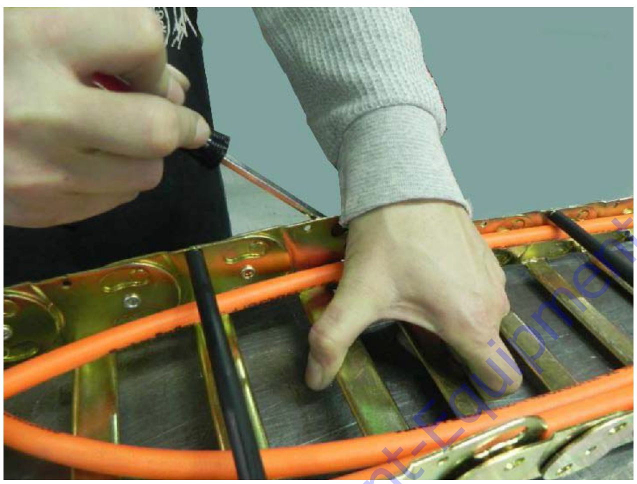


Installing a New Link

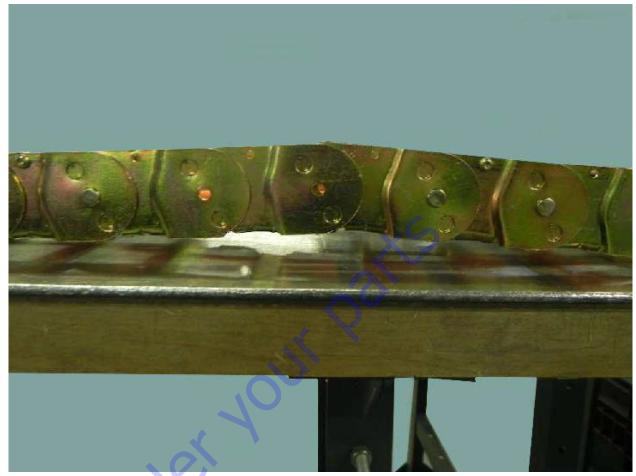
1. Squeeze the peanut cut out end of the new link into the half-shear (female) end of the track section.

2. Spread apart the half-shear (female) end of the new link and slide the peanut end of the track section into it. a screwdriver may be necessary to do this.

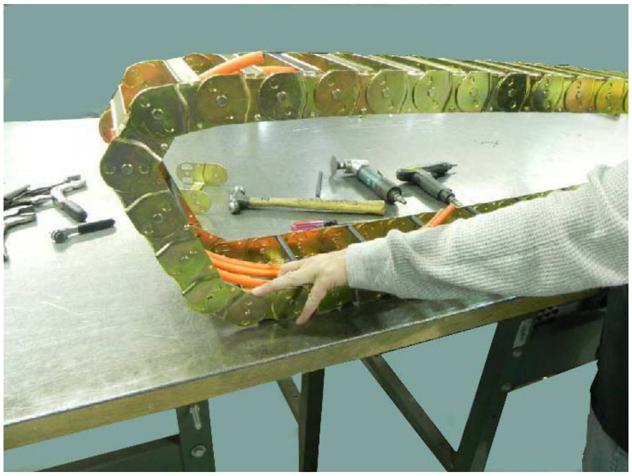




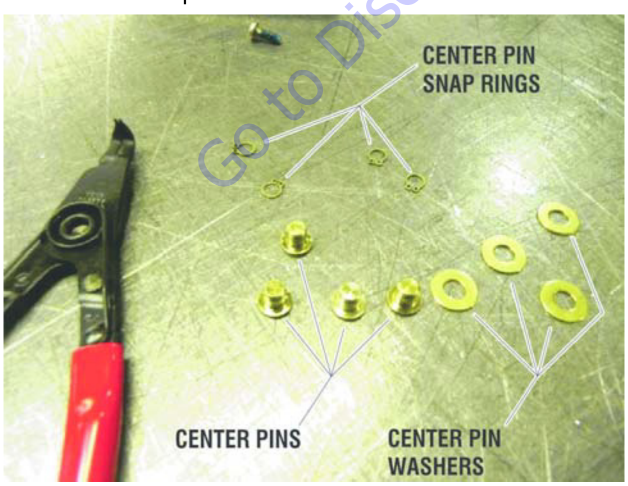
3. After the new link is installed in the powertrack the round half-shears will not fit properly in the peanut cut-outs yet.



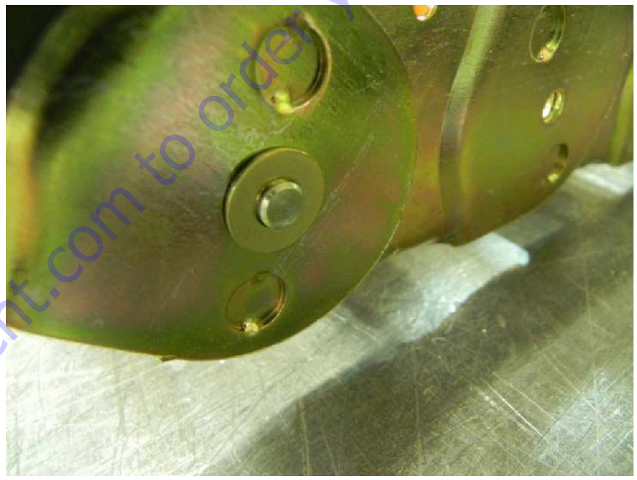
4. Pull the moving end out over the track so that the new connection is positioned in the curve of the powertrack. In this position the round half-shears will rotate into the peanut cut outs.



5. The parts shown below will be used to connect the new link to the powertrack.

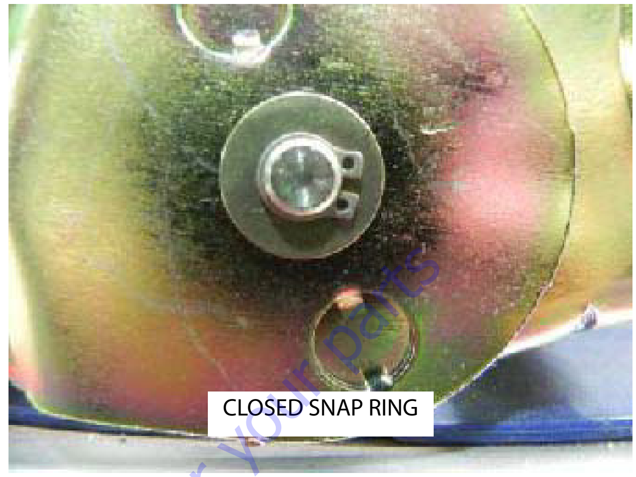


6. Push pin thru center hole then slide washer on pin.



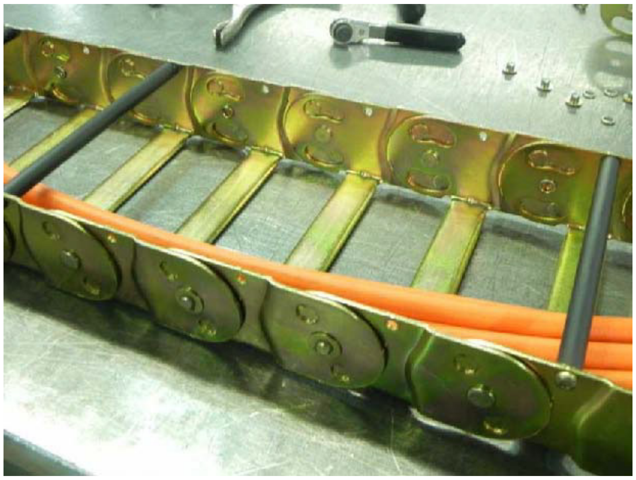
7. Install the snap ring in the groove on the pin. Repeat the pin installation steps for all center holes that have the rivets removed.

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

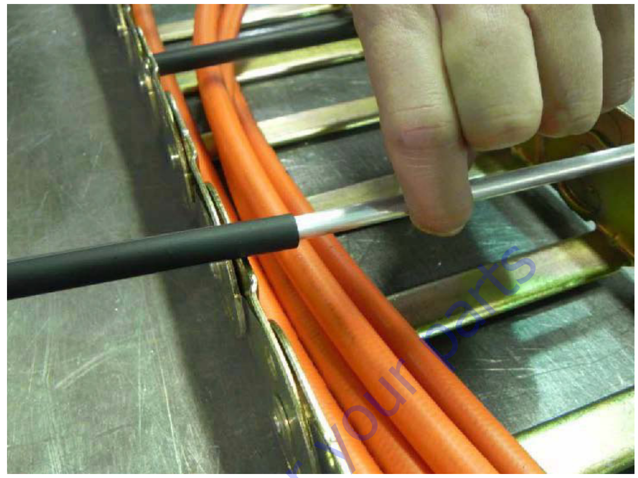


8. Hold new aluminum round bar tightly, then install new 8-32 x 0.500 self-threading torx head screw into one end.

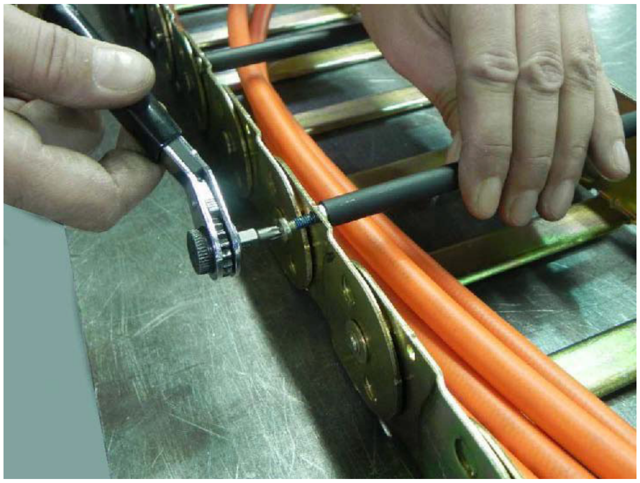
NOTE: *Maximum tightening torque is 18-20 in. lbs.*



9. Pull up on the other end of the round bar and slide the new poly roller onto the bar.

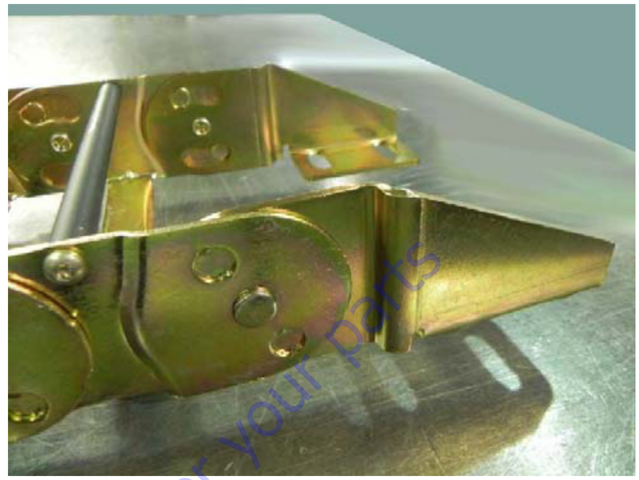


10. Install a new 8-32 x 0.500 self threading screw on the other side.



NOTE: *When tightening screws make sure screw head is seated against link with no space in between the link and underside of screw head. Maximum tightening torque is 18-20 in. lbs.*

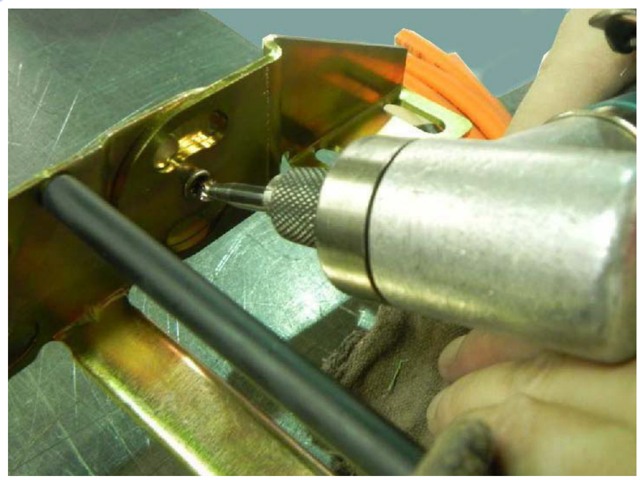
Replacing Fixed End Brackets



1. Remove the rivets the same way as shown under the link removal instructions.

NOTICE

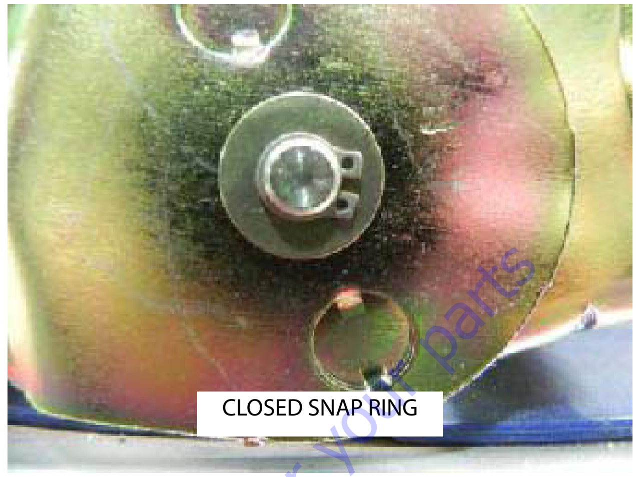
MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.



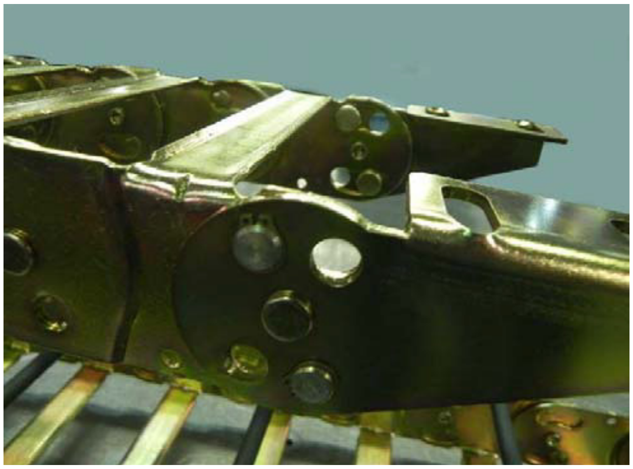
2. Parts used: Bracket Center Pin and Center Pin Snap Ring.

3. Take the new bracket and install bracket center pin and snap ring. Repeat on the other bracket if replacing it as well.

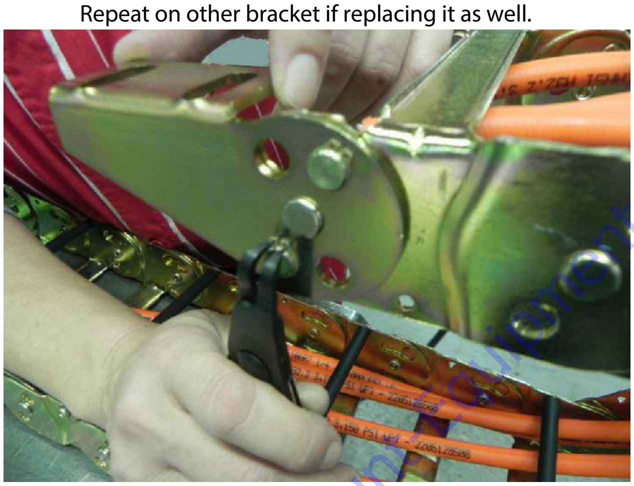
NOTE: *When installing snap rings make sure they are seated in pin groove and closed properly.*



Replacing Moving End Brackets

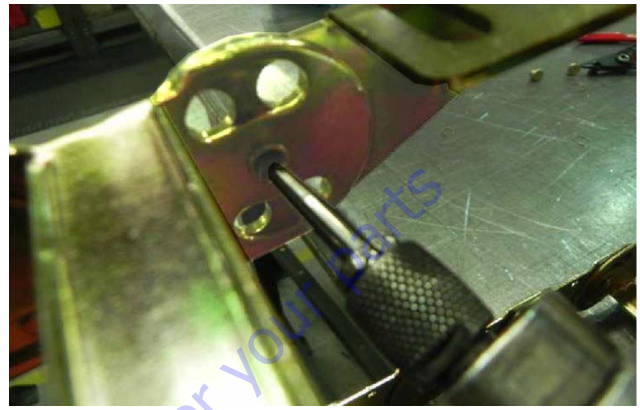


1. Remove existing pins and center rivet. Remove the rivet the same way as shown in the link removal instructions. Repeat on other bracket if replacing it as well.

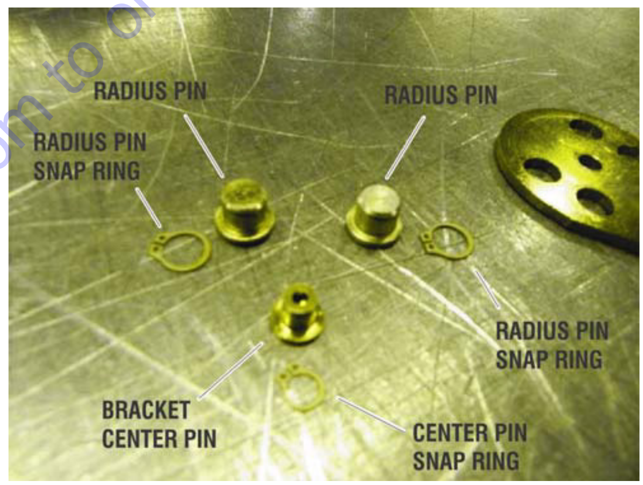


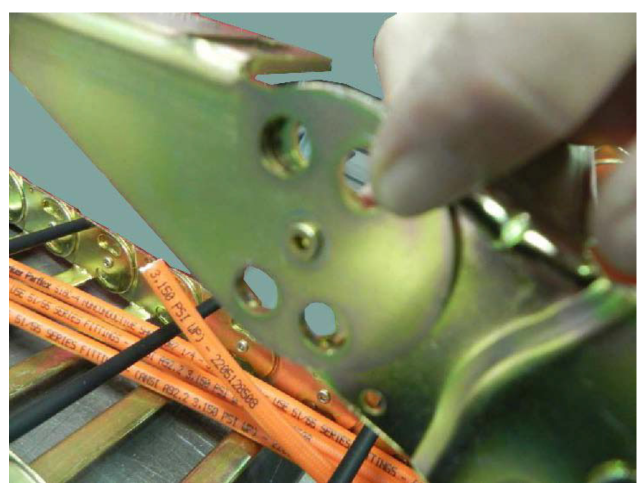
NOTICE

MOVE THE CABLES/HOSES OUT OF THE WAY DURING THE GRINDING PROCESS TO PROTECT THEM. KEEP THE HOSES AND CABLES COVERED TO PREVENT ANY DEBRIS FROM GETTING ON THEM.

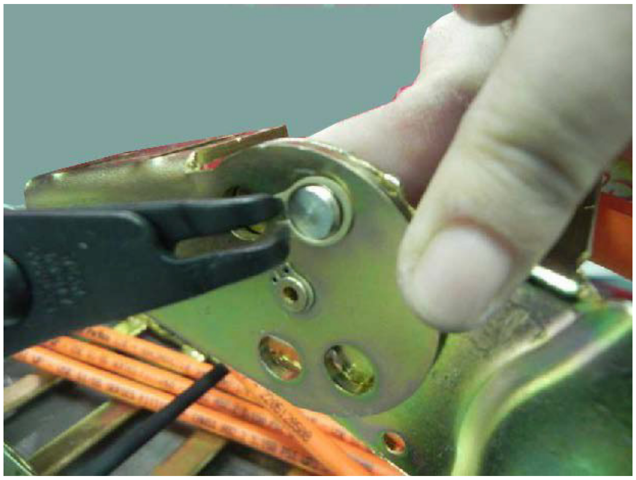


2. Take new bracket and install center pin with snap ring.

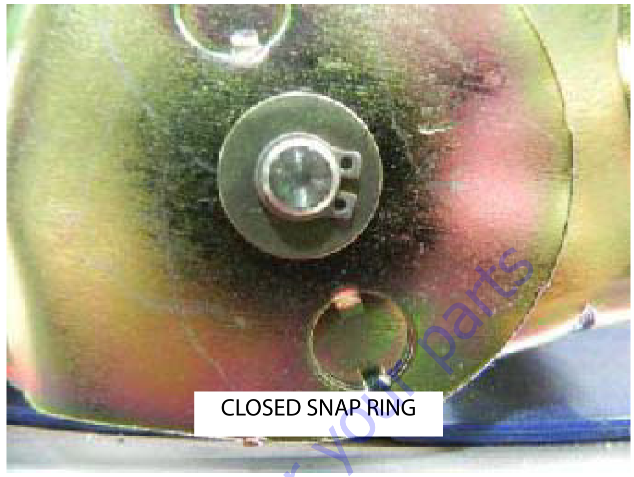




3. Install radius pins into their original locations and install snap rings. Repeat with other moving end if replacing as well.



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



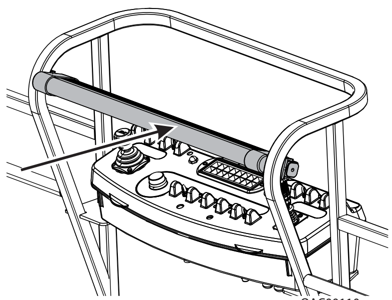
4. When complete make sure that both brackets rotate correctly.

4.18 SKYGUARD

Operation

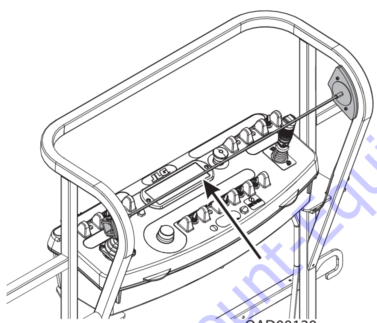
SkyGuard provides enhanced control panel protection. When the SkyGuard sensor is activated, functions in use at the time of actuation will reverse or cutout. The SkyGuard Function Table provides more details on these functions.

Consult the following illustrations to determine which type of SkyGuard the machine is equipped with. Regardless of the type, SkyGuard function according to the SkyGuard Function Table does not change.



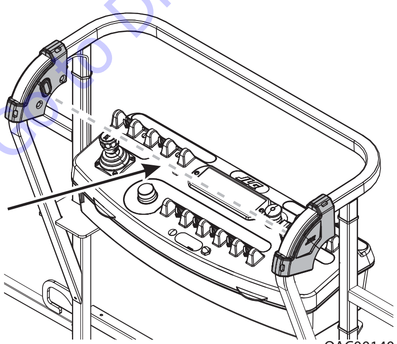
OAC00110

SkyGuard



OAD00120

SkyGuard SkyLine™



OAC00140

SkyGuard SkyEye™

⚠ WARNING

THE MACHINE OPERATOR IS REQUIRED TO PERFORM A DAILY FUNCTION TEST TO ENSURE PROPER OPERATION OF THE SKYGUARD SYSTEM.

Function Test

SKYGUARD ONLY

Perform this function test if **SkyGuard only** is selected in machine setup (refer to Table 6-2).

From the Platform Control Console in an area free from obstructions:

1. Operate the telescope out function, then activate SkyGuard sensor.
2. Once sensor has been activated, ensure telescope out function stops then telescope in function operates for a short duration. Additionally, verify Soft Touch/SkyGuard indicator light flashes and horn sounds. If machine is equipped with SkyGuard beacon, ensure it flashes when sensor activates.
3. With SkyGuard sensor still engaged, press and hold yellow Soft Touch/SkyGuard override button. Operate a function to verify operation can be resumed.
4. Disengage SkyGuard sensor, release controls, and recycle footswitch. Ensure normal operation available.

In Ground Mode:

Operation is allowed regardless of SkyGuard activation.

SOFT TOUCH ONLY

If **Soft Touch only** is selected in machine setup (refer to Table 6-2), machine will treat the Soft Touch/SkyGuard override switch as if it is a Soft Touch switch.

SKYGUARD NOT SELECTED IN MACHINE SETUP

If the SkyGuard option is not selected in the machine setup (refer to Table 6-2), SkyGuard sensor status will be ignored. No function cutout or reversal will be implemented.

Diagnostics & Troubleshooting

If SkyGuard does not function when the sensor is engaged, first verify the configuration under the MACHINE SETUP: SKYGUARD OPTION menu using the handheld Analyzer. Ensure the selected configuration matches the actual system installed on the machine. If not, select the correct configuration, then verify operation.

Additionally, use the handheld analyzer to navigate to the DIAGNOSTICS: FEATURES → SKYGUARD INPUTS menu to determine additional SkyGuard fault information.

Engage the SkyGuard sensor and observe the Analyzer to determine if the switch/relay closes.

If the status of the switch/relay remains OPEN while the SkyGuard sensor is actively engaged, it is possible the sensor has failed and should be replaced immediately.

If the status of the switch/relay remains CLOSED while the SkyGuard sensor is actively engaged, a power or ground wire may not be making good contact or may be loose or broken. Additionally, there is a low probability that both relays may have failed.

If the switch/relay status is in disagreement, then one may have failed or is not installed correctly. In this case, the machine will be inoperable.

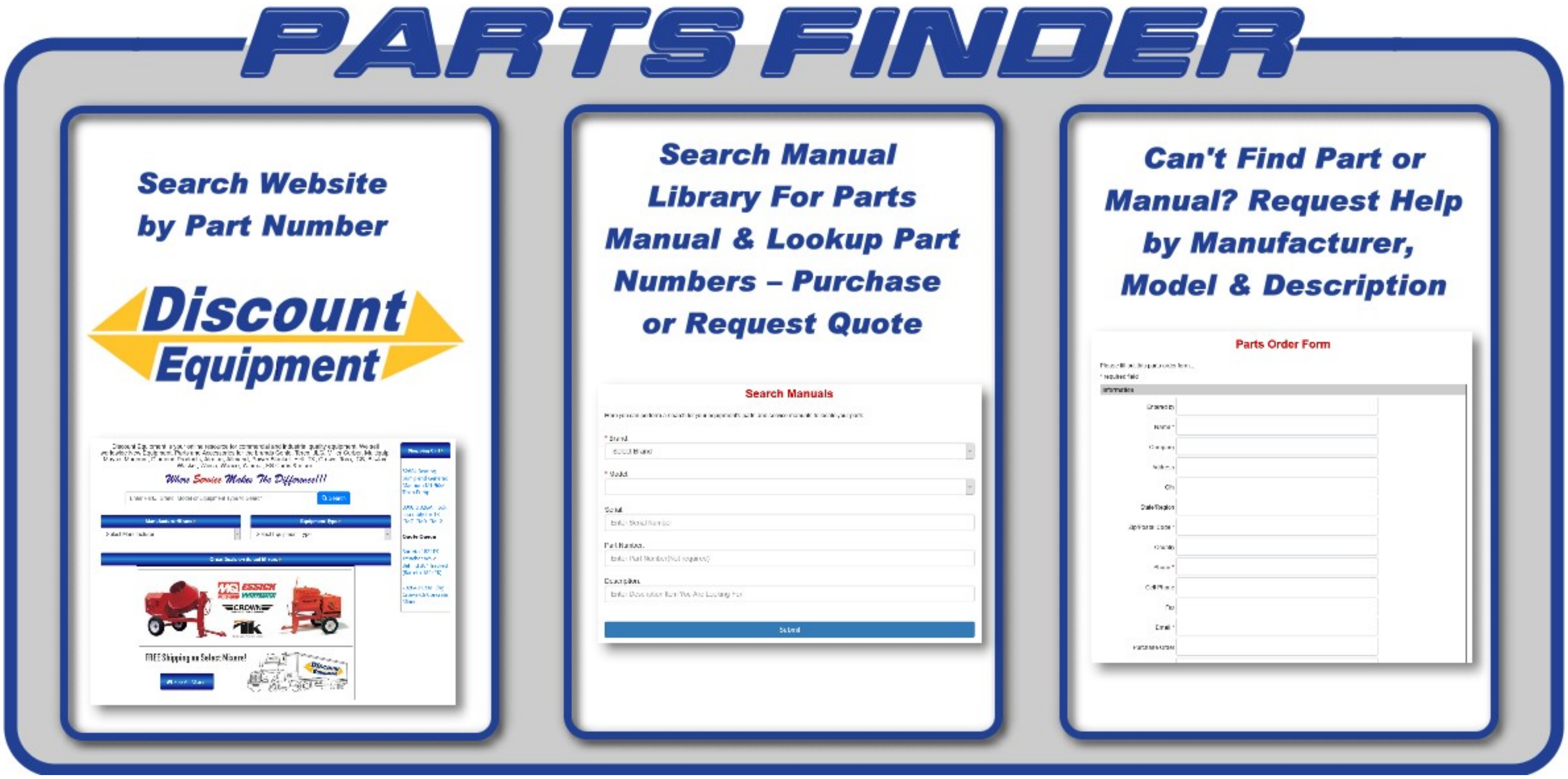
FAULT CODES

Refer to Table 6-11 for more fault code information

- **0039 -** SkyGuard switch activation fault
- **2563 -** SkyGuard switch disagreement fault

Table 4-2. SkyGuard Function Table

Drive Forward	Drive Reverse	Steer	Swing	Tower Lift Up	Tower Lift Down	Boom Lift Up	Boom Lift Down	Boom Tele Out	Boom Tele In	Jib Lift	Jib Swing	Basket Level	Basket Rotate
R*/C**	R	C	R	R	C	R	C	R	C	C	C	C	C
R = Indicates Reversal is Activated													
C = Indicates Cutout is Activated													
*DOS (Drive Orientation System) Enabled													
**DOS Not Enabled, Machine is driving straight without steering, and any other hydraulic function is active													



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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husqvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 5. BASIC HYDRAULIC INFORMATION & SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

NOTE: *All o-ring fittings must be pre-lubricated with hydraulic oil prior to assembly.*

Cup and Brush

The following is needed to correctly oil the o-ring in this manner:

- A small container for hydraulic oil
- Small paint brush

1. Hold the fitting in one hand while using the brush with the other hand to dip into the container. Remove excess hydraulic oil from the brush so an even film of oil is applied on the o-ring.

2. Holding the fitting over the hydraulic oil container, brush an even film of oil around the entire o-ring in the fitting, making sure the entire o-ring is completely saturated.

3. Turn the o-ring on the other side of the fitting and repeat the previous step, ensuring the entire o-ring is coated with hydraulic oil.

Dip Method

NOTE: *This method works best with Face Seal o-rings, but will work for all o-ring fitting types.*

The following is needed to correctly oil the o-ring in this manner:

- A small leak proof container
- Sponge cut to fit inside the container
- A small amount of hydraulic oil to saturate the sponge.

1. Place the sponge inside the container and add hydraulic oil to the sponge until it is fully saturated.
2. Dip the fitting into the sponge using firm pressure. Upon lifting the fitting, a small droplet will form and drip from the bottom of the fitting. This should signify an even coating of oil on the fitting.

3. O-ring Boss type fittings will require more pressure in able to immerse more of the fitting into the saturated sponge. This will also cause more oil to be dispersed from the sponge.

Spray Method

This method requires a pump or trigger spray bottle.

1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

1. Fill the bottle with hydraulic oil.
2. Using slight pressure to the body of the spray bottle, invert the bottle so the brush end is in the downward position.
3. Brush hydraulic oil on the entire o-ring, applying an even coat of oil.

5.2 HYDRAULIC CONNECTION ASSEMBLY AND TORQUE SPECIFICATION

Tapered Thread Types

NPTF = national tapered fuel (Dry Seal) per SAE J476/J512

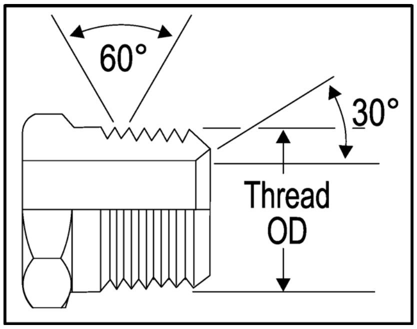


Figure 5-1. NPTF Thread

BSPT = British standard pipe tapered per ISO7-1

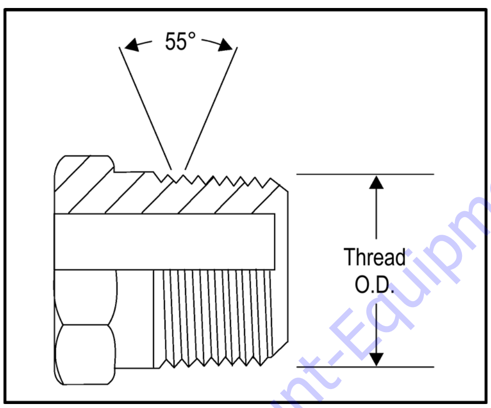


Figure 5-2. BSPT Thread

Straight Thread Types, Tube and Hose Connections

JIC = 37° flare per SAE J514

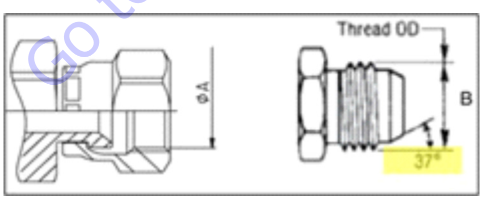


Figure 5-3. JIC Thread

SAE = 45° flare per SAE J512

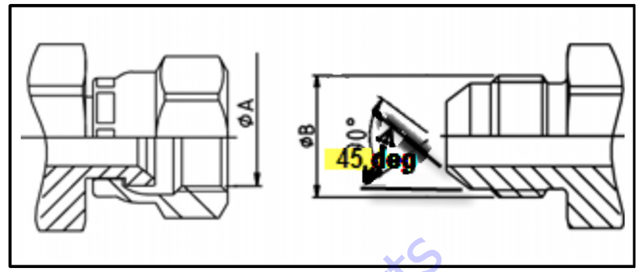


Figure 5-4. SAE Thread

ORFS = o-ring face seal per SAE J1453

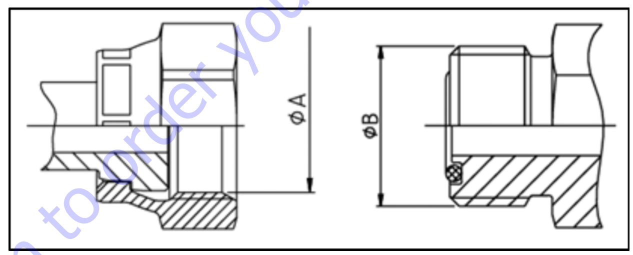


Figure 5-5. ORFS Thread

MBTL = metric flareless bite type fitting, pressure rating L (medium) per ISO 8434, DIN 2353

MBTS = metric flareless bite type fitting, pressure rating S (high) per ISO 8434, DIN 2353

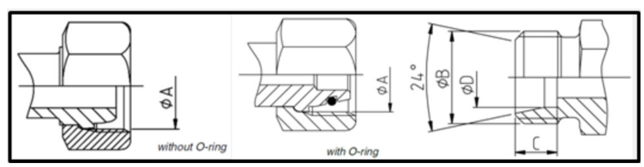


Figure 5-6. MTBL-MBTS Thread

BH = bulkhead connection – JIC, ORFS, MBTL, or MBTS types

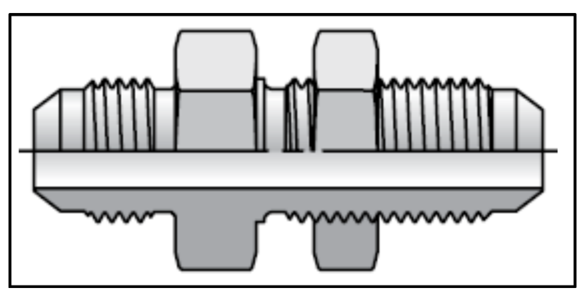


Figure 5-7. Bulkhead Thread

Straight Thread Types, Port Connections

ORB = o-ring boss per SAE J1926, ISO 11926

MPP = metric pipe parallel o-ring boss per SAE J2244, ISO 6149, DIN 3852

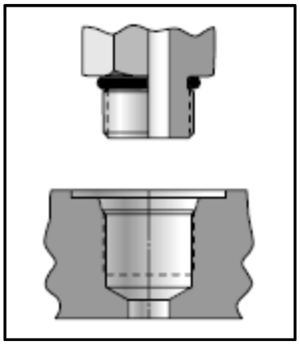


Figure 5-8. ORB-MPP Thread

MFF = metric flat face port per ISO 9974-1

BSPP = British standard parallel pipe per ISO 1179-1, DIN 3852-2

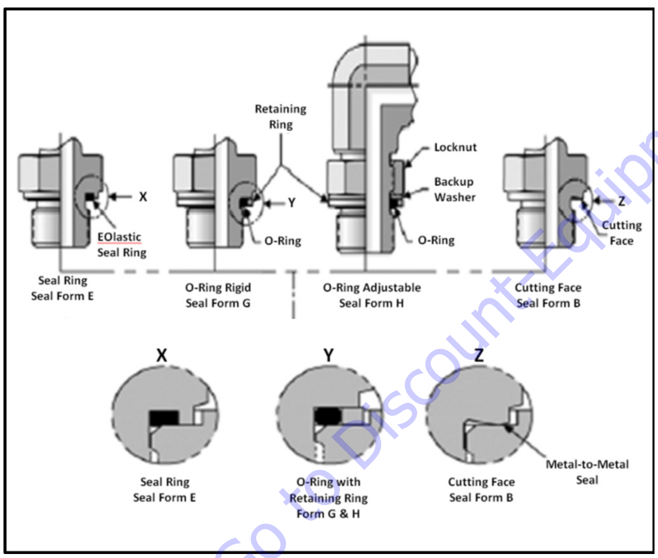


Figure 5-9. MFF-BSPP Thread

Flange Connection Types

FL61 = code 61 flange per SAE J518, ISO 6162

FL62 = code 62 flange per SAE J518, ISO 6162

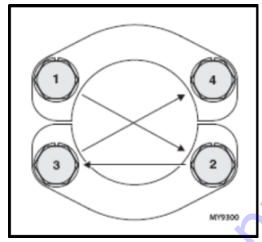


Figure 5-10. ORB-MPP Thread

Tightening Methods

Torque = Application of a twisting force to the applicable connection by use of a precise measurement instrument (i.e. torque wrench).

Finger Tight = The point where the connector will no longer thread onto the mating part when tightened by hand or fingers. Finger Tight is relative to user strength and will have some variance. The average torque applied by this method is 3 ft-lbs [4 N-m] Also referred to as 'Hand Tight.'

TFFT = Turns From Finger Tight; Application of a preload to a connection by first tightening the connection by hand (fingers) and applying an additional rotation counted by a defined number of turns by use of a tool.

FFWR = Flats from Wrench Resistance; Application of a preload to a connection by tightening to the point of initial wrench resistance and turning the nut a described number of 'flats'. A 'flat' is one side of the hexagonal tube nut and equates to 1/6 of a turn. Also referred to as the 'Flats Method.'

Assembly and Torque Specifications

Prior to selecting the appropriate torque from the tables within this section, it is necessary to properly identify the connector being installed. Refer to the Figures and Tables in this section.

GENERAL TUBE TYPE FITTING ASSEMBLY INSTRUCTIONS

1. Take precautions to ensure that fittings and mating components are not damaged during storage, handling or assembly. Nicks and scratches in sealing surfaces can create a path for leaks which could lead to component contamination and/or failure.
2. When making a connection to tubing, compression or flare, inspect the tube in the area of the fitting attachment to ensure that the tube has not been damaged.
3. The assembly process is one of the leading causes for contamination in air and hydraulic systems. Contamination can prevent proper tightening of fittings and adapters from occurring.
    - **a.** Avoid using dirty or oily rags when handling fittings.
    - **b.** If fittings are disassembled, they should be cleaned and inspected for damage. Replace fittings as necessary before re-installing.
    - **c.** Sealing compounds should be applied where specified; however, care should be taken not to introduce sealant into the system.
    - **d.** Avoid applying sealant to the area of the threads where the sealant will be forced into the system. This is generally the first two threads of a fitting.
    - **e.** Sealant should only be applied to the male threads.
    - **f.** Straight thread fittings do not require sealants. O-rings or washers are provided for sealing.
    - **g.** When replacing or installing an O-ring, care is to be taken while transferring the O-ring over the threads as it may become nicked or torn. When replacing an O-ring on a fitting, the use of a thread protector is recommended.
    - **h.** When installing fittings with O-rings, lubrication shall be used to prevent scuffing or tearing of the O-ring. See O-ring Installation (Replacement) in this section.
4. Take care to identify the material of parts to apply the correct torque values.
    - **a.** Verify the material designation in the table headings.
    - **b.** If specifications are given only for steel fittings and components, the values for alternate materials shall be as follows: Aluminum and Brass- reduce steel values by 35%; Stainless Steel- Use the upper limit for steel.
5. To achieve the specified torque, the torque wrench is to be held perpendicular to the axis of rotation.

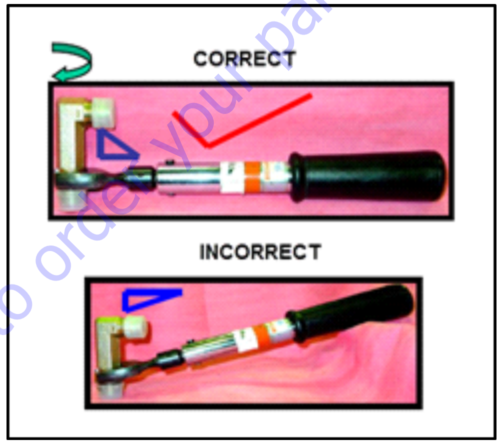


Figure 5-11. Torque Wrench Angle

6. Refer to the appropriate section in this manual for more specific instructions and procedures for each type of fitting connection

Assembly Instructions for American Standard Pipe Thread Tapered (NPTF) Connections.

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Threadlocking Compound 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

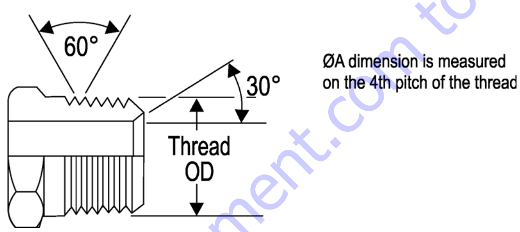
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-1, NPTF Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-1, NPTF Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-1. NPTF Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
Material	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH STEEL, ALUMINUM, OR BRASS MATING COMPONENTS	2	1/8 - 27	0.40	10.24	2 to 3
	4	1/4 - 18	0.54	13.61	2 to 3
	6	3/8 - 18	0.67	17.05	2 to 3
	8	1/2 - 14	0.84	21.22	2 to 3
	12	3/4 - 14	1.05	26.56	2 to 3
	16	1 - 11 1/2	1.31	33.22	1.5 to 2.5
	20	1 1/4 - 11 1/2	1.65	41.98	1.5 to 2.5
	24	1 1/2 - 11 1/2	1.89	48.05	1.5 to 2.5
	32	2 - 11 1/2	2.37	60.09	1.5 to 2.5

* ØA thread dimension for reference only.

** See FFWR and TFFT Methods subsection for TFFT procedure requirements.

Assembly Instructions for British Standard Pipe Thread Tapered (BSPT) Connections

1. Inspect components to ensure male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.
2. Apply a suitable thread sealant, such as Threadlocking Compound 567, to the male pipe threads if not already applied. Ensure the first 1 to 2 threads are uncovered to prevent system contamination.
3. Assemble connection hand tight.
4. Mark fittings, male and female.

⚠ CAUTION

OVER TIGHTENING MAY CAUSE DEFORMATION OF THE PIPE FITTING AND DAMAGE TO THE JOINING FITTING, FLANGE OR COMPONENT MAY OCCUR.

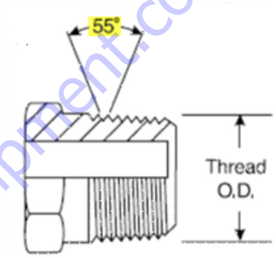
NEVER BACK OFF (LOOSEN) PIPE THREADED CONNECTORS TO ACHIEVE ALIGNMENT. MEET THE MINIMUM REQUIRED TURNS AND USE THE LAST TURN FOR ALIGNMENT.

5. Rotate male fitting the number of turns per Table 5-2, BSPT Pipe Thread. See FFWR and TFFT Methods for TFFT procedure requirements.

NOTE: *TFFT values provided in Table 5-2, BSPT Pipe Thread are applicable for the following material configurations:*

- STEEL fittings with STEEL mating components
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-2. BSPT Pipe Thread



TYPE/FITTING IDENTIFICATION					Turns From Finger Tight (TFFT)**
MATERIAL	Dash Size	Thread Size (BSPT)	ØA* (in)	ØA* (mm)	
STEEL, ALUMINUM, OR BRASS FITTINGS WITH **STEEL, ALUMINUM, OR BRASS** MATING COMPONENTS	2	1/8 - 28	0.38	9.73	2 to 3
	4	1/4 - 19	0.52	13.16	2 to 3
	6	3/8 - 19	0.66	16.66	2 to 3
	8	1/2 - 14	0.83	20.96	2 to 3
	12	3/4 - 14	1.04	26.44	2 to 3
	16	1 - 11	1.31	33.25	1.5 to 2.5
	20	1 1/4 - 11	1.65	41.91	1.5 to 2.5
	24	1 1/2 - 11	1.88	47.80	1.5 to 2.5
	32	2 - 11	2.35	59.61	1.5 to 2.5

* ØA thread dimension for reference only.

** See Appendix B for TFFT procedure requirements.

Assembly Instructions for 37° (JIC) Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting and start threads by hand.

CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

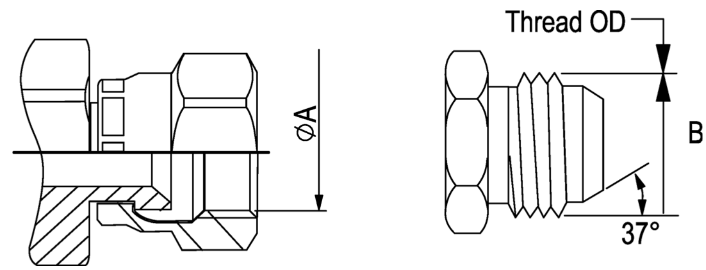
3. Torque assembly to value listed in Table 5-3, 37° Flare (JIC) Thread - Steel or Table 5-4, 37° Flare (JIC) Thread - Aluminum/Brass while using the Double Wrench Method per Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

NOTE: *Torque values provided in Table 5-3, 37° Flare (JIC) Thread - Steel and Table 5-4, 37° Flare (JIC) Thread - Aluminum/ Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-3. 37° Flare (JIC) Thread - Steel

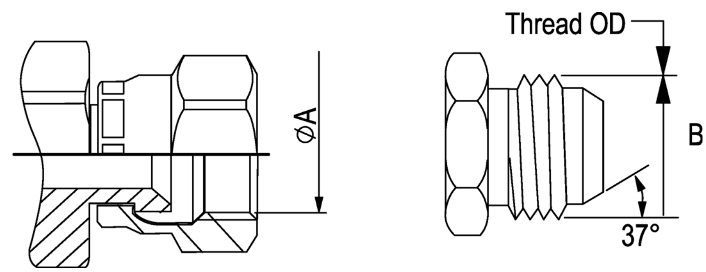


Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	ØB* (in)	ØB* (mm)	[Ft-Lb] Min	[Ft-Lb] Nom	[Ft-Lb] Max	[N-m] Min	[N-m] Nom	[N-m] Max	
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	6	7	7	8	9	10	--
	3	3/8-24	0.34	8.60	0.37	9.50	8	9	10	11	12	14	--
	4	7/16-20	0.39	10.00	0.44	11.10	13	14	14	18	19	19	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	14	15	15	19	20	21	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	22	23	24	30	31	33	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	42	44	46	57	60	63	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	60	63	66	81	85	89	1 to 1-1/2
	12	1 1/16-12	0.97	24.60	1.06	27.00	84	88	92	114	120	125	1 to 1-1/2
	14	13/16-12	1.11	28.30	1.19	30.10	100	105	110	136	142	149	1 to 1-1/2
	16	15/16-12	1.23	31.30	1.31	33.30	118	124	130	160	168	176	3/4 to 1
	20	15/8-12	1.54	39.20	1.63	41.30	168	176	185	228	239	251	3/4 to 1
	24	17/8-12	1.80	45.60	1.87	47.60	195	205	215	264	278	291	3/4 to 1
	32	2 1/2-12	2.42	61.50	2.50	63.50	265	278	292	359	377	395	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Table 5-4. 37° Flare (JIC) Thread - Aluminum/Brass



Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max	
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.28	7.00	0.31	7.75	4	4	5	5	6	7	--
	3	3/8-24	0.34	8.60	0.37	9.50	5	6	7	7	8	9	--
	4	7/16-20	0.39	10.00	0.44	11.10	8	9	9	11	12	13	1-1/2 to 1-3/4
	5	1/2-20	0.46	11.60	0.50	12.70	9	10	10	12	13	14	1 to 1-1/2
	6	9/16-18	0.51	13.00	0.56	14.30	14	15	16	19	20	21	1 to 1-1/2
	8	3/4-16	0.69	17.60	0.75	19.10	27	29	30	37	39	41	1-1/2 to 1-3/4
	10	7/8-14	0.81	20.50	0.87	22.20	39	41	43	53	56	58	1 to 1-1/2
	12	11/16-12	0.97	24.60	1.06	27.00	55	57	60	74	78	81	1 to 1-1/2
	14	13/16-12	1.11	28.30	1.19	30.10	65	68	72	88	93	97	1 to 1-1/2
	16	15/16-12	1.23	31.30	1.31	33.30	77	81	84	104	109	114	3/4 to 1
	20	15/8-12	1.54	39.20	1.63	41.30	109	115	120	148	155	163	3/4 to 1
	24	17/8-12	1.80	45.60	1.87	47.60	127	133	139	172	180	189	3/4 to 1
	32	21/2-12	2.42	61.50	2.50	63.50	172	181	189	234	245	257	3/4 to 1

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Assembly Instructions for 45° SAE Flare Fittings

1. Inspect the flare for obvious visual squareness and concentricity issues with the tube OD. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

DO NOT FORCE A MISALIGNED OR SHORT HOSE/TUBE INTO ALIGNMENT. IT PUTS UNDESIRABLE STRAIN ONTO THE JOINT EVENTUALLY LEADING TO LEAKAGE.

2. Align tube to fitting.
3. Tighten fitting by hand until hand tight.

⚠ CAUTION

THE TORQUE METHOD SHOULD NOT BE USED ON LUBRICATED OR OILY FITTINGS. NO LUBRICATION OR SEALANT IS REQUIRED. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

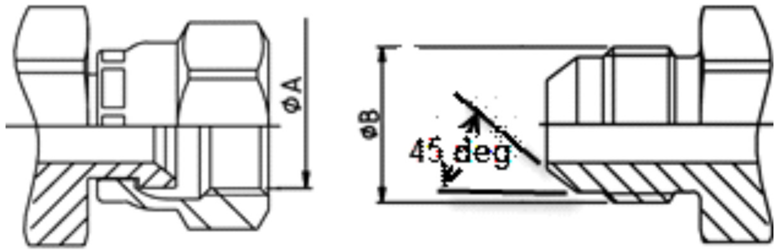
Torque fitting to value listed in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass while using the Double Wrench Method outlined in this section. Refer to FFWR and TFFT Methods for procedure requirements if using the TFFT method.

NOTE: *Torque values provided in Table 5-5, 45° Flare (SAE) - Steel and Table 5-6, 45° Flare (SAE) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

Table 5-5. 45° Flare (SAE) - Steel

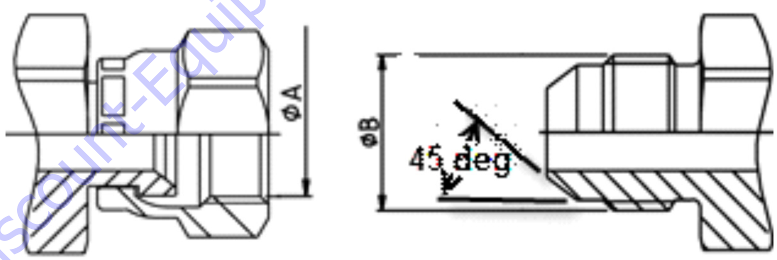


Type/Fitting Identification							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	13	14	14	18	19	19
	6	5/8-18	0.56	14.30	0.63	15.90	22	23	24	30	31	33
	8	3/4-16	0.69	17.50	0.75	19.10	42	44	46	57	60	62
	10	7/8-14	0.81	20.60	0.87	22.20	60	63	66	81	85	89
	12	1 1/16-14	0.98	25.00	1.06	27.00	84	88	92	114	119	125

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 5-6. 45° Flare (SAE) - Aluminum/Brass



Type/Fitting Identification							Torque					
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]		
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	7/16-20	0.39	9.90	0.44	11.10	8	9	9	11	12	12
	6	5/8-18	0.56	14.30	0.63	15.90	14	15	15	19	20	20
	8	3/4-16	0.69	17.50	0.75	19.10	27	29	30	37	39	41
	10	7/8-14	0.81	20.60	0.87	22.20	39	41	43	53	56	58
	12	1 1/16-14	0.98	25.00	1.06	27.00	55	58	61	75	79	83

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for TFFT procedure requirements.

Assembly Instructions for O-Ring Face Seal (ORFS) Fittings

1. Ensure proper O-ring is installed. If O-ring is missing install per O-ring Installation (Replacement).

2. Ensure surface is smooth, free of rust, weld and brazing splatter, splits, dirt, foreign matter, or burrs. If necessary replace fitting or adapter.

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.

4. Place the tube assembly against the fitting body so that the flat face comes in contact with the O-ring. Hand thread the nut onto the fitting body.

5. Torque nut to value listed in Table 5-7, O-ring Face Seal (ORFS) - Steel or Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass while using the Double Wrench Method. Refer to FFWR and TFFT Methods for procedure requirements if using the FFWR method.

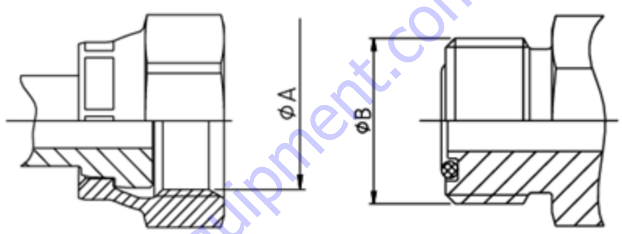
NOTE: *Torque values provided in Table 5-7, O-ring Face Seal (ORFS) - Steel and Table 5-8, O-ring Face Seal (ORFS) - Aluminum/Brass are segregated based on the material configuration of the connection.*

ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or

BRASS mating components

Table 5-7. O-ring Face Seal (ORFS) - Steel

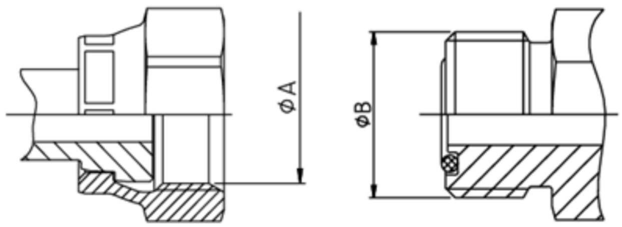


Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size	ØA*		ØB*		[Ft-Lb]			[N-m]			Tube Nuts	Swivel & Hose Ends
		(UNF)	(in)	(mm)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max		
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	18	19	20	25	26	27	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	30	32	33	40	43	45	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	40	42	44	55	57	60	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	60	63	66	81	85	89	1/4 to 1/2	1/2 to 3/4
	12	1 3/16-12	1.11	28.20	1.19	30.10	85	90	94	115	122	127	1/4 to 1/2	1/2 to 3/4
	16	1 7/16-12	1.34	34.15	1.44	36.50	110	116	121	149	157	164	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	150	158	165	203	214	224	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	230	242	253	312	328	343	1/4 to 1/2	1/2 to 3/4
	32	2 1/2-12	2.43	61.67	2.50	63.50	375	394	413	508	534	560	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

Table 5-8. O-ring Face Seal (ORFS) - Aluminum/Brass



Type/Fitting Identification							Torque						Flats from Wrench Resistance (F.F.W.R)**	
MATERIAL	Dash Size	Thread Size (UNF)	ØA* (in)	ØA* (mm)	ØB* (in)	ØB* (mm)	[Ft-Lb] Min	[Ft-Lb] Nom	[Ft-Lb] Max	[N-m] Min	[N-m] Nom	[N-m] Max	Tube Nuts	Swivel & Hose Ends
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	4	9/16-18	0.51	13.00	0.56	14.20	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	6	11/16-16	0.63	15.90	0.69	17.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4
	8	13/16-16	0.75	19.10	0.81	20.60	26	28	29	35	38	39	1/4 to 1/2	1/2 to 3/4
	10	1-14	0.94	23.80	1.00	25.40	39	41	43	53	56	58	1/4 to 1/2	1/2 to 3/4
	12	13/16-12	1.11	28.20	1.19	30.10	55	58	61	75	79	83	1/4 to 1/2	1/2 to 3/4
	16	17/16-12	1.34	34.15	1.44	36.50	72	76	79	98	103	107	1/4 to 1/2	1/2 to 3/4
	20	1 11/16-12	1.59	40.50	1.69	42.90	98	103	108	133	140	146	1/4 to 1/2	1/2 to 3/4
	24	2-12	1.92	48.80	2.00	50.80	12	13	13	16	18	18	1/4 to 1/2	1/2 to 3/4
	32	2 1/2-12	2.43	61.67	2.50	63.50	20	21	22	27	28	30	1/4 to 1/2	1/2 to 3/4

* ØA and ØB thread dimensions for reference only.

** See FFWR and TFFT Methods for FFWR procedure requirements.

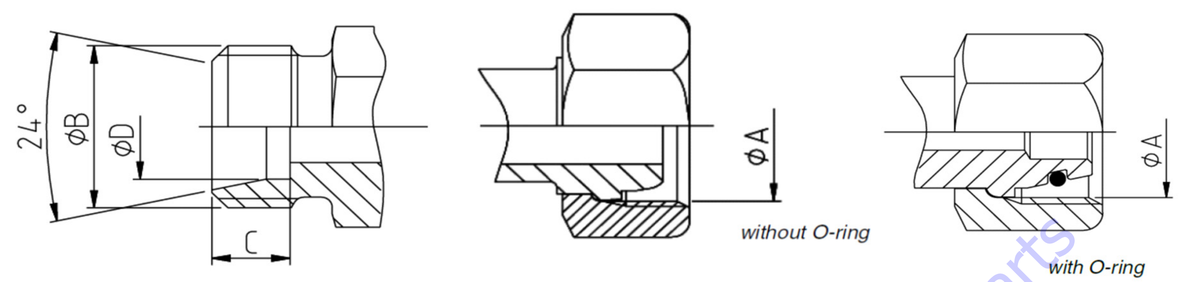
Assembly Instructions for DIN 24° Flare Bite Type Fittings (MBTL and MBTS)

CAUTION

A NON-SQUARE TUBE END CAN CAUSE IMPROPERLY SEATED FITTINGS AND LEAKAGE.

1. Inspect the components to ensure free of contamination, external damage, rust, splits, dirt, foreign matter, or burrs. Ensure tube end is visibly square. If necessary replace fitting or tube.
2. Lubricate thread and cone of fitting body or hardened pre-assembly tool, as well as the progressive ring and nut threads.
3. Slip nut and progressive ring over tube, assuring that they are in the proper orientation.
4. Push the tube end into the coupling body.
5. Slide collet into position and tighten until finger tight. Mark nut and tube in the finger-tight position. Tighten nut to the number of flats listed in Table 5-9, DIN 24°Cone (MBTL & MBTS) while using the Double Wrench Method. The tube must not turn with the nut.

Table 5-9. DIN 24°Cone (MBTL & MBTS)



TYPE/FITTING IDENTIFICATION								DIN 24° CONE FLARELESS BITE FITTING (With or Without O-Ring)						
MATERIAL	TYPE	Tube O.D. (mm)	Thread M Size (Metric)	ØA* (mm)	ØB* (mm)	C* (mm)	ØD* (mm)	Torque [Ft-Lb] Min	Torque [Ft-Lb] Nom	Torque [Ft-Lb] Max	Torque [N-m] Min	Torque [N-m] Nom	Torque [N-m] Max	Flats from Wrench Resistance (F.F.W.R)**
STEEL FITTINGS WITH STEEL MATING COMPONENTS	DIN 24° CONE FLARELESS BITE (MBTL) FITTING	6	M12 x 1.5	10.50	12.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M14 x 1.5	12.50	14.00	7.00	8.20							1.5 to 1.75
		10	M16 x 1.5	14.50	16.00	7.00	10.20							1.5 to 1.75
		12	M18 x 1.5	16.50	18.00	7.00	12.20							1.5 to 1.75
		15	M22 x 1.5	20.50	22.00	7.00	15.20							1.5 to 1.75
		18	M26 x 1.5	24.50	26.00	7.50	18.20							1.5 to 1.75
		22	M30 x 2	27.90	30.00	7.50	22.20							1.5 to 1.75
		28	M36 x 2	33.90	36.00	7.50	28.20							1.5 to 1.75
		35	M45 x 2	42.90	45.00	10.50	35.30							1.5 to 1.75
		42	M52 x 2	49.90	52.00	11.00	42.30							1.5 to 1.75
	TYPE	Tube O.D. (mm)	Thread M Size (Metric)	ØA* (mm)	ØB* (mm)	C* (mm)	ØD* (mm)	Torque [Ft-Lb] Min	Torque [Ft-Lb] Nom	Torque [Ft-Lb] Max	Torque [N-m] Min	Torque [N-m] Nom	Torque [N-m] Max	Flats from Wrench Resistance (F.F.W.R)**
	DIN 24° CONE FLARELESS BITE (MBTS) FITTING	6	M14 x 1.5	12.50	14.00	7.00	6.20	FFWR is the recommended method of fitting assembly. Torque values are application specific due to variability in the fitting supplier, coating, lubrication, and other physical characteristics of the connection. Refer to the specific procedure in the						1.5 to 1.75
		8	M16 x 1.5	14.50	16.00	7.00	8.20							1.5 to 1.75
		10	M18 x 1.5	16.50	18.00	7.50	10.20							1.5 to 1.75
		12	M20 x 1.5	18.50	20.00	7.50	12.20							1.5 to 1.75
		14	M22 x 1.5	20.50	22.00	8.00	14.20							1.5 to 1.75
		16	M24 x 1.5	22.50	24.00	8.50	16.20							1.5 to 1.75
		20	M30 x 2	27.90	30.00	10.50	20.20							1.5 to 1.75
		25	M36 x 2	33.90	36.00	12.00	25.20							1.5 to 1.75
		30	M42 x 2	39.90	42.00	13.50	30.20							1.5 to 1.75
		38	M52 x 2	49.90	52.00	16.00	38.30							1.5 to 1.75

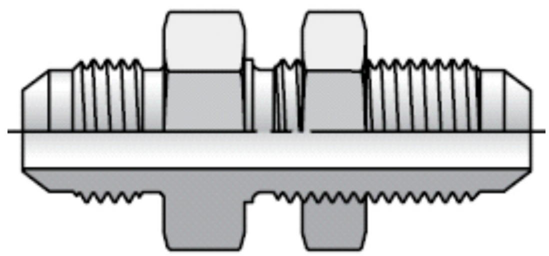
* ØA, ØB, C, & ØD thread dimensions for reference only.

** See Appendix B for FFWR procedure requirements.

Assembly Instructions for Bulkhead (BH) Fittings

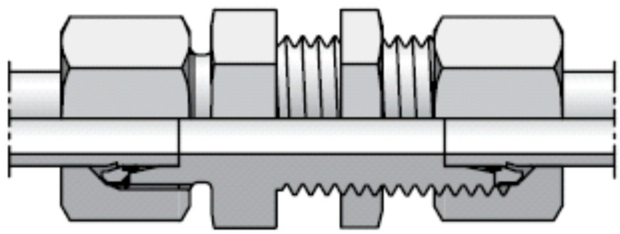
1. Ensure threads and surface are free of rust, weld and brazing splatter, splits, burrs or other foreign material. If necessary replace fitting or adapter.
2. Remove the locknut from the bulkhead assembly.
3. Insert the bulkhead side of the fitting into the panel or bulkhead bracket opening.
4. Hand thread the locknut onto the bulkhead end of the fitting body.
5. Torque nut onto fitting per Table 5-10 and Table 5-11 while using the Double Wrench Method.

Table 5-10. Bulkhead Fittings (BH) - INCH



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	O-RING FACE SEAL (ORFS) BULKHEAD FITTING	4	9/16-18	15	16	17	20	22	23
		6	11/16-16	25	27	28	34	37	38
		8	13/16-16	55	58	61	75	79	83
		10	1-14	85	90	94	115	122	127
		12	1 3/16-12	135	142	149	183	193	202
		14	1 5/16-12	170	179	187	230	243	254
		16	1 7/16-12	200	210	220	271	285	298
		20	1 11/16-12	245	258	270	332	350	366
		24	2-12	270	284	297	366	385	403
	TYPE	Dash Size	Thread Size	Torque					
				[Ft-Lb]			[N-m]		
			(UNF)	Min	Nom	Max	Min	Nom	Max
	37° FLARE (JIC) BULKHEAD FITTING	3	3/8-24	8	9	9	11	12	12
		4	7/16-20	13	14	14	18	19	19
		5	1/2-20	20	21	22	27	28	30
		6	9/16-18	25	27	28	34	37	38
		8	3/4-16	50	53	55	68	72	75
		10	7/8-14	85	90	94	115	122	127
		12	1 1/16-12	135	142	149	183	193	202
		14	1 3/16-12	170	179	187	230	243	254
		16	1 5/16-12	200	210	220	271	285	298
		20	1 5/8-12	245	258	270	332	350	366
		24	1 7/8-12	270	284	297	366	385	403
		32	2 1/2-12	310	326	341	420	442	462

Table 5-11. Bulkhead Fittings (BH) - METRIC



TYPE/FITTING IDENTIFICATION				FASTENING JAM NUT for Bulkhead Connectors					
MATERIAL	TYPE	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS	DIN 24° CONE FLARELESS BITE (MBTL) BULKHEAD FITTING	6	M12 x 1.5	14	15	16	19	20	22
		8	M14 x 1.5	17	18	19	23	24	26
		10	M16 x 1.5	22	23	24	30	31	33
		12	M18 x 1.5	35	37	39	47	50	53
		15	M22 x 1.5	44	47	50	60	64	68
		18	M26 x 1.5	70	75	80	95	102	108
		22	M30 x 2	115	120	125	156	163	169
		28	M36 x 2	150	157	164	203	213	222
		35	M45 x 2	155	162	169	210	220	229
		42	M52 x 2	220	230	240	298	312	325
	DIN 24° CONE FLARELESS BITE (MBTS) BULKHEAD FITTING	Connecting Tube O.D.	Thread M Size	Torque					
				[Ft-Lb]			[N-m]		
		(mm)	(metric)	Min	Nom	Max	Min	Nom	Max
		6	M14 x 1.5	17	15	16	23	20	22
		8	M16 x 1.5	22	18	19	30	24	26
		10	M18 x 1.5	35	23	24	47	31	33
		12	M20 x 1.5	40	35	37	54	47	50
		14	M22 x 1.5	44	47	50	60	64	68
		16	M24 x 1.5	70	75	80	95	102	108
		20	M30 x 2	115	120	125	156	163	169
		25	M36 x 2	150	157	164	203	213	222
		30	M42 x 2	155	162	169	210	220	229
		38	M52 x 2	220	230	240	298	312	325

Assembly Instructions for O-Ring Boss (ORB) Fittings

1. Inspect components to ensure that male and female port threads are free of rust, splits, dirt, foreign matter, or burrs.

2. Ensure proper O-ring is installed. If O-ring is missing install per O-ring Installation (Replacement).

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.

4. For Non-Adjustable and Plugs, thread the fitting by hand until contact.

5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.

6. Torque the fitting or nut to value listed in Table 5-12 thru Table 5-17 while using the Double Wrench Method.

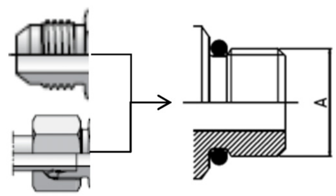
   a. The table headings identify the straight thread O-ring port and the type on the other side of the fitting. The torque will be applied to the straight thread O-ring port.

   b. Torque values provided in Table 5-12 thru Table 5-17 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-12. O-ring Boss (ORB) - Table 1 of 6

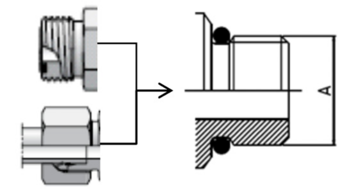


TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(85)	(90)	(94)	10	10	11
	3	3/8-24	0.37	9.52	(155)	(163)	(171)	18	18	19
	4	7/16-20	0.44	11.11	22	23	24	29	31	33
	5	1/2-20	0.50	12.70	23	25	26	32	34	35
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					HEX TYPE PLUGS & STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(55)	(58)	(61)	6	7	7
	3	3/8-24	0.37	9.52	(101)	(106)	(111)	11	12	13
	4	7/16-20	0.44	11.11	14	15	16	19	20	22
	5	1/2-20	0.50	12.70	15	16	17	20	22	23
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-13. O-ring Boss (ORB) - Table 2 of 6

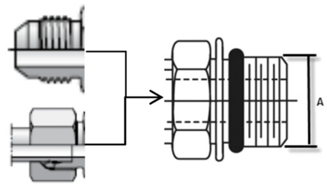


TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	26	27	28	35	37	38
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	17	18	18	23	24	24
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-14. O-ring Boss (ORB) - Table 3 of 6

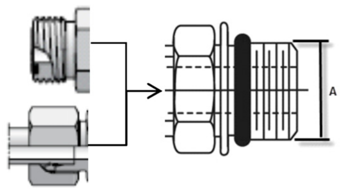


TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(60)	(63)	(66)	7	7	7
	3	3/8-24	0.37	9.52	(100)	(105)	(110)	11	12	12
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	21	22	23	28	30	31
	6	9/16-18	0.56	14.28	29	31	32	40	42	43
	8	3/4-16	0.75	19.10	52	55	57	70	75	77
	10	7/8-14	0.87	22.22	85	90	94	115	122	127
	12	1 1/16-12	1.06	27.00	135	142	149	185	193	202
	14	1 3/16-12	1.19	30.10	175	184	193	235	249	262
	16	1 5/16-12	1.31	33.30	200	210	220	270	285	298
	20	1 5/8-12	1.63	41.30	250	263	275	340	357	373
	24	1 7/8-12	1.87	47.60	305	321	336	415	435	456
	32	2 1/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(39)	(41)	(43)	4	5	5
	3	3/8-24	0.37	9.52	(65)	(69)	(72)	7	8	8
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	15	19	20	20
	6	9/16-18	0.56	14.28	19	20	21	26	27	28
	8	3/4-16	0.75	19.10	34	36	37	46	49	50
	10	7/8-14	0.87	22.22	55	58	61	75	79	83
	12	1 1/16-12	1.06	27.00	88	93	97	119	126	132
	14	1 3/16-12	1.19	30.10	114	120	126	155	163	171
	16	1 5/16-12	1.31	33.30	130	137	143	176	186	194
	20	1 5/8-12	1.63	41.30	163	171	179	221	232	243
	24	1 7/8-12	1.87	47.60	198	208	218	268	282	296
	32	2 1/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-15. O-ring Boss (ORB) - Table 4 of 6



TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	15	16	17	20	22	23
	5	1/2-20	0.50	12.70	30	32	33	40	43	45
	6	9/16-18	0.56	14.28	35	37	39	46	50	53
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560

TYPE/FITTING IDENTIFICATION					ADJUSTABLE STUD END with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	--	--	--	--	--	--
	3	3/8-24	0.37	9.52	--	--	--	--	--	--
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	20	21	21	27	28	28
	6	9/16-18	0.56	14.28	23	24	24	31	33	33
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

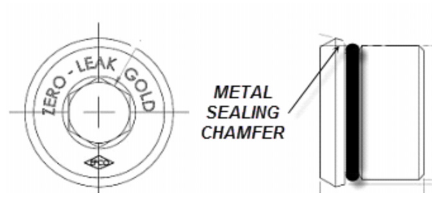
Table 5-16. O-ring Boss (ORB) - Table 5 of 6

TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(30)	(32)	(33)	3	4	4
	3	3/8-24	0.37	9.52	(55)	(58)	(61)	6	7	7
	4	7/16-20	0.44	11.11	10	11	11	14	15	15
	5	1/2-20	0.50	12.70	14	15	16	19	20	22
	6	9/16-18	0.56	14.28	34	36	38	46	49	52
	8	3/4-16	0.75	19.10	60	63	66	80	85	89
	10	7/8-14	0.87	22.22	100	105	110	135	142	149
	12	11/16-12	1.06	27.00	135	142	149	185	193	202
	14	13/16-12	1.19	30.10	175	184	193	235	249	262
	16	15/16-12	1.31	33.30	200	210	220	270	285	298
	20	15/8-12	1.63	41.30	250	263	275	340	357	373
	24	17/8-12	1.87	47.60	305	321	336	415	435	456
	32	21/2-12	2.50	63.50	375	394	413	510	534	560
TYPE/FITTING IDENTIFICATION					HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	(20)	(21)	(21)	2	2	2
	3	3/8-24	0.37	9.52	(36)	(38)	(40)	4	4	5
	4	7/16-20	0.44	11.11	6	7	7	8	9	9
	5	1/2-20	0.50	12.70	9	10	10	12	14	14
	6	9/16-18	0.56	14.28	22	24	25	30	33	34
	8	3/4-16	0.75	19.10	39	41	43	53	56	58
	10	7/8-14	0.87	22.22	65	69	72	88	94	98
	12	11/16-12	1.06	27.00	88	93	97	119	126	132
	14	13/16-12	1.19	30.10	114	120	126	155	163	171
	16	15/16-12	1.31	33.30	130	137	143	176	186	194
	20	15/8-12	1.63	41.30	163	171	179	221	232	243
	24	17/8-12	1.87	47.60	198	208	218	268	282	296
	32	21/2-12	2.50	63.50	244	256	268	331	347	363

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Table 5-17. O-ring Boss (ORB) - Table 6 of 6



TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	11/16-12	1.06	27.00	51	54	57	69	73	77
	14	13/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	15/16-12	1.31	33.30						
	20	15/8-12	1.63	41.30						
	24	17/8-12	1.87	47.60						
	32	21/2-12	2.50	63.50						
TYPE/FITTING IDENTIFICATION					ZERO LEAK GOLD® HOLLOW HEX PLUGS					
MATERIAL	Dash Size	Thread Size	ØA*		Torque					
		(UNF)	(in)	(mm)	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	2	5/16-24	0.31	7.93	2	3	4	3	4	5
	3	3/8-24	0.37	9.52	3	4	5	4	5	7
	4	7/16-20	0.44	11.11	7	8	9	9	11	12
	5	1/2-20	0.50	12.70	9	10	11	12	14	15
	6	9/16-18	0.56	14.28	11	12	13	15	16	18
	8	3/4-16	0.75	19.10	28	30	32	38	41	43
	10	7/8-14	0.87	22.22	46	48	50	62	65	68
	12	11/16-12	1.06	27.00	51	54	57	69	73	77
	14	13/16-12	1.19	30.10	Fitting size greater than -12 not typically specified on JLG applications. Consult specific service procedure if encountered.					
	16	15/16-12	1.31	33.30						
	20	15/8-12	1.63	41.30						
	24	17/8-12	1.87	47.60						
	32	21/2-12	2.50	63.50						

* ØA Thread OD dimension for reference only.

**Removal Torque for Zero Leak Gold® Hollow Hex Plugs is significantly higher than install torque, typically 1.5-3.5X install torque.

Assembly Instructions for Adjustable Port End Metric (MFF) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.

2. If O-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.

4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.

5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.

6. Torque the fitting or nut to value listed in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, or Table 5-23 while using the Double Wrench Method.

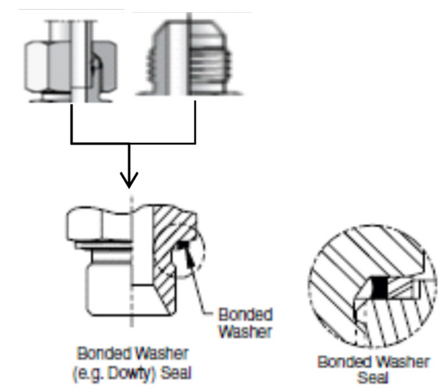
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.

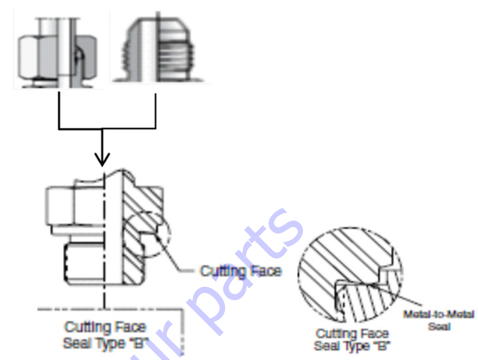
   b. Torque values provided in Table 5-18, Table 5-19, Table 5-20, Table 5-21, Table 5-22, and Table 5-23 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

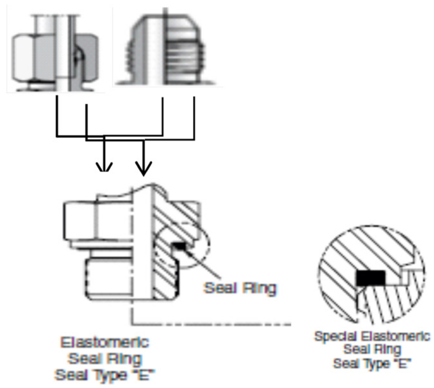
Table 5-18. Metric Flat Face Port (MFF) - L Series - Table 1 of 3

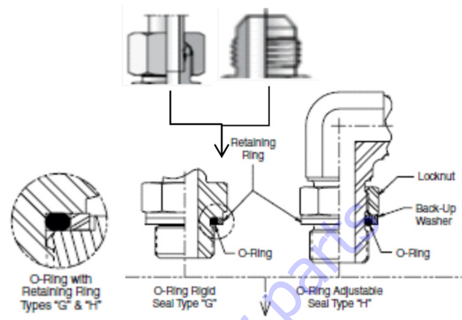




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	7	8	8	9	11	11	13	14	14	18	19	19
	M12x1.5	8	15	16	17	20	22	23	22	23	24	30	31	33
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	33	35	36	45	47	49	48	51	53	65	69	72
	M18x1.5	15	41	43	45	55	58	61	59	62	65	80	84	88
	M22x1.5	18	48	51	53	65	69	72	103	108	113	140	146	153
	M27x2	22	66	70	73	90	95	99	140	147	154	190	199	209
	M33x2	28	111	117	122	150	159	165	251	264	276	340	358	374
	M42x2	35	177	186	195	240	252	264	369	388	406	500	526	550
	M48x2	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	4	5	5	5	7	7	8	9	9	11	12	12
	M12x1.5	8	10	11	11	14	15	15	14	15	16	19	20	22
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	21	22	23	28	30	31	31	33	34	42	45	46
	M18x1.5	15	27	28	29	37	38	39	38	40	42	52	54	57
	M22x1.5	18	31	33	34	42	45	46	67	70	73	91	95	99
	M27x2	22	43	45	47	58	61	64	91	96	100	123	130	136
	M33x2	28	72	76	79	98	103	107	163	171	179	221	232	243
	M42x2	35	115	121	127	156	164	172	240	252	264	325	342	358
	M48x2	42	139	146	153	188	198	207	302	318	332	409	431	450

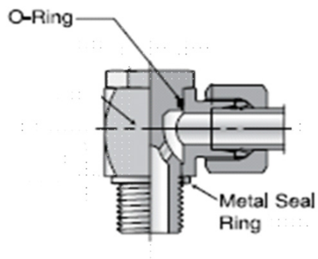
Table 5-19. Metric Flat Face Port (MFF) - L Series - Table 2 of 3

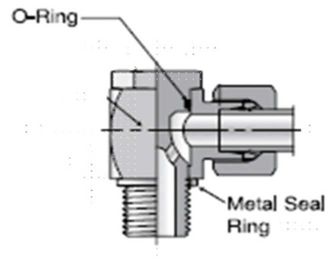


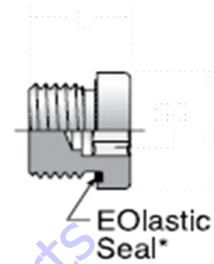


TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	15	18	19	20
	M12x1.5	8	18	19	20	25	26	27	18	19	20	25	26	28
	M14x1.5	10	33	35	36	45	47	49	30	31	32	40	42	44
	M16x1.5	12	41	43	45	55	58	61	41	43	45	55	58	61
	M18x1.5	15	52	55	57	70	75	77	52	54	57	70	74	77
	M22x1.5	18	92	97	101	125	132	137	66	70	73	90	95	99
	M27x2	22	133	140	146	180	190	198	133	139	146	180	189	198
	M33x2	28	229	241	252	310	327	342	229	240	252	310	326	341
	M42x2	35	332	349	365	450	473	495	332	348	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12
	M12x1.5	8	12	13	13	16	18	18	12	13	13	16	18	18
	M14x1.5	10	21	22	23	28	30	31	19	20	21	26	27	29
	M16x1.5	12	27	28	29	37	38	39	26	28	29	36	38	39
	M18x1.5	15	34	36	37	46	49	50	34	35	37	46	48	50
	M22x1.5	18	60	63	66	81	85	89	43	45	47	59	61	64
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-20. Metric Flat Face Port (MFF) - L Series - Table 3 of 3

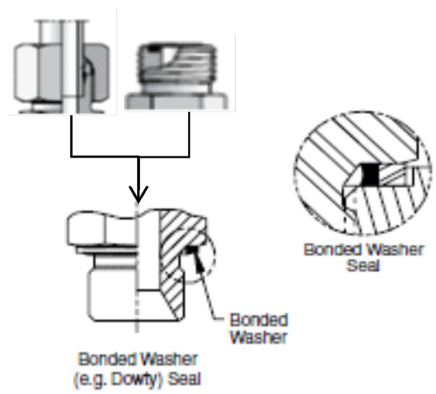


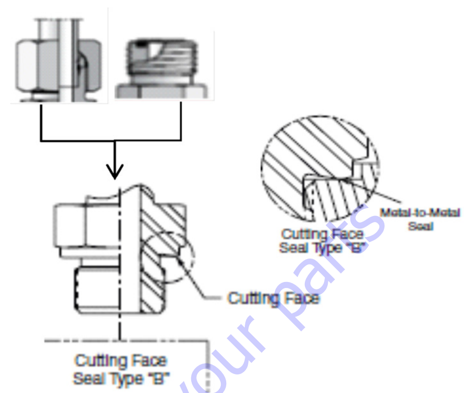




TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	13	14	14	18	19	19	13	14	14	18	19	19	9	10	10	12	14	14
	M12x1.5	8	26	28	29	35	38	39	33	35	36	45	47	49	18	19	20	25	26	27
	M14x1.5	10	37	39	41	50	53	56	41	43	45	55	58	61	26	28	29	35	38	39
	M16x1.5	12	44	46	48	60	62	65	59	62	65	80	84	88	41	43	45	55	58	61
	M18x1.5	15	59	62	65	80	84	88	74	78	81	100	106	110	48	51	53	65	69	72
	M22x1.5	18	89	94	98	120	127	133	103	108	113	140	146	153	66	70	73	90	95	99
	M27x2	22	96	101	106	130	137	144	236	248	260	320	336	353	100	105	110	135	142	149
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	166	175	183	225	237	248
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	266	280	293	360	380	397
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	266	280	293	360	380	397
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	M12x1.5	8	17	18	19	23	24	26	21	22	23	28	30	31	12	13	13	16	18	18
	M14x1.5	10	24	26	27	33	35	37	27	28	29	37	38	39	17	18	19	23	24	26
	M16x1.5	12	29	30	31	39	41	42	38	40	42	52	54	57	27	28	29	37	38	39
	M18x1.5	15	38	40	42	52	54	57	48	51	53	65	69	72	31	33	34	42	45	46
	M22x1.5	18	58	61	64	79	83	87	67	70	73	91	95	99	43	45	47	58	61	64
	M27x2	22	62	66	69	84	89	94	153	161	169	207	218	229	65	69	72	88	94	98
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	108	114	119	146	155	161
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	173	182	190	235	247	258
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	173	182	190	235	247	258

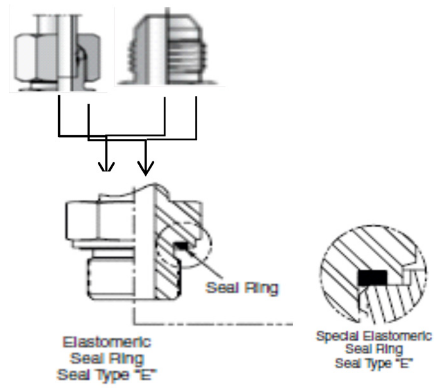
Table 5-21. Metric Flat Face Port (MFF) - S Series - Table 1 of 3

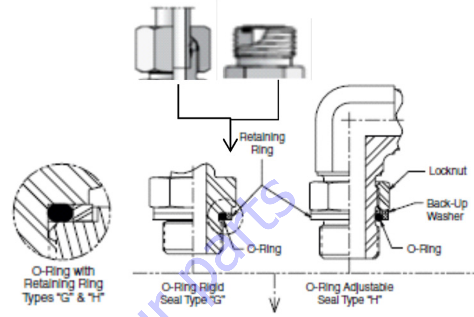




TYPE/FITTING IDENTIFICATION			FORM A (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	15	16	17	20	22	23	26	28	29	35	38	39
	M14x1.5	8	26	28	29	35	38	39	41	43	45	55	58	61
	M16x1.5	10	33	35	36	45	47	49	52	55	57	70	75	77
	M18x1.5	12	41	43	45	55	58	61	81	85	89	110	115	121
	M20x1.5	14	41	43	45	55	58	61	111	117	122	150	159	165
	M22x1.5	16	48	51	53	65	69	72	125	132	138	170	179	187
	M27x2	20	66	70	73	89	95	99	199	209	219	270	283	297
	M33x2	25	111	117	122	150	159	165	302	317	332	410	430	450
	M42x2	30	177	186	195	240	252	264	398	418	438	540	567	594
	M48x2	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M12x1.5	6	10	11	11	14	15	15	17	18	19	23	24	26
	M14x1.5	8	17	18	19	23	24	26	27	28	29	37	38	39
	M16x1.5	10	21	22	23	28	30	31	34	36	37	46	49	50
	M18x1.5	12	27	28	29	37	38	39	53	56	58	72	76	79
	M20x1.5	14	27	28	29	37	38	39	72	76	79	98	103	107
	M22x1.5	16	31	33	34	42	45	46	81	86	90	110	117	122
	M27x2	20	43	45	47	58	61	64	129	136	142	175	184	193
	M33x2	25	72	76	79	98	103	107	196	206	216	266	279	293
	M42x2	30	115	121	127	156	164	172	259	272	285	351	369	386
	M48x2	38	139	146	153	188	198	207	335	352	369	454	477	500

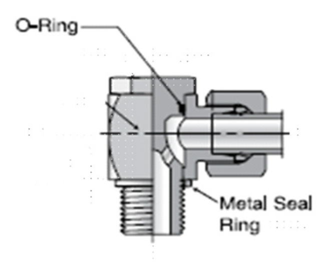
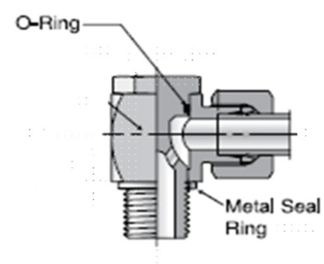
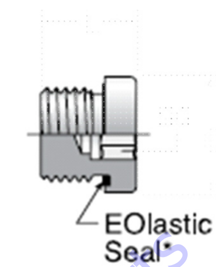
Table 5-22. Metric Flat Face Port (MFF) - S Series - Table 2 of 3





TYPE/FITTING IDENTIFICATION			FORM E (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	26	28	29	35	38	39
	M12x1.5	8	33	35	36	45	47	49	41	43	45	55	58	61
	M14x1.5	10	52	55	57	70	75	77	52	55	57	70	75	77
	M16x1.5	12	66	70	73	90	95	99	66	70	73	90	95	99
	M18x1.5	15	92	97	101	125	132	137	92	97	101	125	132	137
	M22x1.5	18	100	105	110	135	142	149	100	105	110	135	142	149
	M27x2	22	133	140	146	180	190	198	133	140	146	180	190	198
	M33x2	28	229	241	252	310	327	342	229	241	252	310	327	342
	M42x2	35	332	349	365	450	473	495	332	349	365	450	473	495
	M48x2	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	17	18	19	23	24	26
	M12x1.5	8	21	23	23	29	31	32	27	28	29	37	38	39
	M14x1.5	10	34	36	37	46	49	50	34	36	37	46	49	50
	M16x1.5	12	43	45	47	58	61	64	43	45	47	58	61	64
	M18x1.5	15	60	63	66	81	85	89	60	63	66	81	85	89
	M22x1.5	18	65	69	72	88	94	98	65	69	72	88	94	98
	M27x2	22	86	91	95	117	123	129	86	91	95	117	123	129
	M33x2	28	149	157	164	202	213	222	149	157	164	202	213	222
	M42x2	35	216	227	237	293	308	321	216	227	237	293	308	321
	M48x2	42	259	272	285	351	369	386	259	272	285	351	369	386

Table 5-23. Metric Flat Face Port (MFF) - S Series - Table 3 of 3

																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	26	28	29	35	38	39	33	35	36	45	47	49	--	--	--	--	--	--
	M12x1.5	8	37	39	41	50	53	56	41	43	45	55	58	61	--	--	--	--	--	--
	M14x1.5	10	44	46	48	60	62	65	59	62	65	80	84	88	--	--	--	--	--	--
	M16x1.5	12	59	62	65	80	84	88	74	78	81	100	106	110	--	--	--	--	--	--
	M18x1.5	15	81	85	89	110	115	121	92	97	101	125	132	137	59	62	65	80	84	88
	M22x1.5	18	89	94	98	120	127	133	100	105	110	135	142	149	--	--	--	--	--	--
	M27x2	22	100	105	110	135	142	149	236	248	260	320	336	353	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	266	280	293	360	380	397	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	398	418	438	540	567	594	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	516	542	568	700	735	770	--	--	--	--	--	--
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M10x1	6	17	18	19	23	24	26	21	22	23	28	30	31	--	--	--	--	--	--
	M12x1.5	8	24	26	27	33	35	37	27	28	29	37	38	39	--	--	--	--	--	--
	M14x1.5	10	29	30	31	39	41	42	38	40	42	52	54	57	--	--	--	--	--	--
	M16x1.5	12	38	40	42	52	54	57	48	51	53	65	69	72	--	--	--	--	--	--
	M18x1.5	15	53	56	58	72	76	79	60	63	66	81	85	89	38	40	42	52	54	57
	M22x1.5	18	58	61	64	79	83	87	65	69	72	88	94	98	--	--	--	--	--	--
	M27x2	22	65	69	72	88	94	98	153	161	169	207	218	229	--	--	--	--	--	--
	M33x2	28	--	--	--	--	--	--	173	182	190	235	247	258	--	--	--	--	--	--
	M42x2	35	--	--	--	--	--	--	259	272	285	351	369	386	--	--	--	--	--	--
	M48x2	42	--	--	--	--	--	--	335	352	369	454	477	500	--	--	--	--	--	--

Assembly Instructions for Metric ISO 6149 (MPP) Port Assembly Stud Ends

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.

2. If O-ring is not preinstalled, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

⚠ CAUTION

CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

3. Pre-lubricate the O-ring with Hydraulic Oil.

4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.

5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.

6. Torque the fitting or nut to value listed in Table 5-24 while using the Double Wrench Method.

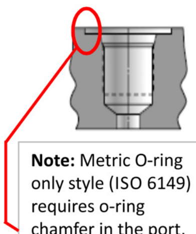
   a. The table headings identify the Metric port and the type on the other side of the fitting. The torque will be applied to the Metric port.

   b. Torque values provided in Table 5-24 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

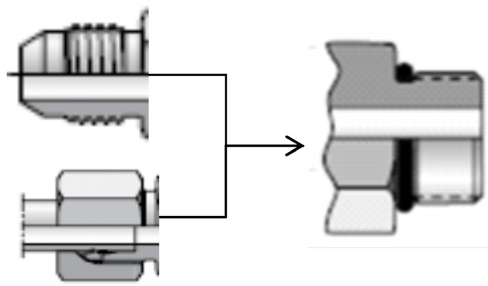
- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

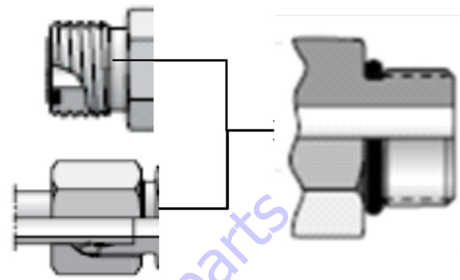
7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-24. Metric Pipe Parallel O-Ring Boss (MPP)



Note: Metric O-ring only style (ISO 6149) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB),**but is not interchangeable.**





TYPE/FITTING IDENTIFICATION			STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	Thread M Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	6	7	7	8	9	9	8	9	9	10	12	12
	M10x1	6	11	12	12	15	16	16	15	16	17	20	22	23
	M12x1.5	8	18	19	20	25	26	27	26	28	29	35	38	39
	M14x1.5	10	26	28	29	35	38	39	33	35	36	45	47	49
	M16x1.5	12	30	32	33	40	43	45	41	43	45	55	58	61
	M18x1.5	15	33	35	36	45	47	49	52	55	57	70	75	77
	M20x1.5	--	--	--	--	--	--	--	59	62	65	80	84	88
	M22x1.5	18	44	46	48	60	62	65	74	78	81	100	106	110
	M27x2	22	74	78	81	100	106	110	125	132	138	170	179	187
	M30x2	--	95	100	105	130	136	142	175	184	193	237	249	262
	M33x2	25	120	126	132	160	171	179	230	242	253	310	328	343
	M38x2	--	135	142	149	183	193	202	235	247	259	319	335	351
	M42x2	30	155	163	171	210	221	232	245	258	270	330	350	366
	M48x2	38	190	200	209	260	271	283	310	326	341	420	442	462
	M60x2	50	230	242	253	315	328	343	370	389	407	500	527	552
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	M8x1	4	4	5	5	5	7	7	5	6	6	7	8	8
	M10x1	6	7	8	8	9	11	11	10	11	11	14	15	15
	M12x1.5	8	12	13	13	16	18	18	17	18	19	23	24	26
	M14x1.5	10	17	18	19	23	24	26	21	22	23	28	30	31
	M16x1.5	12	20	21	21	27	28	28	27	28	29	37	38	39
	M18x1.5	15	21	22	23	28	30	31	34	36	37	46	49	50
	M20x1.5	--	--	--	--	--	--	--	30	40	42	41	54	57
	M22x1.5	18	29	30	31	39	41	42	48	51	53	65	69	72
	M27x2	22	48	51	53	65	69	72	81	86	90	110	117	122
	M30x2	--	62	65	68	84	88	92	114	120	125	155	163	169
	M33x2	25	78	82	86	106	111	117	150	157	164	203	213	222
	M38x2	--	88	93	97	119	126	132	153	161	168	207	218	228
	M42x2	30	101	106	111	137	144	150	159	168	176	216	228	239
	M48x2	38	124	130	136	168	176	184	202	212	222	274	287	301
	M60x2	50	150	157	164	203	213	222	241	253	265	327	343	359

Assembly instructions for Adjustable Port End (BSPP) Fittings

1. Inspect components to ensure that male and female threads and surfaces are free of rust, splits, dirt, foreign matter, or burrs.
2. If O-ring is not pre-installed, install proper size, taking care not to damage it. See O-ring Installation (Replacement) for instructions.

CAUTION

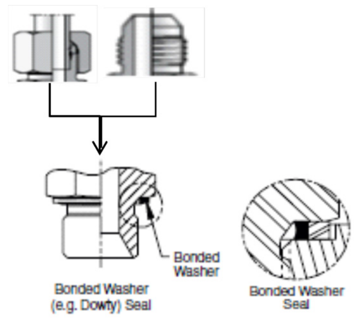
CARE TO BE TAKEN WHEN LUBRICATING O-RING. AVOID ADDING OIL TO THE THREADED CONNECTION OF THE FITTING. THE LUBRICATION WOULD CAUSE INCREASED CLAMPING FORCE AND CAUSE FITTING DAMAGE.

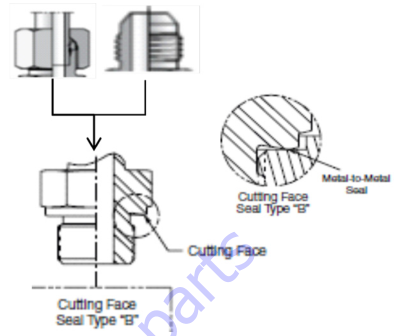
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. For Non-Adjustable Fittings and Plugs, thread the fitting by hand until contact.
5. For Adjustable fittings, refer to Adjustable Stud End Assembly for proper assembly.
6. Torque the fitting or nut to value listed in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, or Table 5-30 while using the Double Wrench Method.
   a. The table headings identify the BSPP port and the type on the other side of the fitting. The torque will be applied to the BSPP port.
   b. Torque values provided in Table 5-25, Table 5-26, Table 5-27, Table 5-28, Table 5-29, and Table 5-30 are segregated based on the material configuration of the connection. 'ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS' indicate either the following material configurations:

- STEEL fittings with ALUMINUM or BRASS mating components
- ALUMINUM or BRASS fittings with STEEL mating components
- ALUMINUM or BRASS fittings with ALUMINUM or BRASS mating components.

7. Inspect to ensure the O-ring is not pinched and the washer is seated flat on the counterbore of the port.

Table 5-25. British Standard Parallel Pipe Port (BSPP) - L Series - Table 1 of 3





TYPE/FITTING IDENTIFICATION			FORM A**(SEALING WASHER) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM B** (CUTTING FACE) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	7	8	8	9	11	11	13	14	14	18	19	19
	G1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G3/8A	12	33	35	36	45	47	49	52	55	57	70	75	77
	G1/2A	15	48	51	53	65	69	72	103	108	113	140	146	153
	G1/2A	18	48	51	53	65	69	72	74	78	81	100	106	110
	G3/4A	22	66	70	73	90	95	99	133	140	146	180	190	198
	G1A	28	111	117	122	150	159	165	243	255	267	330	346	362
	G1-1/4A	35	177	186	195	240	252	264	398	418	438	540	567	594
	G1-1/2A	42	214	225	235	290	305	319	465	489	512	630	663	694
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/8A	6	4	5	5	5	7	7	8	9	9	11	12	12
	G1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G3/8A	12	21	22	23	28	30	31	34	36	37	46	49	50
	G1/2A	15	31	33	34	42	45	46	67	70	73	91	95	99
	G1/2A	18	31	33	34	42	45	46	48	51	53	65	69	72
	G3/4A	22	42	45	47	57	61	64	86	91	95	117	123	129
	G1A	28	72	76	79	98	103	107	158	166	174	214	225	236
	G1-1/4A	35	115	121	127	156	164	172	259	272	285	351	369	386
	G1-1/2A	42	139	146	153	188	198	207	302	318	333	409	431	451

* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-26. British Standard Parallel Pipe Port (BSPP) - L Series - Table 2 of 3

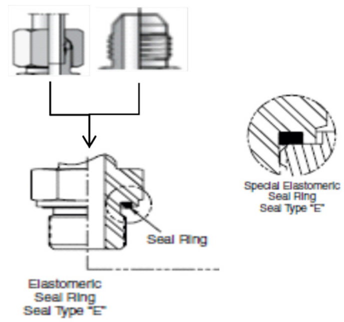
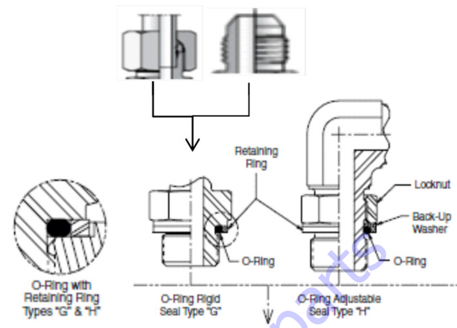
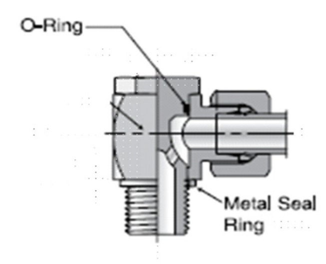
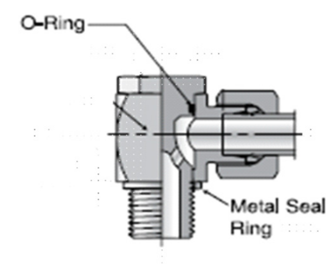
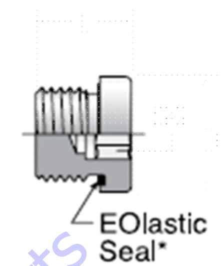
														
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with 37° (JIC) or L series DIN (MBTL) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19
	G 1/4A	8	26	28	29	35	38	39	26	28	29	35	38	39
	G 1/4A	10	26	28	29	35	38	39	26	28	29	35	38	39
	G 3/8A	12	52	55	57	70	75	77	52	55	57	70	75	77
	G 1/2A	15	66	70	73	90	95	99	66	70	73	90	95	99
	G 1/2A	18	66	70	73	90	95	99	66	70	73	90	95	99
	G 3/4A	22	133	140	146	180	190	198	133	140	146	180	190	198
	G 1A	28	229	241	252	310	327	342	229	241	252	310	327	342
	G 1-1/4A	35	332	349	365	450	473	495	332	349	365	450	473	495
	G 1-1/2A	42	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12
	G 1/4A	8	17	18	19	23	24	26	17	18	19	23	24	26
	G 1/4A	10	17	18	19	23	24	26	17	18	19	23	24	26
	G 3/8A	12	34	36	37	46	49	50	34	36	37	46	49	50
	G 1/2A	15	43	45	47	58	61	64	43	45	47	58	61	64
	G 1/2A	18	43	45	47	58	61	64	43	45	47	58	61	64
	G 3/4A	22	86	91	95	117	123	129	86	91	95	117	123	129
	G 1A	28	149	157	164	202	213	222	149	157	164	202	213	222
	G 1-1/4A	35	216	227	237	293	308	321	216	227	237	293	308	321
	G 1-1/2A	42	259	272	285	351	369	386	259	272	285	351	369	386
* Typical for JLG Straight Male Stud Fittings														
** Non typical for JLG Straight Male Stud Fittings, reference only.														
*** Typical for JLG Adjustable Fittings														

Table 5-27. British Standard Parallel Pipe Port (BSPP) - L Series - Table 3 of 3

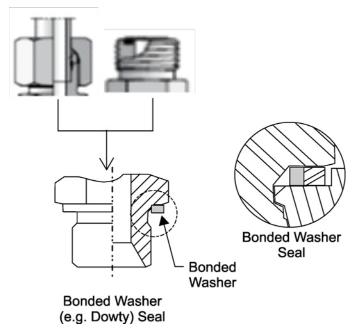
																				
TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with L series DIN (MBTL) opposite end						HIGH PRESSURE BANJO FITTINGS with L series DIN (MBTL) opposite end						FORM E (EOLASTIC SEALING RING) HOLLOW HEX PLUGS					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	13	14	14	18	19	19	13	14	14	18	19	19	10	11	11	13	15	15
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G 1/4A	10	30	32	33	40	43	45	33	35	36	45	47	49	22	23	24	30	31	33
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77	44	46	48	60	62	65
	G 1/2A	15	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G 1/2A	18	66	70	73	90	95	99	89	94	98	120	127	133	59	62	65	80	84	88
	G 3/4A	22	92	97	101	125	132	137	170	179	187	230	243	254	103	108	113	140	146	153
	G 1A	28	--	--	--	--	--	--	236	248	260	320	336	353	148	156	163	200	212	221
	G 1-1/4A	35	--	--	--	--	--	--	398	418	438	540	567	594	295	313.5	332	400	425	450
	G 1-1/2A	42	--	--	--	--	--	--	516	542	568	700	735	770	332	349	365	450	473	495
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/8A	6	8	9	9	11	12	12	8	9	9	11	12	12	6	7	7	8	9	9
	G 1/4A	8	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G 1/4A	10	20	21	21	27	28	28	21	22	23	28	30	31	14	15	16	19	20	22
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50	29	30	31	39	41	42
	G 1/2A	15	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G 1/2A	18	43	45	47	58	61	64	58	61	64	79	83	87	38	40	42	52	54	57
	G 3/4A	22	60	63	66	81	85	89	111	117	122	150	159	165	67	70	73	91	95	99
	G 1A	28	--	--	--	--	--	--	153	161	169	207	218	229	96	101	106	130	137	144
	G 1-1/4A	35	--	--	--	--	--	--	259	272	285	351	369	386	216	227	237	293	308	321
	G 1-1/2A	42	--	--	--	--	--	--	335	352	369	454	477	500	216	227	237	293	308	321

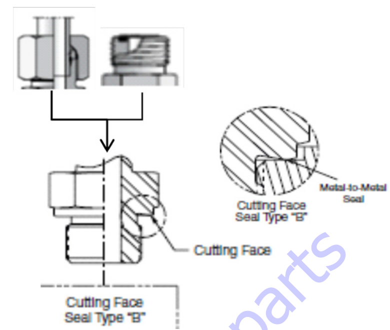
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-28. British Standard Parallel Pipe Port (BSPP) - S Series - Table 1 of 3





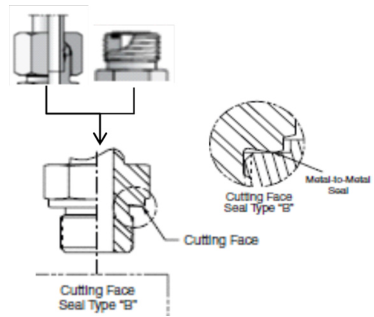
TYPE/FITTING IDENTIFICATION			FORM A** (SEALING WASHER) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end						FORM B** (CUTTING FACE) STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	26	28	29	35	38	39	41	43	45	55	58	61
	G1/4A	8	26	28	29	35	38	39	41	43	45	55	58	61
	G3/8A	10	33	35	36	45	47	49	66	70	73	90	95	99
	G3/8A	12	33	35	36	45	47	49	66	70	73	90	95	99
	G1/2A	14	48	51	53	65	69	72	111	117	122	150	159	165
	G1/2A	16	48	51	53	65	69	72	96	101	106	130	137	144
	G3/4A	20	66	70	73	90	95	99	199	209	219	270	283	297
	G1A	25	111	117	122	150	159	165	251	264	276	340	358	374
	G1-1/4A	30	177	186	195	240	252	264	398	418	438	540	567	594
	G1-1/2A	38	214	225	235	290	305	319	516	542	568	700	735	770
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	17	18	19	23	24	26	27	28	29	37	38	39
	G1/4A	8	17	18	19	23	24	26	27	28	29	37	38	39
	G3/8A	10	21	22	23	28	30	31	43	45	47	58	61	64
	G3/8A	12	21	22	23	28	30	31	43	45	47	58	61	64
	G1/2A	14	31	33	34	42	45	46	72	76	79	98	103	107
	G1/2A	16	31	33	34	42	45	46	62	66	69	84	89	94
	G3/4A	20	43	45	47	58	61	64	129	136	142	175	184	193
	G1A	25	72	76	79	98	103	107	163	171	179	221	232	243
	G1-1/4A	30	115	121	127	156	164	172	259	272	285	351	369	386
	G1-1/2A	38	139	146	153	188	198	207	335	352	369	454	477	500

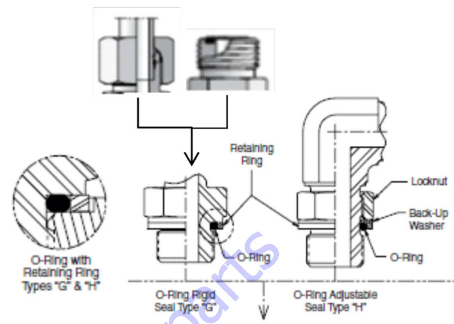
* Typical for JLG Straight Male Stud Fittings

** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-29. British Standard Parallel Pipe Port (BSPP) - S Series - Table 2 of 3





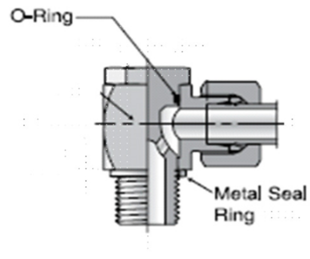
TYPE/FITTING IDENTIFICATION			FORM E* (EOLASTIC SEALING RING) STUD ENDS AND HEX TYPE PLUGS with (ORFS) or S series DIN (MBTS) opposite end						FORM G/H*** (O-RING W/ RETAINING RING) STUD ENDS & ADJUSTABLE STUD ENDS with (ORFS) or S series DIN (MBTS) opposite end					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	41	43	45	55	58	61	26	28	29	35	38	39
	G1/4A	8	41	43	45	55	58	61	26	28	29	35	38	39
	G3/8A	10	59	62	65	80	84	88	52	55	57	70	75	77
	G3/8A	12	59	62	65	80	84	88	52	55	57	70	75	77
	G1/2A	14	85	90	94	115	122	127	66	70	73	90	95	99
	G1/2A	16	85	90	94	115	122	127	66	70	73	90	95	99
	G3/4A	20	133	140	146	180	190	198	133	140	146	180	190	198
	G1A	25	229	241	252	310	327	342	229	241	252	310	327	342
	G1-1/4A	30	332	349	365	450	473	495	332	349	365	450	473	495
	G1-1/2A	38	398	418	438	540	567	594	398	418	438	540	567	594
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G1/4A	6	27	28	29	37	38	39	17	18	19	23	24	26
	G1/4A	8	27	28	29	37	38	39	17	18	19	23	24	26
	G3/8A	10	38	40	42	52	54	57	34	36	37	46	49	50
	G3/8A	12	38	40	42	52	54	57	34	36	37	46	49	50
	G1/2A	14	55	58	61	75	79	83	43	45	47	58	61	64
	G1/2A	16	55	58	61	75	79	83	43	45	47	58	61	64
	G3/4A	20	86	91	95	117	123	129	86	91	95	117	123	129
	G1A	25	149	157	164	202	213	222	149	157	164	202	213	222
	G1-1/4A	30	216	227	237	293	308	321	216	227	237	293	308	321
	G1-1/2A	38	259	272	285	351	369	386	259	272	285	351	369	386

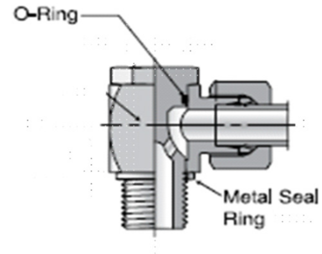
* Typical for JLG Straight Male Stud Fittings

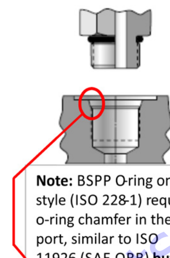
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Table 5-30. British Standard Parallel Pipe Port (BSPP) - S Series - Table 3 of 3







Note: BSPP O-ring only style (ISO 228-1) requires o-ring chamfer in the port, similar to ISO 11926 (SAE ORB), **but is not interchangeable. Not typically used on JLG machines.**

TYPE/FITTING IDENTIFICATION			BANJO FITTINGS with S series DIN (MBTS) opposite end						HIGH PRESSURE BANJO FITTINGS with S series DIN (MBTS) opposite end						JIS/BSPP O-RING ONLY					
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
STEEL FITTINGS WITH STEEL MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	30	32	33	40	43	45	33	35	36	45	47	49	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	30	32	33	40	43	45	33	35	36	45	47	49						
	G 3/8A	10	48	51	53	65	69	72	52	55	57	70	75	77						
	G 3/8A	12	48	51	53	65	69	72	52	55	57	70	75	77						
	G 1/2A	14	66	70	73	90	95	99	89	94	98	120	127	133						
	G 1/2A	16	66	70	73	90	95	99	89	94	98	120	127	133						
	G 3/4A	20	92	97	101	125	132	137	170	179	187	230	243	254						
	G 1A	25	--	--	--	--	--	--	236	248	260	320	336	353						
	G 1-1/4A	30	--	--	--	--	--	--	398	418	438	540	567	594						
	G 1-1/2A	38	--	--	--	--	--	--	516	542	568	700	735	770						
MATERIAL	BSPP Thread G Size	Connecting Tube O.D.	Torque						Torque						Torque					
			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
	(metric)	(mm)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
ALUMINUM/BRASS FITTINGS OR ALUMINUM/BRASS MATING COMPONENTS; UN-LUBRICATED THREADS	G 1/4A	6	20	21	21	27	28	28	22	22	23	30	30	31	Fitting type not typically specified on JLG applications. Refer to the specific procedure in this Service Manual.					
	G 1/4A	8	20	21	21	27	28	28	22	22	23	30	30	31						
	G 3/8A	10	31	33	34	42	45	46	34	36	37	46	49	50						
	G 3/8A	12	31	33	34	42	45	46	34	36	37	46	49	50						
	G 1/2A	14	43	45	47	58	61	64	58	61	64	79	83	87						
	G 1/2A	16	43	45	47	58	61	64	58	61	64	79	83	87						
	G 3/4A	20	60	63	66	81	85	89	111	117	122	150	159	165						
	G 1A	25	--	--	--	--	--	--	153	161	169	207	218	229						
	G 1-1/4A	30	--	--	--	--	--	--	259	272	285	351	369	386						
	G 1-1/2A	38	--	--	--	--	--	--	335	352	368	454	477	499						

* Typical for JLG Straight Male Stud Fittings

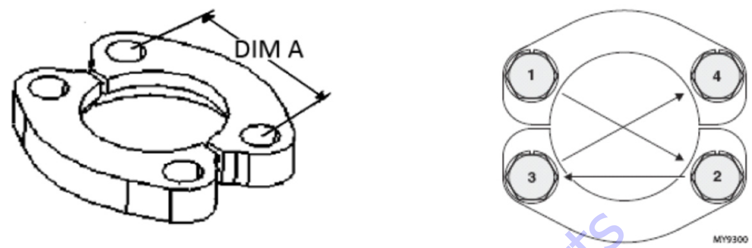
** Non typical for JLG Straight Male Stud Fittings, reference only.

*** Typical for JLG Adjustable Fittings

Assembly Instructions for Flange Connections: (FL61 and FL62)

1. Make sure sealing surfaces are free of rust, splits, scratches, dirt, foreign matter, or burrs.
2. See Figure for O-ring installation instructions.
3. Pre-lubricate the O-ring with Hydraulic Oil.
4. Position flange and clamp halves.
5. Place lock washers on bolt and bolt through clamp halves.
6. Tighten all bolts by hand.
7. Torque bolts in diagonal sequence in two or more increments to the torque listed on Table 5-31and Table 5-32.

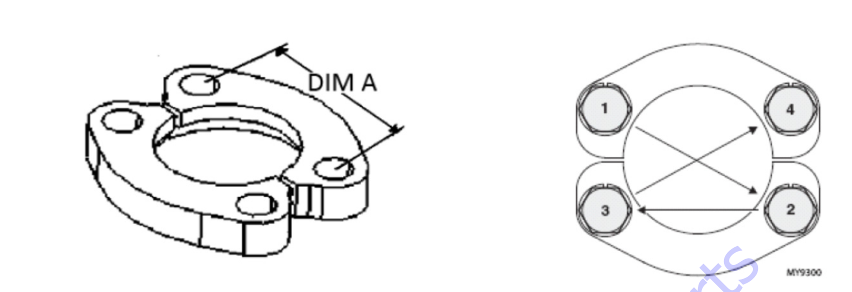
Table 5-31. Flange Code (FL61 & FL62) -Inch Fasteners



TYPE/FITTING IDENTIFICATION							STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)												
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws						
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	5/16-18	18	19	19	24	25	26	24	25	26	32	34	35	
	12	0.75	19	1.88	47.75	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66	
	16	1.00	25	2.06	52.32	3/8-16	32	33	35	43	45	47	44	46	49	60	63	66	
	20	1.25	32	2.31	58.67	7/16-14	52	54	57	70	74	77	68	71	75	92	97	101	
	24	1.50	38	2.75	69.85	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165	
	32	2.00	51	3.06	77.72	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165	
	40	2.50	64	3.50	88.90	1/2-13	77	81	85	105	110	116	111	116	122	150	158	165	
	48	3.00	76	4.19	106.43	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325	
	56	3.50	89	4.75	120.65	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325	
	64	4.00	102	5.13	130.30	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325	
	80	5.00	127	6.00	152.40	5/8-11	155	163	170	210	221	231	218	228	239	295	310	325	
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with GRADE 5 Screws						Fastener Torque for Flanges Equipped with GRADE 8 Screws						
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]			
		(in)	(mm)	(in)	(mm)	(UNF)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	5/16-18	--	--	--	--	--	--	24	25	26	32	34	35	
	12	0.75	19	2.00	50.80	3/8-16	--	--	--	--	--	--	44	46	49	60	63	66	
	16	1.00	25	2.25	57.15	7/16-14	--	--	--	--	--	--	68	71	75	92	97	101	
	20	1.25	32	2.62	66.55	1/2-13	--	--	--	--	--	--	111	116	122	150	158	165	
	20	1.25	32	2.62	66.55	--	--	--	--	--	--	--	--	--	--	--	--	--	
	24	1.50	38	3.12	79.25	5/8-11	--	--	--	--	--	--	218	228	239	295	310	325	
	32	2.00	51	3.81	96.77	3/4-10	--	--	--	--	--	--	332	348	365	450	473	495	

* A dimension for reference only.

Table 5-32. Flange Code (FL61 & FL62) - Metric Fasteners



TYPE/FITTING IDENTIFICATION							STEEL 4-BOLT FLANGE SAE J518 (INCH FASTENERS)												
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 61 SPLIT FLANGE (FL61)	8	0.50	13	1.50	38.10	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
	12	0.75	19	1.88	47.75	M8 x 1.25	18	19	19	24	25	26	18	19	19	24	25	26
	16	1.00	25	2.06	52.32	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	20	1.25	32	2.31	58.67	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	24	1.50	38	2.75	69.85	M10 x 1.5	37	39	41	50	53	55	37	39	41	50	53	55
	32	2.00	51	3.06	77.72	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	40	2.50	64	3.50	88.90	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	48	3.00	76	4.19	106.43	M12 x 1.75	68	71	75	92	97	101	68	71	75	92	97	101
	56	3.50	89	4.75	120.65	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
	64	4.00	102	5.13	130.30	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
	80	5.00	127	6.00	152.40	M16 x 2	155	163	170	210	221	231	155	163	170	210	221	231
TYPE	Inch Flange SAE Dash Size	Flange Size		A*		Bolt Thread Size	Fastener Torque for Flanges Equipped with CLASS 8.8 Screws						Fastener Torque for Flanges Equipped with CLASS 10.9 Screws					
							[Ft-Lb]			[N-m]			[Ft-Lb]			[N-m]		
		(in)	(mm)	(in)	(mm)	(Metric)	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
CODE 62 SPLIT FLANGE (FL62)	8	0.50	13	1.59	40.39	M8 x 1.25	--	--	--	--	--	--	24	25	26	32	34	35
	12	0.75	19	2.00	50.80	M10 x 1.5	--	--	--	--	--	--	52	54	57	70	74	77
	16	1.00	25	2.25	57.15	M12 x 1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M12 x 1.75	--	--	--	--	--	--	96	101	105	130	137	143
	20	1.25	32	2.62	66.55	M14 x 2	--	--	--	--	--	--	133	139	146	180	189	198
	24	1.50	38	3.12	79.25	M16 x 2	--	--	--	--	--	--	218	228	239	295	310	325
	32	2.00	51	3.81	96.77	M20 x 2.5	--	--	--	--	--	--	406	426	446	550	578	605

* A dimension for reference only.

Double Wrench Method

To prevent undesired hose or connector rotation, two wrenches must be used; one torque wrench and one backup wrench. If two wrenches are not used, inadvertent component rotation may occur which absorbs torque and causes improper joint load and leads to leaks. For hose connections, the 'layline' printed on the hose is a good indicator of proper hose installation. A twisted lay-line usually indicates the hose is twisted. See Figure 5-12. for double wrench method requirements.

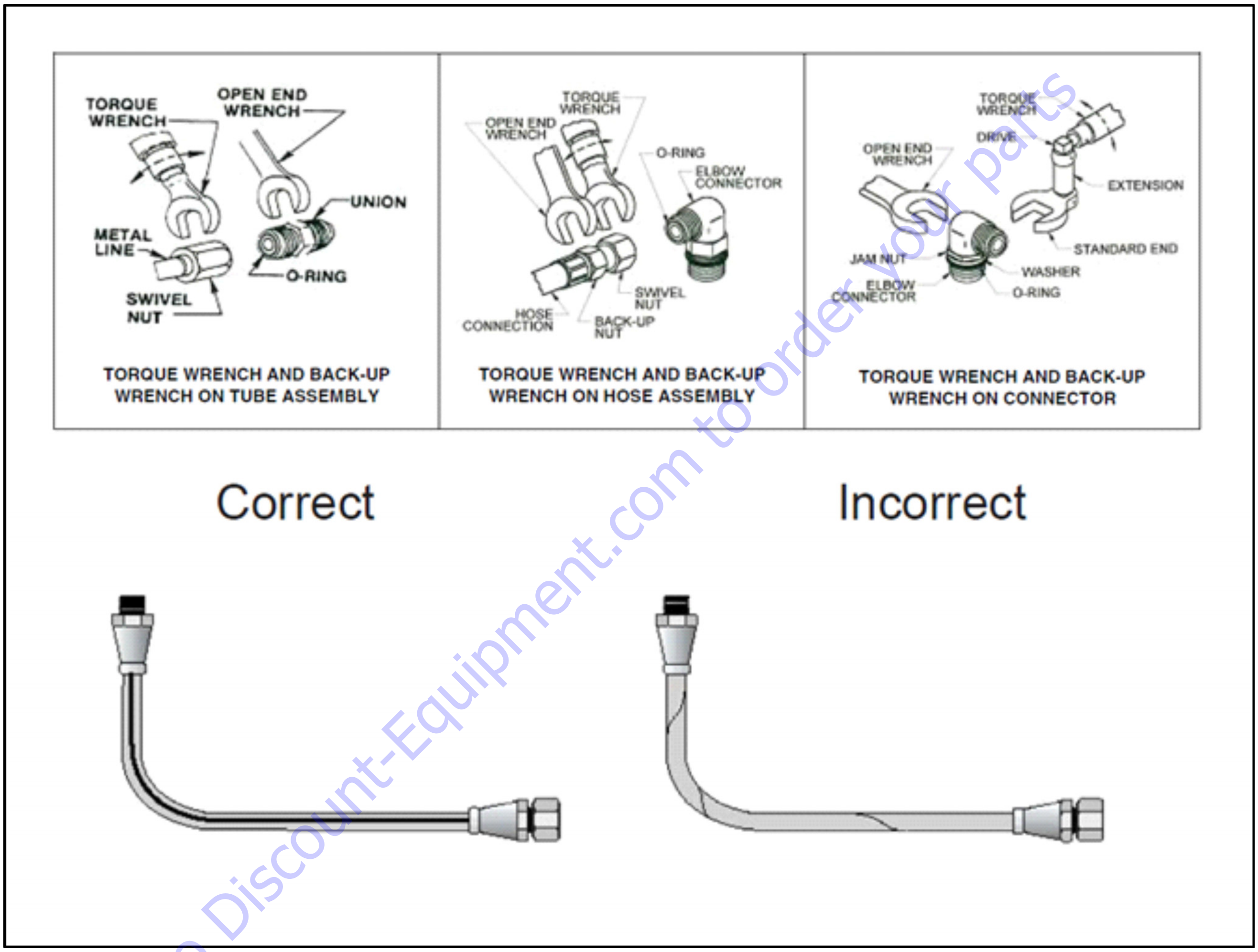


Figure 5-12. Double Wrench Method

FFWR and TFFT Methods

FFWR (FLATS FROM WRENCH RESISTANCE METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter. See Figure 5-13.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten as shown in Figure 5-13. The nut is to be rotated clockwise the number of hex flats as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened. See Figure 5-13.

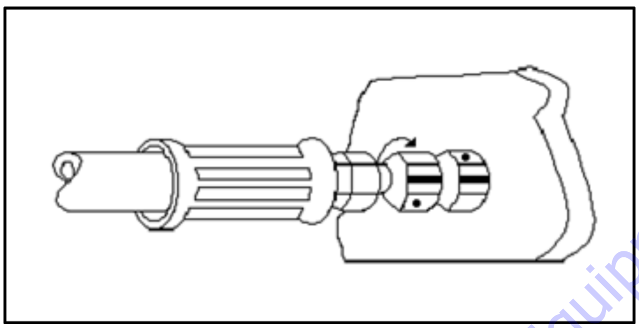


Figure 5-13. FFWR Method

TFFT (TURNS FROM FINGER TIGHT METHOD)

1. Tighten the swivel nut to the mating fitting until no lateral movement of the swivel nut can be detected; finger tight condition.
2. Mark a dot on one of the swivel hex nut flats and another dot in line on the connecting tube adapter.
3. Use the double wrench method per Appendix A, turn the swivel nut to tighten. The nut is to be rotated clockwise the number of turns as defined by the applicable Table in Section 5.0.
4. After the connection has been properly tightened, mark a straight line across the connecting parts, not covering the dots, to indicate the connection has been properly tightened.

Adjustable Stud End Assembly

For Adjustable Stud End Connections; the following assembly steps are to be performed:

1. Lubricate the o-ring with a light coat of hydraulic oil.
2. Position #1 – The o-ring should be located in the groove adjacent to the face of the backup washer. The washer and o-ring should be positioned at the extreme top end of the groove as shown.
3. Position #2 – Position the locknut to just touch the backup washer as shown. The locknut in this position will eliminate potential backup washer damage during the next step.
4. Position #3 – Install the connector into the straight thread box port until the metal backup washer contacts the face of the port as shown.
5. Position #4 – Adjust the connector to the proper position by turning out (counterclockwise) up to a maximum of one turn as shown to provide proper alignment with the mating connector, tube assembly, or hose assembly.
6. Position #5 – Using two wrenches, use the backup wrench to hold the connector in the desired position and then use the torque wrench to tighten the locknut to the appropriate torque.
7. Visually inspect, where possible, the joint to ensure the o-ring is not pinched or bulging out from under the washer and that the backup washer is properly seated flat against the face of the port.

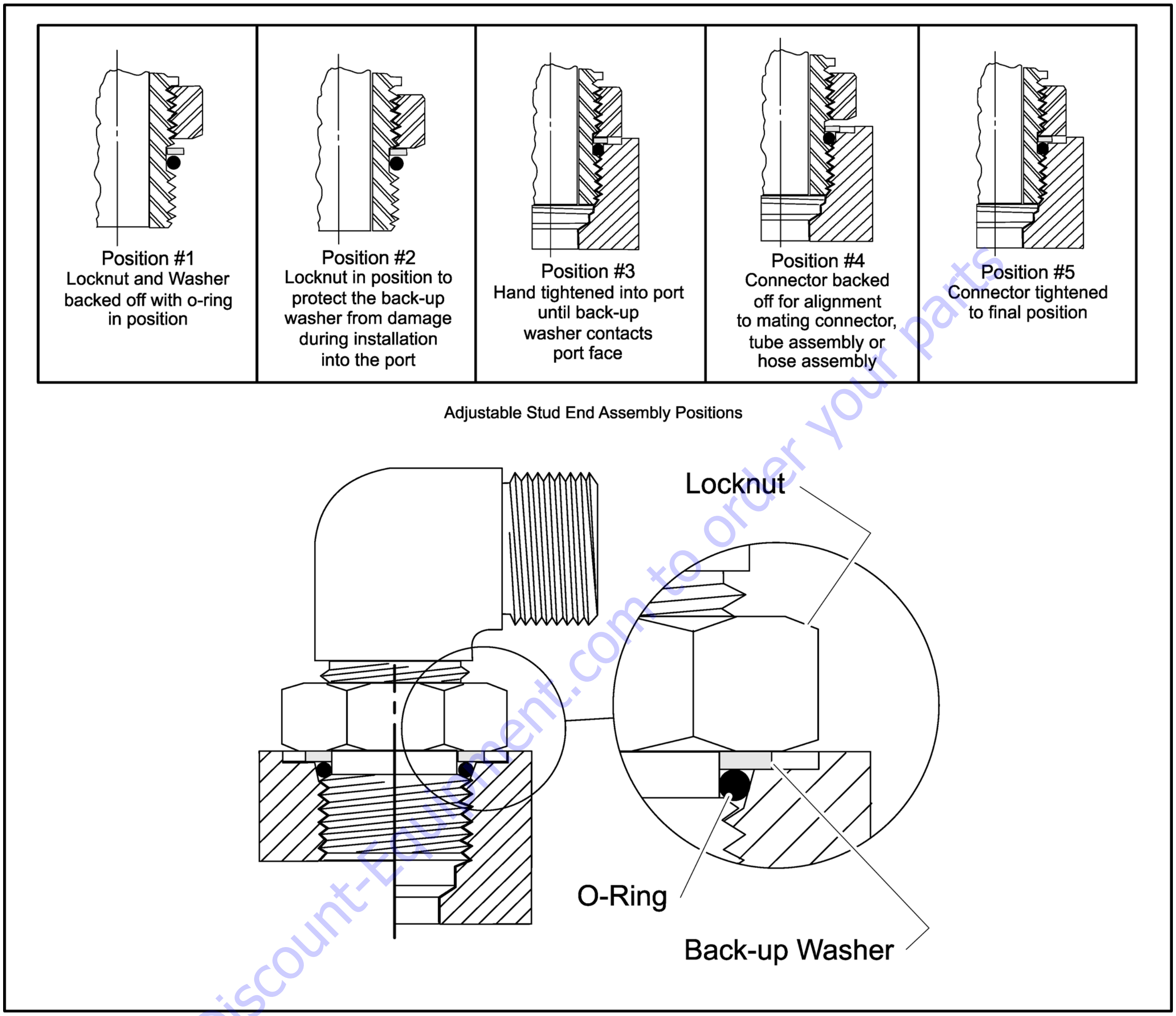


Figure 5-14. Adjustable Stud End Assembly

O-ring Installation (Replacement)

Care must be taken when installing O-rings over threads during replacement or installation. O-rings could become nicked or torn. A damaged O-ring could lead to leakage problems.

1. Inspect O-ring for tears or nicks. If any are found replace O-ring.
2. Ensure proper O-ring to be installed. Many O-rings look the same but are of different material, different hardness, or are slightly different diameters or widths.
3. Use a thread protector when replacing O-rings on fittings.
4. In ORB; ensure O-ring is properly seated in groove. On straight threads, ensure O-ring is seated all the way past the threads prior to installation.
5. Inspect O-ring for any visible nicks or tears. Replace if found.

5.3 HYDRAULIC CYLINDERS

Platform Level Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

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

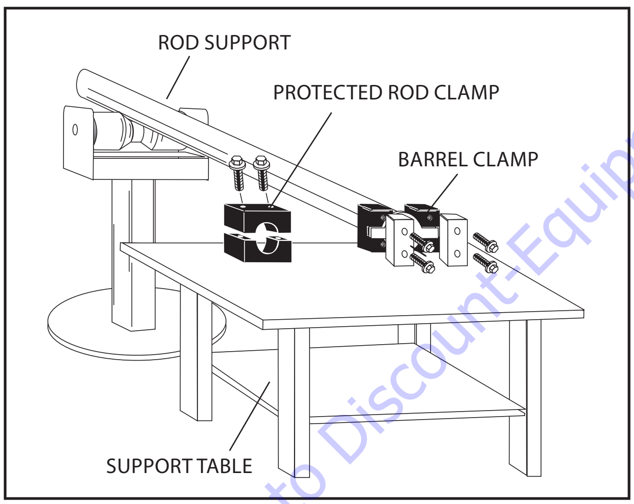


Figure 5-15. Cylinder Barrel Support

5. Using the hook spanner wrench, unscrew the cylinder head from the barrel.
6. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

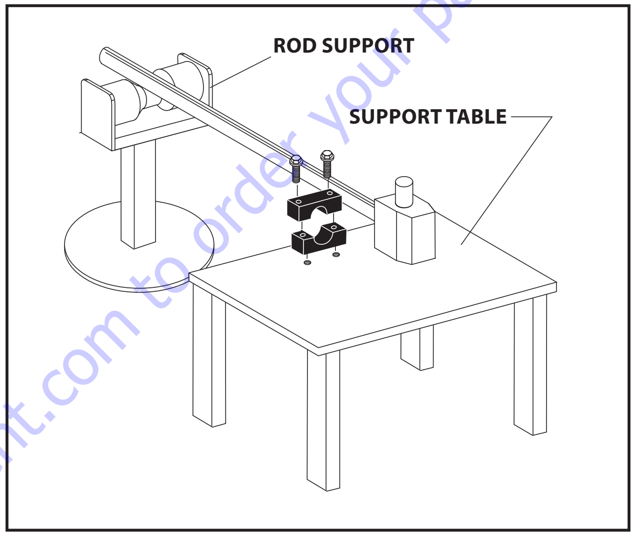
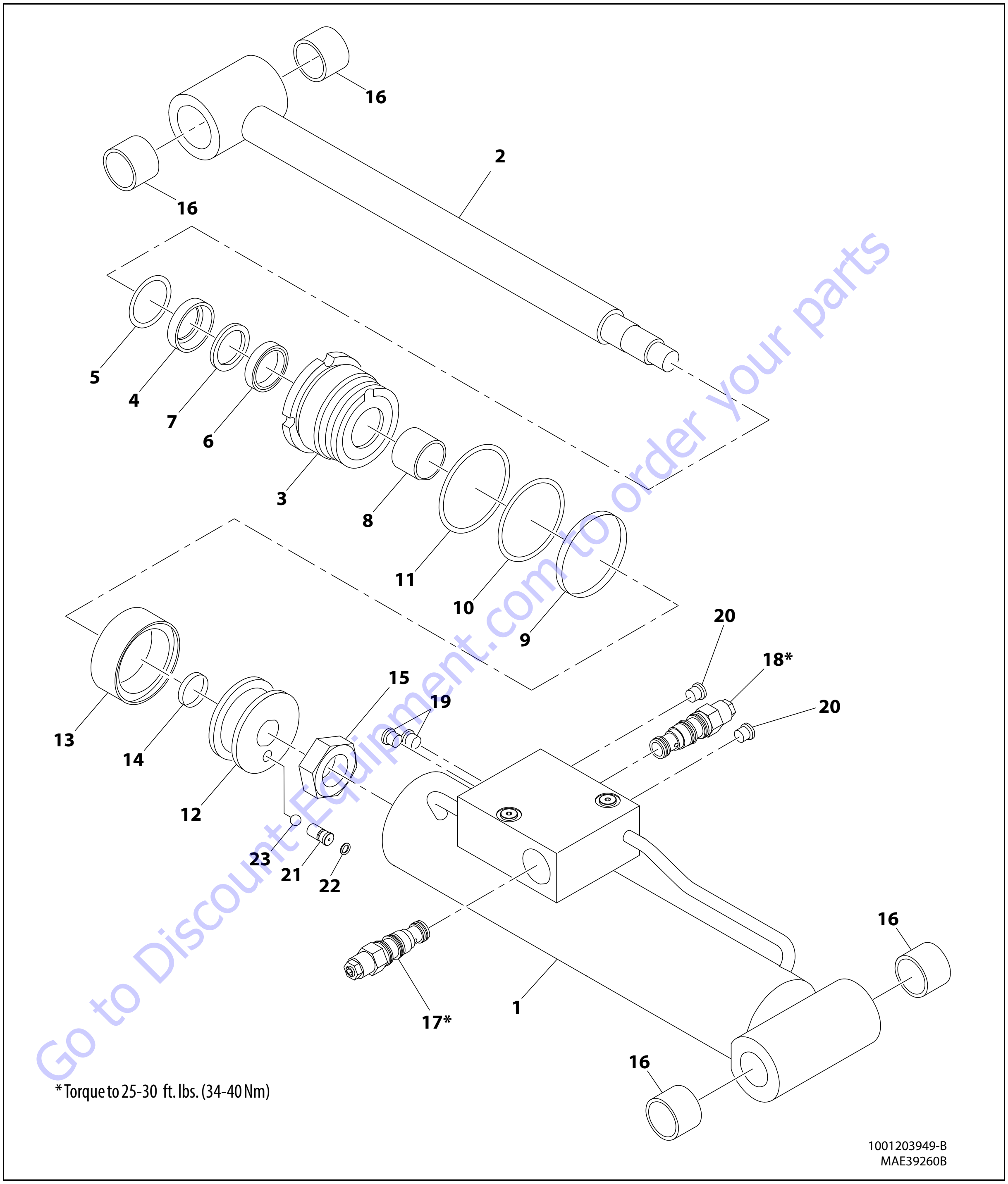


Figure 5-16. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Wear Ring
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Nut
16. Bearing
17. Cartridge Valve
18. Cartridge Valve
19. Plug
20. Plug
21. Phase Valve
22. O-ring
23. Ball

Figure 5-17. Platform Level Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove lock nut which attach the piston to the rod.
10. Remove the phase valve from the piston.
11. Remove the ball and o-ring, if applicable. Discard the o-ring.
12. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
13. Remove and discard the piston seal and o- ring of the piston.
14. Remove the rod from the holding fixture. Remove the cylinder head. Discard the o-ring, backup ring, rod seal, wear ring, retaining ring and wiper seal.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

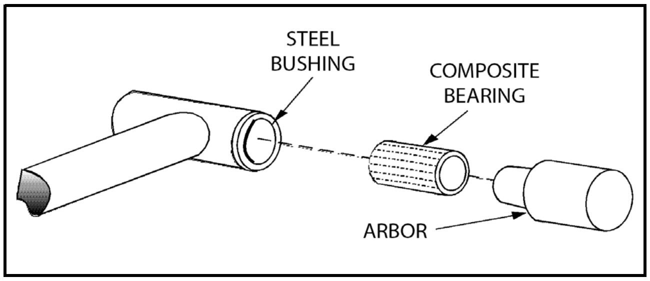


Figure 5-18. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.

13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

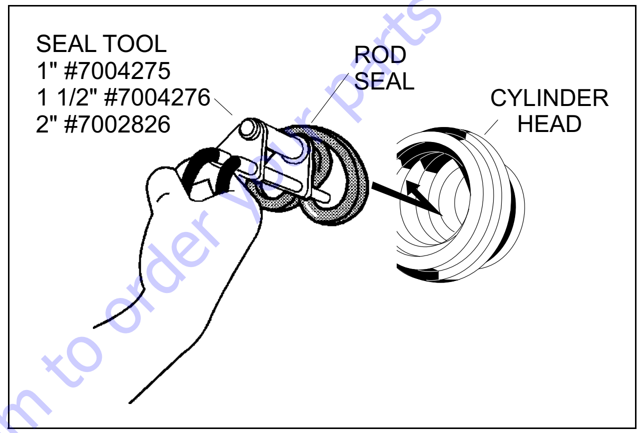


Figure 5-19. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

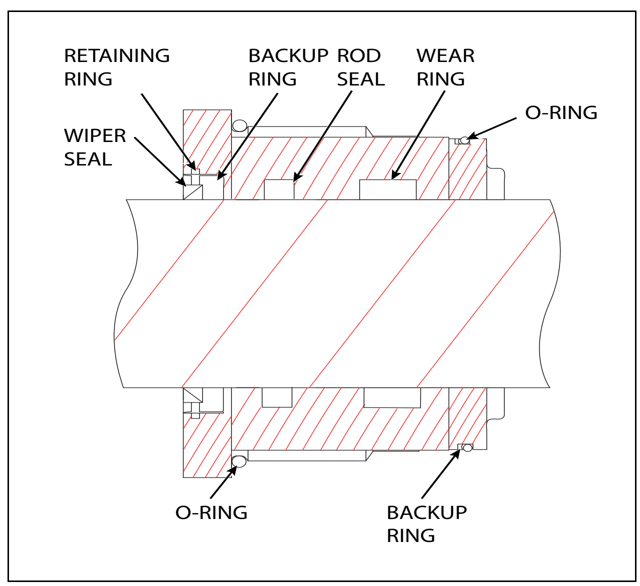
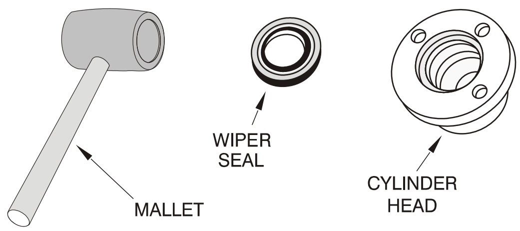


Figure 5-20. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-21. Wiper Seal Installation

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

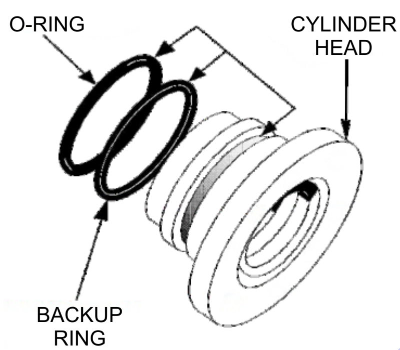


Figure 5-22. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the piston head on the rod, ensuring that the wiper seal and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.

5. Place a new o-ring in the inner piston diameter groove.

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

7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.

8. Install ball and o-ring into the piston, as applicable.

9. Install the valve phase into the piston and torque to 25-30 ft. lbs. (34-40 Nm).

10. Install the lock nut onto the cylinder rod.

11. Remove the cylinder rod from the holding fixture.

12. Place new piston seal in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

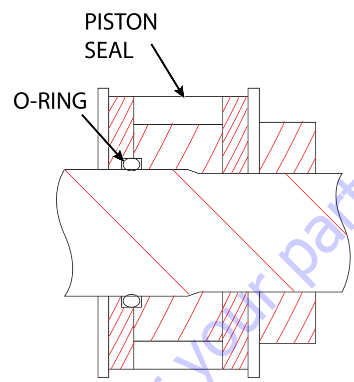


Figure 5-23. Piston Seal Kit Installation

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

NOTICE

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

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

15. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.

16. Screw the cylinder head into the barrel using a spanner wrench.

17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

18. Install the cartridge valves and torque to 25-30 ft. lbs. (34-40 Nm).

19. Install the plugs into the port blocks.

Jib Lift Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ WARNING

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

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

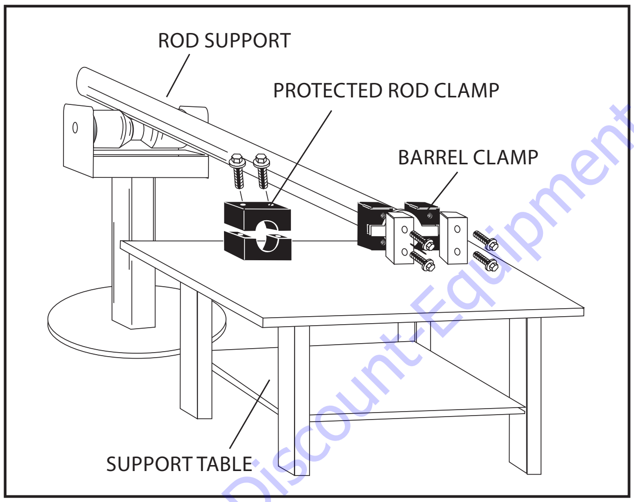


Figure 5-24. Cylinder Barrel Support

5. Using the hook spanner wrench unscrew the cylinder head from the barrel.
6. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

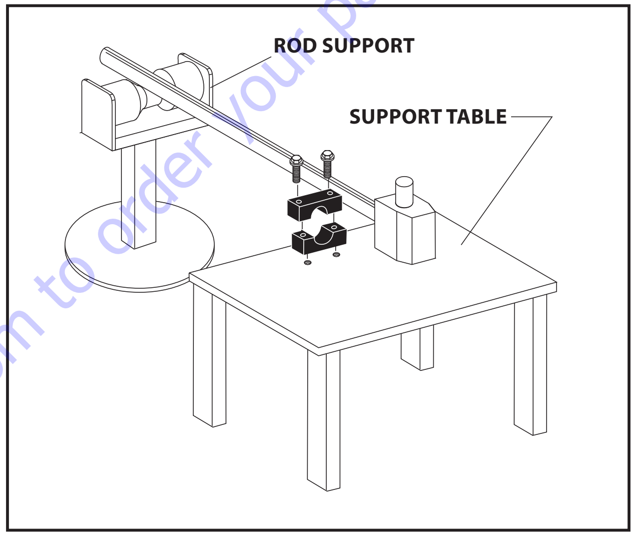
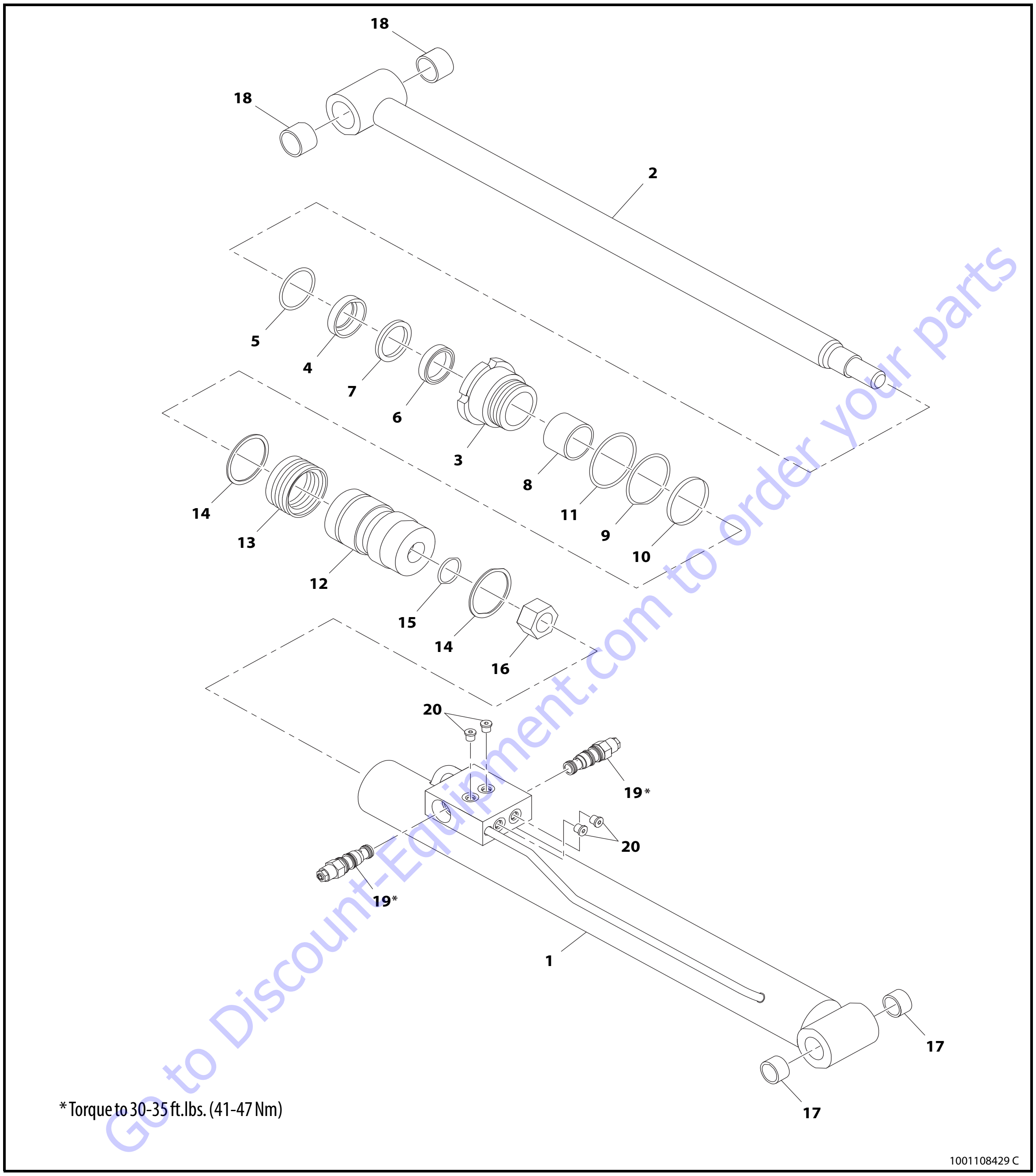


Figure 5-25. Cylinder Rod Support



1. Barrel	5. Retaining Ring	9. O-ring	13. Piston Seal	17. Bearing
2. Rod	6. Rod Seal	10. Backup Ring	14. Piston Ring	18. Bearing
3. Head	7. Backup Ring	11. O-ring	15. O-Ring	19. Counterbalance Valve
4. Wiper Seal	8. Wear Ring	12. Piston	16. Nut	20. Plug

Figure 5-26. Jib Lift Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove lock nut which attach the piston to the rod.
10. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
11. Remove and discard the piston seal, piston ring and o-ring.
12. Remove the rod from the holding fixture. Remove the cylinder head. Discard the o-rings, backup ring, retaining ring, rod seal, wiper seal and wear ring.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

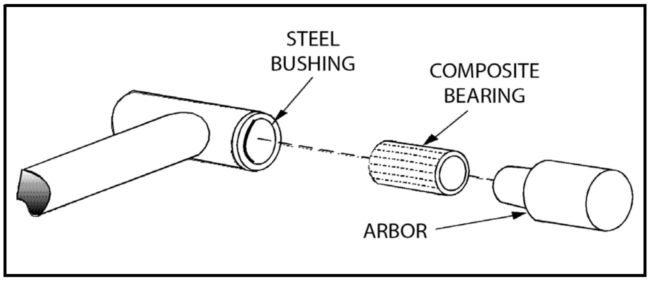


Figure 5-27. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

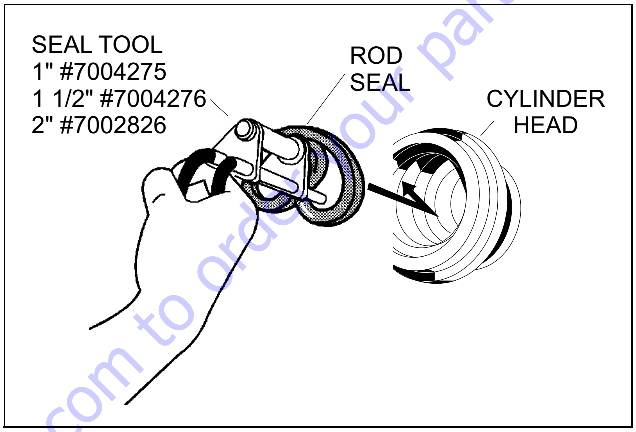


Figure 5-28. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

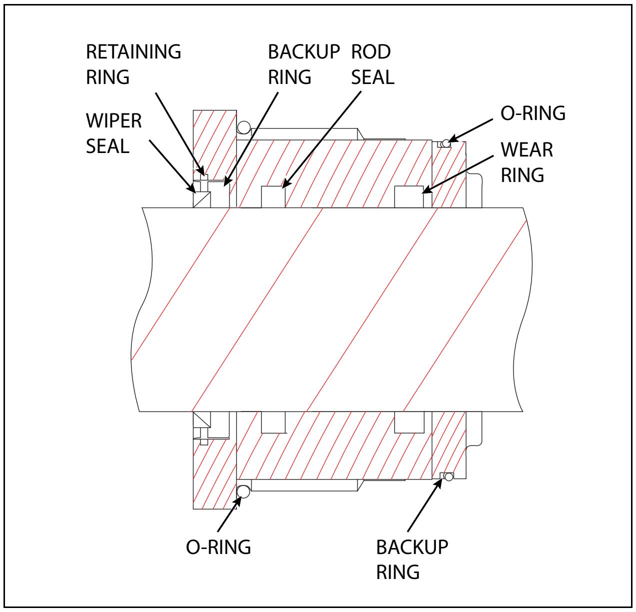
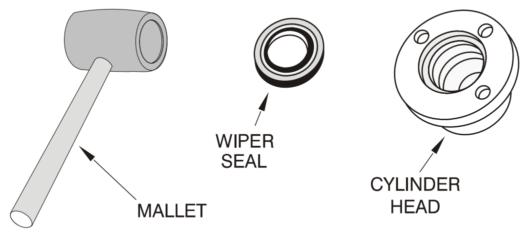


Figure 5-29. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove. Install the new retaining ring into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-30. Wiper Seal Installation

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

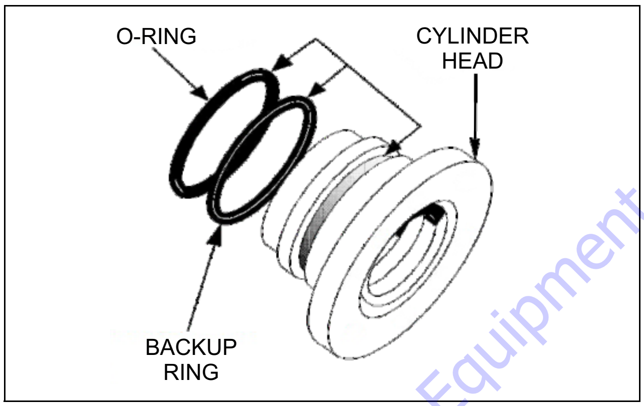


Figure 5-31. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head on the rod, ensuring that the wiper seal and rod seal are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring in the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring is not damaged or dislodged.
8. Install the lock nut onto the cylinder rod.
9. Remove the cylinder rod from the holding fixture.
10. Place new piston rings and seal in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

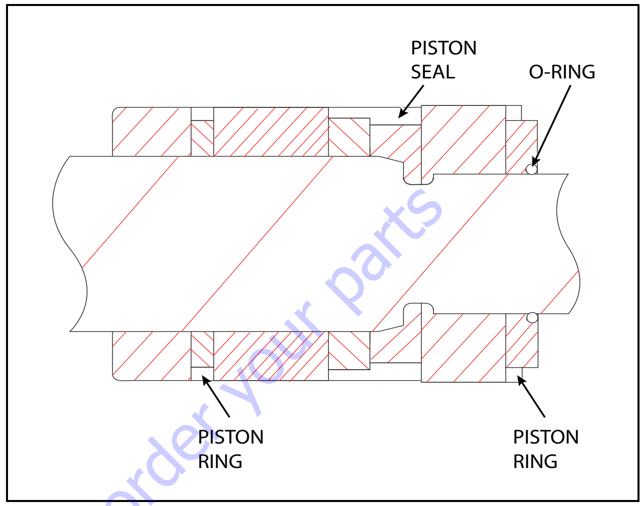


Figure 5-32. Piston Seal Kit Installation

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

NOTICE

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

12. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
13. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.
14. Screw the cylinder head into the barrel using a spanner wrench.
15. 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.
16. Install the counterbalance valves in the rod port block. Torque to 30-35 ft.lbs. (40-47 Nm).
17. Install the plugs into the port blocks.

Main Boom Lift Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the counterbalance valve, check valve and 2 way poppet valve from the cylinder port block and discard the o-rings.
4. Remove the plugs and orifice from the cylinder port block and discard the o-rings.
5. Place the cylinder barrel into a suitable holding fixture.

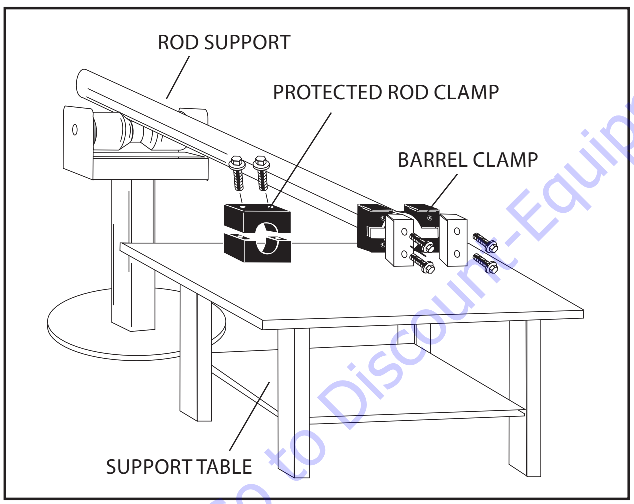


Figure 5-33. Cylinder Barrel Support

6. Using the hook spanner wrench, unscrew the cylinder head from the barrel.
7. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

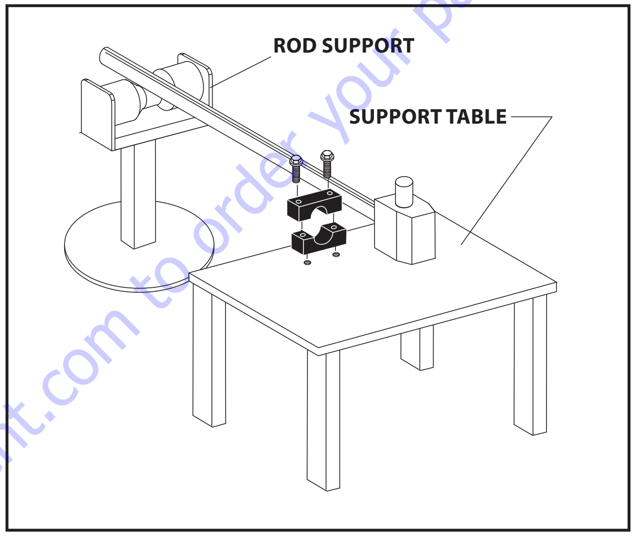
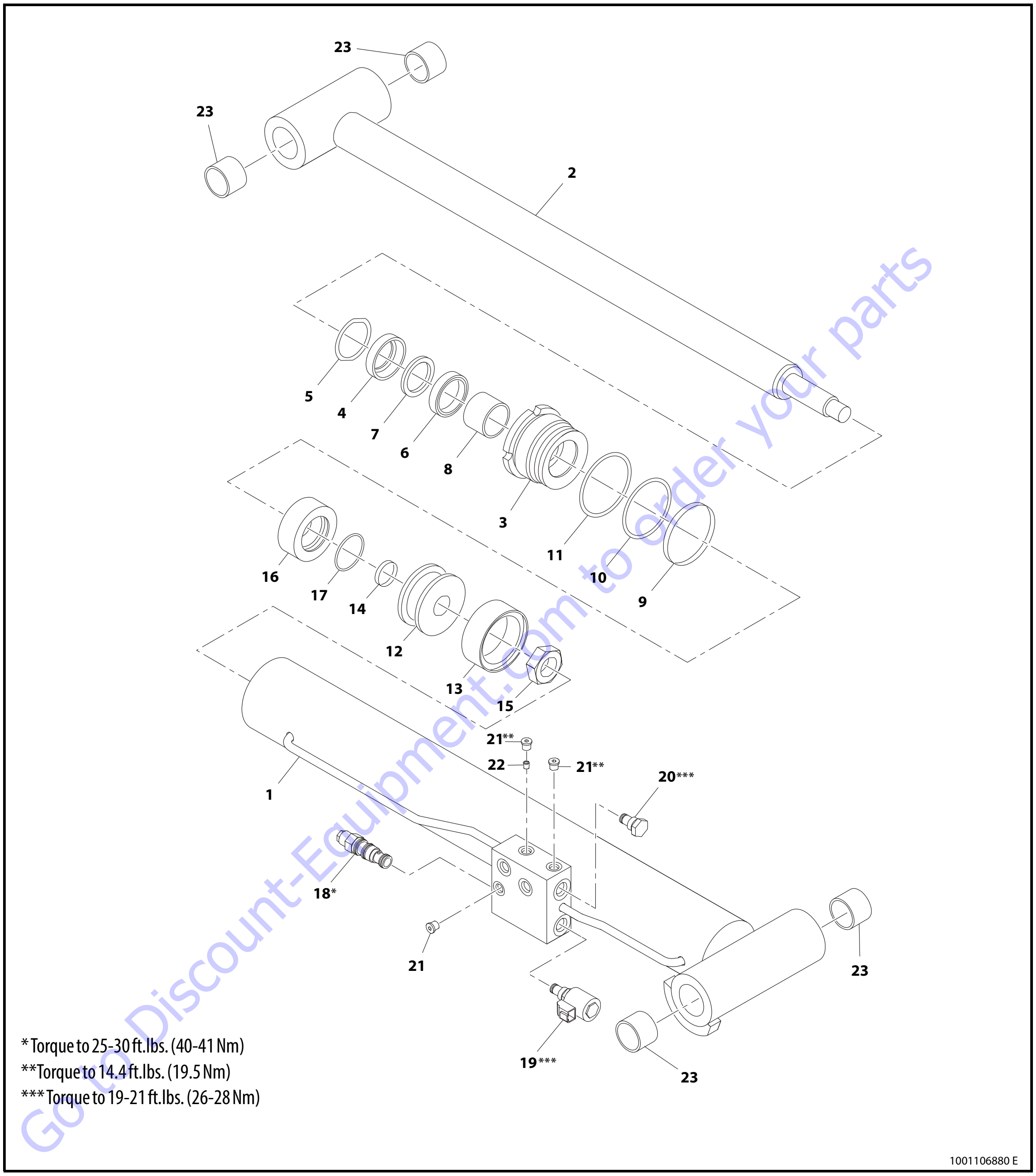


Figure 5-34. Cylinder Rod Support



1. Barrel	6. Rod Seal	11. O-ring	16. Spacer	20. Cartridge Valve
2. Rod	7. Backup Ring	12. Piston	17. O-ring	21. Plug
3. Head	8. Wear Ring	13. Piston Seal	18. Cartridge Valve	22. Orifice
4. Wiper Seal	9. O-ring	14. O-Ring	19. Cartridge Valve	23. Bearing
5. Retaining Ring	10. Backup Ring	15. Nut		

Figure 5-35. Main Boom Lift Cylinder

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. Remove the bearings from the barrel.
11. Loosen and remove lock nut from the piston rod.
12. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
13. Remove and discard the piston seal and o-rings.
14. Remove the spacer from the rod.
15. Remove the rod from the holding fixture. Remove the cylinder head. Remove and discard the o-rings, backup ring, wear ring, rod seal, retainer ring and wiper seal.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

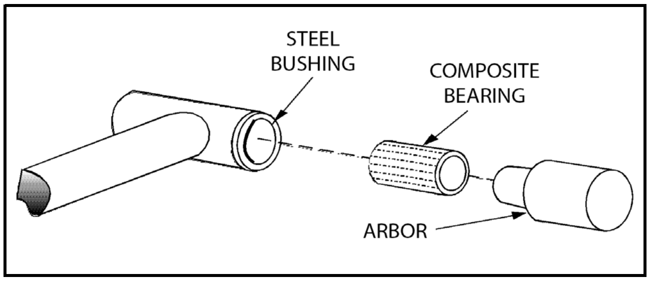


Figure 5-36. Composite Bearing Installation

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

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

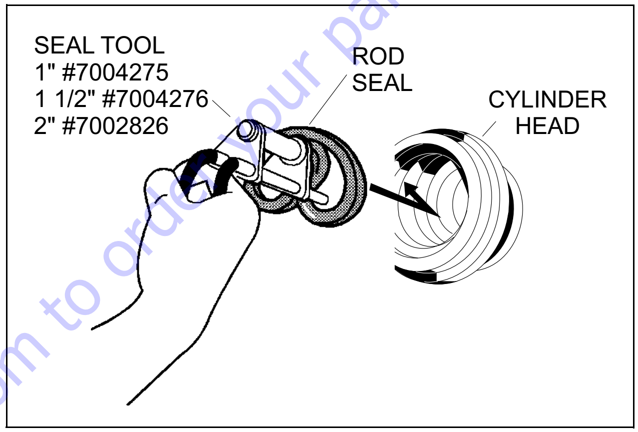


Figure 5-37. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

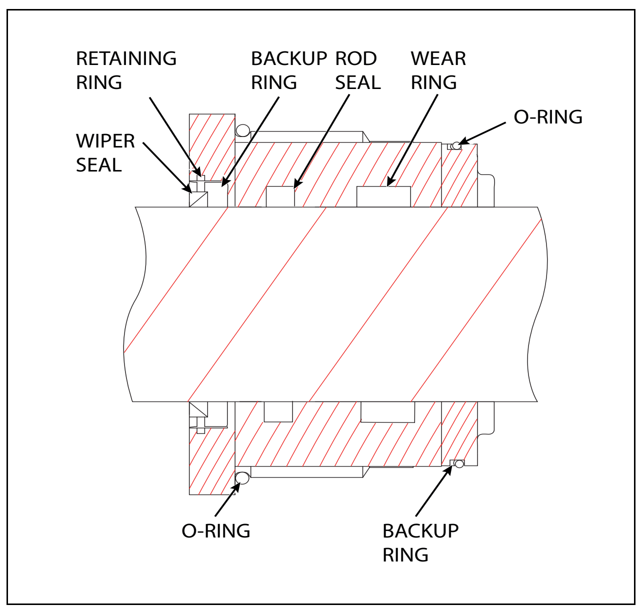
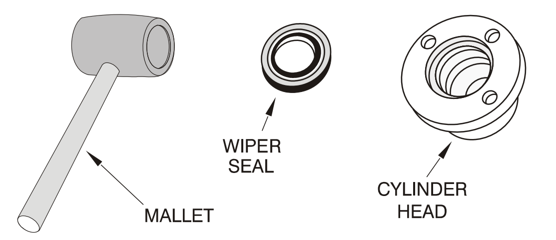


Figure 5-38. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove. Install the new wear ring into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-39. Wiper Seal Installation

3. Place a new o-ring in the applicable outside diameter groove of the cylinder head.

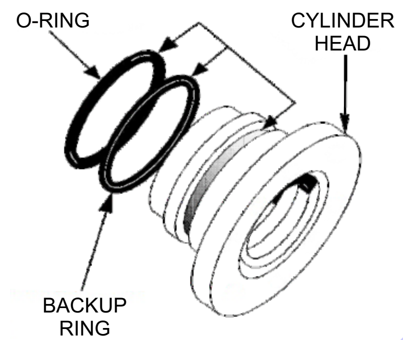


Figure 5-40. Installation of Head Seal Kit

4. Carefully install the head on the rod, ensuring that the wiper seal and rod seals are not damaged or dislodged. Push the head along the rod to the rod end.

5. Install the spacer on the cylinder rod.

6. Place a new o-ring and retaining ring in the inner piston diameter groove.

7. Place the o-rings in outer piston diameter groove.

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

9. Carefully thread the piston on the cylinder rod hand tight until it abuts the spacer end, ensuring that the o-ring are not damaged or dislodged.

10. Install the lock nut.

11. Remove the cylinder rod from the holding fixture.

12. Place new piston seal and spacer in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

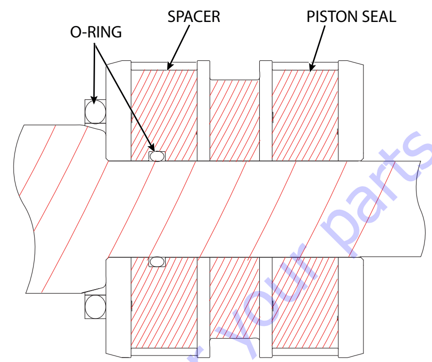


Figure 5-41. Piston Seal Kit Installation

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

NOTICE

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

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

15. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.

16. Secure the cylinder head and cylinder cap.

17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

18. Install the counterbalance valve in the rod port block. Torque to 25-30 ft.lbs. (40-47 Nm).

19. Install the check valve and 2 way poppet valve in the respective port blocks. Torque to 19-21 ft.lbs. (26-28 Nm).

20. Install the orifice and plugs in port block. Torque plugs to 14.4 ft.lbs. (19.5 Nm).

Master Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the plugs from the barrel and discard the o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

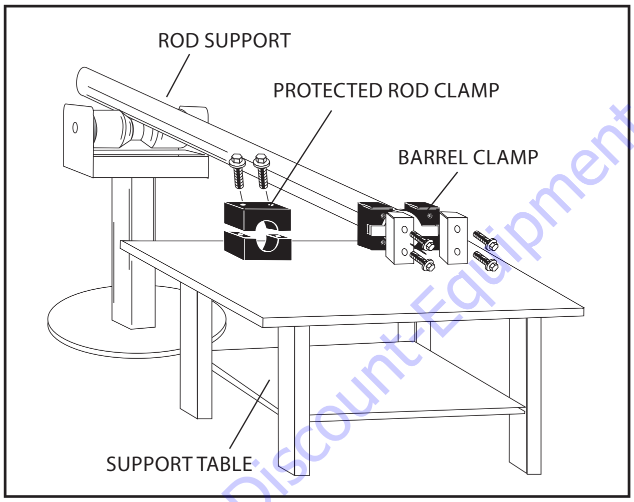


Figure 5-42. Cylinder Barrel Support

5. Using a hook spanner wrench, unscrew the cylinder head from the barrel.
6. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

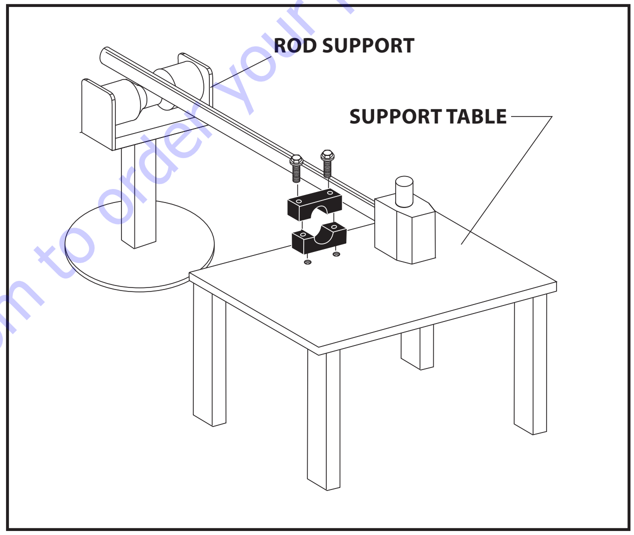
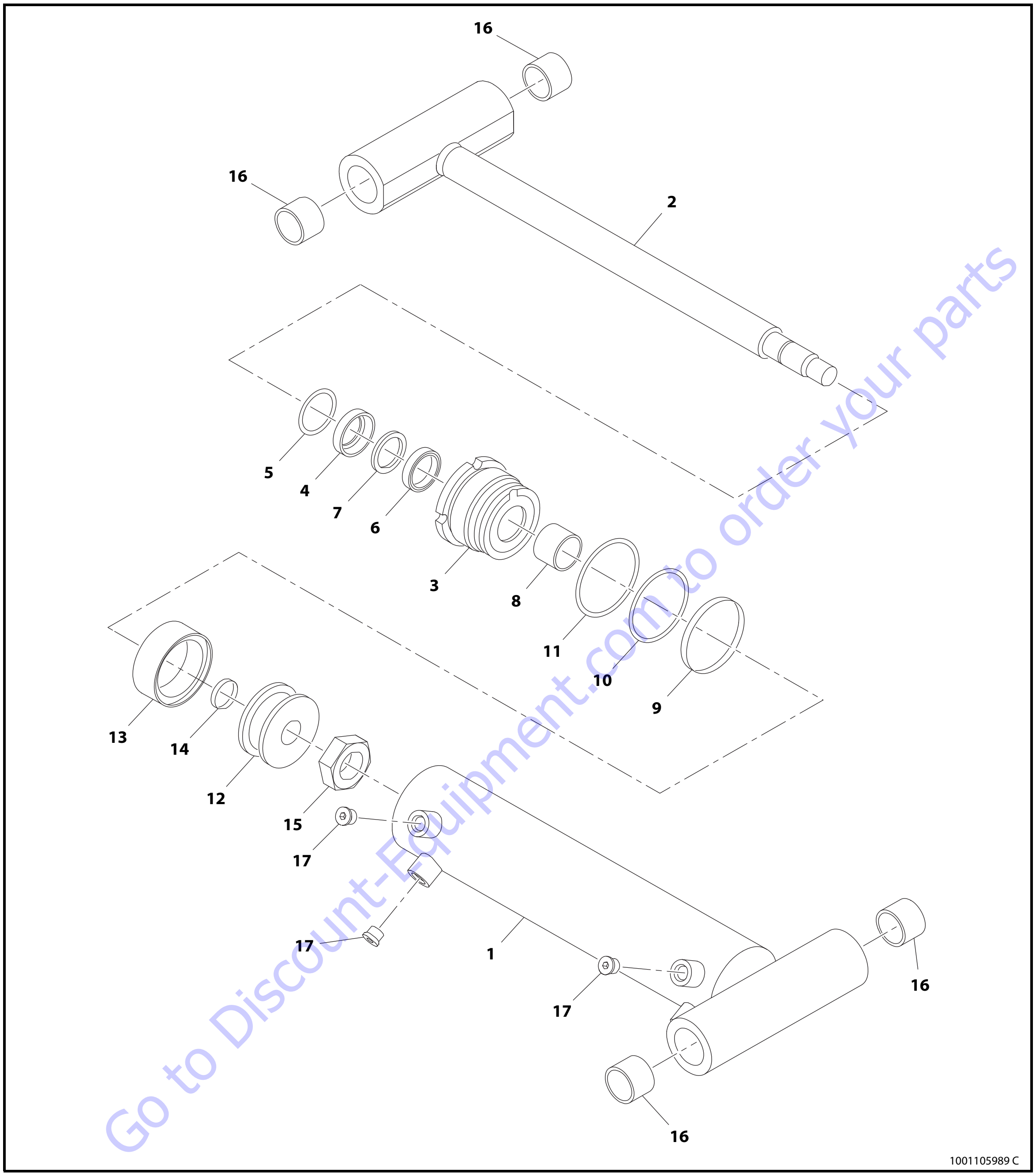


Figure 5-43. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Wear Ring
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-ring
15. Nut
16. Bearing
17. Plug

Figure 5-44. Master Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the lock nut from the cylinder rod.
10. Screw the piston counterclockwise by hand and remove the piston from cylinder rod.
11. remove and discard the piston seal and o-ring.
12. Remove the rod from the holding fixture. Remove the cylinder head. Discard the o-ring, retaining ring, backup ring, rod seal, wiper seal and wear ring.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

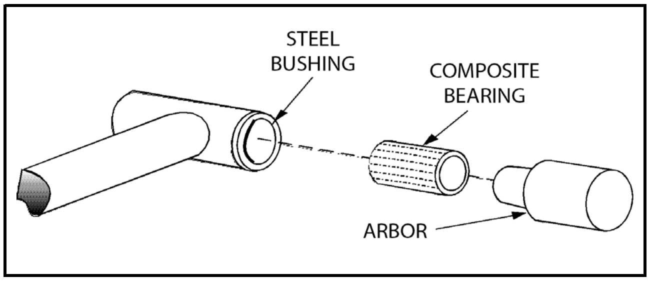


Figure 5-45. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

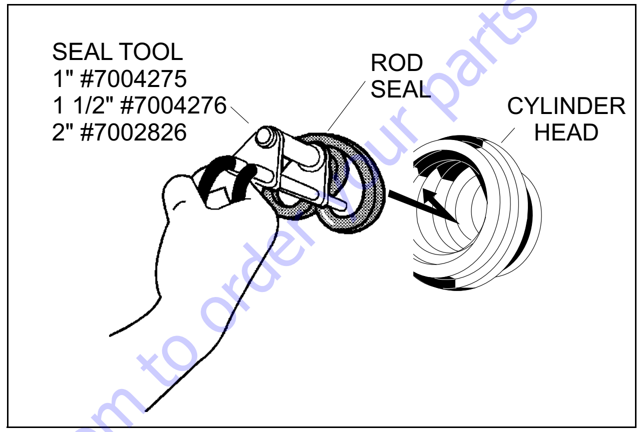


Figure 5-46. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

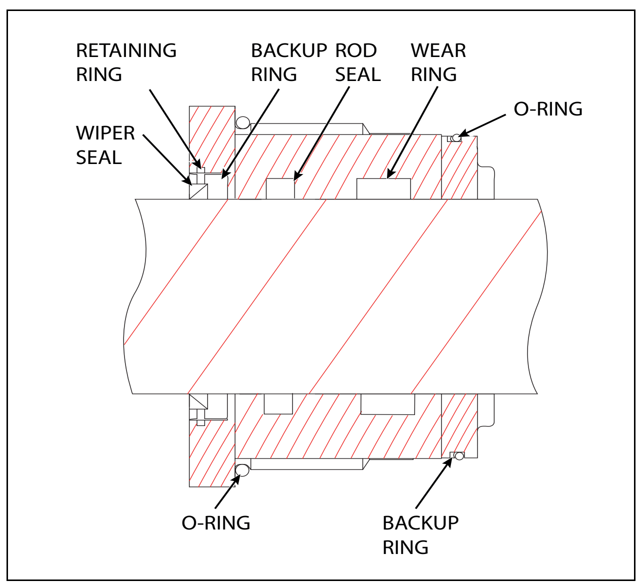
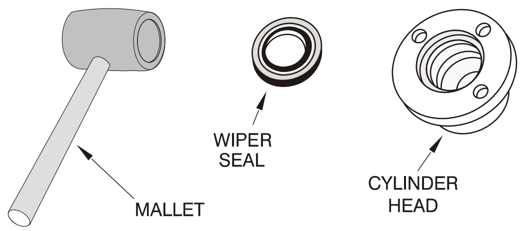


Figure 5-47. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-48. Wiper Seal Installation

3. Place a new o-rings and backup seal in the applicable outside diameter groove of the cylinder head.

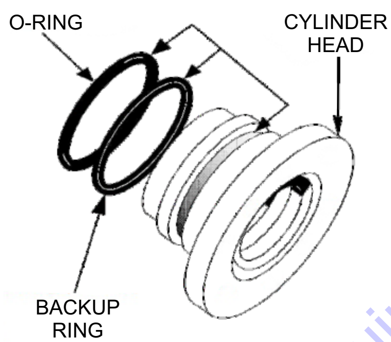


Figure 5-49. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head on the rod, ensuring that the wiper seal and, rod seal and retaining ring are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring in the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
8. Install the lock nut onto the cylinder rod.
9. Remove the piston rod from the holding fixture.
10. Place new piston seal in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

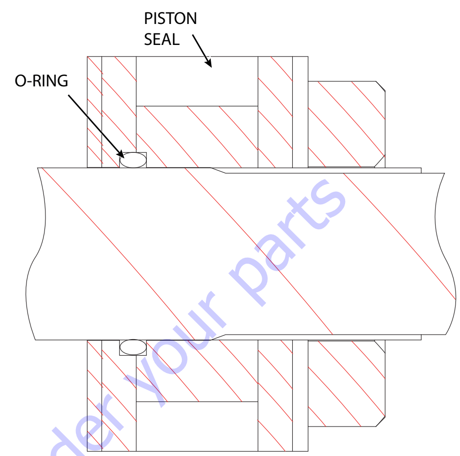


Figure 5-50. Piston Seal Kit Installation

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

NOTICE

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

12. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
13. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.
14. Screw the cylinder head into the barrel using a spanner wrench.
15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
16. Install the plugs into port blocks.

Tower Boom Lift Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove the bearings from the cylinder barrel.
4. Remove the all cartridge valves, plugs and orifice from the block ports of the cylinder. Discard the o-rings.
5. Place the cylinder barrel into a suitable holding fixture.

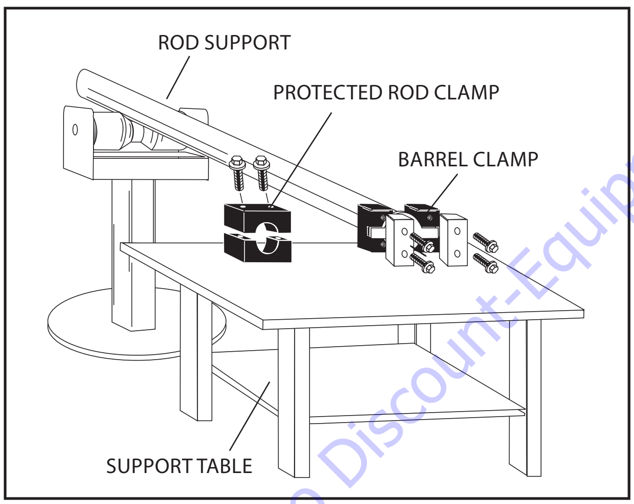


Figure 5-51. Cylinder Barrel Support

6. Using a hook spanner wrench, unscrew the cylinder head from the barrel.
7. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

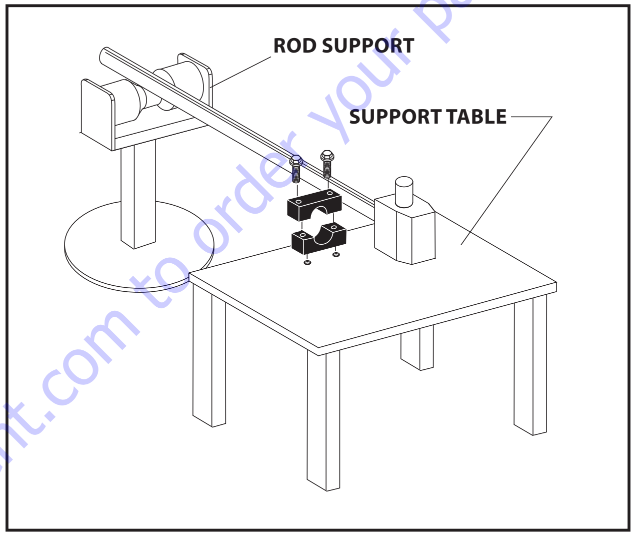
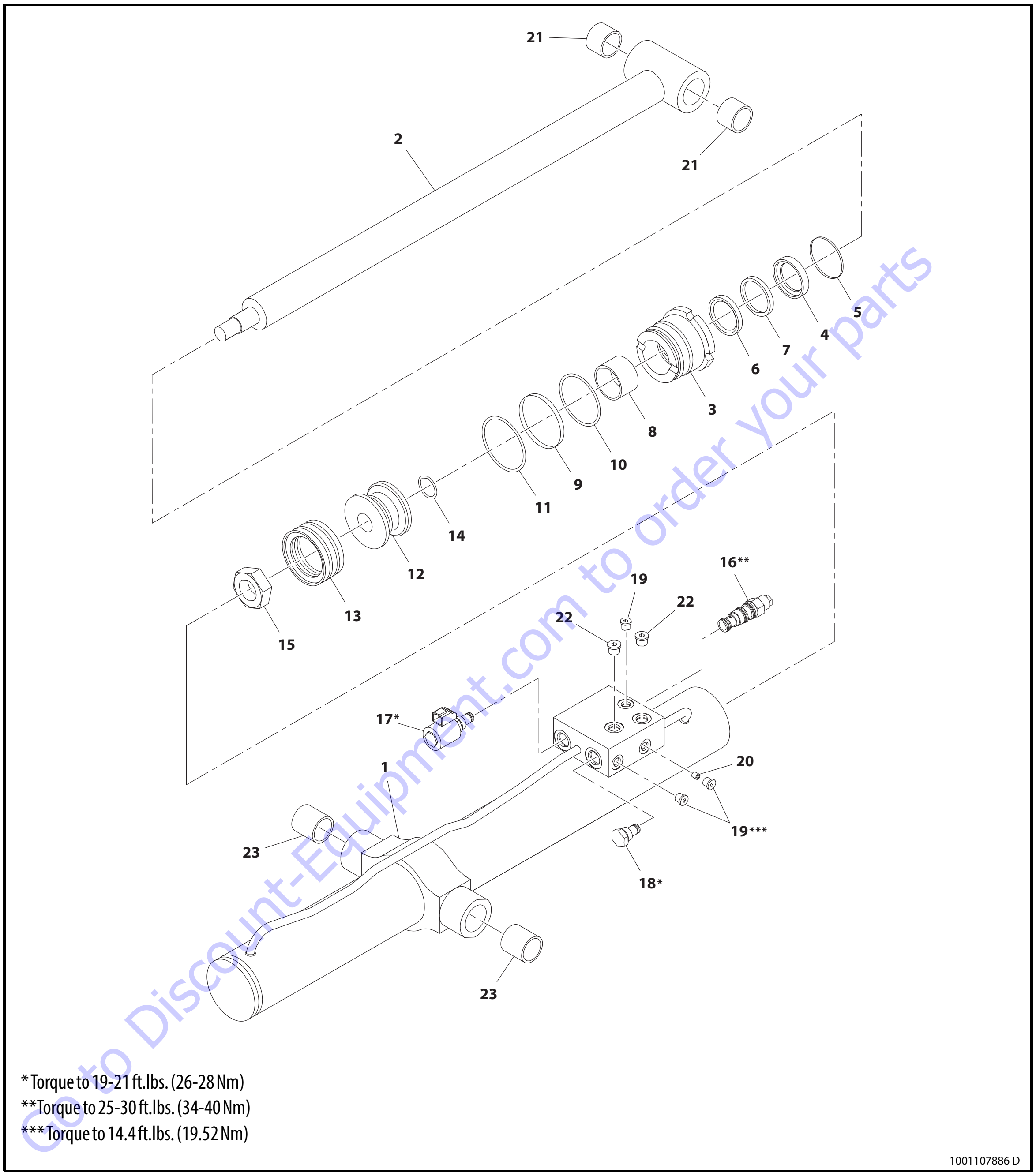


Figure 5-52. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Wear Ring
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-Ring
15. Nut
16. Cartridge Valve
17. Cartridge Valve
18. Cartridge Valve
19. Plug
20. Orifice
21. Bearing
22. Plug
23. Bearing

Figure 5-53. Tower Boom Cylinder

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. Remove the lock nut from the cylinder rod.
11. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
12. Remove and discard the piston seal and o-ring.
13. Remove the cylinder head from rod. Remove and discard the o-ring, backup ring, wear ring, rod seal, wiper seal and retaining ring.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

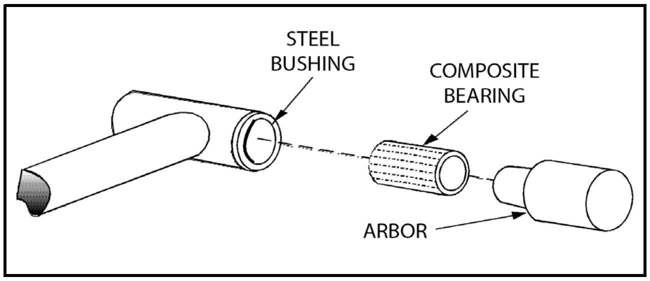


Figure 5-54. Composite Bearing Installation

12. Inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

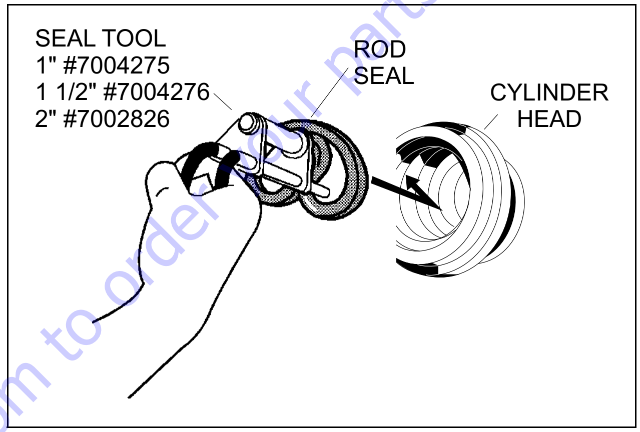


Figure 5-55. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

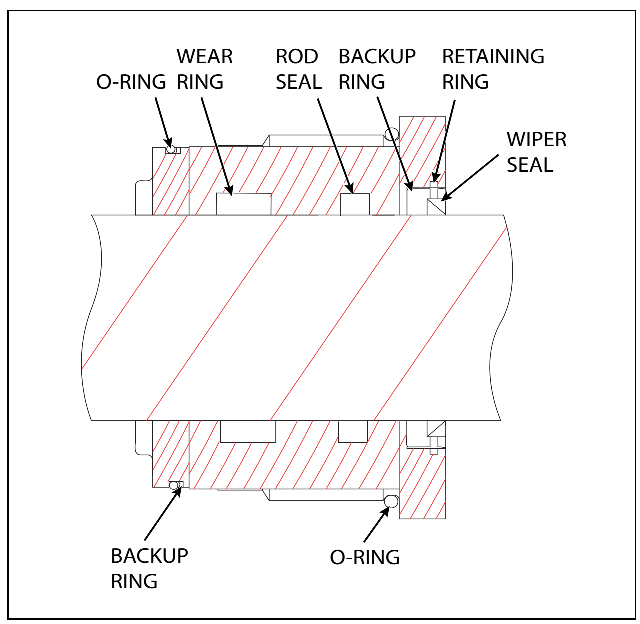
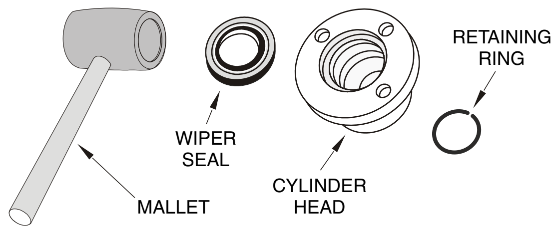


Figure 5-56. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove. Install a new retaining ring into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-57. Wiper Seal Installation

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

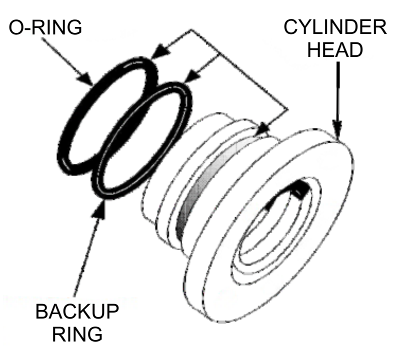


Figure 5-58. Installation of Head Seal Kit

4. Install o-ring onto the cylinder rod. Carefully install the head on the rod, ensuring that the wiper seal and rod seal are not damaged or dislodged. Push the head along the rod to the rod end.
5. Place a new o-ring in the inner piston diameter groove.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
7. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
8. Install the lock nut onto the cylinder rod.
9. Remove the cylinder rod from the holding fixture.
10. Place new piston seal and o-ring in the outer and inner piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

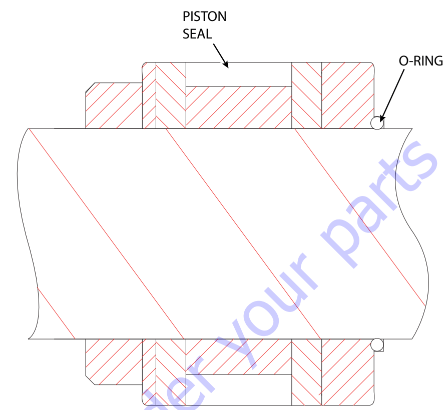


Figure 5-59. Piston Seal Kit Installation

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

NOTICE

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

12. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
13. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.
14. Screw the cylinder head into the barrel using a spanner wrench.
15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.
16. Install the 2 way poppet cartridge valve and torque to 19-21 ft.lbs. (26-28 Nm).
17. Install the counterbalance cartridge valve and torque to 25-30 ft.lbs. (34-40 Nm).
18. Install the check cartridge valve and torque to 19-21 ft. lbs. (26-28 Nm).
19. Install the plugs and torque to 14.4 ft.lbs. (19.5 Nm).

Steer Cylinder

DISASSEMBLY

NOTICE

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

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

WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Place the cylinder barrel into a suitable holding fixture.

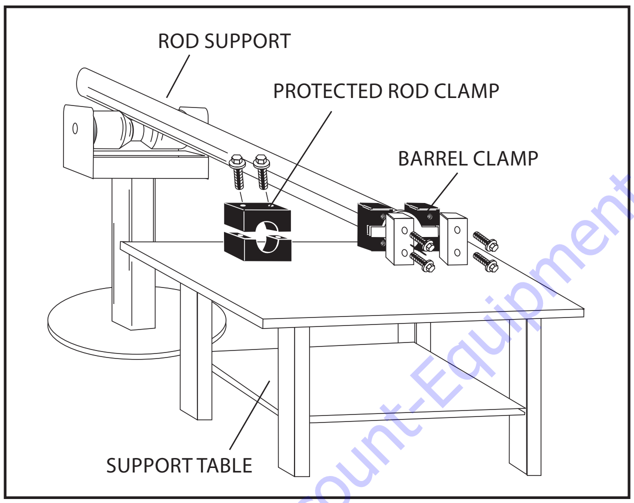


Figure 5-60. Cylinder Barrel Support

4. Using a hook spanner, loosen and remove spanner nut from cylinder barrel.
5. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

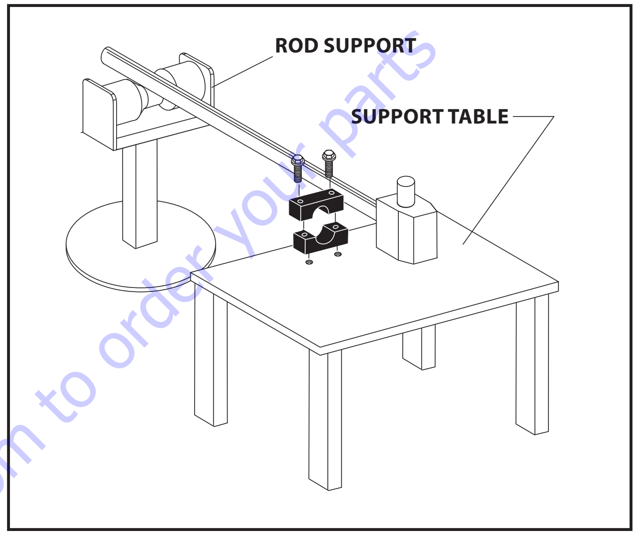
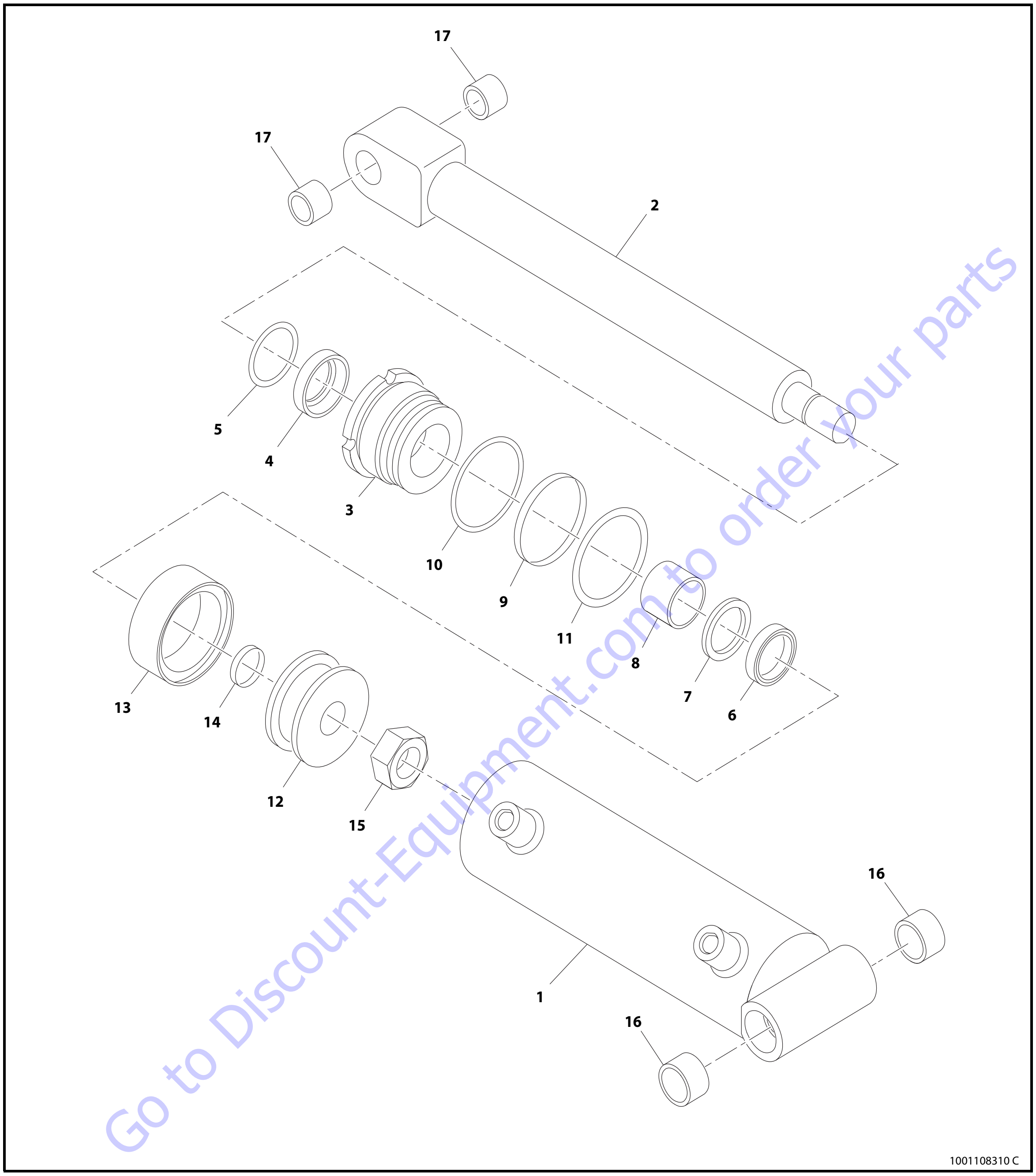


Figure 5-61. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Wear Ring
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-Ring
15. Nut
16. Bearing
17. Bearing

Figure 5-62. Steer Cylinder

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Remove the lock nut from the rod.
9. Remove and discard the piston o-rings, seals and wear rings.
10. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
11. Remove the rod from the holding fixture. Remove the cylinder head. Discard the wear ring, backup ring, o-ring, retaining ring, rod seal and wiper seal.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder Guide inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in guide for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder guide outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. Inspect piston tube for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
12. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
13. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

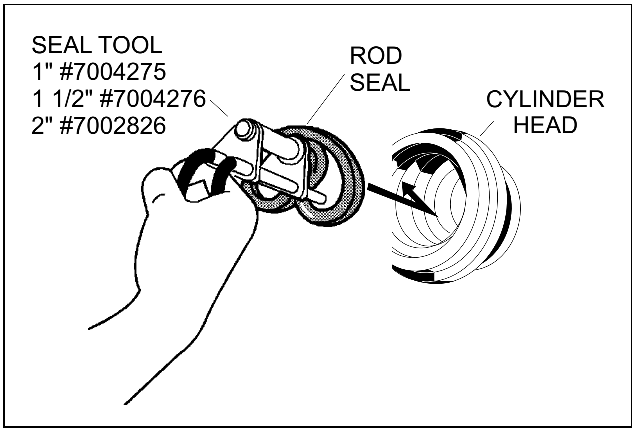


Figure 5-63. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

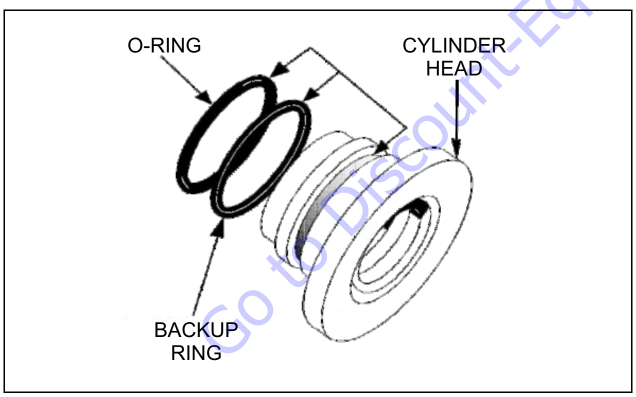
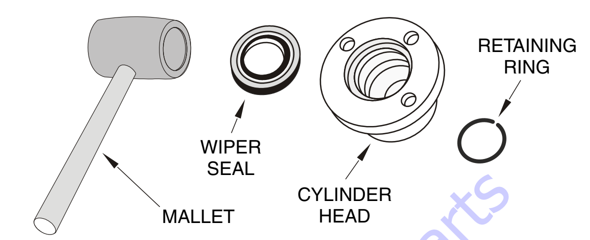


Figure 5-64. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder guide gland groove. Install the new retaining ring into the applicable cylinder guide gland groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-65. Wiper Seal Installation

3. Place a new o-ring and backup seal in the applicable outside diameter groove of the cylinder guide.

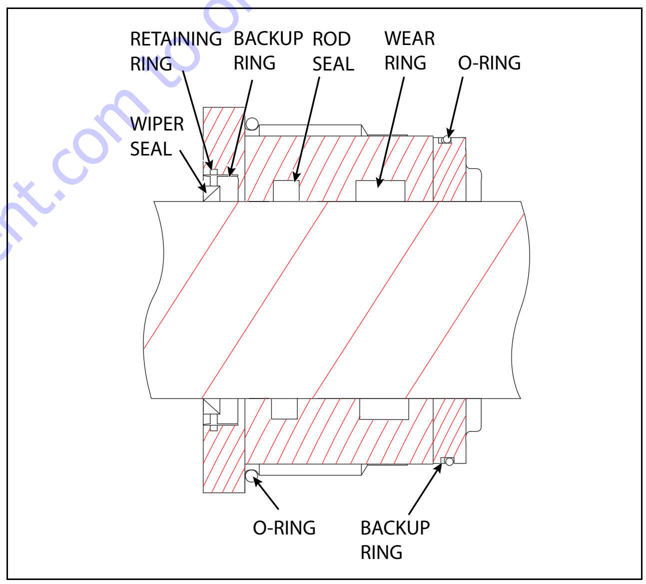


Figure 5-66. Installation of Head Seal Kit

4. Install the piston head on the rod, ensuring that the wiper seal and rod seal are not damaged or dislodged. Push the guide along the rod to the rod end.
5. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
6. Place a new o-ring in the inner piston diameter groove.
7. Install the retaining ring, backup ring and o-ring onto the piston head.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring are not damaged or dislodged.
9. Install the lock nut onto the cylinder rod.

10. Remove the cylinder rod from the holding fixture.

11. Place new piston seal and o-ring in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

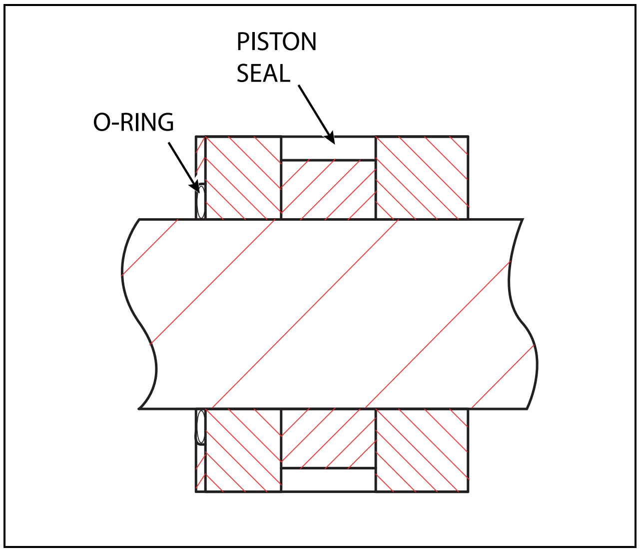


Figure 5-67. Piston Seal Kit Installation

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

NOTICE

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

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

14. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.

15. Screw the cylinder head into the barrel using a spanner wrench.

16. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

Telescope Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ WARNING

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

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.
3. Remove all the counterbalance valves and plugs from the cylinder port block and discard the o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

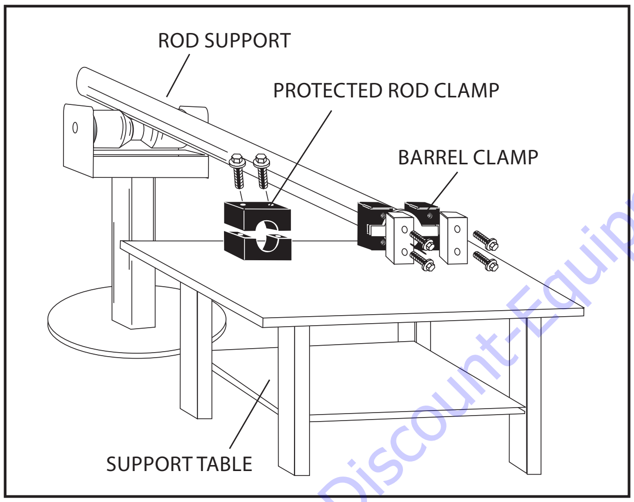


Figure 5-68. Cylinder Barrel Support

5. Using a hook spanner wrench, loosen and remove the cylinder head.
6. Attach a suitable pulling device to the cylinder rod end.

NOTICE

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

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

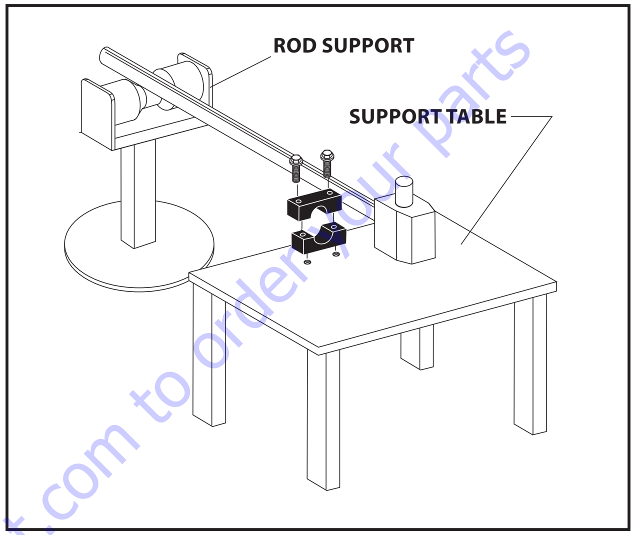
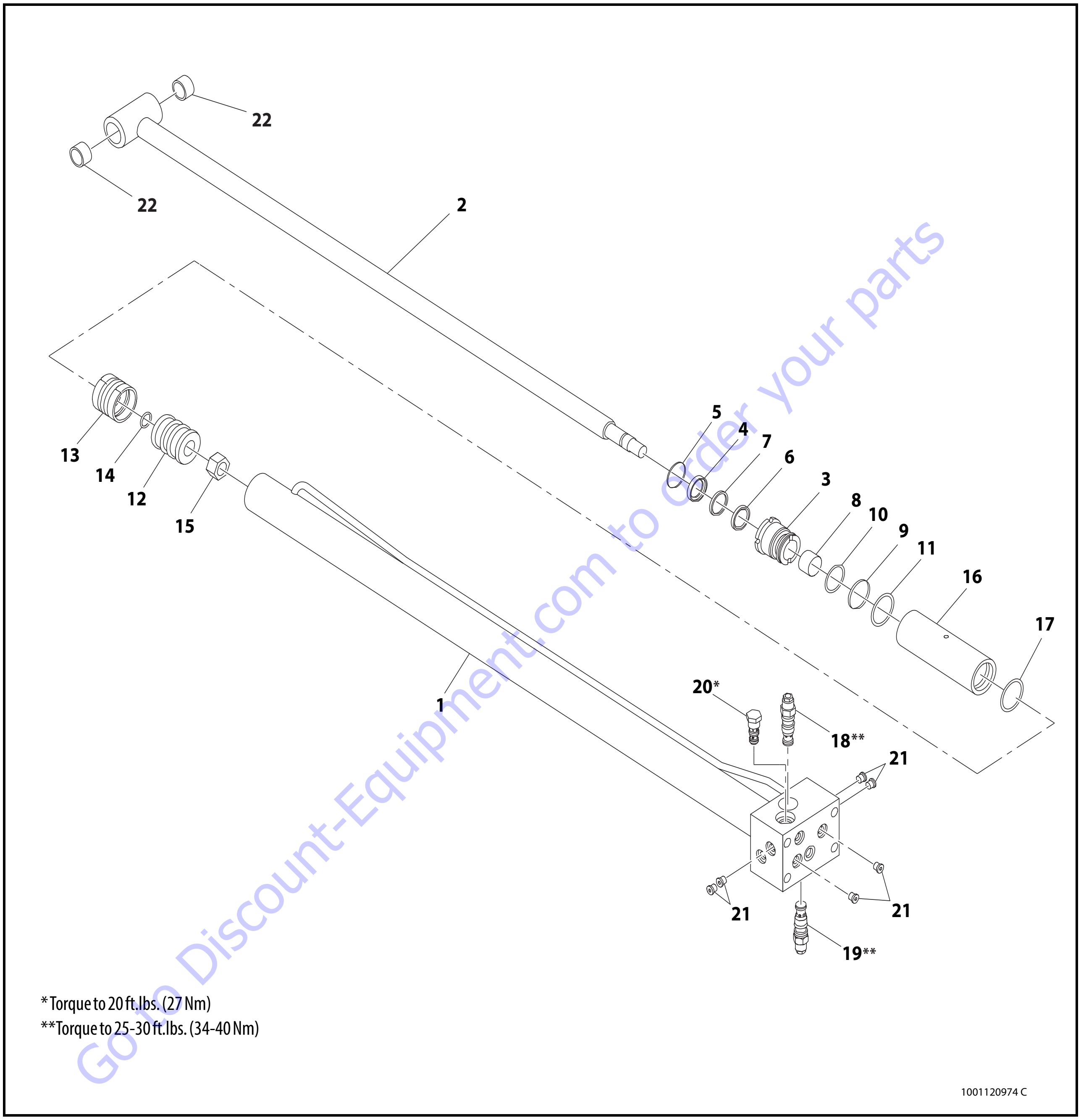


Figure 5-69. Cylinder Rod Support



1. Barrel
2. Rod
3. Head
4. Wiper Seal
5. Retaining Ring
6. Rod Seal
7. Backup Ring
8. Wear Ring
9. O-ring
10. Backup Ring
11. O-ring
12. Piston
13. Piston Seal
14. O-Ring
15. Nut
16. Spacer
17. O-ring
18. Cartridge Valve
19. Cartridge Valve
20. Cartridge Valve
21. Plug
22. Bearing

Figure 5-70. Telescope Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove lock nut from the piston rod.
10. Screw the piston counterclockwise, by hand and remove the piston from cylinder rod.
11. Remove and discard the piston seal and o-ring.
12. Remove the spacer from the cylinder rod.
13. Remove the rod from the holding fixture. Remove the cylinder head. Discard the o-rings, backup ring, wear ring, rod seal, wiper seal and retaining ring.

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 threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

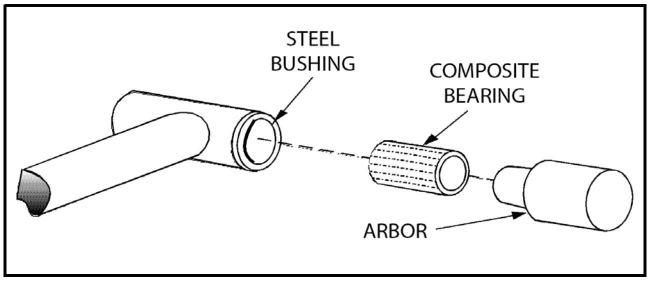


Figure 5-71. Composite Bearing Installation

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

ASSEMBLY

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

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

1. A special tool is used to install a new rod seal into the applicable cylinder head groove.

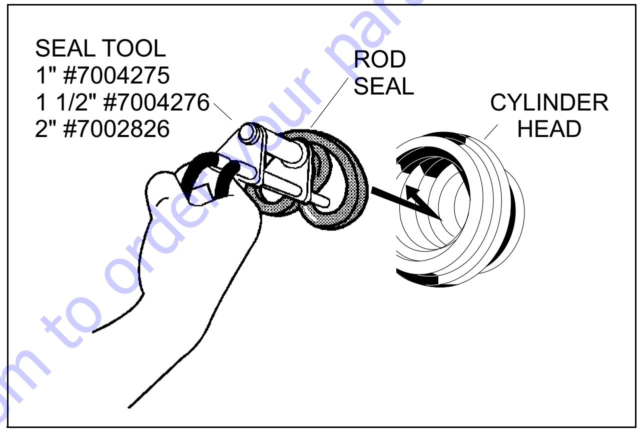


Figure 5-72. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

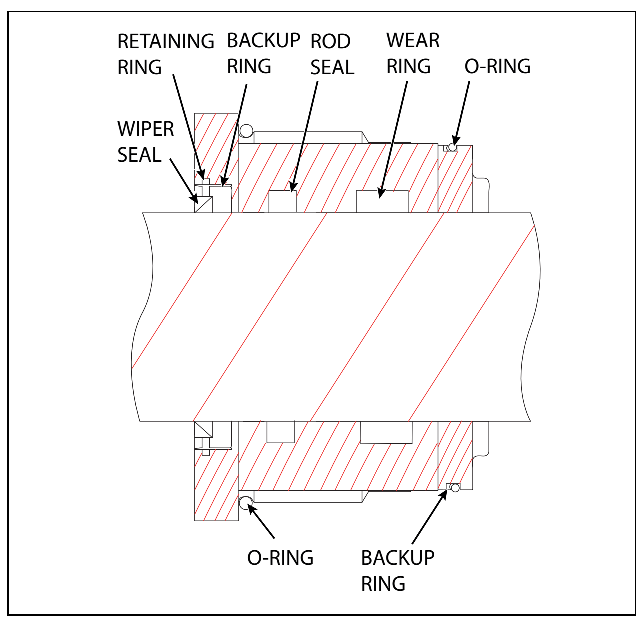
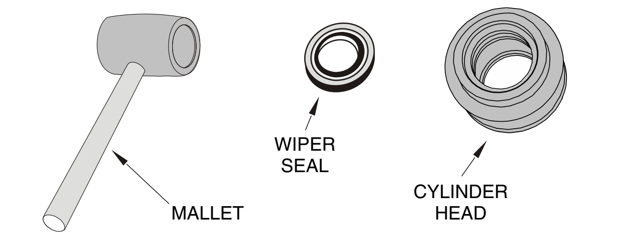


Figure 5-73. Cylinder Head Seal Installation

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head groove.



NOTE: When installing wiper seals, ensure the seals are installed properly. Install the seal so the flat part of the seal is facing into the cylinder head.

Figure 5-74. Wiper Seal Installation

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

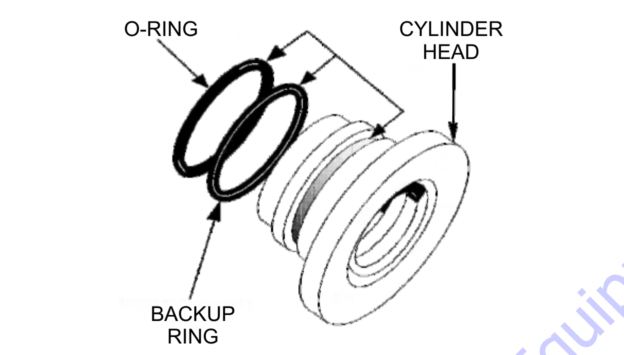


Figure 5-75. Installation of Head Seal Kit

4. Carefully install the head on the rod, ensuring that the wiper seal and rod seal are not damaged or dislodged. Push the head along the rod to the rod end.

5. Push the spacer onto the rod and use setscrew to attach spacer to the rod.

6. Install the retaining ring and wear ring on outer groove of the piston head.

7. Place a new o-ring in the inner piston diameter groove.

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

9. Carefully thread the piston on the cylinder rod hand tight until it abuts spacer end, ensuring that the o-ring are not damaged or dislodged.

10. Install the lock nut onto the cylinder rod.

11. Remove the cylinder rod from the holding fixture.

12. Place new piston seals and o-ring in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D. of the piston is recommended to install the solid seal).

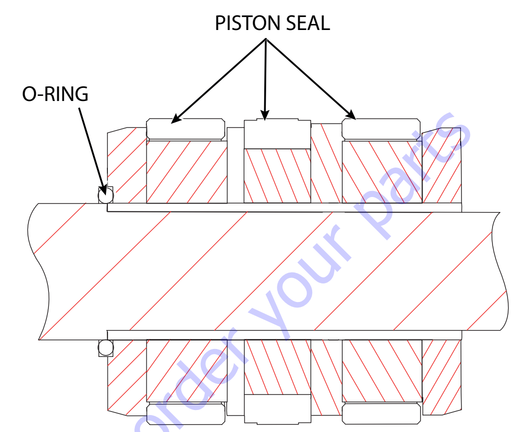


Figure 5-76. Piston Seal Kit Installation

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

NOTICE

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

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

15. Continue pushing the rod into the barrel until the cylinder head can be inserted into the barrel cylinder.

16. Screw the cylinder head into the barrel using a spanner wrench.

17. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

18. Install the load shuttle counterbalance valve in the barrel port block. Torque to 20 ft.lbs. (27 Nm).

19. Install the counterbalance cartridge valves in the barrel port blocks. Torque to 25-30 ft.lbs. (34-40 Nm).

20. Install the plugs onto the port blocks.

5.4 CYLINDER REMOVAL AND INSTALLATION

Main Boom Lift Cylinder Removal

NOTE: *The Main Boom weighs approximately 450 lb (204kg).*

1. Place the machine on a flat and level surface. Place the Main Boom in a horizontal position. Place Lower and Mid Booms 5 degree above horizontal. Support the platform end of main boom with suitable lifting device. Shut down machine and prop boom.
2. Tag and disconnect hydraulic lines from the main lift cylinder. Use suitable container to collect any residual hydraulic fluid. Cap hydraulic lines and ports.

NOTE: *The Main Boom Lift Cylinder weighs approximately 97 lb (44kg).*

3. Secure the main boom lift cylinder with suitable lifting device.
4. Remove the hardware securing the cylinder rod attach pin #1 to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin #1.

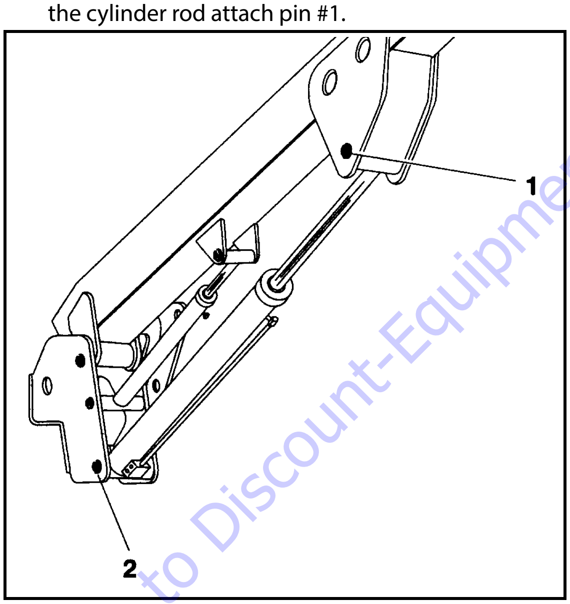


Figure 5-77. Main Boom Lift Cylinder Removal

5. Remove the hardware securing the barrel end attach pin #2. Using a suitable brass drift, drive out the barrel end attach pin #2.
6. Carefully remove the main lift cylinder from the boom and place in a suitable work area.

Main Boom Lift Cylinder Installation

NOTE: *Coat I.D. of bushings with specified lubricant prior to installing pins.*

NOTE: *The Main Boom Lift Cylinder weighs approximately 97 lb (44kg).*

1. Using suitable lifting device, place the Main Lift Cylinder in the position and align with mounting holes on upright.
2. Using a suitable drift, drive the barrel end attach pin #2 through the mounting holes in the lift cylinder and upright. Secure in place with pin retaining hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. With function speed switch at its slowest setting, extend the cylinder rod until attach pin hole aligns with those in boom. Using a suitable drift, drive the cylinder rod attach pin #1 through the aligned holes. Secure the pin in place with pin retaining hardware.
5. Remove the lifting device from the main lift cylinder.
6. Cycle cylinder completely to check for proper functioning. Place boom in stowed position. Check hydraulic fluid level and adjust accordingly.

Main Boom Telescope Cylinder Removal

1. Place machine on flat and level surface, with Main Boom in the horizontal position.
2. Extend Main Boom until fly attach pin #1 is accessible on fly.

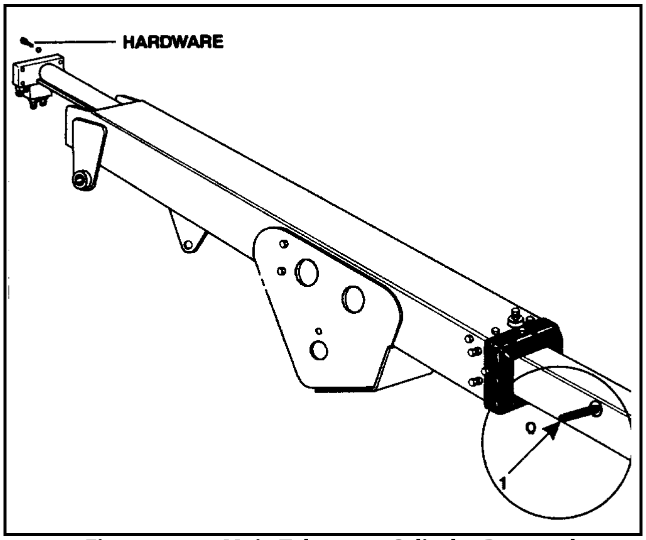


Figure 5-78. Main Telescope Cylinder Removal

NOTE: *The Main Boom weighs approximately 450 lb (204kg).*

3. Support platform end of the Main Boom end with a prop. Support Main Upright end with suitable lifting device.
4. Tag, disconnect hydraulic lines to telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove the retaining rings that retain the telescope cylinder rod to the fly boom.
6. Using a suitable brass drift, carefully drive the telescope cylinder rod pin #1 from the fly boom.
7. Remove the four (4) bolts securing the telescope cylinder barrel end to the base boom.

NOTE: *Care should be taken when removing the telescope cylinder, do not leave cylinder rest on powertrack which could cause damage to powertrack.*

8. Using a suitable brass drift, carefully drive the telescope cylinder pin from the base boom.
9. Attach a suitable sling to the telescope cylinder. Using a suitable lifting device attached to the sling carefully pull the telescope cylinder from the boom assembly.

NOTE: *The Main Telescope Cylinder weighs approximately 130 lb (46.8kg).*

10. Using another lifting device, support the rod end of the cylinder and remove the cylinder from the boom assembly.
11. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

Main Boom Telescope Cylinder Installation

1. Attach a hydraulic power supply to the telescope cylinder ports. Using suitable supports or lifting devices at each end of the cylinder, extend the rod so that the cylinder pin attach holes are the same distance apart as the boom pin attach holes.

NOTE: *The Main Boom weighs approximately 450 lb (204kg).*

2. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.

NOTE: *The Main Telescope Cylinder weighs approximately 130 lb (46.8kg).*

3. Using another lifting device, support the rod end of the cylinder and install the cylinder into the boom assembly.
4. Remove lifting devices from the telescope cylinder.
5. Carefully install the telescope cylinder rod pin #1 through the fly boom and secure it with the retaining rings.
6. Carefully install the telescope cylinder barrel end to base, securing cylinder to the base boom with four (4) bolts and hardware.
7. Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.
8. Remove boom prop and suitable lifting device. Activate hydraulic system.
9. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
10. Check fluid level of hydraulic tank and add as necessary.

Phase Check Cartridge

The phase valve is a back-to-back pair of check valves, one of which is mechanically actuated. This valve is installed in the piston of the level cylinder and is used to keep the master and level cylinders in phase.

NOTE: *Activating the Level Override Up circuit for 30 seconds can bleed the level circuit.*

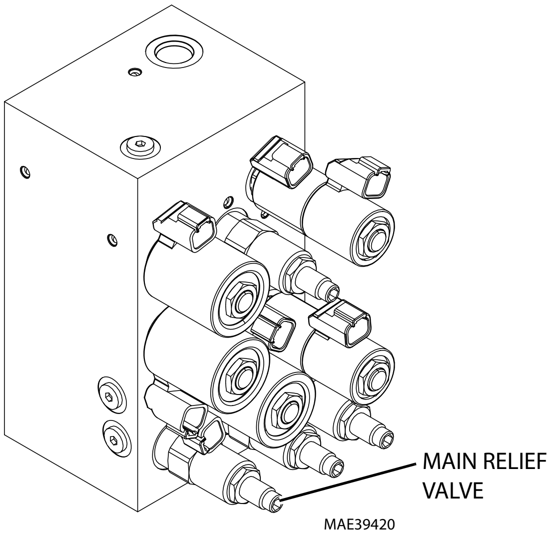
TEST PROCEDURE

1. Place the machine in the following position:
   - **a.** Firm and level surface
   - **b.** Upper boom horizontal (level)
   - **c.** Upper boom fully retracted
   - **d.** Jib down
   - **e.** Platform empty
2. With no load in the platform, activate Level Up for approximately 20 seconds. If the Upper Boom rises, the phase valve is not functioning correctly and must be replaced.

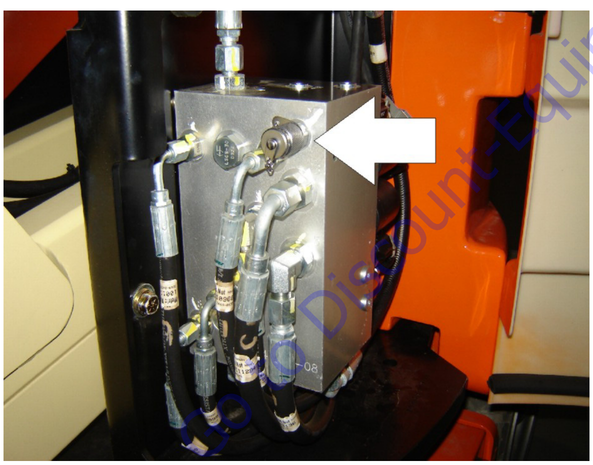
5.5 PRESSURE SETTING PROCEDURE

Adjustments made at the Main Valve Bank

MAIN PRESSURE RELIEF VALVE – 3000 PSI (207BAR)

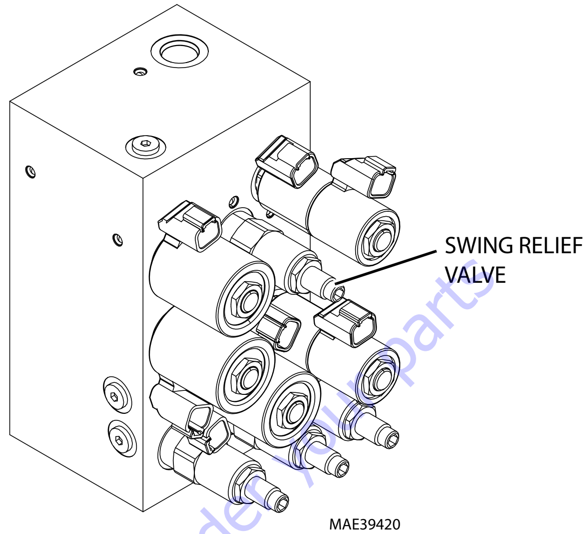


1. Install pressure gauge at port MP of Main Valve Bank. (Remove tower lift up coil, if required.)

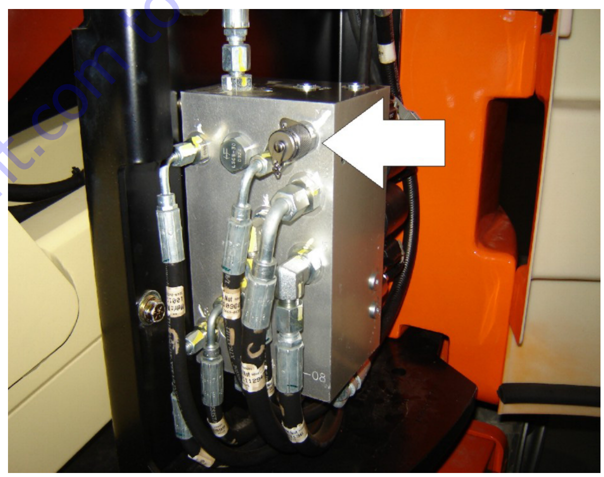


2. Actuate and hold Tower Up to “end of stroke” & take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase setting or counterclockwise to reduce the setting accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

SWING RIGHT / LEFT – 750 PSI (52 BAR)



1. Install pressure gauge at port MP of Main Valve Bank.



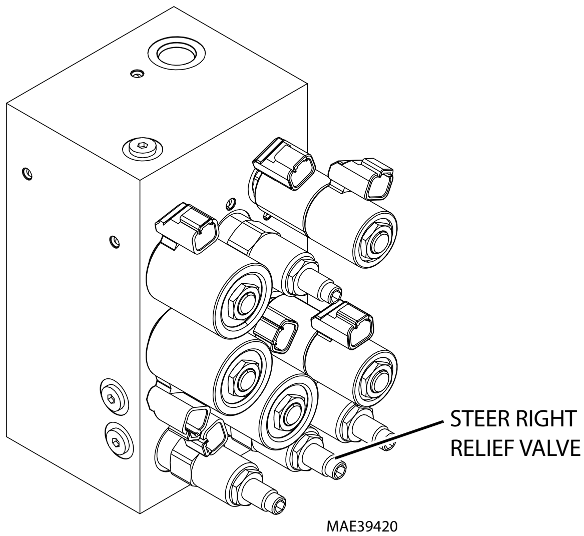
2. Activate Swing Right or Left and hold to the turntable stop. Take pressure reading.
3. After loosening the relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.

⚠ CAUTION

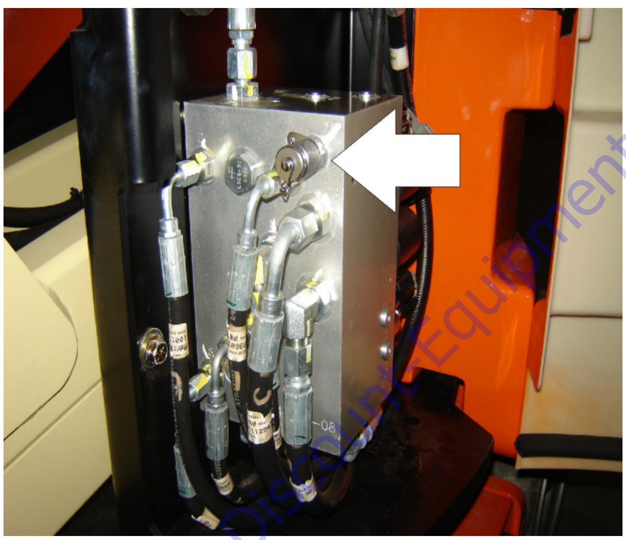
USE CAUTION NOT TO EXCEED A RELIEF VALVE SETTING OF 750 PSI (51 BAR) AS COMPONENTS OF THE SWING CIRCUIT CAN BE DAMAGED.

4. Tighten relief valve jam nut and repeat step 2 to verify setting.

STEER RIGHT – 1400 PSI (97 BAR)

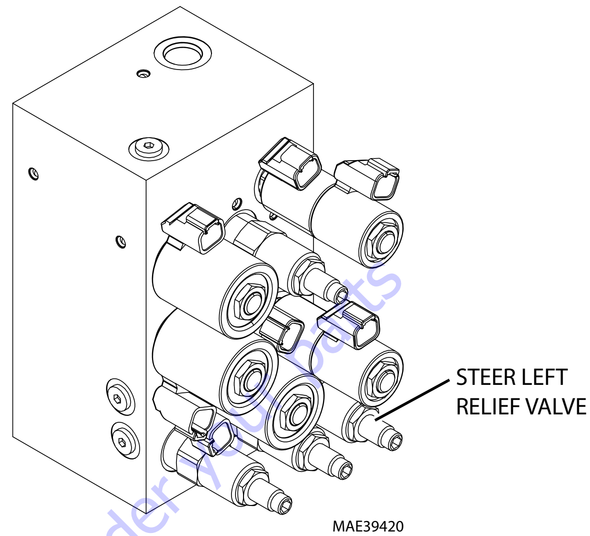


1. Install pressure gauge at port MP of Main Valve Bank.

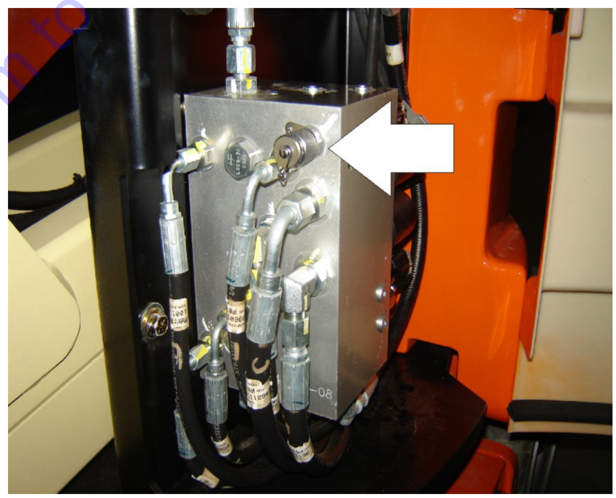


2. Activate Steer Right and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

STEER LEFT – 2000 PSI (138 BAR)



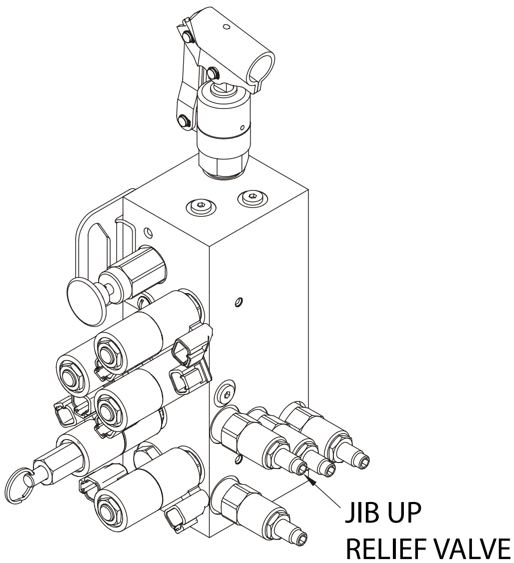
1. Install pressure gauge at port MP of Main Valve Bank.



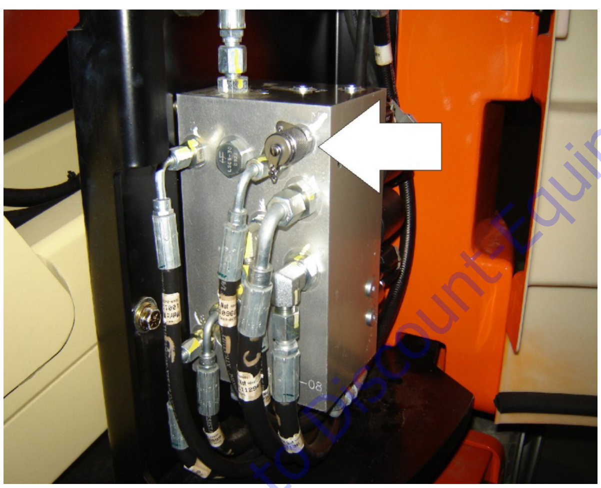
2. Activate Steer Left and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

Adjustments made at the Boom Function Valve Bank

JIB LIFT UP – 2000 PSI (138 BAR)

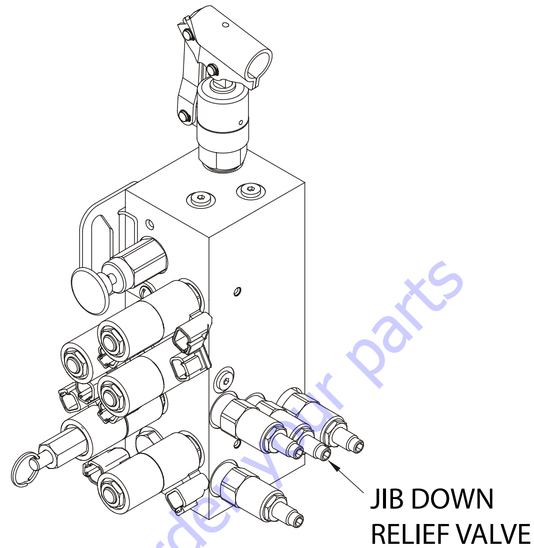


1. Install pressure gauge at port MP of Main Valve Bank.

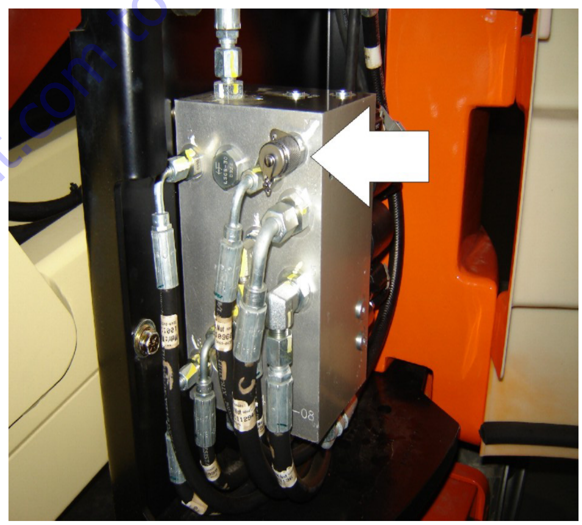


2. Activate Jib Lift Up and hold to end of stroke. Takepres-sure reading.
3. After loosening relief valve jam nut, adjust valve clock-wise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

JIB LIFT DOWN – 1200 PSI (83 BAR)

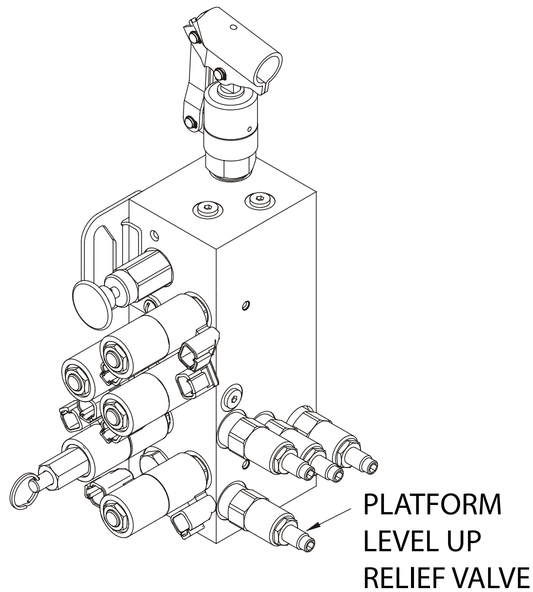


1. Install pressure gauge at port MP of Main Valve Bank.



2. Activate Jib Lift Down and hold to end of stroke. Take pressure reading.
3. After loosening relief valve jam nut, adjust valve clock-wise to increase pressure or counterclockwise to reduce pressure accordingly.
4. Tighten relief valve jam nut and repeat step 2 to verify setting.

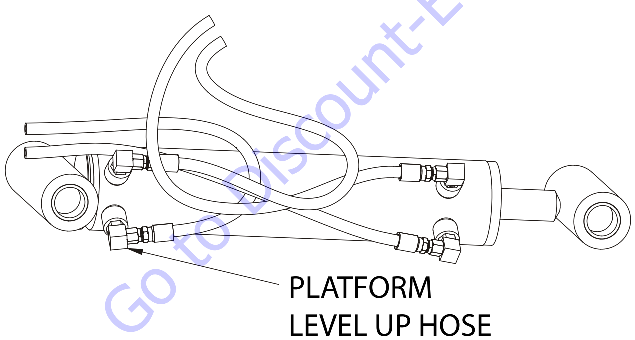
PLATFORM LEVEL UP – 3000 PSI (207 BAR)



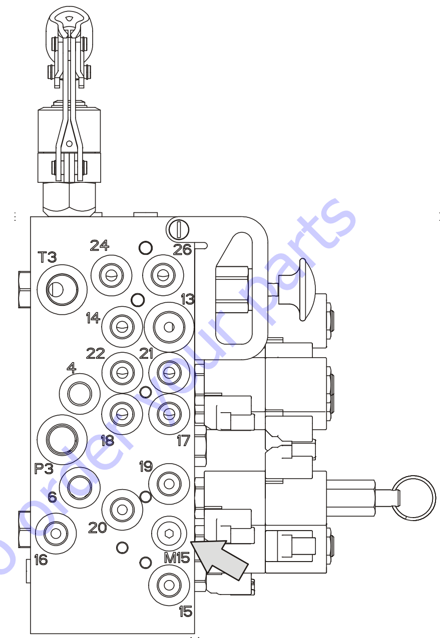
1. Refer to the Main Pressure Relief Valve procedure and temporarily set Main Pressure Relief Valve to 3300 psi (227.5 Bar).
2. Disconnect, cap, & plug the platform level up hose & adapter either at the platform level master cylinder or at port 15 of the Boom Function Valve.

⚠ CAUTION

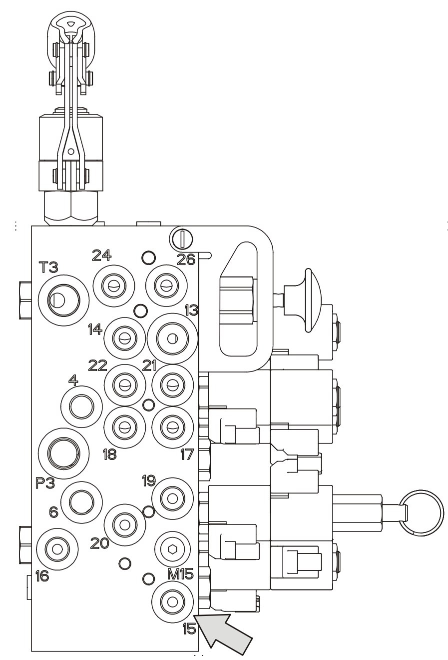
USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE.



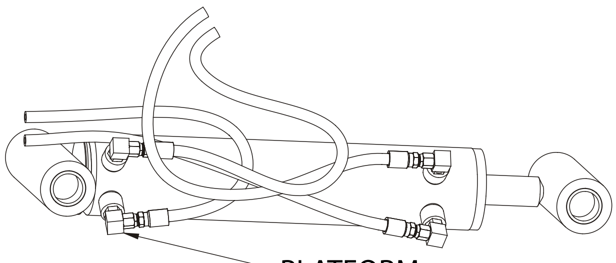
3. Install a pressure gauge in one of the following locations:
   a. At port M15 of Boom Function Valve



   b. At port 15 of Boom Function Valve



c. At end of platform level up hose (do not use this location if port 15 was chosen in step 2.)



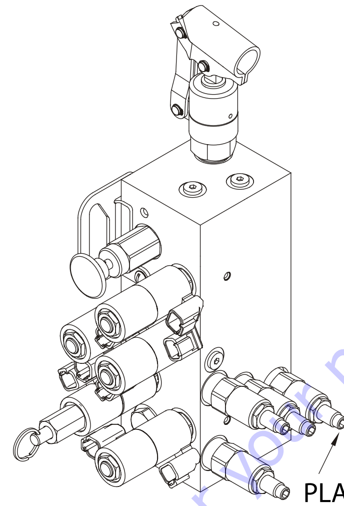
4. Activate Platform Level Up and hold. Take pressure reading.
5. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.
6. Tighten relief valve jam nut. Repeat step 4 and verify the pressure setting.
7. Reconnect the platform level up hose that was disconnected in Step 2.

WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE

8. Refer to the Main Pressure Relief Valve procedure and return Main Pressure Relief Valve to 3000 psi (207 Bar).

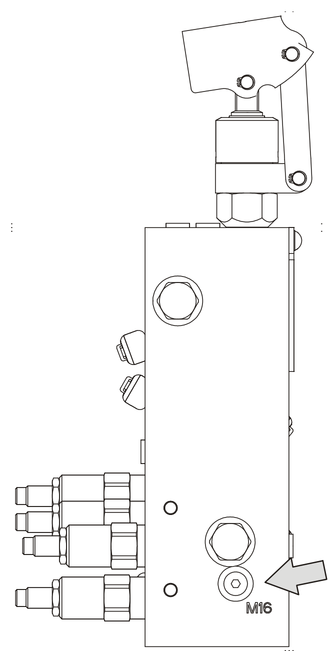
PLATFORM LEVEL DOWN – 1200 PSI (83 BAR)



There are two different methods that can be used to set the Platform Level Down pressure, Option 1 and Option 2. They are outlined as follows.

OPTION 1:

1. Install pressure gauge at port “M16” of Boom Function Valve Bank.



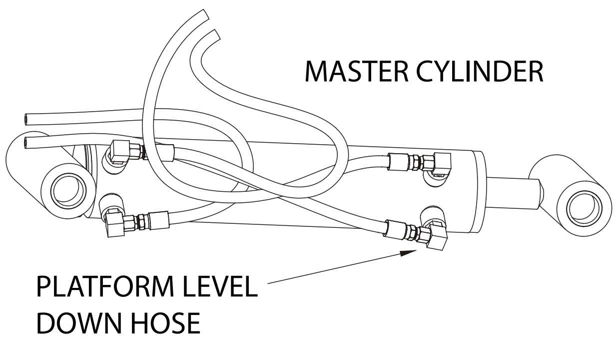
2. Activate Upper Lift Up and hold to end of stroke.
3. Activate Platform Level Down to end of stroke. Take pressure reading.

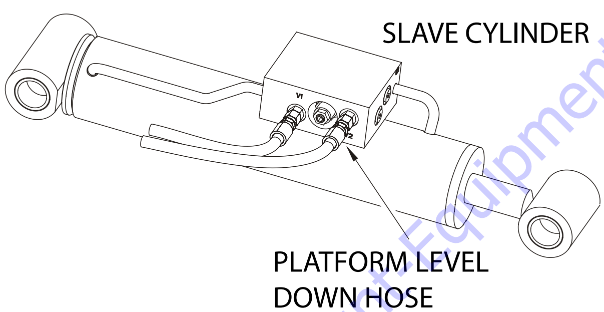
4. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.

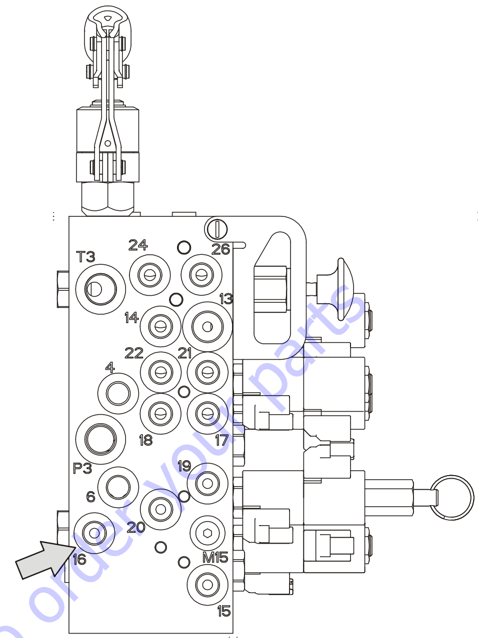
5. Tighten relief valve jam nut. Repeat step 3 and verify the pressure setting.

OPTION 2:

6. Disconnect, cap, and plug the platform level down hose and adapter either at the platform level master cylinder, at the platform level slave cylinder, or at port “16” of the Boom Function Valve Bank.







⚠ WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE

7. Install pressure gauge in one of the following locations:

   a. At port “16” of Boom Function Valve Bank

   b. At end of platform level down hose which was disconnected in step 1 (do not use this location if port “16” was chosen in step 1).

8. Activate Platform Level Down and hold. Take pressure reading.

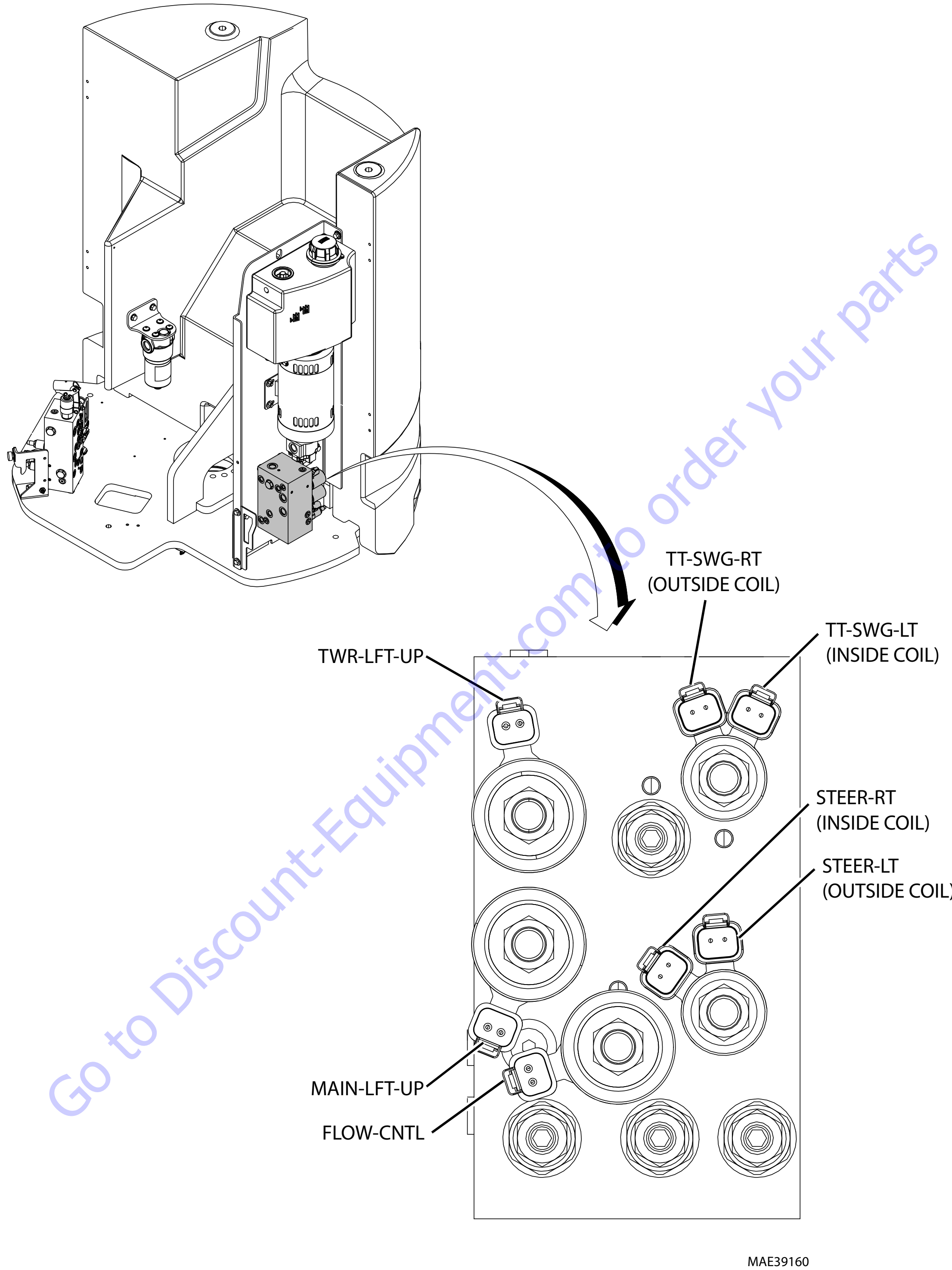
9. After loosening relief valve jam nut, adjust valve clockwise to increase pressure or counterclockwise to reduce pressure accordingly.

10. Tighten relief valve jam nut. Repeat step 3 and verify the pressure setting.

11. Reconnect the platform level down hose that was disconnected in step 1.

⚠ WARNING

USE CAUTION WHEN DISCONNECTING / RECONNECTING HOSES ON THE PLATFORM LEVEL CIRCUIT AS THIS CIRCUIT MAINTAINS PRESSURE.



NOTE: *Coil Resistance (@ 68° F [20° C]) is 7.2 Ohms for Tower Lift Up, Main Lift Up, and Flow Control. All other coils have 9.8 Ohms resistance. These values are all ± 15%.*

Figure 5-79. Main Control Valve - Sheet 1 of 2

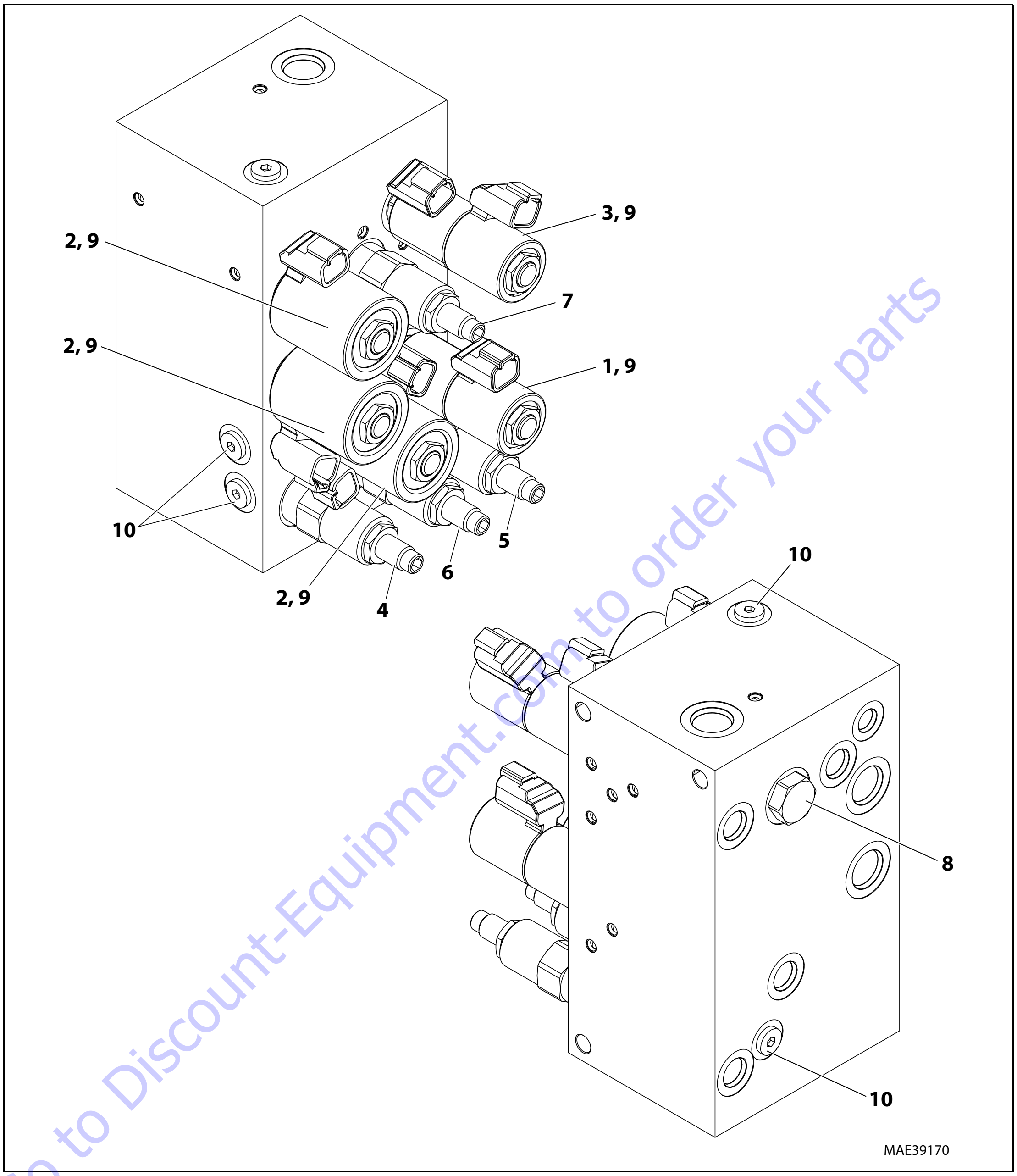
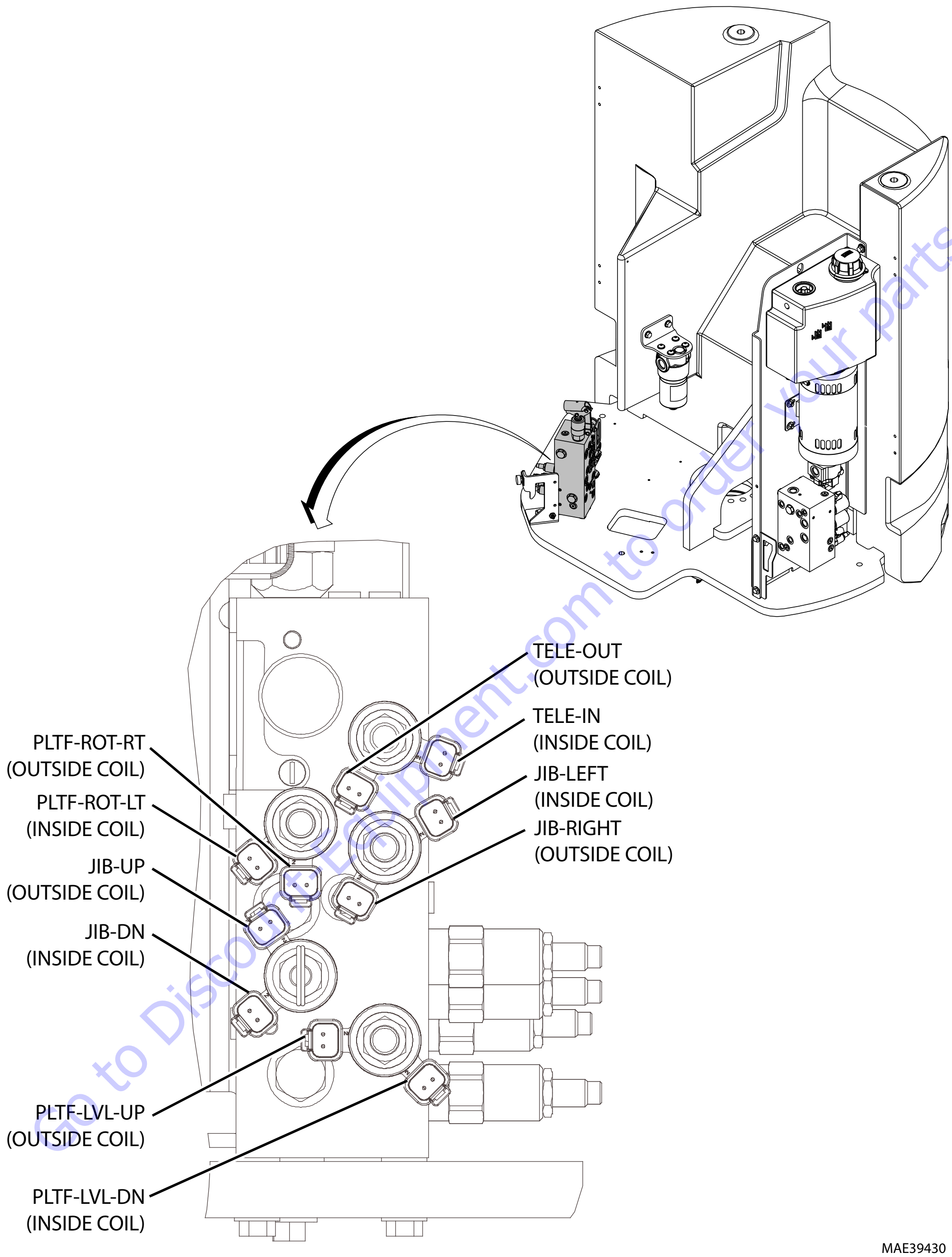


Table 5-33. Main Valve Torque

	Description	Ft. lbs.	Nm
1	Solenoid Valve (Steer)	20	27
2	Solenoid Valve (Flow Control/Main and Tower Lift Dump)	35	47.5
3	Solenoid Valve (Swing)	20	27
4	Relief Valve (Main)	20	27
5	Relief Valve (Steer)	20	27

	Description	Ft. lbs.	Nm
6	Relief Valve (Steer)	20	27
7	Relief Valve (Swing)	20	27
8	Load Shuttle Valve (Swing)	20	27
9	Coil	5	7
10	Port Plug	15	20

Figure 5-80. Main Control Valve - Sheet 2 of 2



NOTE: *Coil Resistance (@ 68° F [20° C]) is 9.8 Ohms ± 15%.*

Figure 5-81. Boom Function Valve - Sheet 1 of 2

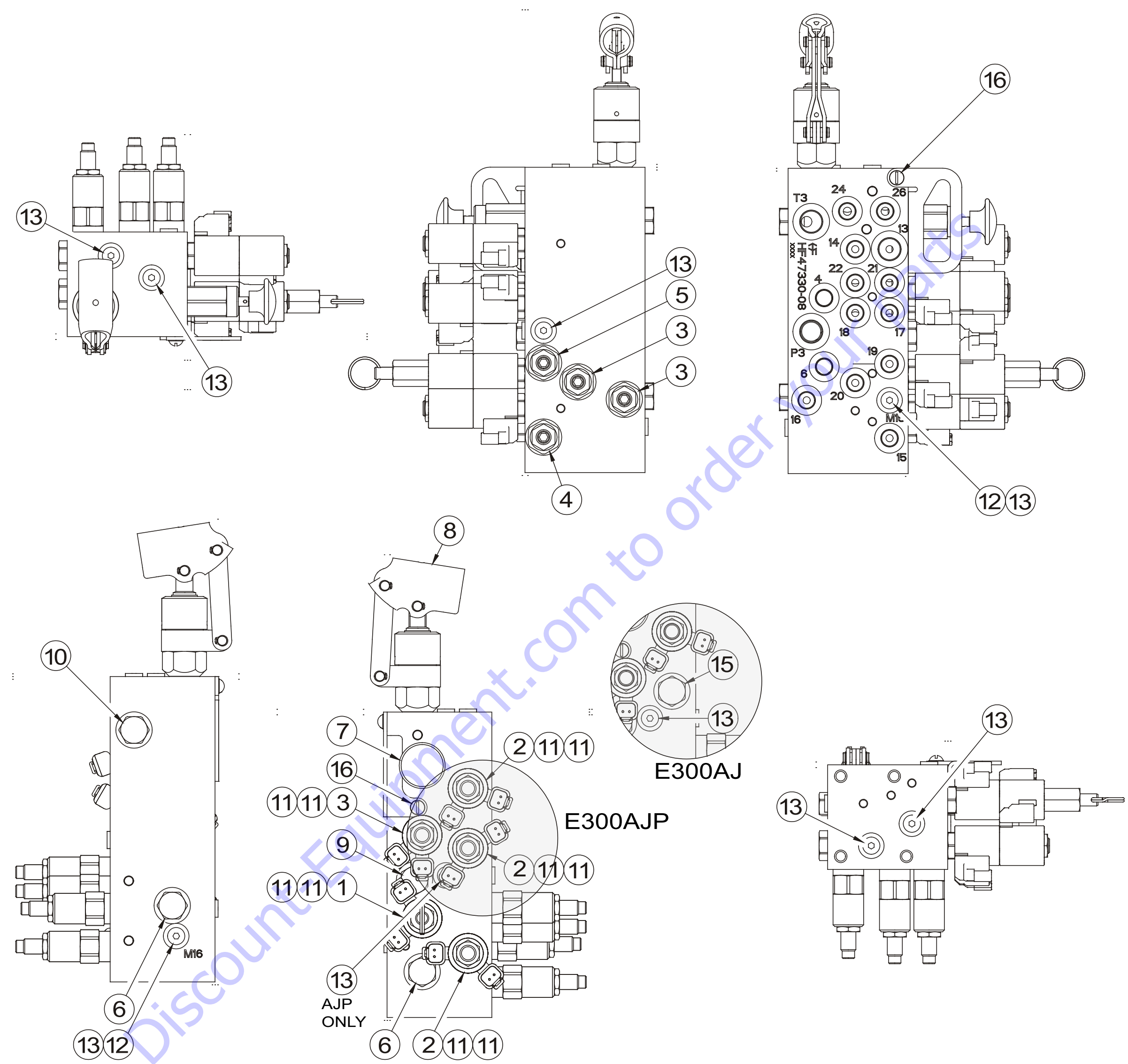
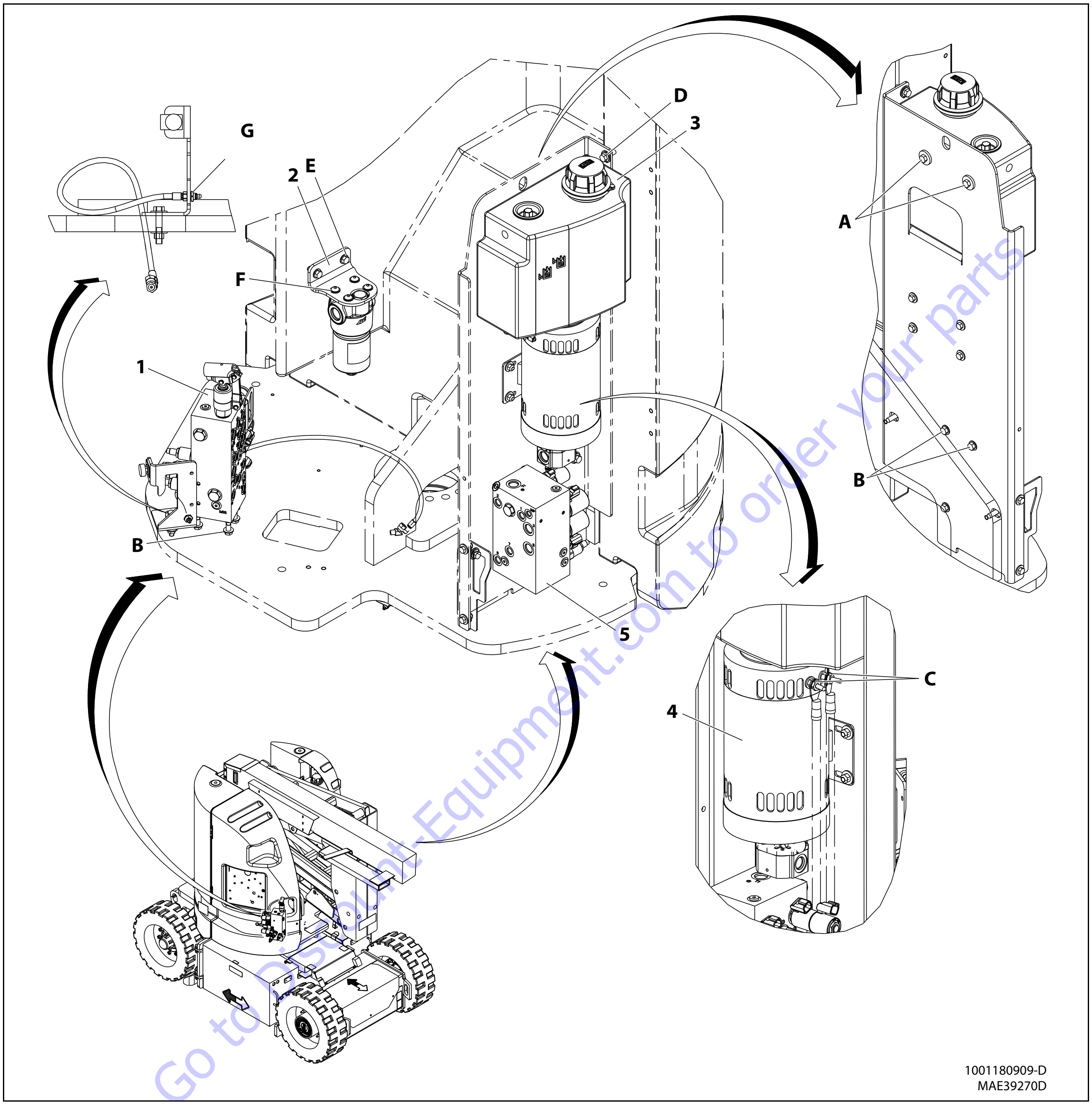


Table 5-2. Boom Function Valve Torques

#	Description	Ft. Lbs.	Nm	#	Description	Ft. Lbs.	Nm	#	Description	Ft. Lbs.	Nm
1	Solenoid Valve	20	27	7	Manual Valve	25	34	13	Port Plug	15	20
2	Solenoid Valve	20	27	8	Hand Pump	30	41	14	Port Plug	25	34
3	Relief Valve	20	27	9	Check Valve	20	27	15	Valve	20	27
4	Relief Valve	25	34	10	Check Valve	20	27	16	Screw	5	7
5	Relief Valve	20	27	11	Coil	5	7				
6	Valve	20	27	12	Orifice Plug	4	5				

Figure 5-82. Boom Function Valve - Sheet 2 of 2



	Ft. lbs.	Nm
A	18	24
B	23	31
C	9	12
D	20	27
E	16-19	22-26

1. Boom Function Valve
2. High Pressure Filter
3. Hydraulic Tank
4. Electric Motor & Pump
5. Main Control Valve

Figure 5-83. Hydraulic Components Location

5.6 INITIAL HYDRAULIC PUMP START-UP PROCEDURE

This procedure must be used when the hydraulic pump or pump/motor assembly is removed or replaced to ensure there is no air trapped in the hydraulic system. Having air in the system can cause damage to the pump.

Procedure

1. Fill the hydraulic reservoir approximately 3/4 full of hydraulic fluid.

2. Unscrew the breather/filler cap from the reservoir.

3. Connect a pressure test hose to the MP port on the Main Control Valve.

4. Insert the other end of the pressure test hose into the hydraulic reservoir's breather/filler port.

NOTE: *Steps 5 and 6 require an assistant.*

5. From the Ground Control Console, momentarily (1 second maximum) activate the platform rotate switch and release.

6. Continue activating the platform rotate switch momentarily until the assistant sees a clear, uniform stream of hydraulic fluid flowing from the test hose into the hydraulic reservoir.

NOTE: *An audible change in the tone of the gear pump should be heard when the air is purged from the gear pump.*

7. Disconnect the pressure test hose from the MP port on the Main Control Valve.

8. Remove the hose end from the hydraulic reservoir's breather/filler port.

9. Install the breather/filler cap.

5.7 HYDRAULIC SCHEMATICS

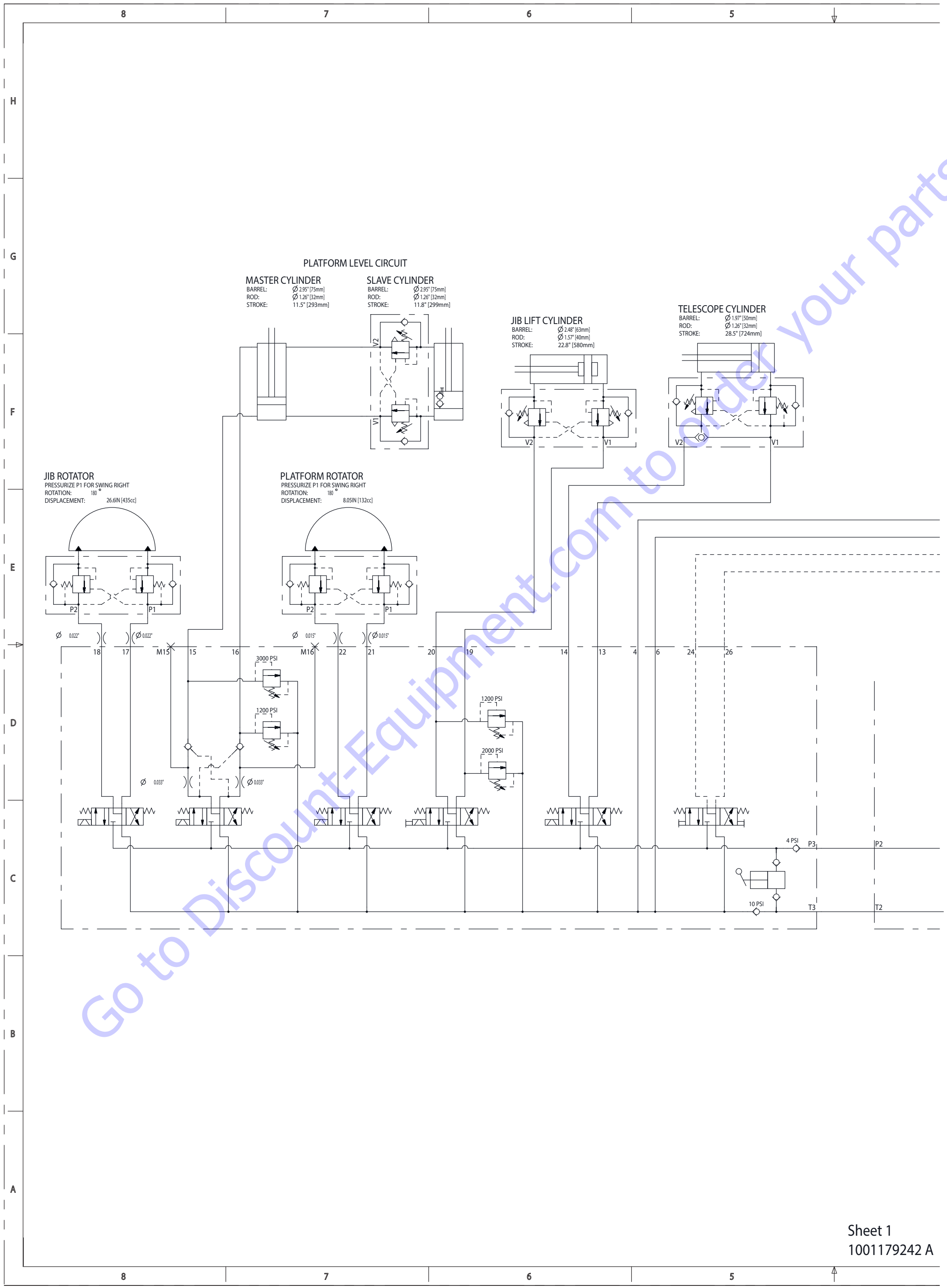


Figure 5-84. Hydraulic Schematic (E300AJP) - Sheet 1 of 4

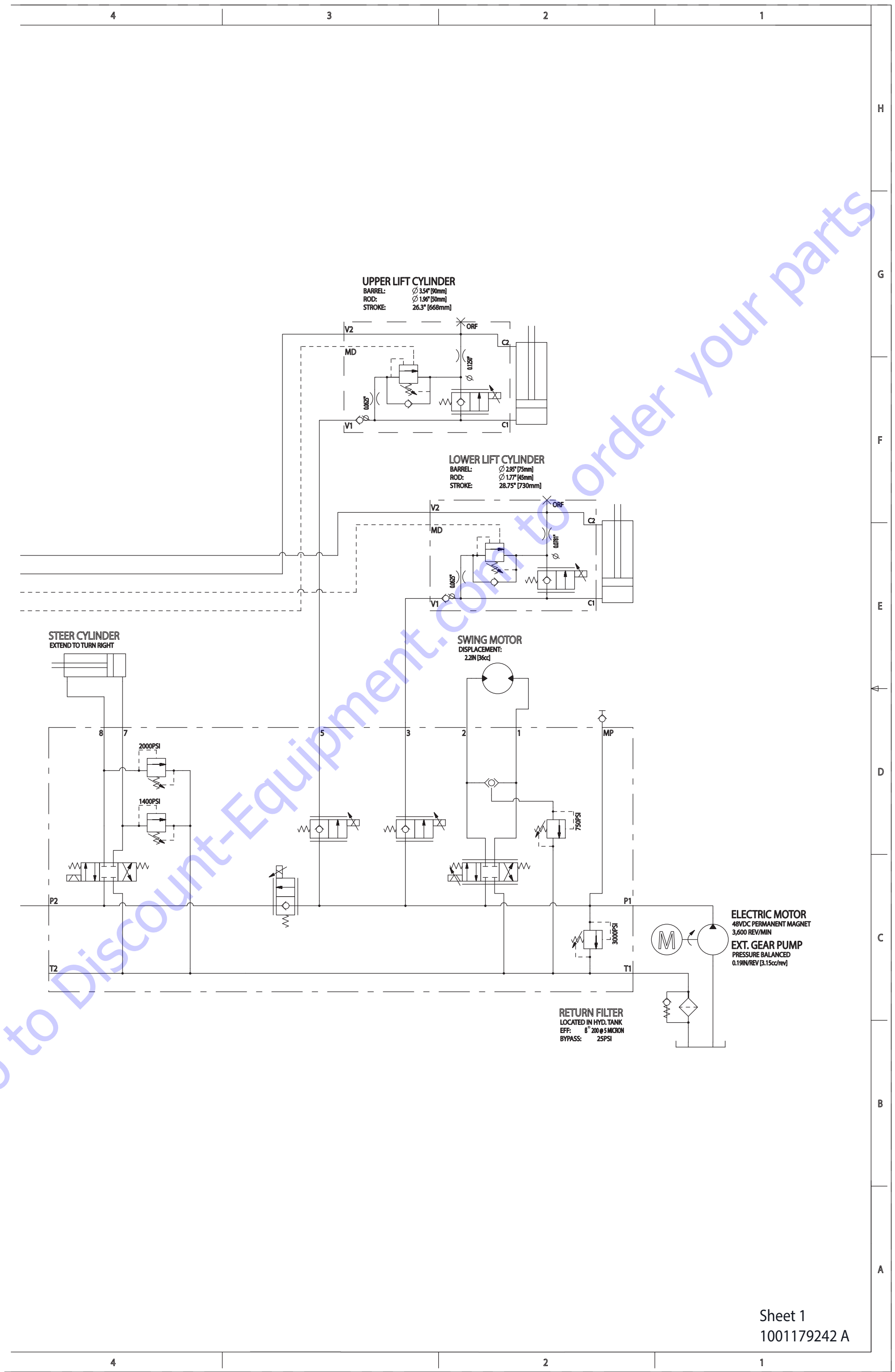


Figure 5-85. Hydraulic Schematic (E300AJP) - Sheet 2 of 4

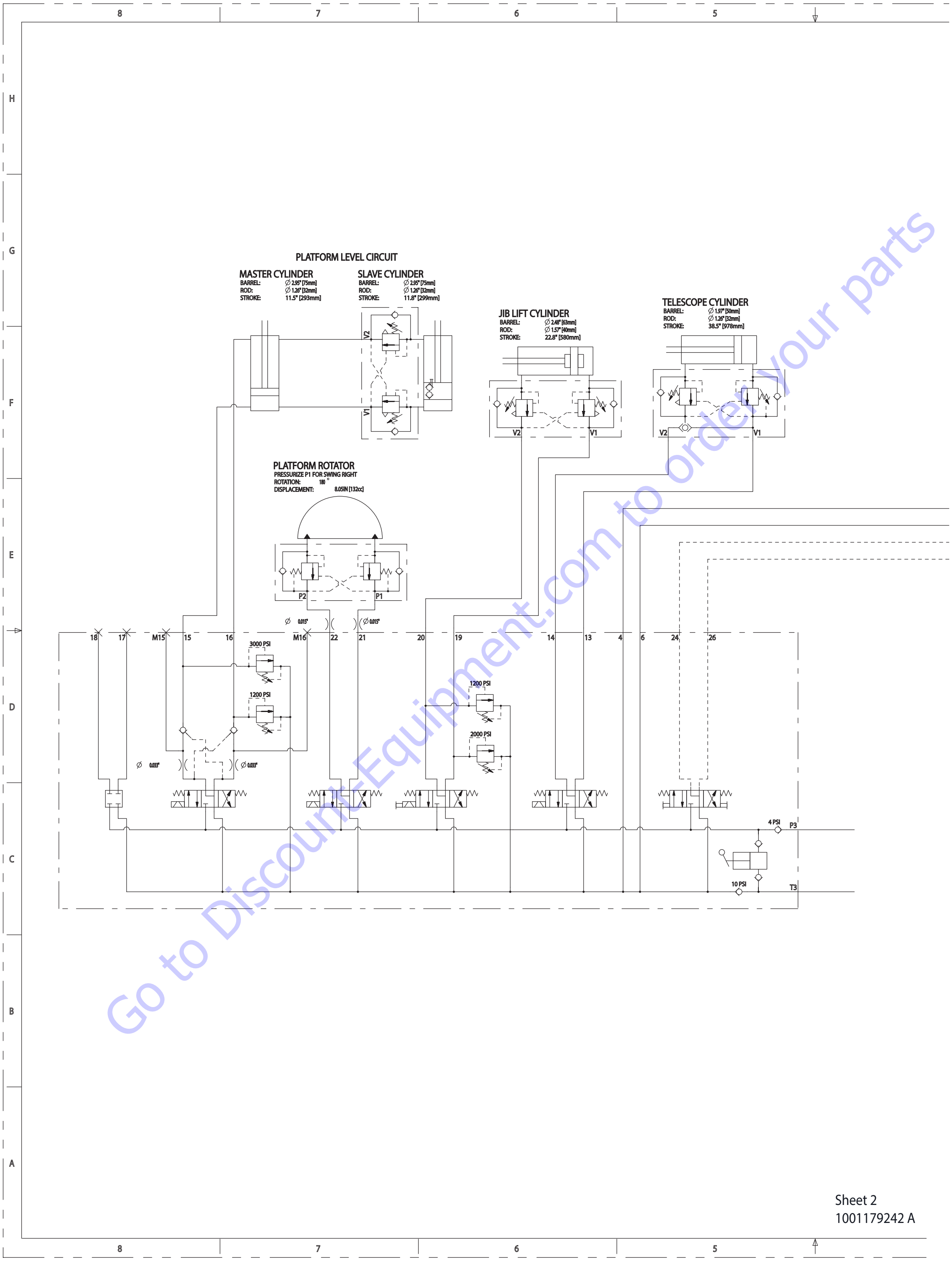


Figure 5-86. Hydraulic Schematic (E300AJ) - Sheet 3 of 4

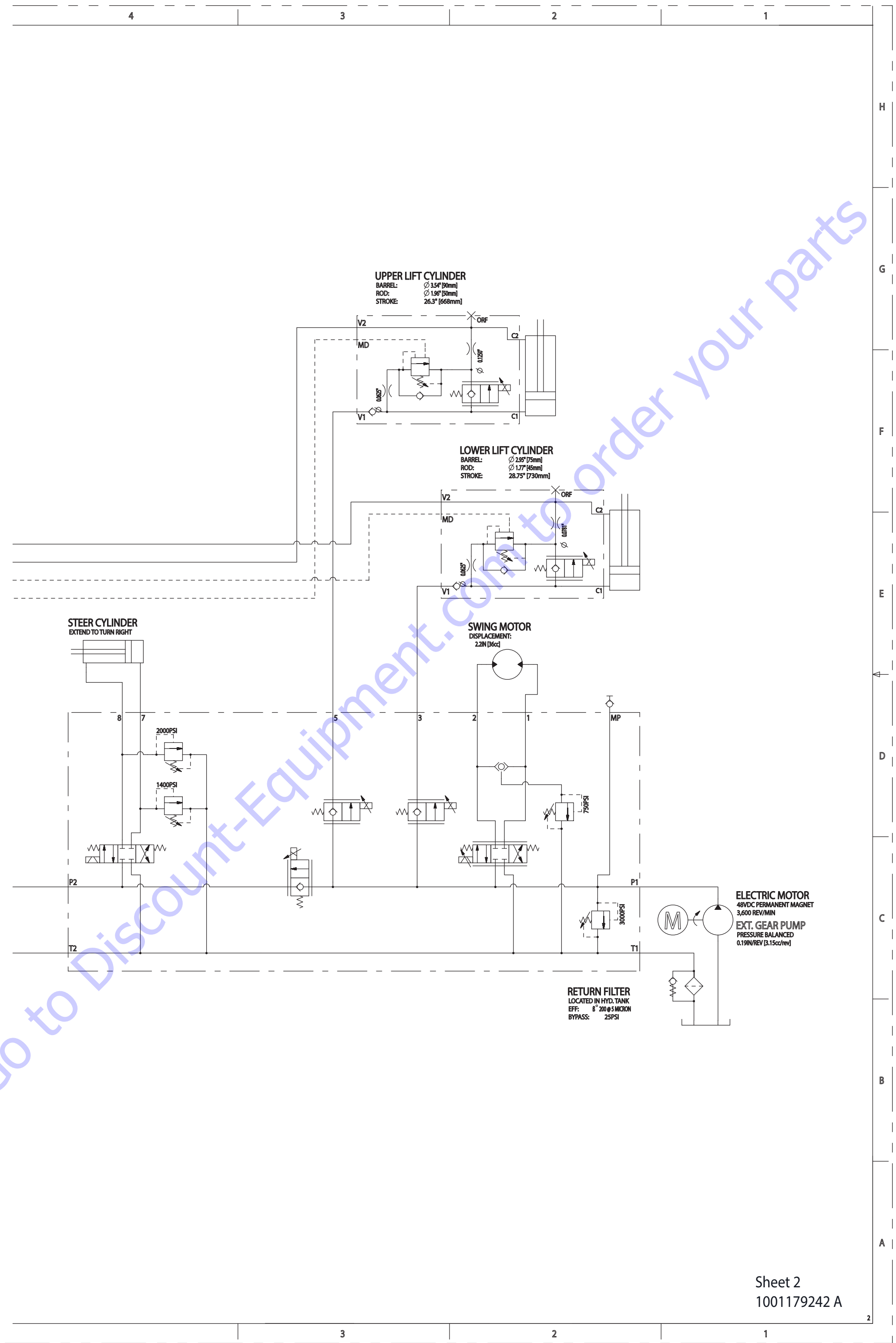
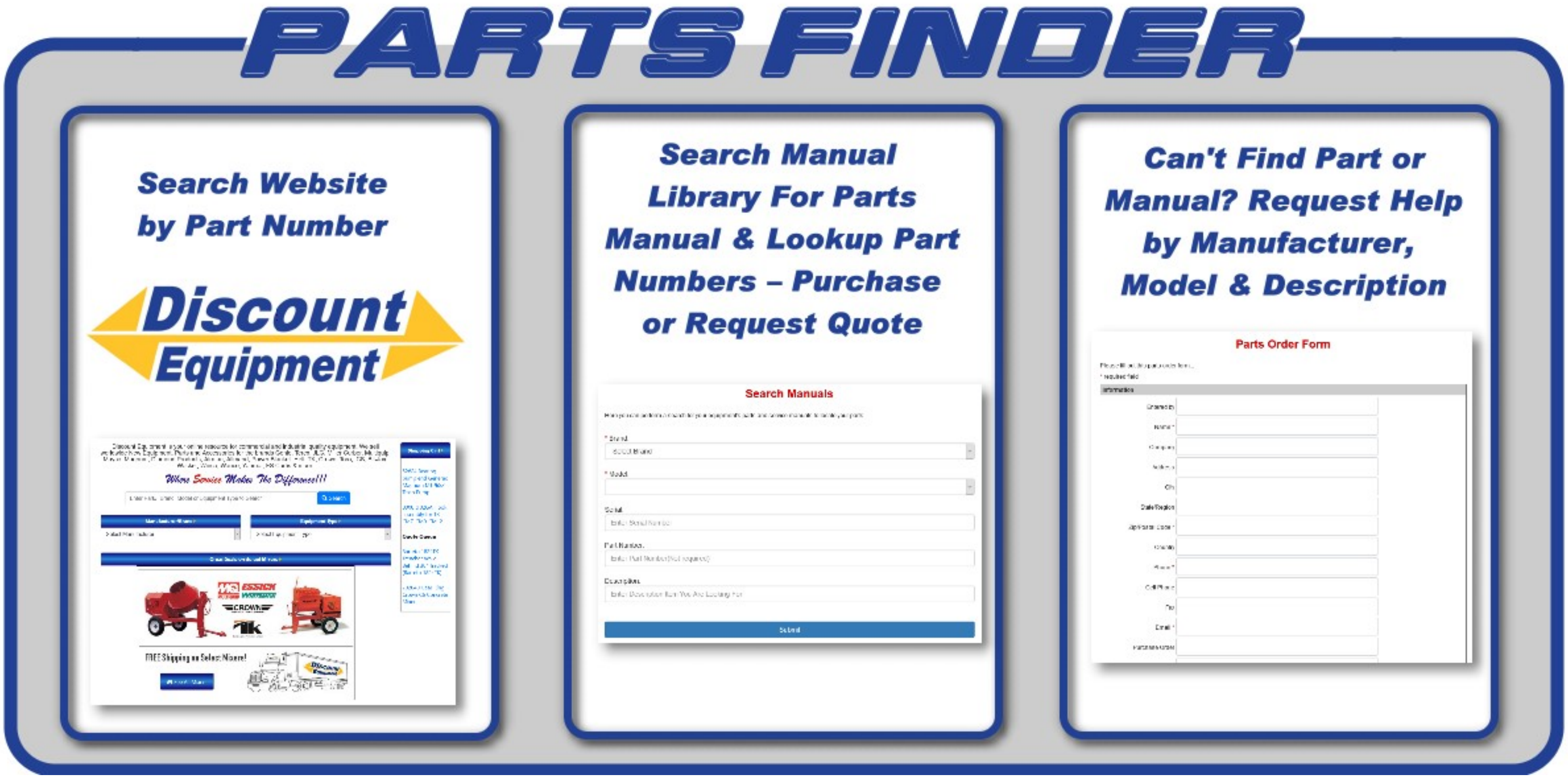


Figure 5-87. Hydraulic Schematic (E300AJ) - Sheet 4 of 4



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Need parts?

Click on this link: **http://www.discount-equipment.com/category/5443-parts/** and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us get you the correct parts. If you don't find the part on the website or on once of the online manuals, please fill out the request form and one of our experienced staff members will get back to you with a quote for the right part that your machine needs.

We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 6. JLG CONTROL SYSTEM

6.1 JLG CONTROL SYSTEM ANALYZER KIT INSTRUCTIONS

Introduction

NOTICE

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

NOTICE

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

The JLG designed Control System is a 48 volt based motor control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep and max.-speed for all boom, drive, and steering functions.

The main lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The motor controller will control current output, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the motor controller. The motor controller also features an adjustable time limit for positive traction.

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes an hour meter, beacon light, function cutout, and ground alarm. These options may be added later but must be programmed into the motor controller when installed.

The Control System may be accessed in one of two ways: Utilizing a custom designed, hand held analyzer (Analyzer Kit, JLG part no. 2901443) which will display two lines of information at a time, by scrolling through the program.

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

The following instructions are for using the hand held analyzer.

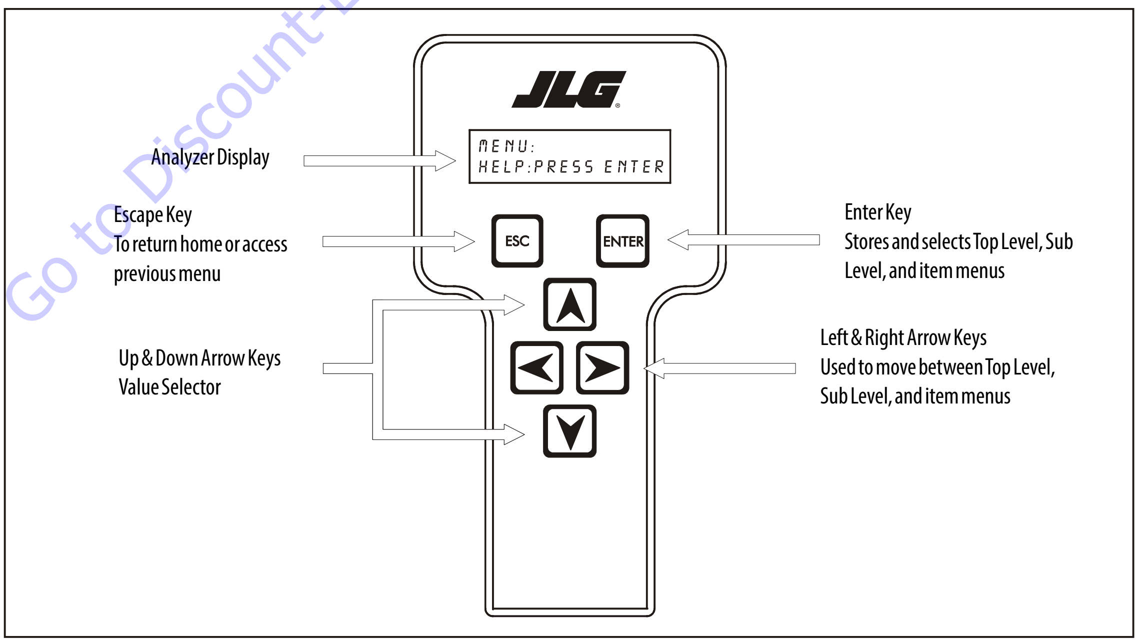


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

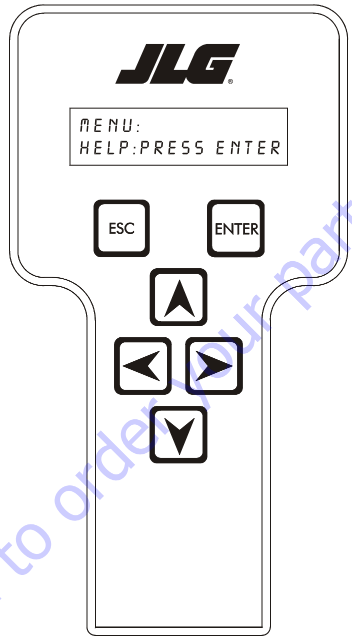
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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

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

Using the Analyzer

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



MENU:
HELP: PRESS ENTER

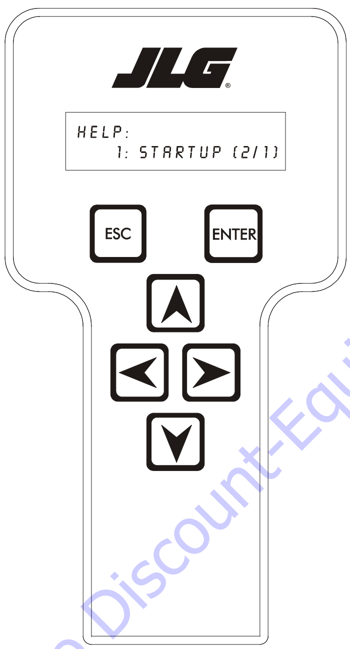
At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER** To cancel a selected menu item, press **ESCAPE** then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

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

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

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



LOGGED HELP
1: STARTUP (2/1)

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESCAPE** ESC two times. **STARTUP (2/1)** indicates a power up.

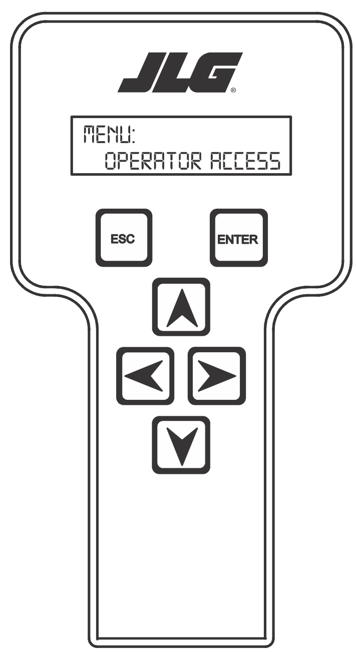
When a top level menu is selected, a new set of menu items may be offered: for example:

DRIVE
BOOM
SYSTEM
DATALOG
VERSIONS

Pressing **ENTER** 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 **ESCAPE** 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 settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:



MENU:
OPERATOR ACCESS

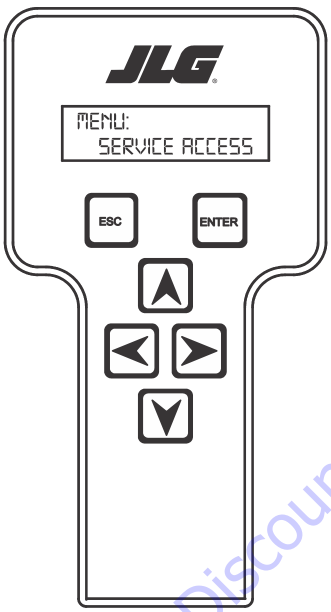
Press **ENTER** to select the **ACCESS LEVEL** menu.

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

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

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 33271.

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

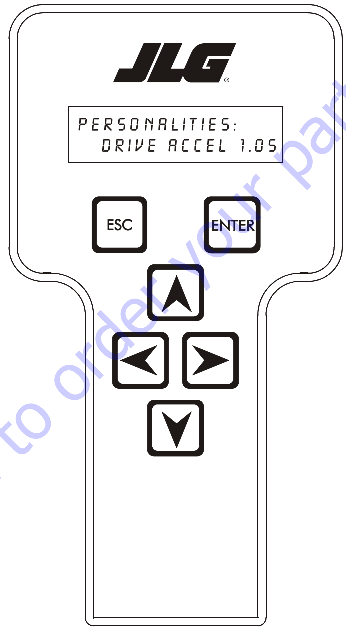


MENU:
SERVICE ACCESS

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

Adjusting Parameters Using the Hand Held Analyzer

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

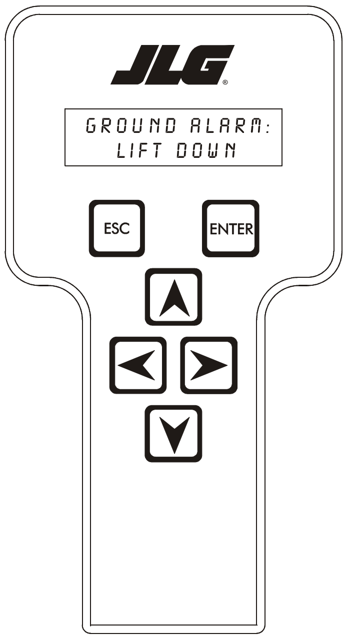


PERSONALITIES:
DRIVE ACCEL 1.0s

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

Machine Setup

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



GROUND ALARM:
LIFT DOWN

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

NOTE: *Refer to Table 6-6, Machine Setup Descriptions, and Table 6-5, Machine Setup Descriptions in this Service Manual for the recommended factory settings.*

NOTE: *Password 33271 will give you access to Access Level, which will permit you to change all machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

ELEVATION CUTBACK

⚠ WARNING

CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

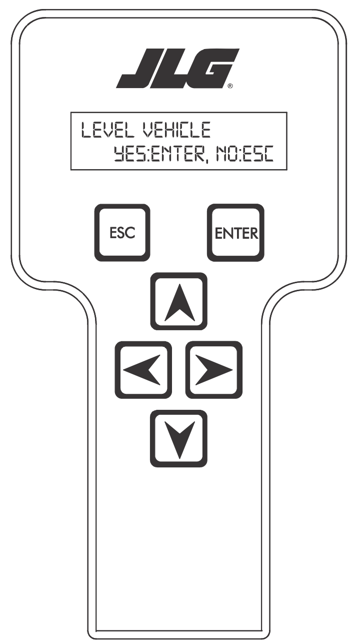
NOTICE

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

Level Vehicle Description

⚠ WARNING

DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available at password level 2 ENTER confirms that vehicle is currently level, and zeroes the tilt sensor measurements

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT OUT
CONT(S)	CONTRACTOR(S)
COOR	COORDINATED
CRK PT	CRACK POINT
CRP	CREEP
CUT	CUTOUT
CYL	CYLINDER
DECEL	DECELERATE
D	DOWN
DN	DOWN
DWN	DOWN
DEG.	DEGREE
DOS	DRIVE ORIENTATION SYSTEM
DRV	DRIVE
E	ERROR
E&T	ELEVATED & TILTED
ELEV	ELEVATION
ENG	ENGINE
EXT	EXTEND
F	FRONT
FL	FLOW
FNT	FRONT
FOR	FORWARD
FWD	FORWARD
FSW	FOOT SWITCH
FUNC	FUNCTION
G	GROUND

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
GND	GROUND
GRN	GREEN
GM	GROUND MODULE
H	HOURS
HW	HARDWARE
HWFS	HARDWARE FAILSAFE
I	IN or CURRENT
JOY	JOYSTICK
L	LEFT
LB	POUND
LEN	LENGTH
LIM	LIMIT
LT	LEFT
LVL	LEVEL
M	MINUTES
MIN	MINIMUM
MAX	MAXIMUM
M	MAIN
MN	MAIN
NO	NORMALLY OPEN or NO
NC	NORMALLY CLOSED
O	OUT
O/C	OPEN CIRCUIT
OP	OPEN
O/R	OVERRIDE or OUTRIGGER
O//R	OVERRIDE
OSC	OSCILLATING
OVRD	OVERRIDE
P	PLATFORM
P	PRESSURE
PCV	PROPORTIONAL CONTROL VALVE
PLAT	PLATFORM
PLT	PLATFORM
PM	PLATFORM MODULE
POT	POTENTIOMETER
PRES	PRESSURE
PRS	PRESSURE
PT	POINT
R	REAR or RIGHT
REV	REVERSE or REVISION
RET	RETRACT
ROT.	ROTATE
RT	RIGHT

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
S/C	SHORT CIRCUIT
SEL	SELECTOR
SN	SERIAL NUMBER
SPD	SPEED
STOW	STOWED
STOWD	STOWED
SW	SWITCH or SOFTWARE
TELE	TELESCOPE
TEMP	TEMPERATURE
TORQ.	TORQUE
TRN	TRANSPORT
T/T	TURNTABLE
T	TOWER
TURNTBL	TURNTABLE
TWR	TOWER
U	UPPER or UP
V	VOLT
VER	VERSION
VLV	VALVE
WIT	WITNESS
YEL	YELLOW

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
NOTE: *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.*			
MODEL NUMBER: 1	**1**	**E300**	**1**
	2	E400	
	3	E400N	
	4	E450	
	5	E600	
MARKET: 2	**1**	**ANSI USA**	**1**
	2	ANSI EXPORT	
	3	CSA	
	4	CE	
	5	AUSTRALIA	
	6	JAPAN	
	7	GB	
BATTERIES: 3* *Certain battery visibilities are dependent on model selection.	**1**	**310AH Flooded**	**1-E300**
	2	375AH Flooded	
	3	312AH AGM	
	4	415AH Flooded	
	5	390AH AGM)	

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
TILT: 4	1	5 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	
	2	4 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	
	3	3 DEGREES+CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows the tower lift up, drive, telescope out and lift up.	
	4	**4 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.**	**4 ANSI USA, ANSI Export, CSA, JAPAN**
	5	4 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.	
	6	**3 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep when drive reversal is allowed, drive is disallowed otherwise.**	**6 CE, AUS, GB**
GROUND ALARM: 5	1	NO: No ground alarm installed.	
	2	DRIVE: Travel alarm sounds when the drive function is active.	
	3	DESCENT: Descent alarm sounds when lift down is active.	
	4	**MOTION: Motion alarm sounds when any function is active.**	**4**
ALARM/HORN: 6	1	SEPERATE: Ambient alarm installed	
	2	**COMBINED: Single Horn / Alarm installed**	**2**
JIB: 7	1	NO: No jib installed.	
	2	**YES: Jib installed which has up and down movements only.**	**2**
JIB SWING: 8	1	NO: No jib swing installed.	
	2	**YES: Jib installed which has side to side movements.**	**2**

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
SKYGUARD: 9	1 **2**	NO: No Sky Guard system installed. **YES: Sky Guard system installed**.	 **2**
SOFT TOUCH: 10	**1** 2	**NO: No Soft Touch system installed.** YES: Soft Touch system installed.	**1**
H & T LIGHTS: 11	**1** 2	**NO: No head and tail lights installed.** YES: Head and tail lights installed	**1**
LOAD SYSTEM: 12* * Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.	**1** 2 3 4	**NO: No load sensor installed.** WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500 mS on, 500 mS off), platform alarm beeps (5 sec ON, 2 sec OFF).	**1**
FUNCTION CUTOUT: 13* * Only visible under certain market selections. * Certain market selections will limit load system options or alter default setting.	**1** 2 3	**NO: No drive cutout.** BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive and steer cutout above elevation.	**1**
DISPLAY UNITS: 14	**1** **2**	**METRIC** **IMPERIAL**	**1** **CSA, CE, AUS, JAPAN, GB** **2** **ANSI USA, ANSI Export**

Table 6-2. Machine Configuration Programming Information - Version P1.10

Configuration Digit	Number	Description	Default Number
ALERT BEACON: 15* * Only visible if Skyguard is selected.	**1** 2	**OFF FOR CREEP** 20 FPM FOR CREEP	**1**
TEMP OUTPUT: 16* * Certain market selection will display temp cutout options.	**1** 2	**NO:** YES: Low temp cutout system is installed.	**1**
WHEEL DRIVE: 17* * Only visible if E600 model is selected.	**1** 2	**4WD:Front wheel assist (4WD) system is installed** 2WD: Front wheel assist (4WD) system is not installed.	**1**
CHARGER INTERLOCK: 18	**1** 2	**DRIVE ONLY: Drive function is disabled when battery charger is plugged in.** CUTOUT ALL: Drive and bottom function is disabled when battery charger is plugged in.	**1**
PLAT LVL OVR CUT: 19	**1** 2	**NO: Platform level functions above elevation.** YES: Platform level does not function above elevation.	**1**

1001201628-D

Table 6-3. Machine Configuration Programming Settings - Version P1.10

E300	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Model Number	**1**	**1**	**1**	**1**	**1**	**1**
Market	**1**	**2**	**3**	**4**	**5**	**6**
Batteries	**1**	**1**	**1**	**1**	**1**	**1**
	X	X	X	X	X	X
	3	3	3	3	3	3
	X	X	X	X	X	X
	X	X	X	X	X	X
Tilt	1	1	1		X	1
	2	2	2		X	2
	3	3	3	3	3	3
	4	**4**	**4**	X	X	**4**
	5	5	5	X	X	5
	6	**6**	**6**	**6**	**6**	**6**
Ground Alarm	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	**4**	**4**	**4**	**4**	**4**
Alarm/Horn	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Jib	X	X	X	X	X	X
	X	X	X	X	X	X
Jib Swing	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Skyguard	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**
Soft Touch	X	X	X	X	X	X
	X	X	X	X	X	X
Head & Tail Lights	X	X	X	X	X	X
		X	X	X	X	X
Load System	X	**1**		1	1	1
	X	*2*	X	X	X	*2*
	X	3	X	X	**3**	**3**
		4	X	**4**		4
Function Cutout	**1**	**1**	**1**		**1**	**1**
		2	2	**2**	2	2
	3	3	3	X	3	3
Display Units	1	1	**1**	**1**	**1**	**1**
	2	**2**	2	2	2	2
Alert Beacon	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Temp Cutout	X	**1**		**1**		X
	X	2	X	2	X	X
Wheel Drive	X	X	X	X	X	X
	X	X	X	X	X	X
Charger Interlock	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2
Plat Lvl Ovr Cut	**1**	**1**	**1**	**1**	**1**	**1**
	2	2	2	2	2	2

BOLD TEXT indicates the default setting. Plain text indicates another available selection. ***ITALIC TEXT*** *text* indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

1001201628-D

6.2 MACHINE PERSONALITY SETTINGS

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

Table 6-4. Personality Ranges/Defaults - Version P1.10

FUNCTION	PERSONALITY	RANGE	DEFAULTS
DRIVE	ACCELeration	0.5s to 5.0s	2.0s
	DECELeration	0.3s to 5.0s	3.0s
	DECELeration to stop	0.3s to 2.0s	1.0s
	MAXimum speed	75 to 100%	100%
	REDUCED MAXimum speed and MAXimum Reverse Drive	50 to 74%	60%
	ELEVATED MAXimum speed (ANSI)	5 to 15%	7%
	ELEVATED MAXimum speed (CE)	5 to 15%	7%
	CREEP MAXimum speed	5 to 15%	7%
STEER	ACCELeration	0.1 to 5.0s	2.0s
	DECELeration	0.1 to 5.0s	0.3s
	MINimum LEFT speed	20 to 40%	35%
	MAXimum LEFT speed	50 to 90%	70%
	MINimum RIGHT speed	20 to 40%	35%
	MAXimum RIGHT speed	50 to 90%	90%
SWING	ACCELeration	0.1 to 5.0s	2.5s
	DECELeration	0.1 to 5.0s	2.5s
	MINimum LEFT speed	1 to 15%	1%
	MAXimum LEFT speed	26 to 60%	35%
	CREEP Maximum LEFT speed	16 to 25%	20%
	MINimum RIGHT speed	1 to 15%	1%
	MAXimum RIGHT speed	26 to 60%	35%
	CREEP maximum RIGHT speed	16 to 25%	20%

Table 6-4. Personality Ranges/Defaults - Version P1.10

FUNCTION	PERSONALITY	RANGE	DEFAULTS
BOOM LIFT	ACCELeration	0.1 to 5.0s	2.5s
	DECELeration	0.1 to 5.0s	2.5s
	MINimum UP speed	1 to 15%	1%
	MAXimum UP speed	36 to 100%	95%
	CREEP maximum UP speed	16 to 35%	35%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	36 to 80%	45%
	CREEP maximum DOWN speed	16 to 35%	20%
TOWER LIFT	ACCELeration	0.1 to 5.0s	3s
	DECELeration	0.1 to 5.0s	1s
	MINimum UP speed	1 to 20%	20%
	MAXimum UP speed	51 to 100%	100%
	CREEP maximum UP speed	21 to 35%	35%
	MINimum DOWN speed	1 to 15%	15%
	MAXimum DOWN speed	26 to 60%	45%
	CREEP maximum DOWN speed	16 to 25%	20%
TELESCOPE	ACCELeration	0.1 to 5.0s	1.5s
	DECELeration	0.1 to 5.0s	1.5s
	MINimum IN speed	1 to 15%	15%
	MAXimum IN speed	31 to 60%	48%
	CREEP maximum IN speed	16 to 30%	30%
	MINimum OUT speed	1 to 15%	15%
	MAXimum OUT speed	31 to 60%	45%
	CREEP maximum OUT speed	16 to 30%	30%
JIB LIFT	ACCELeration	0.1 to 5.0s	1.2s
	DECELeration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	15%
	MAXimum UP speed	21 to 60%	45%
	CREEP maximum UP speed	16 to 25%	23%
	MINimum DOWN speed	1 to 15%	15%
	MAXimum DOWN speed	21 to 60%	30%

Table 6-4. Personality Ranges/Defaults - Version P1.10

FUNCTION	PERSONALITY	RANGE	DEFAULTS
	CREEP maximum DOWN speed	16 to 20%	20%
JIB SWING	ACCELeration	0.1 to 5.0s	2.0s
	DECELeration	0.1 to 5.0s	1.0s
	MINimum LEFT speed	1 to 15%	10%
	MAXimum LEFT speed	26 to 50%	30%
	CREEP Maximum LEFT speed	16 to 25%	23%
	MINimum RIGHT speed	1 to 15%	10%
	MAXimum RIGHT speed	26 to 50%	30%
	CREEP maximum RIGHT speed	16 to 25%	23%
PLATFORM LEVEL	ACCELeration	0.1 to 5.0s	1.0s
	DECELeration	0.1 to 5.0s	0.5s
	MINimum UP speed	1 to 15%	15%
	MAXimum UP speed	36 to 60%	40%
	CREEP maximum UP speed	16 to 35%	32%
	MINimum DOWN speed	1 to 15%	1%
	MAXimum DOWN speed	31 to 60%	32%
	CREEP maximum DOWN speed	16 to 30%	20%
PLATFORM ROTATE	ACCELeration	0.1 to 5.0s	1.5s
	DECELeration	0.1 to 5.0s	1.5s
	MINimum LEFT speed	1 to 15%	10%
	MAXimum LEFT speed	19 to 50%	28%
	CREEP Maximum LEFT speed	16 to 25%	21%
	MINimum RIGHT speed	1 to 15%	10%
	MAXimum RIGHT speed	19 to 50%	28%
	CREEP maximum RIGHT speed	16 to 25%	21%
GROUND MODE	Swing	26 to 60%	34%
	Tower UP	51 to 100%	80%
	Tower Down	26 to 60%	44%
	Lift UP	36 to 80%	65%
	Lift DOWN	36 to 80%	40%
	Telescope IN	31 to 60%	44%

Table 6-4. Personality Ranges/Defaults - Version P1.10

FUNCTION	PERSONALITY	RANGE	DEFAULTS
	Telescope OUT	31 to 60%	44%
	Jib UP	31 to 60%	40%
	Jib DOWN	21 to 60%	29%
	Jib SWING	21 to 60%	29%
	Platform LEVEL	31 to 60%	31%
	Platform ROTATE	19 to 50%	27%
ALARM/HORN	Volume HORN	25 to 100%	100%
	Volume ALARM	25 to 100%	75%
TEMPERATURE CUT	LOW Cutout set	-30°C to 0°C	-30°C
	OFFset	0°C to 10°C	5°C

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ANALYZER MENU STRUCTURE

NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

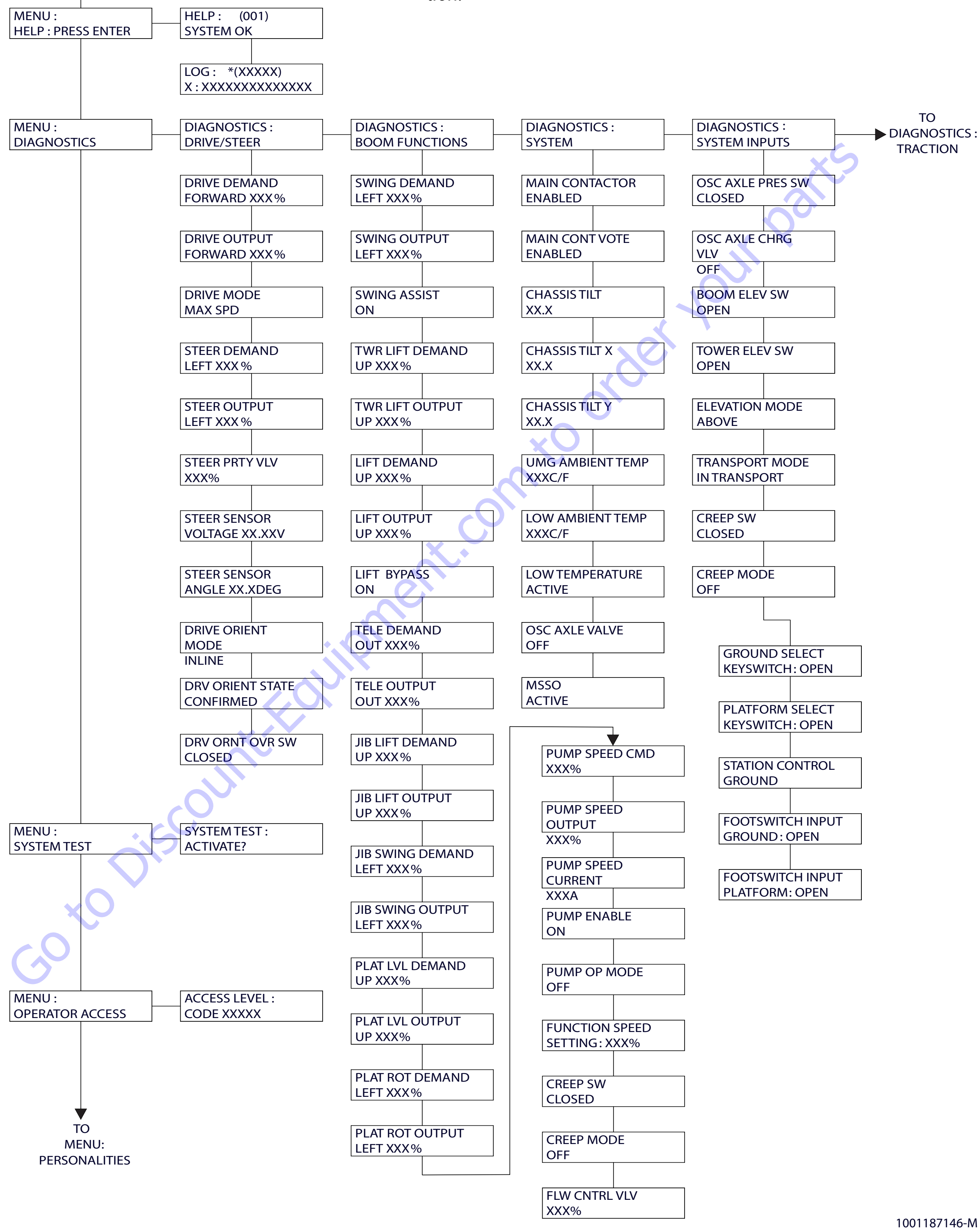
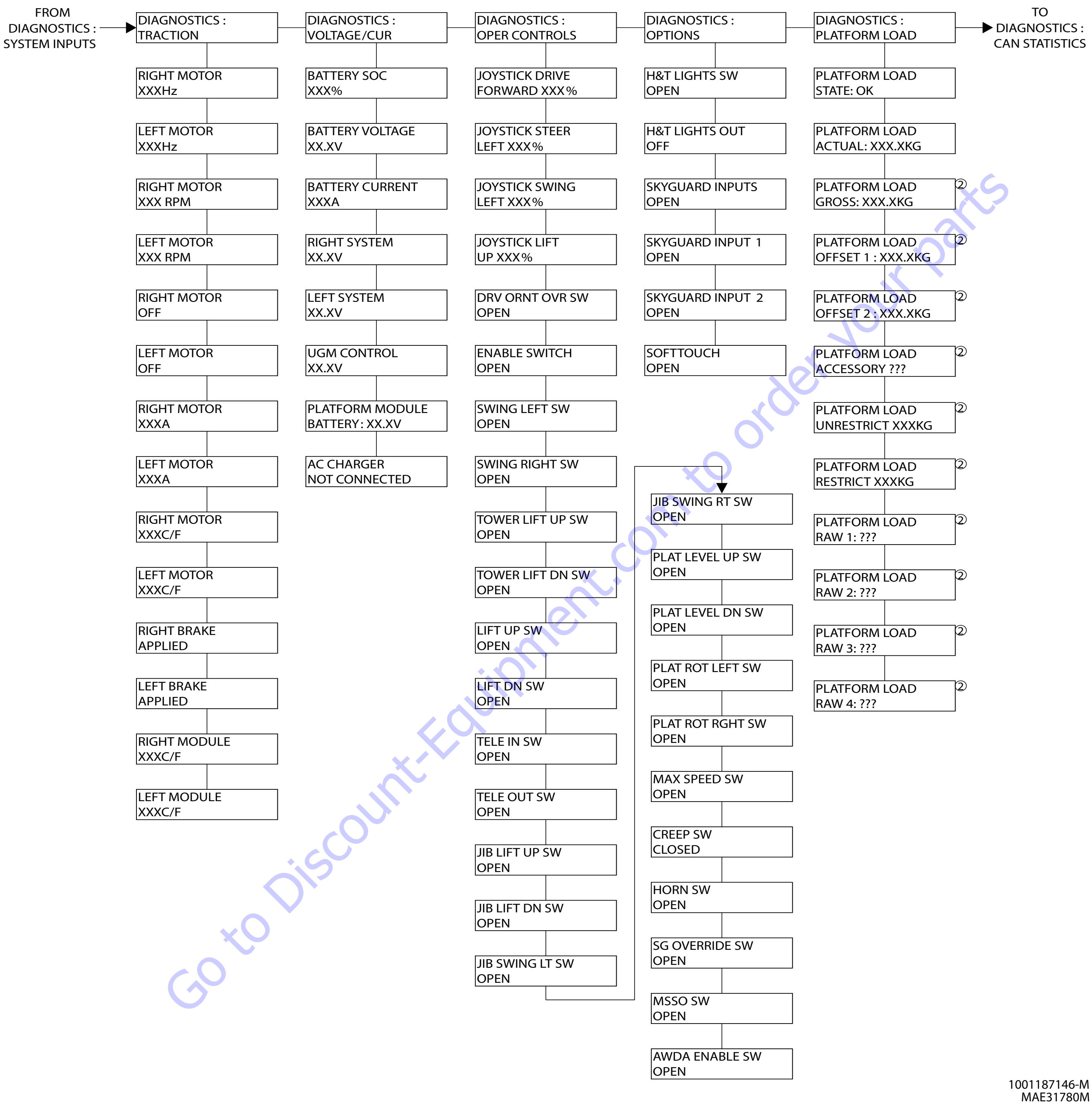
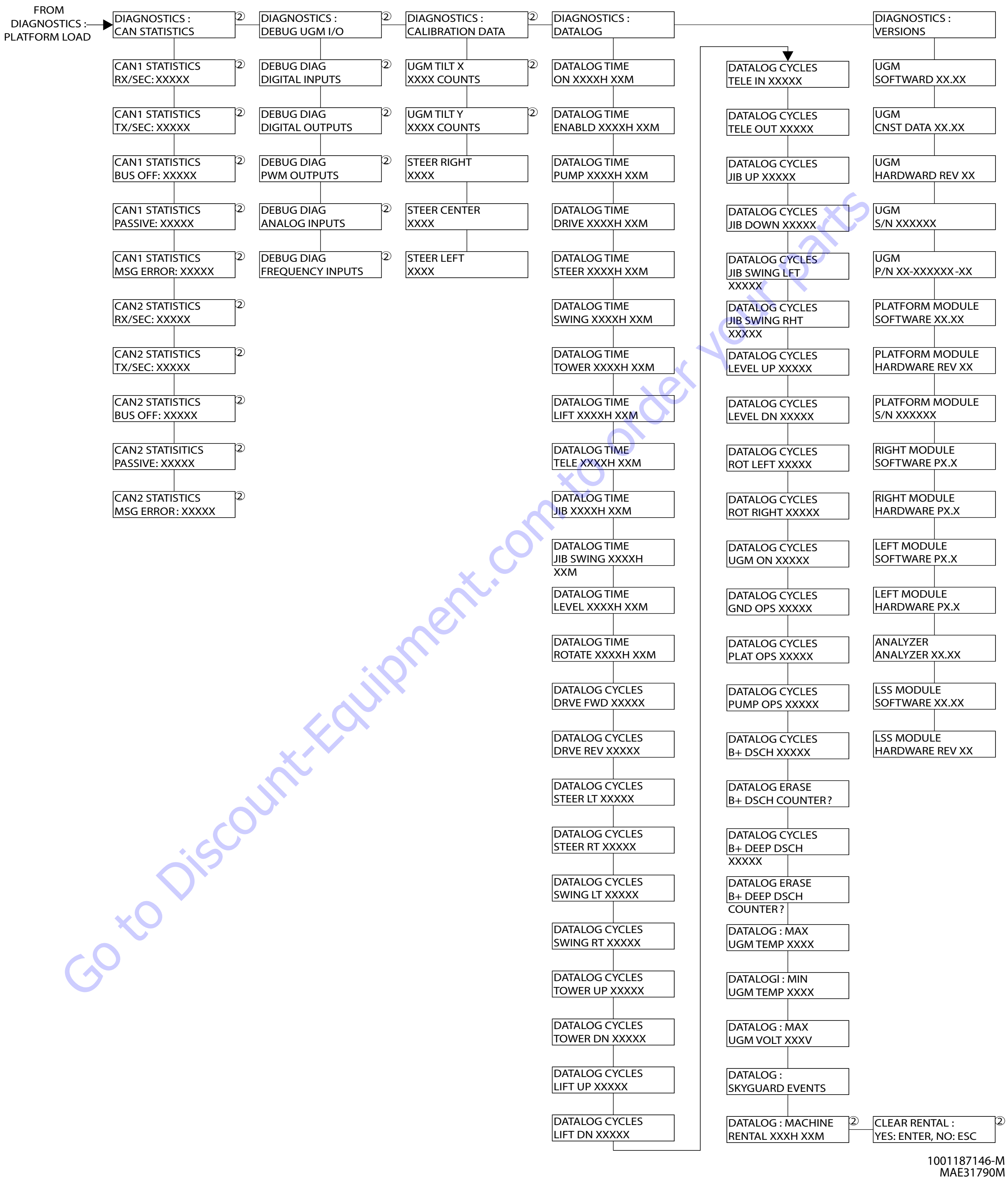


Figure 6-2. Analyzer Flow Chart, Version P1.10 - Sheet 1 of 5



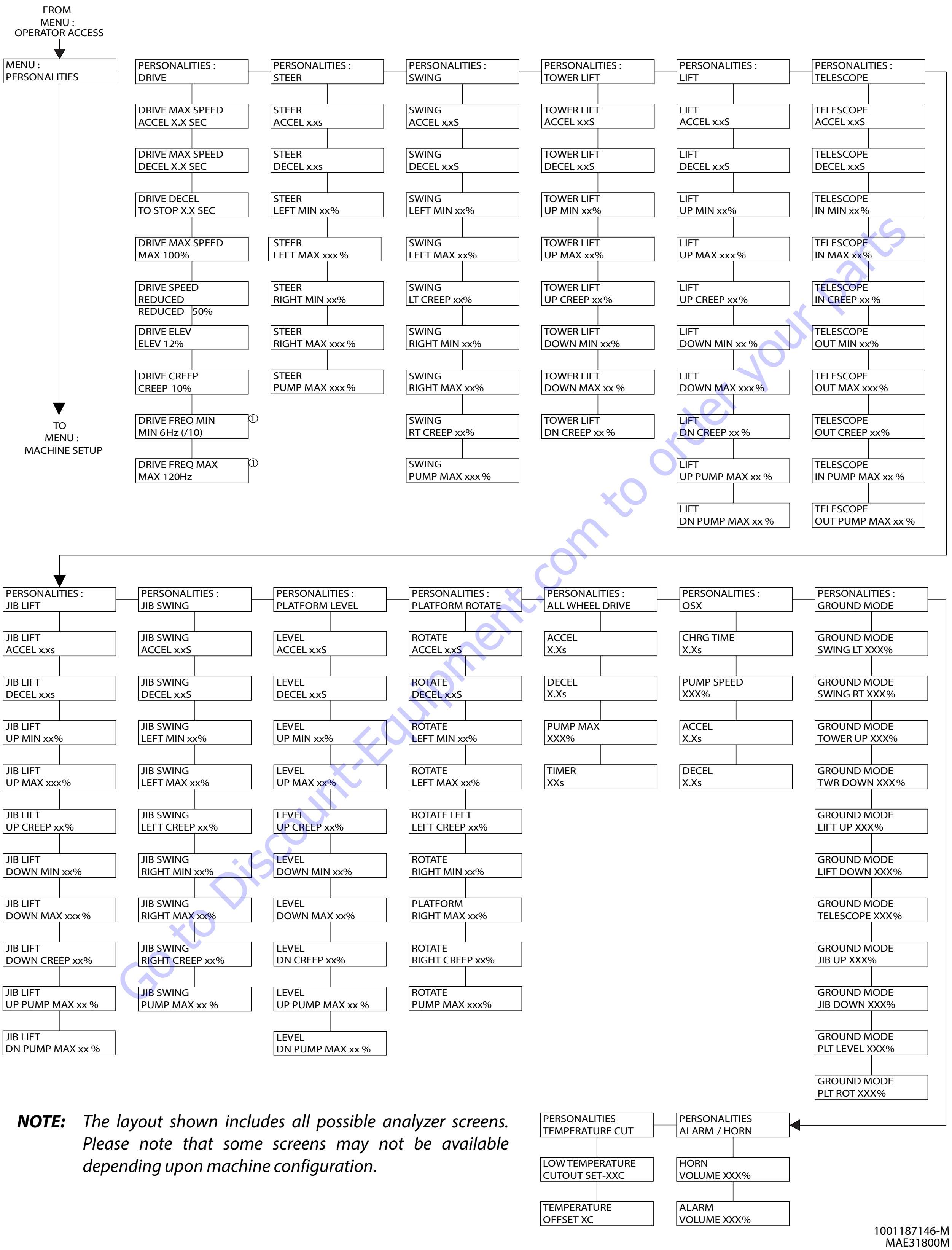
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-3. Analyzer Flow Chart, Version P1.10 - Sheet 2 of 5



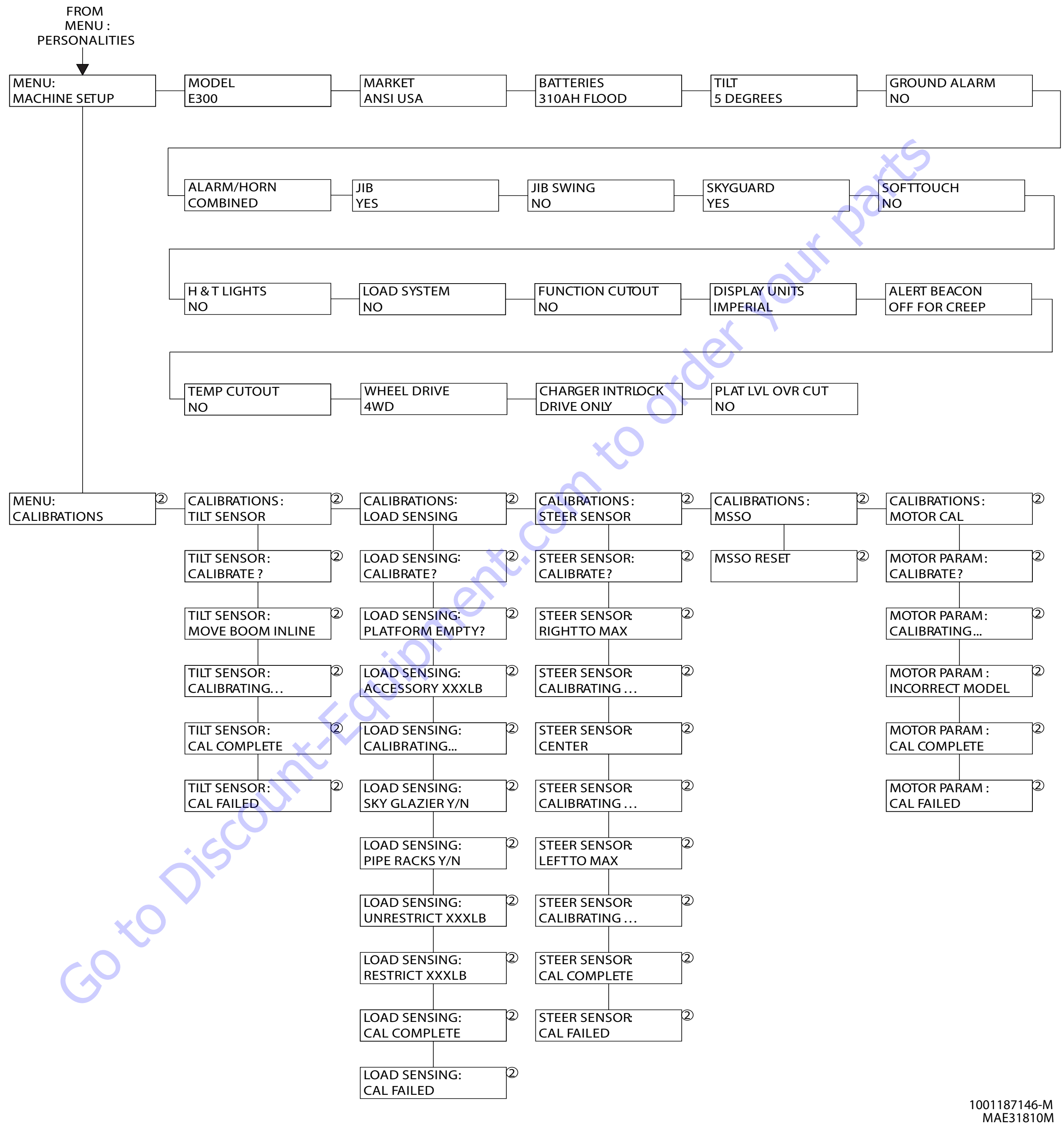
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-4. Analyzer Flow Chart, Version P1.10 - Sheet 3 of 5



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-5. Analyzer Flow Chart, Version P1.10 - Sheet 4 of 5



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-6. Analyzer Flow Chart, Version P1.10 - Sheet 5 of 5

6.3 MACHINE ORIENTATION WHEN PERFORMING TEST

Drive (Below elevation): Test should be done on a smooth, level surface. The Drive select switch should be in the “Max Speed” position. Start approximately 25 ft (7.6 m) from starting point so the unit is at a maximum speed when starting the test. Result should be recorded for a 200ft (61m) course. Drive Forward, “High speed”, record time. Drive Reverse, “High speed”, record time.

NOTE: *Drive Reverse “High Speed” will be the same as Drive Reverse “Reduced Speed”.*

Drive Reduced (below elevation): Test should be done on a smooth, level surface. The Drive select switch should be in the “Reduced Speed” position. Start approximately 25 ft (7.6 m) from starting point so the unit is at a maximum speed when starting the test. Result should be recorded for a 200 ft (61 m) course. Drive Forward, “Reduced speed”, record Time. Drive Reverse, “Reduced speed”, record Time.

Drive (above elevation): Test should be done on a smooth, level surface. The drive select switch should be in the “Max Speed” position, the boom should be >10° above horizontal to ensure the drive is operating in elevated mode. Result should be recorded for a 50 ft (15.2 m) course. Drive Forward, Record Time. Drive reverse, Record Time.

Swing: Boom at full elevation, Telescope retracted. Swing turntable right to end stop. Swing Left to end stop, record time. Swing Right to end stop, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Swing left and right. Return Knob to fully clockwise.

Tower Lift: Tower Lift in stowed position, Telescope Retracted, Main lift horizontal. Tower Lift Up, record time. Tower Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Tower Up and Down. Return Knob to fully clockwise.

Main lift: Main Lift in stowed position Tower Lift in stowed position, Telescope Retracted. Main Lift Up, record time. Main Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Lift Up and Down. Return Knob to fully clockwise.

Telescope: Main Lift at full elevation, Telescope Retracted. Telescope Out, record time. Telescope In, record time. Turn Platform Speed Control Knob fully counterclockwise to enter creep mode; creep light on Panel must be energized. Verify that machine will Telescope Up and Down. Return Knob to fully clockwise.

Jib Lift: Platform level and centered with boom. Jib Lift Down until stop. Jib Lift Up, record time. Jib Lift Down, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Jib Lift Up and Down. Return Knob to fully clockwise.

Jib Swing: Platform level and centered with boom. Jib Lift Horizontal and swing fully to left stop. Swing right to end stop, record time. Swing left to end stop, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Jib swing left and right. Return Knob to fully clockwise.

Platform Rotate: Platform level, Rotate Platform Right until stop. Platform Left, record time. Platform Right, record time. Turn Platform Speed Control Knob fully counterclockwise to enter Creep mode; Creep light on Panel must be energized. Verify that machine will Platform Rotate Left and Right. Return Knob to fully clockwise.

NOTE: *When the platform speed control knob is turned fully counterclockwise. The platform rotate may not work, this is acceptable.*

Test Notes

1. Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.
2. Stop watch should be started with the function movement, not with actuation of the joystick or switch.
3. Drive speeds should be set to the values below regardless of the tire size.
4. All speed tests are run from the platform, these speeds do not reflect the ground control operation.
5. The Platform Speed Control knob must be at full speed (turned clockwise completely) unless noted.
6. Some flow control functions may not work with the Platform Speed Control knob clicked into the creep position.
7. Functional speeds may vary due to cold thick hydraulic oil. Test should be run with the oil temperature above 38° C (100° F).

Table 6-5. Function Speeds

Function	Speed (In Seconds)
Main Lift Up	24-27
Main Lift Down	20-23
Turntable Swing Right & Left 360°	75-90
NOTE: *Swing Left to Swing Right should be within 10% of each other.*	
Telescope Out	8-12
Telescope In	8-12
Platform Rotate - Right & Left 180°	20-24
NOTE: *Rotate Left to Swing Right should be within 15% of each other.*	
Jib Lift Up	22-25
Jib Lift Down	22-25
Jib Swing Right and Left (AJ & AJP)	20-35
Lower Lift Up	17-22
Lower Lift Down	17-20
Drive Fwd Below Elevation	30-35
Drive Reduced/Drive Reverse Below Elevation	50-59
Drive Above Elevation (ANSI)	110-120
Drive Above Elevation (CE)	110-120
NOTE: *Drive Forward Max to 100% (Typical)*	
NOTE: *Drive Reverse Max = Drive Reduced Max (Below Elevation)*	

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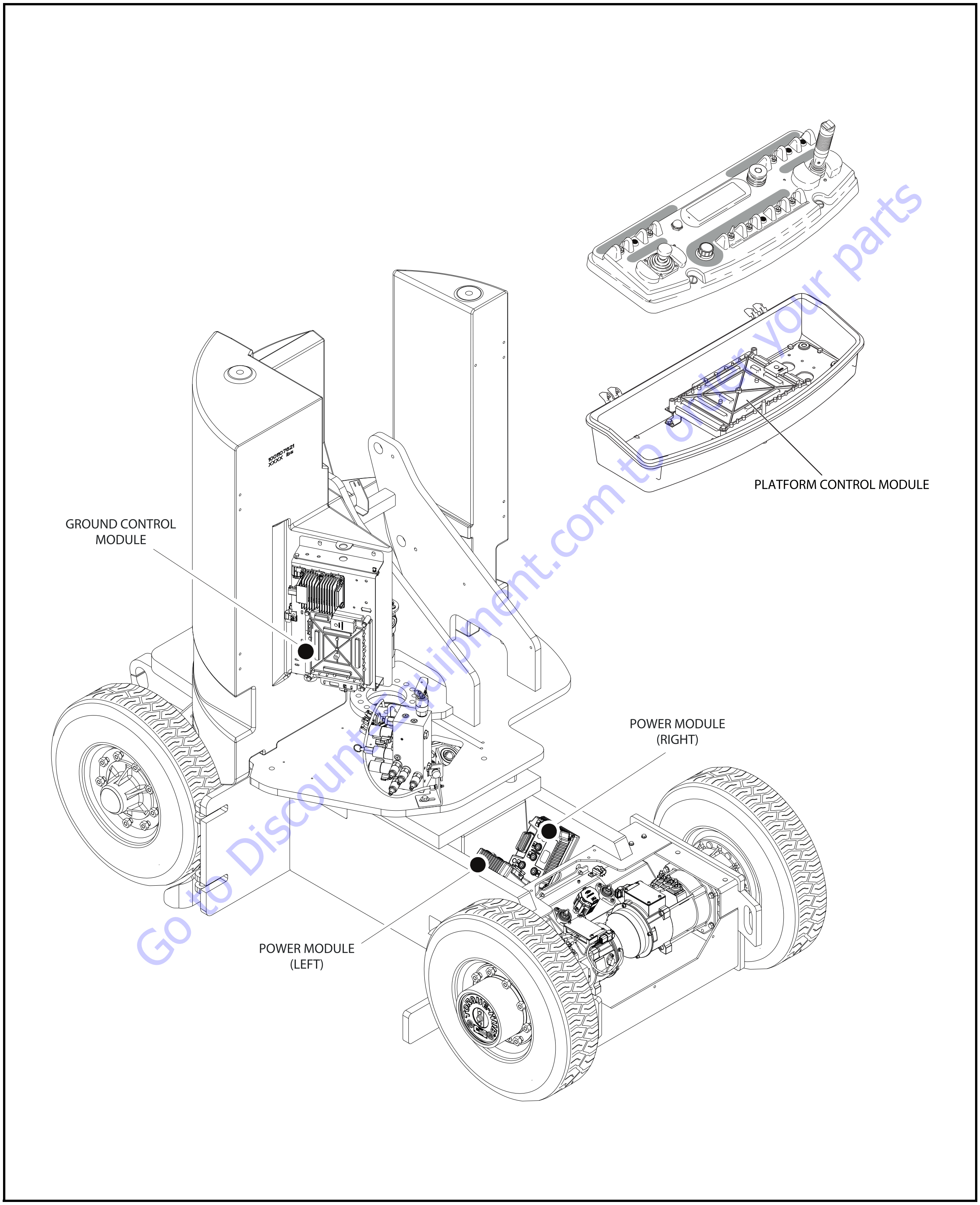
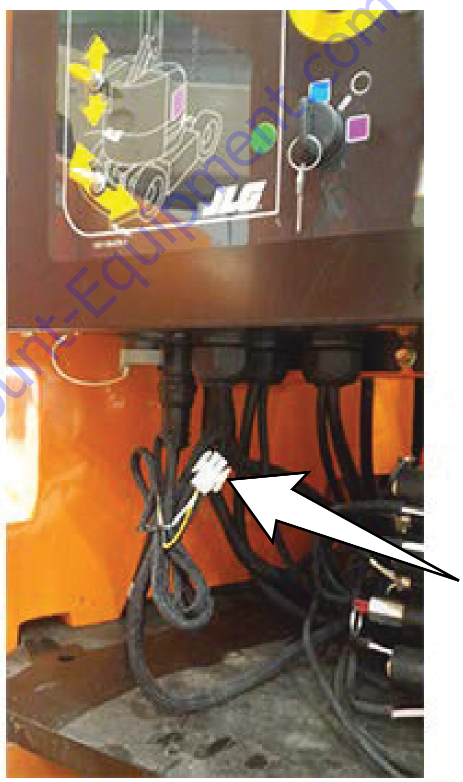


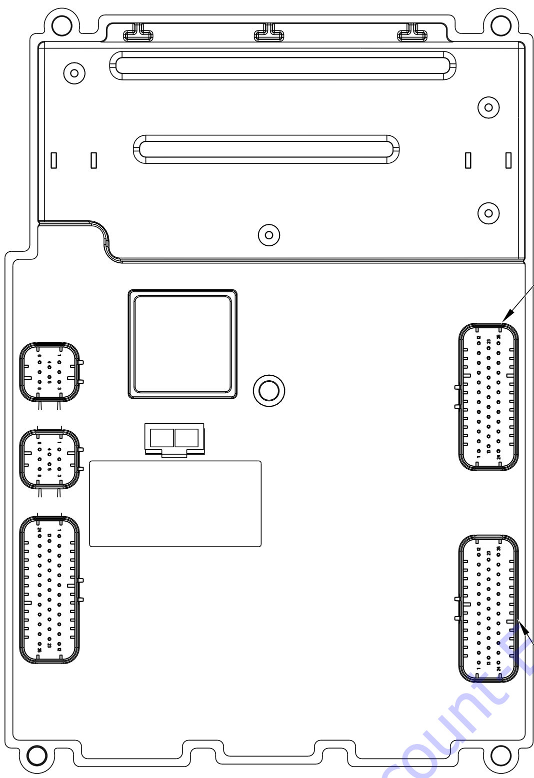
Figure 6-7. Control Module Location

PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-8. Analyzer Connecting Points



CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J2 GRAY	1	UNALLOCATED (JIB RT)	DIGITAL INPUT
	2	UNALLOCATED (JIB LT)	DIGITAL INPUT
	3	UNUSED (BATTERY VOLTAGE)	BATTERY VOLTAGE
	4	DRIVE ORIENTATION SYSTEM OVERRIDE SWITCH	HS DIGITAL INPUT
	5	UNALLOCATED (BASKET STOW SWITCH)	DIGITAL INPUT
	6	CHASSIS TILTED INDICATOR	LAMP OUTPUT
	7	FUNCTION ENABLE INDICATOR	LAMP OUTPUT
	8	VEHICLE SYSTEM DISTRESS INDICATOR	LAMP OUTPUT
	9	CREEP SPEED INDICATOR	LAMP OUTPUT
	10	UNUSED (BROKEN CABLE INDICATOR)	LAMP OUTPUT
	11	PLATFORM OVERLOADED INDICATOR	LAMP OUTPUT
	12	UNUSED (500 LB CAPACITY INDICATOR)	LAMP OUTPUT
	13	LOW BATTERY INDICATOR	LAMP OUTPUT
	14	DRIVE ORIENTATION SYSTEM INDICATOR	LAMP OUTPUT
	15	UNUSED (GENERATOR ON INDICATOR)	LAMP OUTPUT
	16	SKYGUARD INDICATOR	LAMP OUTPUT
	17	UNUSED (GLOW PLUG ENGAGED INDICATOR)	LAMP OUTPUT
	18	LAMP RETURN	GROUND
	19	SOFT TOUCH INDICATOR	LAMP OUTPUT
	20	UNUSED	LAMP OUTPUT
	21	UNUSED (LOW FUEL INDICATOR)	LAMP OUTPUT
	22	1/4 BAT CHG INDICATOR	LAMP OUTPUT
	23	3/4 BAT CHG INDICATOR	LAMP OUTPUT
	24	1/2 BAT CHG INDICATOR	LAMP OUTPUT
	25	BAT CHG INDICATORS RETURN	GROUND
	26	ANALYZER POWER	ANALYZER POWER
	27	ANALYZER GROUND	ANALYZER GROUND
	28	ANALYZER RX	ANALYZER RX
	29	ANALYZER TX	ANALYZER TX
	30	UNUSED (BATTERY VOLTAGE)	BATTERY VOLTAGE
	31	SOFT TOUCH POWER	BATTERY VOLTAGE
	32	LSS POWER	BATTERY VOLTAGE
	33	UNUSED (PLT DISP POWER)	BATTERY VOLTAGE
	34	UNUSED (SWITCH POWER)	BATTERY VOLTAGE
	35	FULL BAT CHG INDICATOR	LAMP OUTPUT

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J1 NATURAL	1	TOWER LIFT UP	DIGITAL INPUT
	2	TOWER LIFT DOWN	DIGITAL INPUT
	3	UNUSED (TOWER TELESCOPE IN)	DIGITAL INPUT
	4	UNUSED (TOWER TELESCOPE OUT)	DIGITAL INPUT
	5	MAIN TELESCOPE IN	DIGITAL INPUT
	6	MAIN TELESCOPE OUT	DIGITAL INPUT
	7	PLATFORM ROTATE RIGHT	DIGITAL INPUT
	8	PLATFORM ROTATE LEFT	DIGITAL INPUT
	9	PLATFORM LEVEL UP	DIGITAL INPUT
	10	PLATFORM LEVEL DOWN	DIGITAL INPUT
	11	JIB UP	DIGITAL INPUT
	12	JIB DOWN	DIGITAL INPUT
	13	SPEED PUMP POTENTIOMETER GROUND	GROUND
	14	UNUSED (ENGINE START)	DIGITAL INPUT
	15	UNUSED (AUXILIARY DESCENT)	DIGITAL INPUT
	16	UNUSED (CRAB STEER SELECT)	DIGITAL INPUT
	17	UNUSED (COORDINATED STEER SELECT)	DIGITAL INPUT
	18	SWITCH POWER	BATTERY VOLTAGE
	19	UNALLOCATED	DIGITAL INPUT
	20	SOFT TOUCH SWITCH	DIGITAL INPUT
	21	UNALLOCATED	DIGITAL INPUT
	22	UNALLOCATED	DIGITAL INPUT
	23	SKYGUARD INPUT #2	DIGITAL INPUT
	24	UNALLOCATED	DIGITAL INPUT
	25	UNALLOCATED	DIGITAL INPUT
	26	UNALLOCATED	DIGITAL INPUT
	27	SPEED MODE	DIGITAL INPUT
	28	UNUSED (TORQUE MODE (LOW ENGINE))	DIGITAL INPUT
	29	SOFT TOUCH/SKYGUARD OVERRIDE	DIGITAL INPUT
	30	HEAD/TAIL LIGHT	DIGITAL INPUT
	31	HORN	DIGITAL INPUT
	32	CREEP MODE	DIGITAL INPUT
	33	UNUSED (GENSET ENABLE/DISABLE)	DIGITAL INPUT
	34	SPEED PUMP POTENTIOMETER REFERENCE VOLTAGE	+7 REFERENCE VOLTAGE
	35	SPEED PUMP POTENTIOMETER	ANALOG INPUT

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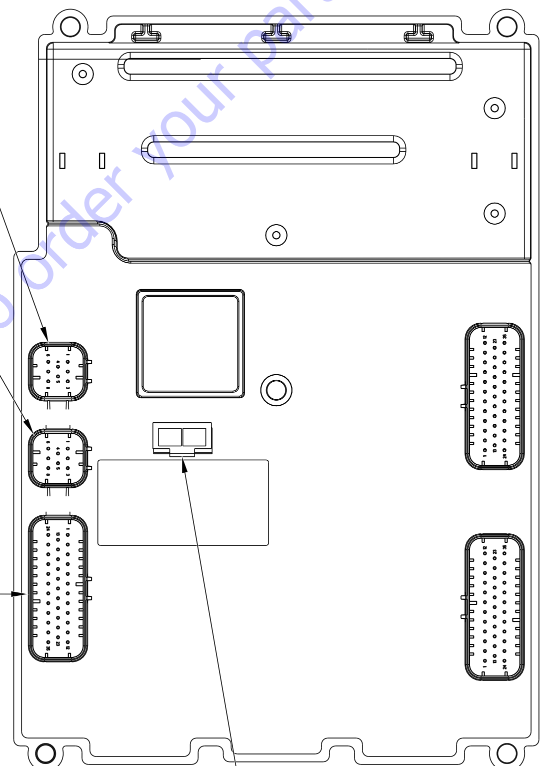
Figure 6-9. Platform Control Module - Sheet 1 of 2

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J5 NATURAL	1	LIFT / SWING JOYSTICK SUPPLY VOLTAGE	SUPPLY VOLTAGE
	2	LIFT CENTER TAP	ANALOG INPUT
	3	LIFT SIGNAL	ANALOG INPUT
	4	SWING SIGNAL	ANALOG INPUT
	5	SWING CENTER TAP	ANALOG INPUT
	6	UNUSED	ANALOG INPUT
	7	LIFT / SWING JOYSTICK RETURN	GROUND
	8	UNUSED	GROUND

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J6 BLACK	1	DRIVE / STEER JOYSTICK SUPPLY VOLTAGE	SUPPLY VOLTAGE
	2	DRIVE CENTER TAP	ANALOG INPUT
	3	DRIVE SIGNAL	ANALOG INPUT
	4	UNUSED	ANALOG INPUT
	5	STEER LEFT	ANALOG INPUT
	6	STEER RIGHT	ANALOG INPUT
	7	DRIVE / STEER JOYSTICK RETURN	GROUND
	8	UNUSED	GROUND

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J7 BLACK	1	GROUND MODE	PLATFORM EMS
	2	PLATFORM EMS	PLATFORM MODE
	3	PLATFORM EMS TO GROUND MODULE	GROUND MODE
	4	FOOTSWITCH (FUNCTION ENABLE SWITCH) POWER	BATTERY VOLTAGE
	5	UNUSED (INVERTER SWITCH POWER)	BATTERY VOLTAGE
	6	UNUSED (JIB BLOCK LIMIT SWITCH POWER)	BATTERY VOLTAGE
	7	SKYGUARD POWER	BATTERY VOLTAGE
	8	FOOTSWITCH SIGNAL	DIGITAL INPUT
	9	UNUSED (INVERTER ON SIGNAL)	DIGITAL INPUT
	10	UNUSED (+7 REFERENCE VOLTAGE)	+7 REFERENCE VOLTAGE
	11	UNUSED (LOAD CELL INPUT 1)	ANALOG INPUT
	12	UNUSED (LOAD CELL INPUT 2)	ANALOG INPUT
	13	UNALLOCATED	ANALOG INPUT
	14	UNUSED (GROUND RETURN)	GROUND
	15	UNUSED (LOAD CELL REFERENCE VOLTAGE)	+7 REFERENCE VOLTAGE
	16	LOAD CELL RETURN	GROUND
	17	UNUSED (JIB BLOCK LIMIT SWITCH)	HS DIGITAL INPUT
	18	SKYGUARD INPUT #1	HS DIGITAL INPUT
	19	PLATFORM ALARM	LAMP OUTPUT
	20	PLATFORM ALARM RETURN	GROUND
	21	PLATFORM LEVEL UP	ME DIGITAL OUTPUT
	22	PLATFORM LEVEL DOWN	ME DIGITAL OUTPUT
	23	VALVE RETURN	GROUND
	24	SKYGUARD RETURN	GROUND
	25	JIB UP	ME DIGITAL OUTPUT
	26	JIB DOWN	ME DIGITAL OUTPUT
	27	JIB RIGHT	ME DIGITAL OUTPUT
	28	JIB LEFT	ME DIGITAL OUTPUT
	29	PLT DISP RETURN	GROUND
	30	CAN LOW	CAN LOW
	31	CAN HIGH	CAN HIGH
	32	CAN SHIELD	CAN SHIELD
	33	PLATFORM ROTATE LEFT	ME DIGITAL OUTPUT
	34	PLATFORM ROTATE RIGHT	ME DIGITAL OUTPUT
	35	UNUSED (GROUND RETURN)	GROUND



CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J8	1	MODULE GROUND	GROUND
	2	MODULE POWER	BATTERY VOLTAGE

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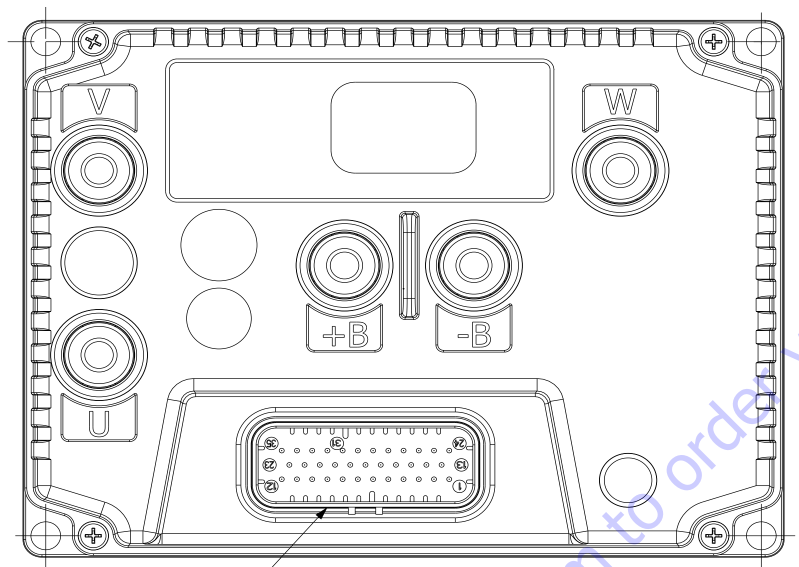
Figure 6-10. Platform Control Module - Sheet 2 of 2



CONNECTOR	PIN	FUNCTION	TYPE	
J1	1	UNUSED	DIGITAL	INPUT
	2	ELECTRO BRAKE	DIGITAL	OUTPUT
	3	ELECTRO BRAKE SUPPLY (POS)	VBAT	INPUT
	4	ELECTRO BRAKE DRIVER (NEG)	PWM	OUTPUT
	5	SENSOR GROUND	GROUND	INPUT
	6	MODULE ADDRESS	DIGITAL	INPUT
	7	UNUSED	DIGITAL	INPUT
	8	UNUSED	DIGITAL	OUTPUT
	9	UNUSED	DIGITAL	OUTPUT
	10	KEY SWITCH (IGNITION)	DIGITAL	INPUT
	11	UNUSED	DIGITAL	OUTPUT
	12	UNUSED	PWM	OUTPUT
	13	WHEEL ENCODER PIN B	DIGITAL	INPUT
	14	WHEEL ENCODER PIN A	DIGITAL	INPUT
	15	UNUSED	ANALOG	INPUT
	16	UNUSED	DIGITAL	INPUT
	17	UNUSED	DIGITAL	INPUT
	18	UNUSED	DIGITAL	INPUT
	19	UNUSED	DIGITAL	INPUT
	20	UNUSED	DIGITAL	INPUT
	21	UNUSED	DIGITAL	INPUT
	22	MOTOR THERMAL SENSOR	ANALOG	INPUT
	23	UNUSED	PWM	OUTPUT
	24	UNUSED	PWM	OUTPUT
	25	WHEEL ENCODER POWER (+5 VOLTS)	VOLTAGE	OUTPUT
	26	UNUSED	DIGITAL	OUTPUT
	27	CAN LOW	COMM	I/O
	28	CAN HIGH	COMM	I/O
	29	UNUSED	DIGITAL	INPUT
	30	UNUSED	ANALOG	INPUT
	31	UNUSED	DIGITAL	INPUT
	32	UNUSED	DIGITAL	INPUT
	33	UNUSED	DIGITAL	OUTPUT
	34	UNUSED	DIGITAL	OUTPUT
	35	UNUSED	DIGITAL	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
-B	1	MODULE GROUND	GROUND	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
+B	1	MODULE POWER	VBAT	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
U	1	MOTOR PHASE U	AC	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
V	1	MOTOR PHASE V	AC	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
W	1	MOTOR PHASE W	AC	OUTPUT

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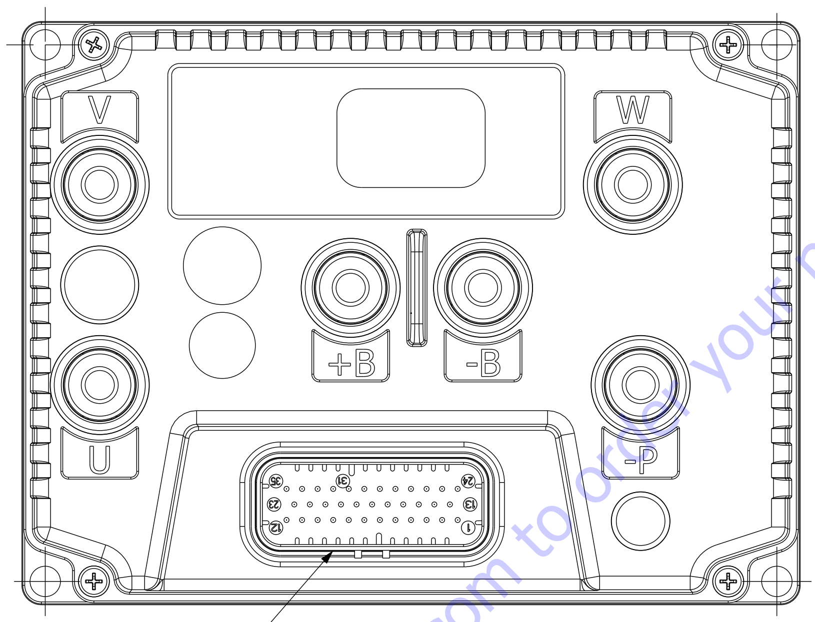
Figure 6-11. Power Module - LH



CONNECTOR	PIN	FUNCTION	TYPE	
J1	1	UNUSED	DIGITAL	INPUT
	2	ELECTRO BRAKE	DIGITAL	OUTPUT
	3	ELECTRO BRAKE SUPPLY (POS)	VBAT	INPUT
	4	ELECTRO BRAKE DRIVER (NEG)	PWM	OUTPUT
	5	WHEEL ENCODER GROUND	GROUND	INPUT
	6	MODULE ADDRESS	DIGITAL	INPUT
	7	UNUSED	DIGITAL	INPUT
	8	UNUSED	DIGITAL	OUTPUT
	9	UNUSED	DIGITAL	OUTPUT
	10	KEY SWITCH (IGNITION)	DIGITAL	INPUT
	11	UNUSED	DIGITAL	OUTPUT
	12	CONTACTOR DRIVER (MASTER)	PWM	OUTPUT
	13	WHEEL ENCODER PIN B	DIGITAL	INPUT
	14	WHEEL ENCODER PIN A	DIGITAL	INPUT
	15	STEERING ANGLE (MASTER)	ANALOG	INPUT
	16	CHARGER INTERLOCK (MASTER)	DIGITAL	INPUT
	17	UNUSED	DIGITAL	INPUT
	18	UNUSED	DIGITAL	INPUT
	19	UNUSED	DIGITAL	INPUT
	20	UNUSED	DIGITAL	INPUT
	21	UNUSED	DIGITAL	INPUT
	22	MOTOR THERMAL SENSOR	ANALOG	INPUT
	23	UNUSED	PWM	OUTPUT
	24	UNUSED	PWM	OUTPUT
	25	WHEEL ENCODER POWER (+5 VOLTS)	VOLTAGE	OUTPUT
	26	UNUSED	DIGITAL	OUTPUT
	27	CAN LOW	COMM	I/O
	28	CAN HIGH	COMM	I/O
	29	UNUSED	DIGITAL	INPUT
	30	UNUSED	ANALOG	INPUT
	31	UNUSED	DIGITAL	INPUT
	32	UNUSED	DIGITAL	INPUT
	33	UNUSED	DIGITAL	OUTPUT
	34	UNUSED	DIGITAL	OUTPUT
	35	UNUSED	DIGITAL	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
-B	1	MODULE GROUND	GROUND	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
+B	1	MODULE POWER	VBAT	INPUT

CONNECTOR	PIN	FUNCTION	TYPE	
-P	1	PUMP	PWM	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
U	1	MOTOR PHASE U	AC	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
V	1	MOTOR PHASE V	AC	OUTPUT

CONNECTOR	PIN	FUNCTION	TYPE	
W	1	MOTOR PHASE W	AC	OUTPUT

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Figure 6-12. Power Module - RH

Connector	Pin	Function	Type	
J1 (Natural)	1	UNUSED	DIGITAL	OUTPUT
	2	ALERT BEACON POWER	DIGITAL	OUTPUT
	3	UNUSED	DIGITAL	OUTPUT
	4	ALERT BEACON GROUND	GROUND	INPUT
	5	UNUSED	GROUND	INPUT
	6	UNUSED	DIGITAL	OUTPUT
	7	UNUSED	DIGITAL	OUTPUT
	8	UNUSED (GROUND)	GROUND	INPUT
	9	UNUSED (GROUND)	GROUND	INPUT
	10	UNUSED	DIGITAL	OUTPUT
	11	UNUSED	DIGITAL	OUTPUT
	12	UNUSED	DIGITAL	OUTPUT
	13	DRIVE ENABLE RELAY (VOTE)	DIGITAL	OUTPUT
	14	UNUSED	ANALOG	INPUT
	15	UNUSED	ANALOG	INPUT
	16	UNUSED	FREQUENCY	INPUT
	17	UNUSED	GROUND	INPUT
	18	UNUSED	GROUND	INPUT
	19	DRIVE ENABLE RELAY GROUND (VOTE)	GROUND	INPUT
	20	UNUSED	DIGITAL	OUTPUT
	21	UNUSED	DIGITAL	INPUT
	22	UNUSED	DIGITAL	OUTPUT
	23	UNUSED	DIGITAL	OUTPUT
	24	UNUSED	N/C	N/C
	25	UNUSED (RESERVED FOR RS-485 HIGH)	SERIAL	I/O
	26	UNUSED (RESERVED FOR RS-485 LOW)	SERIAL	I/O
	27	UNUSED (GROUND)	GROUND	INPUT
	28	ANALYZER POWER	VOLTAGE	OUTPUT
	29	ANALYZER RS-232 RX	SERIAL	INPUT
	30	ANALYZER RS-232 TX	SERIAL	OUTPUT
	31	ANALYZER GROUND	GROUND	INPUT
	32	UNUSED	DIGITAL	OUTPUT
	33	UNUSED (GROUND)	GROUND	INPUT
	34	UNUSED	DIGITAL	INPUT
	35	UNUSED	DIGITAL	INPUT

Connector	Pin	Function	Type	
J2 (Gray)	1	UNUSED	DIGITAL	OUTPUT
	2	UNUSED	DIGITAL	OUTPUT
	3	TELESCOPE IN SOLENOID	DIGITAL	OUTPUT
	4	JIB RIGHT SOLENOID	DIGITAL	OUTPUT
	5	PLATFORM LEVEL UP SOLENOID	DIGITAL	OUTPUT
	6	UNUSED	GROUND	INPUT
	7	PLATFORM LEVEL DOWN SOLENOID	DIGITAL	OUTPUT
	8	UNUSED	DIGITAL	OUTPUT
	9	TOWER LIFT DOWN SOLENOID	DIGITAL	OUTPUT
	10	PLATFORM ROTATE LEFT SOLENOID	DIGITAL	OUTPUT
	11	MAIN LIFT UP SOLENOID	DIGITAL	OUTPUT
	12	JIB UP SOLENOID	DIGITAL	OUTPUT
	13	UNUSED	DIGITAL	OUTPUT
	14	PLATFORM/JIB ROTATE SOLENOID GROUND	GROUND	INPUT
	15	TELESCOPE OUT SOLENOID	DIGITAL	OUTPUT
	16	SIDESWING LEFT SOLENOID	DIGITAL	OUTPUT
	17	TELESCOPE SOLENOID GROUND	GROUND	INPUT
	18	UNUSED	GROUND	INPUT
	19	UNUSED	DIGITAL	OUTPUT
	20	TOWER LIFT UP SOLENOID	DIGITAL	OUTPUT
	21	PLATFORM ROTATE RIGHT SOLENOID	DIGITAL	OUTPUT
	22	LIFT DOWN SOLENOID	DIGITAL	OUTPUT
	23	JIB DOWN SOLENOID	DIGITAL	OUTPUT
	24	UNUSED	DIGITAL	INPUT
	25	UNUSED	ANALOG	INPUT
	26	HEAD / TAIL LIGHT ENABLE RELAY	DIGITAL	OUTPUT
	27	GROUND ALARM OUTPUT	DIGITAL	OUTPUT
	28	STEER SOLENOID GROUND	GROUND	INPUT
	29	GROUND ALARM GROUND	GROUND	INPUT
	30	UNUSED	GROUND	INPUT
	31	FLOW CONTROL SOLENOID	DIGITAL	OUTPUT
	32	STEER RIGHT SOLENOID	DIGITAL	OUTPUT
	33	STEER LEFT SOLENOID	DIGITAL	OUTPUT
	34	SWING LEFT SOLENOID	DIGITAL	OUTPUT
	35	SWING RIGHT SOLENOID	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J3 (Black)	1	UNUSED	GROUND	INPUT
	2	MAIN LIFT CURRENT FEEDBACK (LSD CURRENT SENSE 2)	GROUND	INPUT
	3	UNUSED (GROUND)	GROUND	INPUT
	4	SWING CURRENT FEEDBACK (LSD CURRENT SENSE 4)	GROUND	INPUT
	5	TOWER LIFT CURRENT FEEDBACK (LSD CURRENT SENSE 5)	GROUND	INPUT
	6	FLOW CONTROL VALVE CURRENT FEEDBACK (LSD CURRENT SENSE 6)	GROUND	INPUT
	7	BATTERY VOLTAGE FOR GROUND ALARM	VBAT	OUTPUT
	8	UNUSED	DIGITAL	INPUT
	9	UNUSED	DIGITAL	INPUT
	10	UNUSED	DIGITAL	INPUT
	11	UNUSED	DIGITAL	INPUT
	12	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	13	UNUSED	ANALOG	INPUT
	14	UNUSED (LSD CURRENT SENSE 3)	GROUND	INPUT

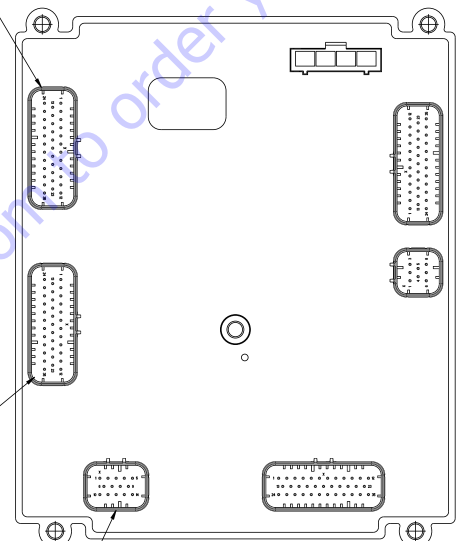

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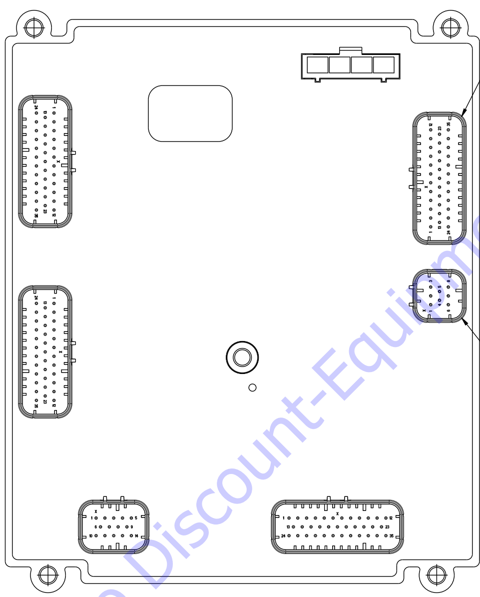
Figure 6-13. Ground Control Module - Sheet 1 of 3

Connector	Pin	Function	Type	
J7 (Black)	1	PLATFORM EMS	DIGITAL	INPUT
	2	PLATFORM MODE	DIGITAL	INPUT
	3	GROUND MODE	DIGITAL	INPUT
	4	UPPER BOOM ELEVATION SWITCH	ANALOG	INPUT
	5	UNUSED	VOLTAGE	OUTPUT
	6	CAN1 TERMINATOR	TERM	I/O
	7	LOWER BOOM ELEVATION SWITCH	ANALOG	INPUT
	8	UNUSED	ANALOG	INPUT
	9	UNUSED (GROUND)	GROUND	INPUT
	10	UNUSED (GROUND)	GROUND	INPUT
	11	DOS SWITCH	DIGITAL	INPUT
	12	UNUSED	DIGITAL	INPUT
	13	CAN1 HIGH	SERIAL	I/O
	14	GROUND MODE POWER TO PLATFORM	DIGITAL	INPUT
	15	FOOTSWITCH	DIGITAL	INPUT
	16	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	17	CAN1 TERMINATOR	TERM	I/O
	18	UNUSED (CAN1 SHIELD)	GROUND	INPUT
	19	UNUSED (GROUND)	GROUND	INPUT
	20	UNUSED	ANALOG	INPUT
	21	UNUSED	DIGITAL	INPUT
	22	UNUSED	DIGITAL	INPUT
	23	UNUSED	DIGITAL	INPUT
	24	CAN1 LOW	SERIAL	I/O
	25	TILT SENSOR GROUND	GROUND	INPUT
	26	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	27	UNUSED (+5 VOLTS)	VOLTAGE	OUTPUT
	28	UNUSED	GROUND	INPUT
	29	BATTERY VOLTAGE FOR TILT SENSOR	VBAT	OUTPUT
	30	BATTERY VOLTAGE FOR BOOM LIMIT SWITCH	VBAT	OUTPUT
	31	UNUSED	VBAT	OUTPUT
	32	DOSSWITCH POWER	VBAT	OUTPUT
	33	UNUSED	VBAT	OUTPUT
	34	UNUSED	VBAT	OUTPUT
	35	UNUSED	DIGITAL	INPUT

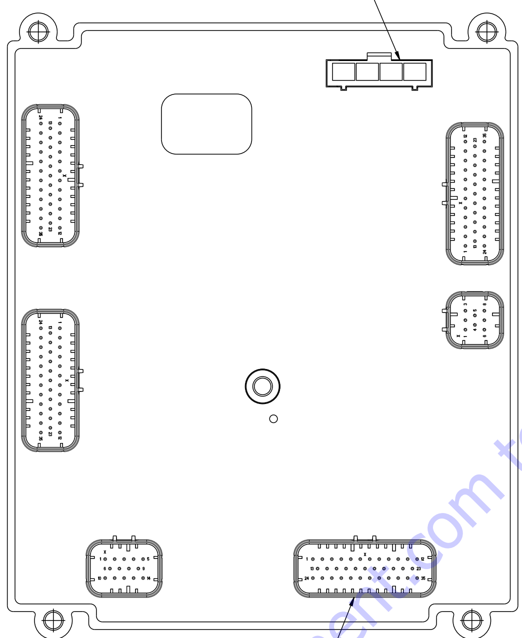


Connector	Pin	Function	Type	
J12 (Blue)	1	UNUSED	FREQUENCY	INPUT
	2	UNUSED	FREQUENCY	INPUT
	3	CAN2 HIGH (ISOLATED)	SERIAL	I/O
	4	CAN2 LOW (ISOLATED)	SERIAL	I/O
	5	CAN2 SHIELD (ISOLATED)	GROUND	INPUT
	6	UNUSED	TERM	I/O
	7	UNUSED	TERM	I/O
	8	MSSO	DIGITAL	INPUT

1001182700 R

Figure 6-14. Ground Control Module - Sheet 2 of 3

Connector	Pin	Function	Type	
J8 (Black)	1	MODULE GROUND / GROUND FROM BATTERY	GROUND	OUTPUT
	2	MODULE POWER / GROUND EMS	VBAT	INPUT
	3	GROUND TO PLATFORM MODULE	GROUND	INPUT
	4	POWER TO PLATFORM MODULE / GROUND EMS OUT TO PLATFORM	VBAT	OUTPUT



Connector	Pin	Function	Type	
J4 (Blue)	1	UNUSED	DIGITAL	OUTPUT
	2	UNUSED	DIGITAL	OUTPUT
	3	UNUSED	DIGITAL	OUTPUT
	4	UNUSED	DIGITAL	INPUT
	5	PLATFORM LEVEL DOWN	DIGITAL	INPUT
	6	PLATFORM ROTATE LEFT	DIGITAL	INPUT
	7	MAIN TELESCOPE IN	DIGITAL	INPUT
	8	JIB DOWN	DIGITAL	INPUT
	9	JIB LEFT	DIGITAL	INPUT
	10	TOWER LIFT UP	DIGITAL	INPUT
	11	UNUSED	DIGITAL	INPUT
	12	UNUSED	DIGITAL	OUTPUT
	13	UNUSED	DIGITAL	OUTPUT
	14	PLATFORM OVERLOADED INDICATOR	DIGITAL	OUTPUT
	15	UNUSED	DIGITAL	OUTPUT
	16	AUXILIARY POWER / FUNCTION ENABLE	DIGITAL	INPUT
	17	PLATFORM LEVEL UP	DIGITAL	INPUT
	18	PLATFORM ROTATE RIGHT	DIGITAL	INPUT
	19	JIB UP	DIGITAL	INPUT
	20	JIB RIGHT	DIGITAL	INPUT
	21	TOWER LIFT DOWN	DIGITAL	INPUT
	22	UNUSED	DIGITAL	INPUT
	23	MAIN LIFT UP	DIGITAL	INPUT
	24	BATTERY VOLTAGE FOR MDI	VBAT	OUTPUT
	25	BATTERY VOLTAGE FOR SWITCHES	VBAT	OUTPUT
	26	UNUSED	DIGITAL	OUTPUT
	27	UNUSED	DIGITAL	OUTPUT
	28	UNUSED	DIGITAL	OUTPUT
	29	UNUSED	DIGITAL	OUTPUT
	30	TELESCOPE OUT	DIGITAL	INPUT
	31	LAMP GROUND	GROUND	INPUT
	32	MDI GROUND	GROUND	INPUT
	33	MAIN LIFT DOWN	DIGITAL	INPUT
	34	SWING LEFT	DIGITAL	INPUT
	35	SWING RIGHT	DIGITAL	INPUT

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Figure 6-15. Ground Control Module - Sheet 3 of 3

Table 6-6. Machine Setup Descriptions

MODEL NUMBER...	Displays/adjusts machine model NOTE: all personalities reset to default when model number is altered
TILT...	Displays/adjusts tilt sensor function
DRIVE CUTOUT...	Displays/adjusts drive cutout switch presence/ function
FUNCTION CUTOUT...	Displays/adjusts function cutout switch presence/function
JIB…	Displays/adjusts jib presence
GROUND ALARM...	Displays/adjusts ground alarm presence/ function

Help Descriptions and Fault Flash Codes

Table 6-7. JLG Control System Flash Codes

Code	Description
2-1	Faulty Footswitch/EMS
2-2	Drive/Steer inputs/Footswitch Interlocks
2-3	Boom function inputs/Lift-Swing Joystick
2-5	Function Cutout/Drive Cutout
3-1	Contactors miswired/Motors miswired
3-2	Line contactor welded
3-3	Contactor short circuit or valve short circuit
4-2	Controller Overtemperature
4-4	Battery voltage out of range
6-6	CANbus inputs
7-7	Traction /Pump motor wiring or motor faulty
9-9	Problem with Controller

Analyzer Diagnostics Menu Structure

In the following structure descriptions, an intended item is selected by pressing ENTER; pressing ESCAPE steps back to the next outer level. The LEFT or RIGHT arrow keys move between items in the same level. The UP or DOWN arrow keys alter a value if allowed.

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
DRIVE/STEER [Platform Mode =True]	DRIVE DEMAND	FORWARD/REVERSE XXX%	Direction and calibrated Control System Command percentage
	DRIVE OUTPUT	FORWARD/REVERSE XXX%	UGM direction and output speed command
	DRIVE MODE	MAX SPEED/REDUCED SPEED	Drive Mode status
	STEER DEMAND	LEFT/RIGHT XXX%	Direction and percentage of input command from Drive/Steer Joystick
	STEER OUTPUT	LEFT/RIGHT XXX%	UGM directional valve output status
	STEER SENSOR	VOLTAGE XX.XXV	Steer sensor raw voltage reported by MTM
	STEER SENSOR	ANGLE XX.XDEG	Steer sensor angle reported by MTM
	DRV ORIENT MODE	INLINE/SWUNG	State of DOS switch (prox energized when in line to close normally open contacts)
	DRV ORIENT STATE	CONFIRMED/REQUIRED	InLine and DOS Active = Confirmed
	DRV ORNT OVR SW	CLOSED/OPEN	State of Drive Orientation Override Switch
BOOM FUNCTIONS	SWING DEMAND	LEFT/RIGHT XXX%	Direction and percentage of input command from Swing Joystick or Ground %
	SWING OUTPUT	LEFT/RIGHT XXX%	Direction and valve PWM output percentage
	TWR LIFT DEMAND	UP/DOWN XXX%	Direction and percentage of input command from Function Speed Pot or Ground %
	TWR LIFT OUTPUT	UP/DOWN XXX%	Direction and valve PWM output percentage
	LIFT DEMAND	UP/DOWN XXX%	Direction and percentage of Lift input command
	LIFT OUTPUT	UP/DOWN XXX%	Direction and valve PWM output percentage
	TELE DEMAND	IN/OUT XXX%/CREEP	Direction and percentage of input command (or CREEP if applicable) from Function Speed Pot or Ground%
	TELE OUTPUT	IN/OUT/OFF	Direction/state of Tele directional valve
	JIB LIFT DEMAND	UP/DOWN XXX%/CREEP	Direction and percentage of input command (or CREEP if applicable) from Function Speed Pot or Ground% [Machine SetUP -> JIB -> YES]
	JIB LIFT OUTPUT	UP/OFF/DOWN XXX%	Direction for Up, but % command for Down [Machine SetUP -> JIB -> YES]
	JIB SWING DEMAND	LEFT/RIGHT XXX%/CREEP	Direction and percentage of input command (or CREEP if applicable) from Function Speed Pot or Ground% [Machine SetUP -> JIB SWING -> YES]
	JIB SWING OUTPUT	LEFT/RIGHT XXX%	Direction for Left, but % command for Right [Machine SetUP -> JIB SWING -> YES]

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	PLAT LVL DEMAND	UP/DOWN XXX%/CREEP	Direction and percentage of input command (or CREEP if applicable) from Function Speed Pot or Ground%
	PLAT LVL OUTPUT	UP/DOWN XXX%	Direction/state of Level directional valve
	PLAT ROT DEMAND	LEFT/RIGHT XXX%/CREEP	Direction and percentage of input command (or CREEP if applicable) from Function Speed Pot or Ground%
	PLAT ROT OUTPUT	LEFT/RIGHT XXX%	Direction/state of Rotate directional valve
	PUMP SPEED CMD	XXX%	UGM pump command value: 0-100%
	PUMP SPEED FDBK	XXX%	Pump PWM reported from MTM
	PUMP CURRENT	FDBK: XXXA	Pump current reported from MTM
	PUMP ENABLE	ON/OFF	UGM pump enable bit status
	PUMP OP MODE	OFF/RUNNING	Pump status from MTM
	FUNCTION SPEED [Platform Mode = True]	SETTING: XXX%	Displays the percentage demand from the Function Speed Potentiometer.
	CREEP SW [Platform Mode = True]	OPEN/CLOSED	Status of Creep Switch Input
	CREEP MODE	ON/OFF	Displays status of Creep Mode
	FLOW CONTRL VLV	XXX%	Duty cycle of flow control proportional valve
SYSTEM	MAIN CONTACTOR	ENABLED/DISABLED	Status of Main Contactor reported by Zapi module
	MAIN CONT VOTE	ENABLED/DISABLED	Status of Main Contactor voting relay by UGM
	CHASSIS TILT	XX.XDEG	Combined X/Y Absolute Angle
	CHASSIS TILT	X-AXIS: XX.XDEG	X Angle with respect to sign
	CHASSIS TILT	Y-AXIS: XX.XDEG	Y Angle with respect to sign
	UGM AMBIENT TEMP	XXXC/XXXF	Ambient Temperature Sensor Reading from on-board UGM Sensor
	LOW AMBIENT TEMP	XXXC/XXXF	Low Temp Cutout Sensor Ambient Temperature sensor Reading [MACHINE SETUP ' TEMP CUTOUT = YES
	LOW TEMPERATURE	CUTOUT: ACTIVE/INACTIVE/FAULTY	Status of Low Temperature Cutout; Only displayed if MACHINE SETUP→TEMP CUTOUT = YES
	MSSO	ACTIVE/INACTIVE	Status of MSSO [MACHINE SETUP'MARKET=CE and Operating Mode=Ground]

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
SYSTEM INPUTS	BOOM ELEV SW	OPEN/CLOSED	State of Boom Elevation Switch #1
	TOWER ELEV SW	OPEN/CLOSED	State of Boom Elevation Switch #2
	ELEVATION MODE	ABOVE/NOT ABOVE	Elevation State
	TRANSPORT MODE	IN TRANSPORT/OUT OF TRANSPORT	Transport Position
	CREEP SW	OPEN/CLOSED	Status of Creep Switch Input
	CREEP MODE	ON/OFF	Displays status of Creep Mode
	GROUND SELECT	KEYSWITCH: OPEN	Displays whether Ground Keyswitch position is being selected
		KEYSWITCH: CLOSED	
	PLATFORM SELECT	KEYSWITCH: OPEN	Displays whether Platform Keyswitch position is being selected
		KEYSWITCH: CLOSED	
	STATION CONTROL	GROUND/PLATFORM	Displays Active control station per System Mode definition
	FOOTSWITCH INPUT	GROUND: OPEN	State of Footswitch input at UGM (Open with Footswitch is not activated).
		GROUND: CLOSED	
	FOOTSWITCH INPUT	PLATFORM: CLOSED	State of Footswitch input at PM (Closed when footswitch not activated).
		PLATFORM: OPEN	
TRACTION	RIGHT MOTOR	FREQ XXX.X Hz	Motor drive frequency reported by associated PM
	LEFT MOTOR	FREQ XXX.X Hz	Motor drive frequency reported by associated PM
	RIGHT MOTOR	SPEED XXX RPM	Motor encoder speed reported by associated PM
	LEFT MOTOR	SPEED XXX RPM	Motor encoder speed reported by associated PM
	RIGHT MOTOR	OFF/REGEN/DRIVE/MOTOR BRAKE/ PARKING BRAKE	Traction mode status as reported by associated PM
	LEFT MOTOR	OFF/REGEN/DRIVE/MOTOR BRAKE/ PARKING BRAKE	Traction mode status as reported by associated PM
	RIGHT MOTOR	CURRENT XXXA	ACrms Motor current reported by associated PM; display in Platform Mode only
	LEFT MOTOR	CURRENT XXXA	ACrms Motor current reported by associated PM; display in Platform Mode only
	RIGHT MOTOR	TEMP XXXC/F	Module temperature reported by PM; display in Platform Mode only
	LEFT MOTOR	TEMP XXXC/F	Module temperature reported by PM; display in Platform Mode only
	RIGHT BRAKE	APPLIED/RELEASED	Brake status reported by associated PM
	LEFT BRAKE	APPLIED/RELEASED	Brake status reported by associated PM
	RIGHT MODULE	TEMP XXXC/F	Module temperature reported by PM; display in Platform Mode only
	LEFT MODULE	TEMP XXXC/F	Module temperature reported by PM; display in Platform Mode only

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
VOLTAGE/CUR	BATTERY SOC	XXX%/DISCHARGED/DEEP DISCHARGED	UGM calculated battery State-of-Charge; display percentage unless Discharged or Deeply Discharged
	BATTERY VOLTAGE	XX.XXV	UGM computed Vbat from MTM with compensation for voltage drop
	BATTERY CURRENT	XXXA	
	RIGHT SYSTEM	VOLTAGE XX.XXV	Real time system voltage reported by associated PM and compensated by UGM; not SOC
	LEFT SYSTEM	VOLTAGE XX.XXV	Real time system voltage reported by associated PM and compensated by UGM; not SOC
	UGM CONTROL	VOLTAGE XX.XV	UGM measured system control voltage
	PLATFORM MODULE	VOLTAGE XX.XV	Platform Module reported battery voltage measurement
	AC CHARGER	CONNECTED/NOT CONNECTED	Reflect status of charger connectivity reported by MTM
OPER CONTROLS	JOYSTICK DRIVE	FORWARD/REVERSE XXX%	Drive Joystick drive direction and command percentage as reported from PM [Platform Mode = TRUE]
	JOYSTICK STEER	LEFT/RIGHT XXX%	Drive Joystick steer direction and percentage command as reported from PM [Platform Mode = TRUE]
	JOYSTICK SWING	LEFT/RIGHT XXX%	Lift/Swing Joystick Swing direction and percentage command as reported from PM [Platform Mode = TRUE]
	JOYSTICK LIFT	UP/DOWN XXX%	Lift/Swing Joystick Lift direction and percentage command as reported from PM [Platform Mode = TRUE]
	DRV ORNT OVR SW	CLOSED/OPEN	State of Drive Orientation Override Switch [Platform Mode = TRUE]
	ENABLE	OPEN/CLOSED	Status of FUNCTION ENABLE Toggle Switch Input [Ground Mode = TRUE]
	SWING LEFT SW	OPEN/CLOSED	Status of Ground Toggle Switch Input [Ground Mode = TRUE]
	SWING RIGHT SW	OPEN/CLOSED	Status of Ground Toggle Switch Input [Ground Mode = TRUE]
	TOWER LIFT UP SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	TOWER LIFT DN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	LIFT UP SW	OPEN/CLOSED	Status of Ground Toggle Switch Input [Ground Mode = TRUE]
	LIFT DN SW	OPEN/CLOSED	Status of Ground Toggle Switch Input [Ground Mode = TRUE]
	TELE IN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	TELE OUT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1^{st} Line)	Parameter (Displayed on Analyzer 1^{st} Line)	Parameter Value (Displayed on Analyzer 2^{nd} Line)	Description
	JIB LIFT UP SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input [MACHINE SETUP ' Jib = YES]
	JIB LIFT DN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input [MACHINE SETUP ' Jib = YES]
	JIB SWING LT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input [MACHINE SETUP ' Jib Swing = YES]
	JIB SWING RT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input [MACHINE SETUP ' Jib Swing = YES]
	PLAT LEVEL UP SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT LEVEL DN SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT ROT LEFT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	PLAT ROT RGHT SW	OPEN/CLOSED	Status of Ground/Platform Toggle Switch Input
	MAX SPEED SW	OPEN/CLOSED	Status of Platform Toggle Switch Input [Platform Mode = TRUE]
	CREEP SW	OPEN/CLOSED	Status of Creep Switch Input [Platform Mode = TRUE]
	HORN SW	OPEN/CLOSED	Status of Platform Switch Input [Platform Mode = TRUE]
	SG OVERRIDE SW	OPEN/CLOSED	Status of Platform SkyGuard Override Switch Input if MACHINE SETUP →SKYGUARD = YES
	MSSO SW	OPEN/CLOSED	Status of MSSO switch; [MACHINE SETUP'MARKET=CE and Ground mode = TRUE]
OPTIONS	H&T LIGHTS SW	OPEN/CLOSED	Status of Platform Toggle Switch Input [Platform Mode = TRUE and MACHINE SETUP ' H&T LIGHTS = YES]
	H&T LIGHTS OUT	ON/OFF	UGM Nite Brite Relay Enable output [Platform Mode = TRUE and MACHINE SETUP ' H&T LIGHTS = YES]
	SKYGUARD INPUTS	OPEN/CLOSED/DISAGREE	SkyGuard Input #1 (PLT J7-18) AND SkyGuard Input #2 (PLT J1-23) state [Platform Mode = TRUE and MACHINE SETUP ' SKYGUARD ? NO]
	SKYGUARD INPUT 1	OPEN/CLOSED	State of SkyGuard Platform Input #1 (J7-18); relay NC contacts - closed when active [Platform Mode = true and MACHINE SETUP ' SKYGUARD ? NO]
	SKYGUARD INPUT 2	OPEN/CLOSED	State of SkyGuard Platform Input #2 (J1-23); relay NC contacts - closed when active [Platform Mode= TRUE and MACHINE SETUP ' SKYGUARD ? NO]
	SOFTTOUCH INPUT	OPEN/CLOSED	State of softtouch input (Platform input J1-20) [MACHINE SETUP ' SOFTTOUCH = YES]

Table 6-8. DIAGNOSTICS - Menu Descriptions

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 1st Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
PLATFORM LOAD (DISPLAY ONLY IF MACHINE SETUP→ LOAD SYSTEM ≠ NO)	PLATFORM LOAD	STATE: OK/OVER LOAD	LSS Status
	PLATFORM LOAD	ACTUAL: XXX.XKG	Actual measured weight
	PLATFORM LOAD	GROSS: XXX.XKG	Combined weight of all cells; accounting for sign.
	PLATFORM LOAD	OFFSET: XXX.XKG	Tare weight of Platform Empty
	PLATFORM LOAD	ACC'Y XXX.XKG	Stored Accessory weight; visible only if Accessory recognized
	PLATFORM LOAD	CELL 1: XXX.XKG	Gross weight reading of Cell 1
	PLATFORM LOAD	CELL 2: XXX.XKG	Gross weight reading of Cell 2
	PLATFORM LOAD	CELL 3: XXX.XKG	Gross weight reading of Cell 3
	PLATFORM LOAD	CELL 4: XXX.XKG	Gross weight reading of Cell 4
CAN STATISTICS	CAN 1 STATISTICS	RX/SEC: XXX	
	CAN 1 STATISTICS	TX/SEC: XXX	
	CAN 1 STATISTICS	BUS OFF: XXX	
	CAN 1 STATISTICS	PASSIVE: XXX	
	CAN 1 STATISTICS	MSG ERROR: XXXX	
	CAN 2 STATISTICS	RX/SEC: XXX	
	CAN 2 STATISTICS	TX/SEC: XXX	
	CAN 2 STATISTICS	BUS OFF: XXX	
	CAN 2 STATISTICS	PASSIVE: XXX	
	CAN 2 STATISTICS	MSG ERROR: XXXX	

System Self Test

The system self test is utilized to locate typical problems. See Table 6-9, System Test Descriptions and Table 6-10, System Test Messages for information concerning the tests performed and available messages in this mode.

1. When the key switch is in the platform position and the self test enabled, the self test function will test all valves, contactors, platform inputs, indicator lamps, and system alarms for various fault conditions.

   When the key switch is in the ground position, the self test function will test all valves, the line contactor, ground control inputs, and the ground alarm output for various fault conditions.

2. In order to test the inputs on the machine, the controller will ask the service technician to perform various tasks at the appropriate operator control station. An example of this is "Close LLU Switch". The controller expects the operator to close the lower lift up switch. When the controller sees that the lower lift up switch has been closed, it will move on to the next input, lower lift down LLD. If the switch is faulty or the wiring is faulty, the controller will not move on to the next input. The controller will continue to wait for the closure of the input. If the operator knows the switch is faulty and wants to continue the tests he must simply press the enter key on the analyzer to continue.

3. After the controller has conducted the tests from the chosen operator station, it will display "TESTS COMPLETE". This indicates that the controller has checked all inputs and outputs for that station.

NOTICE

IN ORDER FOR THE MACHINE TO FUNCTION AFTER THE SELF TEST IS COMPLETE, POWER MUST BE RECYCLED USING THE EMS OR THE KEY SWITCH.

Table 6-9. System Test Descriptions

RUN SYSTEM TEST	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 is found, to confirm that the fault has been noted and to continue the system test. ***NOTE:*** *A flashing message is critical, and prevents the system test running*
ACTIVATE YES:ENTER, NO:ESC	Not available once tests are activated ENTER activates system tests ***NOTE:*** *Cannot be done while controller is in use (footswitch closed) and for a short time afterwards*

Table 6-10. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
RUNNING		Initial display when system test is run while running certain "critical" checks are made.
	CHECK GROUND/ PLATFORM SELECT	The analyzer must be connected to the active control station to run the system test
	CHECK CAN WIRING	The system test cannot run unless the CAN Bus is operating properly
	BATTERY VOLTAGE TOO LOW	The system test cannot run with MTM-reported battery voltage below 39.5V (not UGM-compensated value)
	BATTERY VOLTAGE TOO HIGH	The system test cannot run with the MTM-reported battery voltage above 65V
	CHECK SPEED	Reported vehicle speed must = 0 Hz (or mph)
	HIGH TILT ANGLE	The vehicle is tilted > 3° or the tilt sensor if faulty
	OPEN FOOTSWITCH	In platform mode, the footswitch must be open at the start of the test.
	CLOSE FOOTSWITCH	In platform mode, the operator must close the footswitch when this message is displayed
	BAD FOOTSWITCH	The two footswitch signals are not changing together, probably because one is open circuit. Check footswitch and wiring.
	OPEN FOOTSWITCH	In platform mode, the operator must open the footswitch when this message is displayed.
	PLATFORM OVERLOADED	Load Sensing is configured and the ground module considers the platform to be overloaded
TESTING VALVES	CLOSE FOOTSWITCH	*Check for Footswitch closed
	OPEN FOOTSWITCH	*Wait for Footswitch to open
	PRESS AND HOLD FOOTSWITCH	*The operator must engage and hold the footswitch for the next batch of tests to be successful. This is due to the hardware high side driver cutout in the ground module
	OPEN FOOTSWITCH	*Wait for Footswitch to open the advance
	FLOW CTRL VALVE	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	STEER RIGHT	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay
	STEER LEFT	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	SWING LEFT	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	SWING RIGHT	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	LIFT UP	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	LIFT DOWN	SHORT TO BATTERY or OPEN-CIRCUIT; or SHORT TO GROUND (or advance test after short delay) do not energize for E300
	TELESCOPE OUT	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	TELESCOPE IN	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	TOWER UP (E300)	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	TOWER DOWN (E300)	SHORT TO BATTERY or OPEN-CIRCUIT; or SHORT TO GROUND (or advance test after short delay). do not energize for E300
	JIB UP	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	JIB DOWN	SHORT TO BATTERY or OPEN-CIRCUIT (or advance test after short delay)
	JIB LT VALVE	SHORT TO BATTERY or OPEN-CIRCUIT (or advance test after short delay)
	JIB RT VALVE	SHORT TO BATTERY or OPEN-CIRCUIT (or advance test after short delay)
	PLATFORM LT VALVE	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)

Table 6-10. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
	PLATFORM RT VALVE	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	PLATFORM LEVEL UP	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	PLATFORM LEVEL DOWN	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay)
	HEAD/TAIL LIGHTS	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay); displayed if the head/tail light option is configured.
	VOTE RELAY	SHORT TO BATTERY or OPEN-CIRCUIT or SHORT TO GROUND (or advance test after short delay); displayed if the head/tail light option is configured.
CHECKING PLATFORM INPUTS	DRIVE MAX SPEED	OPEN or CLOSED (advance after switch closed to open)
	DRIVE REDUCED SPEED	OPEN or CLOSED (advance after switch closed to open)
	CL PLATFORM UP	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM UP	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM DOWN	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM DOWN	OPEN or CLOSED (advanced test after switch toggles)
	LIFT JOYSTICK TO UP MAX	(wait for joystick to reach +100% then advance)
	LIFT JOYSTICK TO DOWN MAX	(wait for joystick to reach -100% then advance)
	SWING JOYSTICK TO LEFT MAX	(wait for joystick to reach -100% then advance)
	SWING JOYSTICK TO RIGHT MAX	(wait for joystick to reach +100% then advance)
	CREEP SWITCH CCW	OPEN or CLOSED (advanced test after switch toggles)
	CREEP SWITCH CW	OPEN or CLOSED (advanced test after switch toggles)
	FUNC SPD TO MAX	
	FUNC SPD TO MIN	
	CL HORN	OPEN or CLOSED (advanced test after switch toggles)
	OP HORN	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM RGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM RGHT	OPEN or CLOSED (advanced test after switch toggles)
	CL TOWER UP	OPEN or CLOSED (advanced test after switch toggles) (E300)
	OP TOWER UP	OPEN or CLOSED (advanced test after switch toggles) (E300)
	CL TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E300)
	OP TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles) (E300)
	CL JIB UP	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB UP	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB DOWN	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB DOWN	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	CL TELE IN	OPEN or CLOSED (advanced test after switch toggles)

Table 6-10. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
	OP TELE IN	OPEN or CLOSED (advanced test after switch toggles)
	CL TELE OUT	OPEN or CLOSED (advanced test after switch toggles)
	OP TELE OUT	OPEN or CLOSED (advanced test after switch toggles)
	CL DRIVE ORIENT	OPEN or CLOSED (advanced test after switch toggles)
	OP DRIVE ORIENT	OPEN or CLOSED (advanced test after switch toggles)
	DRIVE JOYSTICK TO FORWARD MAX	(wait for joystick to reach +100% then advance)
	DRIVE JOYSTICK TO BACK MAX	(wait for joystick to reach -100% then advance)
	STEER TO LEFT MAX	OPEN or CLOSED (advanced test after switch toggles)
	STEER TO RIGHT MAX	OPEN or CLOSED (advanced test after switch toggles)
	CL HEADLIGHT SWITCH	OPEN or CLOSED (advanced test after switch toggles)
	OP HEADLIGHT SWITCH	OPEN or CLOSED (advanced test after switch toggles)
	CL SKYGUARD OVR	OPEN or CLOSED (advanced test after switch toggles); display on if MACHINE SETUP ' SKYGUARD = YES
	OP SKYGUARD OVR	OPEN or CLOSED (advanced test after switch toggles); display on if MACHINE SETUP ' SKYGUARD = YES
	ENGAGE SKYGUARD	SkyGuard bar pressed; SkyGuard inputs #1 and #2 must both change to low state for passing condition; display on if MACHINE SETUP ' SKYGUARD = YES
	RELEASE SKYGUARD	Both SkyGuard inputs must change to high; display on if MACHINE SETUP ' SKYGUARD = YES
	ENGAGE SOFTTOUCH	OPEN or CLOSED (advanced test after switch toggles); display on if MACHINE SETUP ' SOFTTOUCH = YES
	RELEASE SOFTTOUCH	OPEN or CLOSED (advanced test after switch toggles); display on if MACHINE SETUP ' SOFTTOUCH= YES
CHECKING GROUND INPUTS	CL SWING RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP SWING RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	CL SWING LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP SWING LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL TOWER UP	OPEN or CLOSED (advanced test after switch toggles)
	OP TOWER UP	OPEN or CLOSED (advanced test after switch toggles)
	CL TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles)
	OP TOWER DOWN	OPEN or CLOSED (advanced test after switch toggles)
	CL LIFT UP	OPEN or CLOSED (advanced test after switch toggles)
	OP LIFT UP	OPEN or CLOSED (advanced test after switch toggles)
	CL LIFT DOWN	OPEN or CLOSED (advanced test after switch toggles)
	OP LIFT DOWN	OPEN or CLOSED (advanced test after switch toggles)
	CL TELE OUT	OPEN or CLOSED (advanced test after switch toggles)
	OP TELE OUT	OPEN or CLOSED (advanced test after switch toggles)
	CL TELE IN	OPEN or CLOSED (advanced test after switch toggles)
	OP TELE IN	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB UP	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB UP	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB DOWN	OPEN or CLOSED (advanced test after switch toggles)

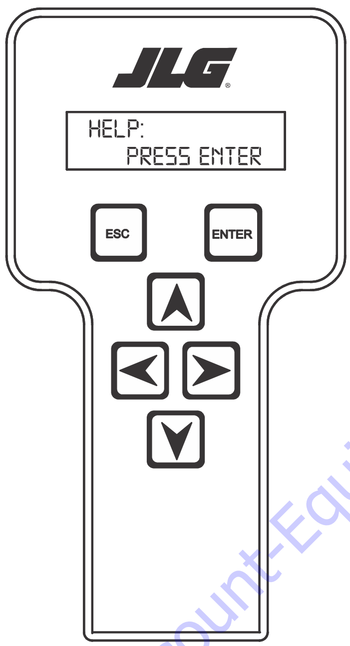
Table 6-10. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
	OP JIB DOWN	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB SWING LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB SWING LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL JIB SWING RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP JIB SWING RIGHT	OPEN or CLOSED (advanced test after switch toggles)
	CL PATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM LEFT	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM RGHT	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM RGHT	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM UP	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM UP	OPEN or CLOSED (advanced test after switch toggles)
	CL PLATFORM DOWN	OPEN or CLOSED (advanced test after switch toggles)
	OP PLATFORM DOWN	OPEN or CLOSED (advanced test after switch toggles)
	CL FUNC ENABLE	OPEN or CLOSED (advanced test after switch toggles)
	OP FUNC ENABLE	OPEN or CLOSED (advanced test after switch toggles)
	CL MSSO SWITCH	OPEN or CLOSED (advanced test after switch toggles); display only if MACHINE SETUP ' MARKET = CE
	OP MSSO SWITCH	OPEN or CLOSED (advanced test after switch toggles); display only if MACHINE SETUP ' MARKET = CE
TESTING PLATFORM LAMPS	BAT FULL LAMP ON	
	BAT 3/4 LAMP ON	
	BAT 1/2 LAMP ON	
	BAT 1/4 LAMP ON	
	LOW BATTERY	
	ENABLE LAMP ON	
	CREEP LAMP ON	
	DISTRESS LAMP ON	
	TILT LAMP ON	
	OVERLOAD LAMP ON	Display only if LSS configured
	DRIVE ORIENTATION LAMP ON	
	SKYGUARD LAMP ON	Display on if SkyGuard configured
	SOFTTOUCH	Display if Soft Touch configured
	PLAT ALARM ON	
	HORN ON	
TESTING GROUND LAMPS	OVERLOAD LAMP ON	Display only if MACHINE SETUP ' MARKET = CE
	ALERT BEACON	Display only if MACHINE SETUP-> ALERT BEACON = 20FPM FOR CREEP
TESTS COMPLETE		Indicates that the system test is complete. Any problems reported should have been noted and should now be rectified. Press ESC/CANCEL to return to the RUN SYSTEM TEST Analyzer menu.

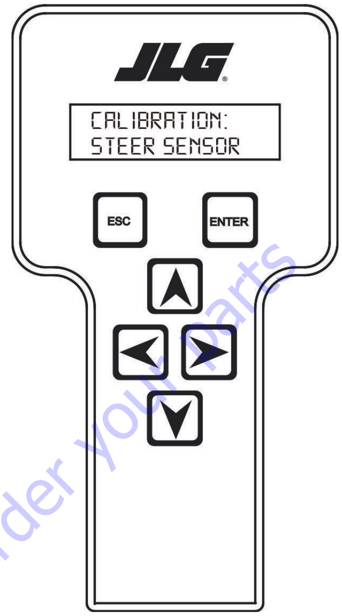
6.4 CALIBRATING STEER

When calibrating steering, each individual wheel must be calibrated in order to make the tire and wheel parallel with the frame. Two methods to help ensure proper calibration are the use of a carpenter's square to square the spindle to the axle or aligning the two wheels on one side using a stretched string.

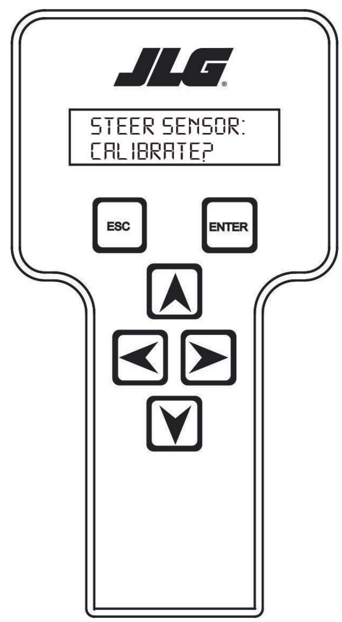
1. Position the Platform/Ground select switch to the Platform position.
2. Plug the analyzer into the connector at the base of the platform control box.
3. Pull out the Emergency Stop switch and Start the engine.
4. The analyzer screen should read:



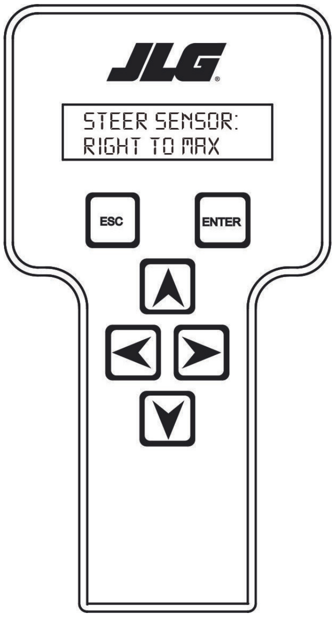
5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.
8. Use the arrow keys to reach STEER SENSOR. The screen will read:



9. Hit Enter. The screen will read:



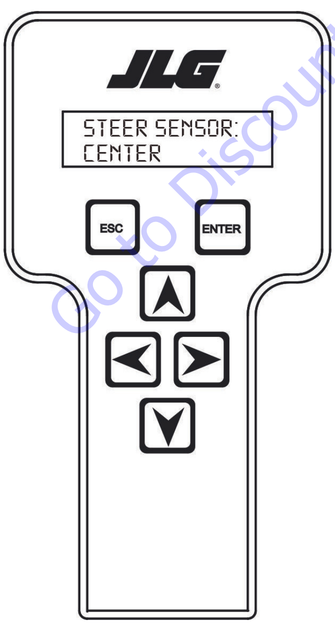
10. Hit Enter. The screen will read:



11. Activate the steer control until the tire and wheel are straight in relationship with the chassis, then leave off the control. The display will read Right Steer Maximum value.

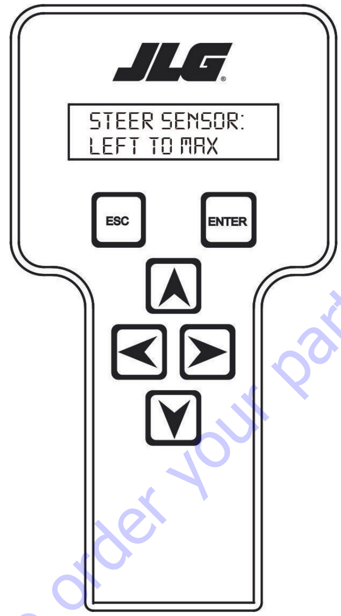
12. Hit Enter. The screen will read:

NOTE: *It's important that the tires are pointed as straight as possible. This will allow Max Drive Speed, longer run times and reduced motor and controller heat.*



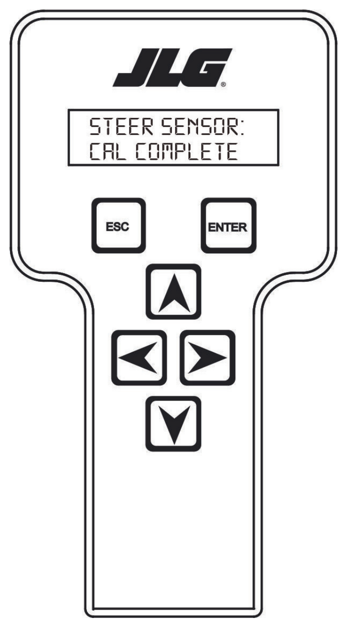
13. The display will read steering Center position value.

14. Hit Enter. The screen will read:



15. The display will read Left Steer Maximum value.

16. Hit Enter. The screen will read:



17. After completing all the Steer Calibrations, hit ESC twice to go back to CALIBRATIONS.

6.5 CALIBRATING TILT SENSOR

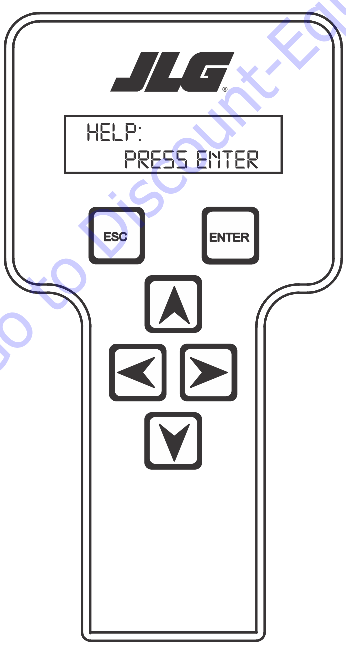
NOTICE

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE-FOLLOWING PROCEDURE IS PERFORMED.

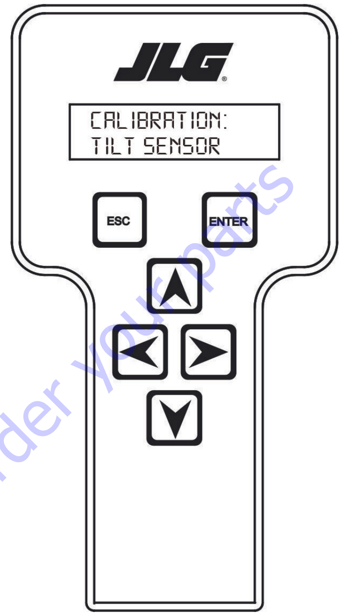
⚠ WARNING

DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.

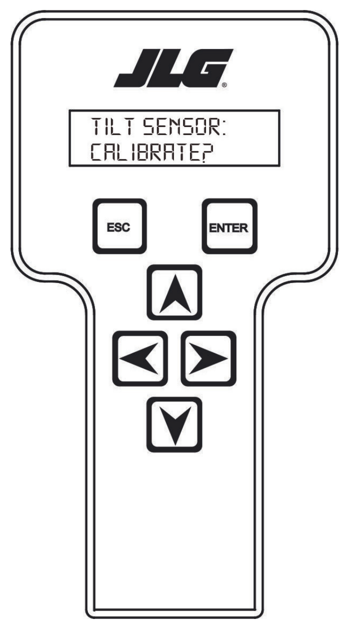
1. Use the following procedure to calibrate the tilt sensor.
2. Before the tilt sensor can be calibrated, the following conditions must be met:
    a. Steering previously calibrated.
    b. Wheels straight.
    c. Turntable centered.
    d. Boom fully retracted.
    e. Boom angle is less than 45°.
    f. Machine on firm, level ground.
3. Position the Platform/Ground select switch to the Platform position.
4. Plug the analyzer into the connector inside the Ground control box.
5. Pull out the Emergency Stop switch and Start the engine.
6. The analyzer screen should read:



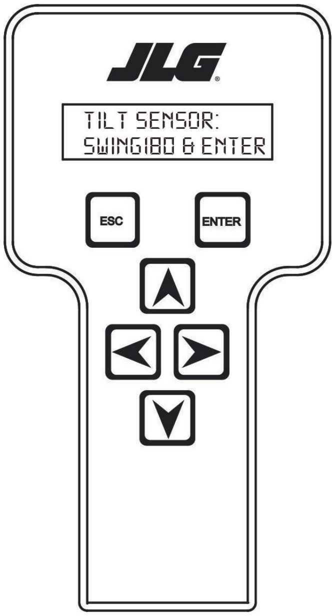
7. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
8. Enter the Access Code, 33271.
9. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.
10. Use the arrow keys to reach TILT SENSOR. The screen will read:



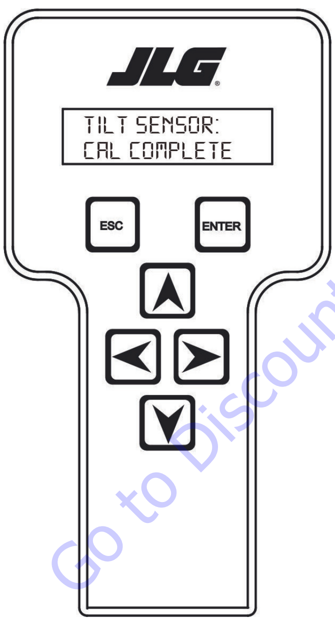
11. Hit Enter. The screen will read:



12. When prompted, swing turntable 180° to opposite end of chassis.



13. Hit Enter. The screen will read:



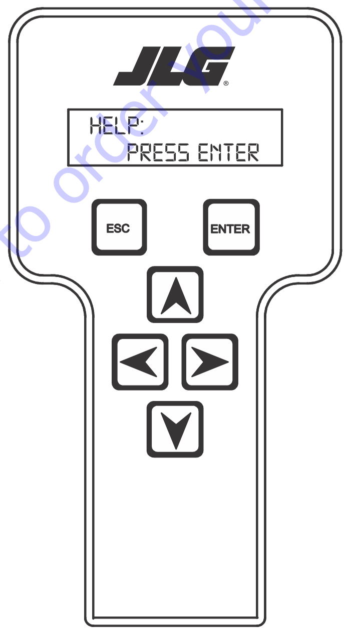
14. Upon completing swing calibration, swing turntable 180° back to the stowed position.

15. Hit ESC twice to go back to CALIBRATIONS.

6.6 CALIBRATING LOAD SENSING

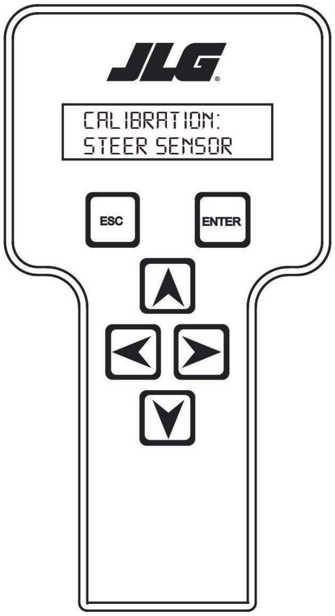
NOTE: *Calibration sub-menu LOAD SENSING is visible only if MACHINE SET-UP sub-menu LOAD SYSTEM is selected to NO.*

1. Position the Platform/Ground select switch to the Platform position.
2. Plug the analyzer into the connector at the base of the platform control box.
3. Pull out the Emergency Stop switch and Start the engine.
4. The analyzer screen should read:

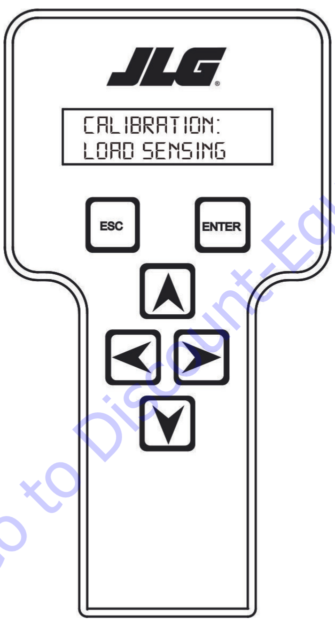


5. Use the arrow button to reach ACCESS LEVEL. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

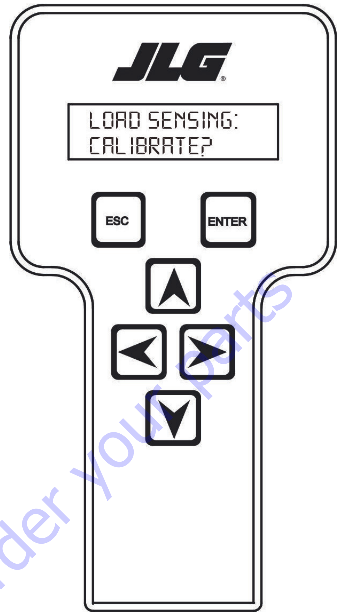
8. Use the arrow keys to reach LOAD SENSING. The screen will read:



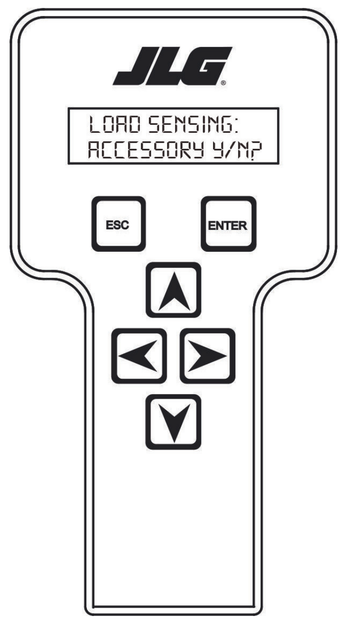
9. Hit Enter. The screen will read:



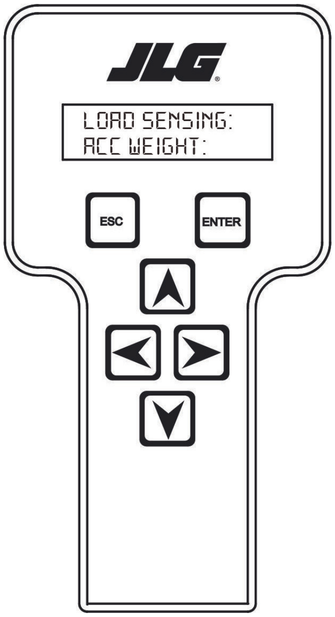
10. Hit Enter. The screen will read:



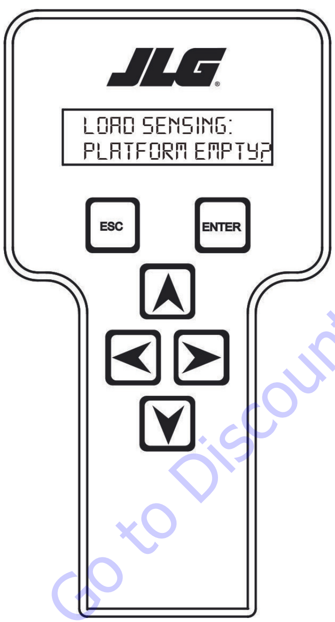
11. Hit Enter. The screen will read:



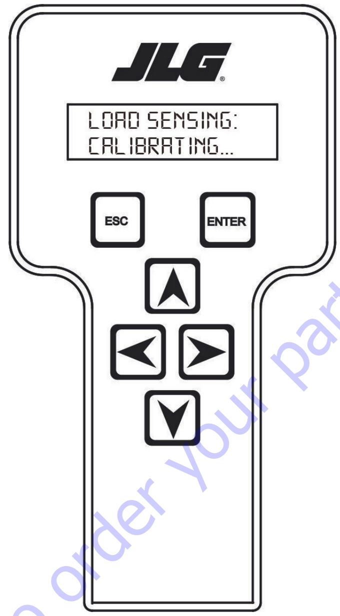
12. Hit Enter. The screen will read:



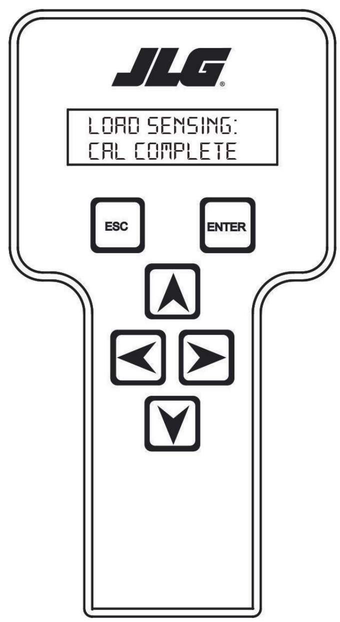
13. Hit Enter. The screen will read:



14. Hit Enter. The screen will read:



15. After few seconds, the screen will read:



16. Hit ESC twice to go back to CALIBRATIONS

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
001	EVERYTHING OK	The UGM determines that platform station (EVERYTING OK) OR ground station (GROUND MODE OK) is selected and no system faults exist, including Power Module check; 0 (No Fault)	Occurrence of active DTC
002	GROUND MODE OK	The normal help message in Ground Mode. Displays on the analyzer only.	Ground Mode selected; & occurrence of active DTC
008	FUNCTIONS LOCKED OUT - SYSTEM POWERED DOWN	Conditions exist and time for automatic power-down has expired.	Power cycled
0010	RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION	Machine is in the Out Of Transport Position	Machine is not Out of Transport; If Swung, DOS transition requirements are required to return to In Line speed
0011	FSW OPEN	Machine is in Platform Mode; Any of the following Platform inputs become active after power up, but before Machine Enabled: Drive joystick is not in the neutral position, Steer, Lift and/or Swing joystick is not in the neutral position; Tower Lift; Telescope; Platform Level; Platform Rotate; Jib Lift (if MACHINE SETUP -> JIB = YES); Jib Swing (if MACHINE SETUP -> JIB PLUS = YES);	Controls initialized
0012	RUNNING AT CREEP - CREEP SWITCH OPEN	Machine is in Platform Mode; Platform creep switch input = HIGH; Fault RUNNING AT CREEP – TILTED AND ABOVE ELEVATION (0013) is not active	Platform creep switch input = Low
0013	RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	Machine is in Platform mode; Machine is Above Elevation and Tilted; MACHINE SETUP-> TILT (not + CUT)	Not all of the trigger conditions are met; Then non-Creep function speed permitted after controls initialized
0033	TRACTION MOTOR AT CURRENT LIMIT	Machine is in Platform Mode and UGM detects that Traction Current reported by any Power Module > 270A for 3000ms; MTM or SPM will keep the Traction motor current below limit (280A@48V) but will not report fault;	Currents return to levels below trigger level for same time period as trigger; UGM shall remove Creep speed restriction after controls initialized
0036	FUNCTION PREVENTED - FUNCTION SELECTED BEFORE GROUND ENABLE	Machine is in Ground Mode (DTC 002); Machine is not enabled; Any valid ground control input becomes active;	Controls Initialized.
0039	SKYGUARD ACTIVE – FUNCTIONS CUTOUT	Machine is in Platform Mode and SkyGuard Enabled	Trigger conditions are no longer true
0047	DRIVING IN CREEP – STEEP DESCENT	UGM detects that the machine is descending a grade steeper than the MAX Grade setpoint (greater than or equal to): MAX Grade setpoint = 16.5 degrees for period of greater than 1 second. [MACHINE SETUP = E300].	The UGM detects that the grade in direction of travel is more than 3 degrees less than the machine's trip point.

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
0048	BATTERY CHARGE LOW	Battery SOC < 10%	Battery SOC > Discharged; speed restrictions removed after controls initialized
0046	TORQUE CUTBACK - EXCESSIVE TILT	UGM detects that the machine is ascending an inclination of greater than or equal to: 16.5 degrees for period of greater than 1 second. [MACHINE SETUP = E300].	The UGM detects that the grade in direction of travel is more than 3 degrees less than the machine's trip point
211	POWER CYCLE	The normal help message is issued to designate the start of each power cycle in Analyzer Logged Help; new entry only recorded if new DTCs occurred since last power cycle	No special conditions required
212	KEYSWITCH FAULTY	UGM Ground Mode (input J7-3) and UGM Platform Mode (input J7-2) are both HIGH at the same time	UGM Ground Mode (input J7-3) or UGM Platform Mode (input J7-2) = LOW
213	FSW FAULTY	The ground footswitch input and platform footswitch input have been both HIGH or both LOW for greater than or equal to 1 second	Power cycled
221	FUNCTION PROBLEM - HORN PERMANENTLY SELECTED	The horn switch was closed during power-up	Horn switch input = LOW
224	FUNCTION PROBLEM - STEER LEFT PERMANENTLY SELECTED	Machine in Platform Mode; Steer Left Switch input = HIGH at Startup	Steer Left Switch returns to neutral; steer functions enabled after remaining controls are initialized
225	FUNCTION PROBLEM - STEER RIGHT PERMANENTLY SELECTED	Machine in Platform Mode; Steer Right Switch input = HIGH at Startup	Steer Right Switch returns to neutral; Steer functions enabled after remaining controls are initialized
227	STEER SWITCHES FAULTY	Both steer switch inputs on the Drive/Steer joystick are High (detectable in Platform or Ground mode).	Steer Right and Steer Left are no longer simultaneous HIGH: steer and full Drive speed permitted after controls are initialized
2211	FSW INTERLOCK TRIPPED	Machine is in Platform Mode; A Machine Enabled state has been active for greater than or equal to 7 seconds without activation of any drive, steer, or boom functions	The footswitch is released
2212	DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	The machine is in Platform Mode and the drive joystick is not in the neutral position immediately following Start Up,. The machine is in Platform Mode and a proper machine enable signal is received or DTC 2213, 2221 or 2223 is active while the drive joystick is not in the neutral position.	If triggered by the drive joystick not being in the neutral position immediately following Start Up THEN when Drive joystick is returned to its neutral position and the machine is not in the Enabled state. If triggered by proper machine enable signal being received while the drive joystick is not in the neutral position then when the Drive joystick is returned to neutral or the footswitch is released
2213	STEER LOCKED - SELECTED BEFORE FOOTSWITCH	The UGM detects that the machine is in Platform Mode and a proper machine enable signal is received or DTC 2212, 2221 or 2223 is active while the steer controls are not in the neutral position.	When the steer controls are returned to neutral or the footswitch is released
2216	D/S JOY. OUT OF RANGE HIGH	The PM detects that the drive or steer joystick signal voltage > 8.1V and reports the fault to the UGM.	The PM no longer reports the fault

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
2217	D/S JOY. CENTER TAP BAD	The PM detects that the drive/steer center tap voltage is not between 3.31 volts and 3.75 volts and reports the fault to the UGM	The PM detects that the drive/steer center tap voltage is between 3.31 and 3.75 volts and no longer reports the fault to the UGM
2219	L/S JOY. OUT OF RANGE HIGH	The PM detects that the Lift or Swing joystick signal voltage > 8.1V and reports the fault to the UGM.	The PM detects that the lift/swing center tap voltage is between 3.31 and 3.75 volts and no longer reports the fault to the UGM
2220	L/S JOY. CENTER TAP BAD	The PM detects that the Lift or Swing center tap voltage is not between 3.31 volts and 3.75 volts and reports the fault to the UGM	The PM detects that the lift/swing center tap voltage is between 3.31 and 3.75 volts and no longer reports the fault to the UGM
2221	LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	The machine is in Platform Mode and the Lift and/or Swing controls are not in the neutral position immediately following Start Up -OR- The machine is in Platform Mode and a proper machine enable signal is received or DTC 2212, 2213 or 2223 is active while the Lift/Swing joystick is not in the neutral position.	If triggered by the Lift/Swing controls not being in the neutral position immediately following Start Up, then when Lift/Swing controls are returned to neutral and the machine is not in the Enabled state. If triggered by proper machine enable signal being received while the Lift/Swing controls are not in the neutral position, then when the Lift/Swing controls are returned to neutral or the footswitch is released
2222	WAITING FOR FSW TO BE OPEN	Machine is in Platform Mode AND Footswitch has been engaged since Start Up	Footswitch is disengaged
2223	FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE	The machine is in Platform Mode and a proper machine enable signal is received or DTC 2212, 2213 or 2221 is active while any of the following boom control inputs are engaged: AWDA Enable, Tower Lift, Telescope, Platform Level, Platform Rotate, Jib Lift (if MACHINE SETUP -> JIB = YES) and Jib Rotate (if MACHINE SETUP -> JIB PLUS = YES)	None of the boom controls that trigger this fault are engaged or the Footswitch is disengaged.
2245	FUNCTION PROBLEM - JIB SWING LEFT PERMANENTLY SELECTED	The machine is in Platform mode and the Jib Swing Left input = High at Startup	Jib Swing Left input = LOW while the machine is not Enabled
2246	FUNCTION PROBLEM - JIB SWING RIGHT PERMANENTLY SELECTED	The machine is in Platform mode and the Jib Swing Right input = High at Startup	Jib Swing Right input = LOW while the machine is not Enabled
2247	FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED	The machine is in Platform mode and the Platform Rotate Left input = High at Startup	Platform Rotate Left input = LOW while the machine is not Enabled
2248	FUNCTION PROBLEM - PLATFORM ROTATE RIGHT PERMANENTLY SELECTED	The machine is in Platform mode and the Platform Rotate Right input = High at Startup	Platform Rotate Right input = LOW while the machine is not Enabled
2249	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	The machine is in Platform mode and the Jib Lift Up input = High at Startup	Jib Lift Up input = LOW while the machine is not Enabled
2250	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	The machine is in Platform mode and the Jib Lift Down input = High at Startup	Jib Lift Down input = LOW while the machine is not Enabled
2251	FUNCTION PROBLEM - TELESCOPE IN PERMANENTLY SELECTED	The machine is in Platform mode and the Telescope In input = High at Startup	Telescope In input = LOW while the machine is not Enabled
2252	FUNCTION PROBLEM - TELESCOPE OUT PERMANENTLY SELECTED	The machine is in Platform mode and the Telescope Out input = High at Startup	Telescope Out input = LOW while the machine is not Enabled
2257	FUNCTION PROBLEM - TOWER LIFT UP PERMANENTLY SELECTED	The machine is in Platform mode and the Tower Lift Up input = High at Startup	Telescope Out input = LOW while the machine is not Enabled
2258	FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED	The machine is in Platform mode and the Tower Lift Down input = High at Startup	Tower Lift Down input = LOW while the machine is not Enabled

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
2262	FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED	The machine is in Platform mode and the Platform Level Up input = High at Startup	Platform Level Up input = LOW while the machine is not Enabled
2263	FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMANENTLY SELECTED	The machine is in Platform mode and the Platform Level Down input = High at Startup	Platform Level Down input = LOW while the machine is not Enabled
2264	FUNCTION PROBLEM - DOS OVERRIDE PERMANENTLY SELECTED	The machine is in Platform mode and the Drive Orientation switch input = High at Startup	Drive Orientation input = LOW while the machine is not Enabled
2286	FUNCTION PROBLEM - SOFT TOUCH / SKYGUARD OVERRIDE PERMANENTLY SELECTED	[(MACHINE SETUP → SKYGUARD = YES) or (MACHINE SETUP → SOFT TOUCH = YES)]; Machine is in Platform Mode; The Soft Touch / SkyGuard Override switch input = High at Startup	The Soft Touch / SkyGuard Override switch input = Low
234	FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	Both inputs associated with mutually exclusive operations are simultaneously active.	Trigger conditions no longer true.
2310	FUNCTION PROBLEM - GROUND ENABLE PERMANENTLY SELECTED	The machine is in Ground mode and the Function Enable input = High at Startup	Enable switch = LOW; Enable permitted after controls initializ
2370	FUNCTION PROBLEM - JIB LIFT UP PERMANENTLY SELECTED	If MACHINE SETUP ü JIB = YES and the machine is in Ground mode and the subject switch input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
2371	FUNCTION PROBLEM - JIB LIFT DOWN PERMANENTLY SELECTED	If MACHINE SETUP ü JIB = YES and the machine is in Ground mode and the subject switch input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
2372	FUNCTION PROBLEM - SWING LEFT PERMANENTLY SELECTED	The machine is in Ground mode and the Swing Left = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
2373	FUNCTION PROBLEM - SWING RIGHT PERMANENTLY SELECTED	The machine is in Ground mode and the Swing Right input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23105	FUNCTION PROBLEM - TOWER LIFT UP PERMANENTLY SELECTED	The machine is in Ground mode and the Tower Lift Up input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23106	FUNCTION PROBLEM - TOWER LIFT DOWN PERMANENTLY SELECTED	The machine is in Ground mode and the Tower Lift Down input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23107	FUNCTION PROBLEM - LIFT UP PERMANENTLY SELECTED	The machine is in Ground mode and the Lift Up input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23108	FUNCTION PROBLEM - LIFT DOWN PERMANENTLY SELECTED	The machine is in Ground mode and the Lift Down input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23109	FUNCTION PROBLEM - TELESCOPE IN PERMANENTLY SELECTED	The machine is in Ground mode and the Telescope In input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23110	FUNCTION PROBLEM - TELESCOPE OUT PERMANENTLY SELECTED	The machine is in Ground mode and the Telescope Out input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23111	FUNCTION PROBLEM - PLATFORM LEVEL UP PERMANENTLY SELECTED	The machine is in Ground mode and the Platform Level Up input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23112	FUNCTION PROBLEM - PLATFORM LEVEL DOWN PERMANENTLY SELECTED	The machine is in Ground mode and the Platform Level Down input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23113	FUNCTION PROBLEM - PLATFORM ROTATE LEFT PERMANENTLY SELECTED	The machine is in Ground mode and the Platform Rotate Left input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23114	FUNCTION PROBLEM - PLATFORM ROTATE RIGHT PERMANENTLY SELECTED	The machine is in Ground mode and the Platform Rotate Right input = High at Start Up	Function switch returns to neutral and the machine is not in the Enabled state.
23163	FUNCTION PROBLEM - MSSO PERMANENTLY SELECTED	UGM determines that MSSO low-side switch is selected at Startup	Function switch returns to neutral and the machine is not in the Enabled state.
23171	FUNCTION PROBLEM - JIB SWING LEFT PERMANENTLY SELECTED	The machine is in Ground mode and the Jib Swing Left input = High at Start Up	Jib Swing Left input = LOW and the machine is not in the Enabled state.

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
23172	FUNCTION PROBLEM - JIB SWING RIGHT PERMANENTLY SELECTED	The machine is in Ground mode and the Jib Swing Right input = High at Start Up	Jib Swing Right input = LOW and the machine is not in the Enabled state.
241	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE LOW	System is in platform mode; MACHINE SETUP -> TEMP CUTOUT = yes; Low Temperature Cutout Sensor reads less than or equal to -50 C.f	Ambient Temperature sensor reading > -50 °C THEN speed restrictions removed after controls are initialized
242	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE HIGH	System is in platform mode; MACHINE SETUP -> TEMP CUTOUT = yes; Low Temperature Cutout Sensor reads greater than or equal to 85 C.	Ambient Temperature sensor reading > -50 °C; Speed restrictions removed after controls are initialized
253	DRIVE PREVENTED - CHARGER CONNECTED	MACHINE SETUP => CHARGER INTERLOCK = DRIVE ONLY;	Trigger conditions not true; Restrictions remove after CntIni
259	MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS	The MACHINE SETUP => MODEL has changed	Power cycle
2514	BOOM PREVENTED - DRIVE SELECTED	MACHINE SETUP => FUNCTION CUTOUT = BOOM CUTOUT; Drive or Steer is already engaged; The boom is Above Elevation; The operator is attempting to activate one of the boom functions DTC 2514 supersedes DTC 2518 if drive/steer and boom functions are both active when machine transitions from Below Elevation to Above Elevation.	Not all of the trigger conditions are met
2516	DRIVE PREVENTED - ABOVE ELEVATION	MACHINE SETUP => FUNCTION CUTOUT = DRIVE CUTOUT; The boom is Above Elevation; The operator is attempting to activate Drive or Steer;	Not all of the trigger conditions are met
2518	DRIVE PREVENTED – BOOM SELECTED	MACHINE SETUP => FUNCTION CUTOUT = DRIVE CUTOUT; The boom is Above Elevation; The operator is attempting to activate Drive or Steer;	Not all of the trigger conditions are met
2538	FUNCTION PREVENTED – CHARGER CONNECTED	MACHINE SETUP => CHARGER INTERLOCK = CUTOUT ALL; MTM reports charger connected; UGM determines that machine is Enabled, and a function command was attempted.	Not all of the trigger conditions are met; Restricts removed after CntIni
2548	SYSTEM TEST MODE ACTIVE	UGM determines that System Test Mode is active	Power cycled
2549	DRIVE & BOOM PREVENTED - SOFT TOUCH ACTIVE	MACHINE SETUP → SOFT TOUCH = YES; Machine is in Platform Mode; Soft Touch State = Enabled	Not all of the trigger conditions are met
2563	SKYGUARD SWITCH – DISAGREEMENT	MACHINE SETUP => SKYGUARD ≠ NO; Machine is in Platform Mode; [(SkyGuard input #1 Platform Module J7-18) ≠ (SkyGuard input #2 Platform Module J1-23)] > 160ms	[{SkyGuard inputs (Platform Module J7-18 = High) and (Platform Module J1-23 = High)} and (Footswitch State = Not Depressed)]
2564	DRIVE PREVENTED – LEFT BRAKE NOT RELEASING	Module detects brakes have not released because EB coil is damaged	Power cycle
2565	DRIVE PREVENTED – RIGHT BRAKE NOT RELEASING	Module detects brakes have not released because EB coil is damaged	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
2568	TEMPERATURE CUTOUT ACTIVE – AMBIENT TEMPERATURE TOO LOW	Low Temperature Cutout = Active	Low Temperature Cutout = Inactive; speed restrictions removed after controls are initialized
2576	PLATFORM LEVEL PREVENTED – ABOVE ELEVATION	UGM has determined that all of the following conditions exists: Platform Level Override Cutout = Enabled; Machine is Enabled; The Platform Level Up or Down switch input = High;	Not all of the trigger conditions are met
2578	FUNCTION PREVENTED – TILTED & ABOVE ELEVATION	Machine is in Platform mode Machine is Above Elevation and Tilted MACHINE SETUP → TILT → X DEGREES + CUT and the operator is attempting to activate Drive or Steer, Lift Up, Tower Up or Telescope Out. Where X = 3, 4, or 5 Degrees)	At least one of the trigger conditions is not met; then non-Creep function speed permitted after controls initialized.
2579	DRIVE PREVENTED – EXCESSIVE GRADE	DTC 0046 is active; Drive speed request, in direction of ascending grade, is greater than zero;	CntIni (drive joystick returned to center position)
3111	MAIN CONTACTOR DRIVER – PERMANENTLY OFF	Master Traction Module detects that the line contactor driver is out of order and not able to close (Contactor Driver; 75)	Power cycle
3112	MAIN CONTACTOR – OPEN CIRCUIT	Master Traction Module detects current through Contactor Coil but no voltage on Contactor contacts during active traction or pump.	Power cycled
3212	MAIN CONTACTOR – WELDED OR MISWIRED	Master Traction Module determines at Startup that Line Contactor is closed/stuck before command	Power cycle
3213	MAIN CONTACTOR DRIVER – PERMANENTLY ON	Master Traction Module detects that the line contactor driver output failed short or contactor coil is disconnected/open circuit	Power cycle
334	LIFT UP VALVE – OPEN CIRCUIT	The UGM detects OC at the Lift Up Solenoid	UGM no longer detects OC; Speed restriction removed after CntIni;
336	LIFT DOWN VALVE – OPEN CIRCUIT	The UGM detects OC at the Lift Down Solenoid	UGM no longer detects open circuit; Inhibits and restrictions removed after CntrlIni;
337	STEER LEFT VALVE – SHORT TO BATTERY	UGM detects a short to battery at steer left output	Power cycle
338	STEER LEFT VALVE – OPEN CIRCUIT	The UGM detects an open circuit at steer left output	UGM no longer detects OC; Speed restriction removed after CntIni.
339	STEER RIGHT VALVE – SHORT TO BATTERY	The UGM detects a short to battery at steer right output	Power cycle
3310	STEER RIGHT VALVE – OPEN CIRCUIT	The UGM detects an open circuit at steer right output	UGM no longer detects OC; Speed restriction removed after CntIni.
3311	GROUND ALARM – SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
3371	GROUND ALARM – SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
3376	HEAD TAIL LIGHT - SHORT TO GROUND	MACHINE SETUP -> H & T LIGHTS = YES; UGM detects a short to ground at head/tail light relay output	Power cycle
3377	HEAD TAIL LIGHT - OPEN CIRCUIT	MACHINE SETUP -> H & T LIGHTS = YES; UGM detects a short to ground at head/tail light relay output	UGM no longer detects open circuit

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
3378	HEAD TAIL LIGHT - SHORT TO BATTERY	MACHINE SETUP -> H & T LIGHTS = YES; UGM detects a short to battery at head/tail light relay output	Power cycle
3382	PLATFORM LEVEL UP VALVE - SHORT TO GROUND	The UGM detects a short to ground at the platform level up output	Power cycle
3383	PLATFORM LEVEL UP VALVE - OPEN CIRCUIT	The UGM detects an open circuit at the platform level up output	UGM no longer detects open circuit; speed restrictions removed after controls are initialized
3384	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at the platform level up output	Power cycle
3388	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	The UGM detects a short to ground at the platform level down output	Power cycle
3389	PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT	The UGM detects an open circuit at the platform level down output	UGM no longer detects open circuit; Prohibits and restrictions removed after Cntlni
3390	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at the platform level down output	Power cycle
3394	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	UGM detects a short to ground at platform rotate left output	Power cycle
3395	PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT	UGM detects an open circuit at platform rotate left output	UGM no longer detects OC; Speed restrictions removed after Cntlni;
3396	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	UGM detects a short to battery at platform rotate left output	Power cycle
3397	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	UGM detects a short to ground at platform rotate right output	Power cycle
3398	PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT	UGM detects an open circuit at platform rotate right output	UGM no longer detects OC; Speed restrictions removed after Cntlni;
3399	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	UGM detects a short to battery at platform rotate right output	Power cycle
33100	JIB LIFT UP VALVE - SHORT TO GROUND	MachineSetup -> Jib = YES; UGM detects a short to ground at the jib lift up output;	Power cycle
33101	JIB LIFT UP VALVE - OPEN CIRCUIT	MachineSetup -> Jib = YES; UGM detects a open circuit at the jib lift up output	UGM no longer detects OC; Speed restriction removed after Cntlni;
33102	JIB LIFT UP VALVE - SHORT TO BATTERY	MachineSetup -> Jib = YES; UGM detects a short to battery at the jib lift up output	Power cycle
33103	JIB LIFT DOWN VALVE - SHORT TO GROUND	MachineSetup -> Jib = YES; UGM detects a short to ground at the jib lift down output	Power cycle
33104	JIB LIFT DOWN VALVE - OPEN CIRCUIT	MachineSetup -> Jib = YES; UGM detects a open circuit at the jib lift down output	UGM no longer detects open circuit; Inhibits and restrictions removed after Cntrllni;
33105	JIB LIFT DOWN VALVE - SHORT TO BATTERY	MachineSetup -> Jib = YES; UGM detects a short to battery at the jib lift down output	Power cycle
33106	TOWER LIFT UP VALVE - SHORT TO GROUND	The UGM detects a short to ground at the tower lift up output	Power cycle
33107	TOWER LIFT UP VALVE - OPEN CIRCUIT	The UGM detects an open circuit at the tower lift up output	UGM no longer detects OC; Speed restriction removed after Cntlni;

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
33108	TOWER LIFT UP VALVE - SHORT TO BATTERY	The UGM detects a short to ground at the tower lift up output	Power cycle
33109	TOWER LIFT DOWN VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33110	TOWER LIFT DOWN VALVE - OPEN CIRCUIT	The UGM detects an open circuit supporting the Tower Down Solenoid	UGM no longer detects open circuit; Inhibits and restrictions removed after Cntrllni;
33111	TOWER LIFT DOWN VALVE - SHORT TO BATTERY	The UGM detects a short to ground at the tower lift down output	Power cycle
33118	SWING RIGHT VALVE - SHORT TO GROUND	The UGM detects a short to ground at the Swing Right output	Power cycle
33119	SWING RIGHT VALVE - OPEN CIRCUIT	The UGM detects an open circuit at the Swing Right output	UGM no longer detects OC; Speed restrictions removed after CntIni
33120	TELESCOPE IN VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33122	SWING LEFT VALVE - SHORT TO GROUND	The UGM detects a short to ground at the Swing Left output	Power cycle
33123	TELESCOPE OUT VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33175	JIB ROTATE LEFT VALVE - OPEN CIRCUIT	MACHINE SETUP -> JIB PLUS = YES; UGM detects an open circuit at the jib rotate left output	UGM no longer detects OC; Speed restrictions removed after CntIni
33176	JIB ROTATE LEFT VALVE - SHORT TO BATTERY	MACHINE SETUP -> JIB PLUS = YES; UGM detects a short to ground at the jib rotate left output	Power cycle
33177	JIB ROTATE LEFT VALVE - SHORT TO GROUND	MACHINE SETUP -> JIB PLUS = YES; UGM detects a short to battery at the jib rotate left output	Power cycle
33178	JIB ROTATE RIGHT VALVE - OPEN CIRCUIT	MACHINE SETUP -> JIB PLUS = YES; UGM detects an open circuit at the jib rotate right output	UGM no longer detects OC; Speed restrictions removed after CntIni
33179	JIB ROTATE RIGHT VALVE - SHORT TO BATTERY	MACHINE SETUP -> JIB PLUS = YES; UGM detects a short to battery at the jib rotate right output	Power cycle
33180	JIB ROTATE RIGHT VALVE - SHORT TO GROUND	MACHINE SETUP -> JIB PLUS = YES; UGM detects a short to ground at the jib rotate right output	Power cycle
33182	LIFT VALVES - SHORT TO BATTERY	UGM detects a short to 12V battery at either the Lift Up or Lift Down valve	Power cycle
33186	TELESCOPE OUT VALVE - OPEN CIRCUIT	UGM detects an open circuit at this output	UGM no longer detects OC. Speed restrictions removed after CntIni
33188	TELESCOPE OUT VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33189	TELESCOPE IN VALVE - OPEN CIRCU	The UGM detects an open circuit at this output	UGM no longer detects OC. Speed restrictions removed after CntIni
33190	TELESCOPE IN VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33295	SWING LEFT VALVE - OPEN CIRCUIT	The UGM detects an open circuit at the Swing Left output	UGM no longer detects OC; Speed restrictions removed after CntIni
33298	STEER LEFT - SHORT TO GROUND	The UGM detects a short to ground at steer left output.	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
33305	STEER RIGHT - SHORT TO GROUND	The UGM detects a short to ground at steer right output.	Power cycle
33314	FLOW CONTROL VALVE - OPEN CIRCUIT	The UGM detects an OC at this output	Power cycle
33315	FLOW CONTROL VALVE - SHORT TO BATTERY	The UGM detects a short to 12V battery at this output	Power cycle
33316	FLOW CONTROL VALVE - SHORT TO GROUND	The UGM detects a short to ground at this output	Power cycle
33406	LIFT UP VALVE - SHORT TO GROUND	The UGM detects STG at the Lift Up Solenoid	Power cycle
33407	LIFT DOWN VALVE - SHORT TO GROUND	The UGM detects STG at the Lift Down Solenoid	Power cycle
33412	SWING VALVES - SHORT TO BATTERY	The UGM detects a short to 12V battery at the either Swing output	Power cycle
33425	TOWER LIFT VALVES - SHORT TO BATTERY	The UGM detects a short to battery at either the Tower Lift Up or Tower Lift Down valve.	Power cycle
33479	VOTING RELAY - SHORT TO BATTERY	UGM detects a short to battery at this output	Power cycle
33480	VOTING RELAY - SHORT TO GROUND	UGM detects a short to ground at the voting relay output	Power cycle
33549	VOTING RELAY - OPEN CIRCUIT	UGM detects an open circuit at the voting relay output	Power cycle
33578	STEER PRIORITY BYPASS VALVE - OPEN CIRCUIT	The UGM detects an OC at steer priority bypass output	UGM no longer detects OC; Speed restriction removed after CntlnI.
33579	STEER PRIORITY BYPASS VALVE - SHORT TO GROUND	The UGM detects a short to ground at steer priority bypass output	Power cycle
33580	STEER PRIORITY BYPASS VALVE - SHORT TO BATTERY	The UGM detects a short to battery at steer priority bypass output	Power cycle
33624	SWING BYPASS VALVE - SHORT TO GROUND	The UGM detects a short to ground at swing bypass output	Power cycle
33625	SWING BYPASS VALVE - SHORT TO BATTERY	The UGM detects a short to battery at swing bypass output	Power cycle
33626	SWING BYPASS VALVE - OPEN CIRCUIT	The UGM detects open circuit at swing bypass output	UGM no longer detects OC; Speed restriction removed after CntlnI.
33627	LIFT BYPASS VALVE - SHORT TO GROUND	The UGM detects STG at lift bypass output;	Power cycle
33628	LIFT BYPASS VALVE - SHORT TO BATTERY	The UGM detects STB at lift bypass output	Power cycle
33629	LIFT BYPASS VALVE - OPEN CIRCUIT	The UGM detects OC at lift bypass output	Power cycle
4219	REAR LEFT MODULE TEMPERATURE - OUT OF RANGE	The Power Module temperature sensor is out of the permitted operating range and reports a fault	Traction module no longer reporting fault; Creep restriction removed after controls initialized
4220	REAR RIGHT MODULE TEMPERATURE - OUT OF RANGE	The Front Right Power Module temperature sensor is out of the permitted operating range and reports a fault	Traction module no longer reporting fault; Creep restriction removed after controls initialized
4223	REAR LEFT MODULE TOO HOT - PLEASE WAIT	Associated Power Module has reached thermal cutout limit	Traction module no longer reporting fault; Creep restriction removed after controls initialized
4224	REAR RIGHT MODULE TOO HOT - PLEASE WAIT	Front Right Power Module has reached thermal cutout limit	Traction module no longer reporting fault; Creep restriction removed after controls initialized
4228	REAR LEFT MOTOR TEMPERATURE - OUT OF RANGE	The Power Module reports that motor temperature sensor is out of range due to Open-Circuit (Temp Out of Range – High > 240°C), STG (Temp Out of Range – Low < -30°C) or damage	Traction module no longer reporting fault; Creep restriction removed after controls initialized

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
4229	REAR RIGHT MOTOR TEMPERATURE - OUT OF RANGE	The Power Module reports that motor temperature sensor is out of range due to Open-Circuit (Temp Out of Range – High > 240°C), STG (Temp Out of Range – Low < -30°C) or damage	Traction module no longer reporting fault; Creep restriction removed after controls initialized
4232	REAR LEFT MOTOR TOO HOT - PLEASE WAIT	The UGM determines that the drive motor temperature reported by the PM > 140°C but < 200°C or the PM determines that motor temperature sensor is reporting > 150°C UGM to suppress if DTCs 4228 is active.	Power Module no longer report fault and UGM determines motor temp ≤ 140°C (149-10°C) and Controls initialized. Drive disable reset when motor temp ≤ 139°C (149-10°C) and Drive Joystick in Neutral.
4233	REAR RIGHT MOTOR TOO HOT - PLEASE WAIT	The UGM determines that the drive motor temperature reported by the PM > 140°C but < 200°C or the PM determines that motor temperature sensor is reporting > 150°C UGM to suppress if DTCs 4229 is active.	Power Module no longer report fault and UGM determines motor temp ≤ 140°C (149-10°C) and Controls initialized. Drive disable reset when motor temp ≤ 139°C (149-10°C) and Drive Joystick in Neutral.
441	BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN	The UGM detects that its 12V supply voltage is less than 9.0 volts for 5 seconds.	UGM voltage > 9.25V
442	BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN	The UGM detects that its 12V supply voltage > 16.0 volts	Power cycle
443	LSS BATTERY VOLTAGE TOO HIGH	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM determines that LSS error bit is set for supply voltage too high (> 34.0V)	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
444	LSS BATTERY VOLTAGE TOO LOW	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM determines that LSS error bit is set for supply voltage too low (< 9.0V)	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
4420	BATTERY DEEPLY DISCHARGED	UGM determines that the SOC% related to the Battery has reached the Deeply Discharged condition. Based on SOC% only, not Voltage threshold; No audible annunciation for this DTC.	Power cycle
4430	BATTERY VOLTAGE TOO LOW	UGM detects that its supply voltage < 11 volts for 5 seconds.	UGM voltage > 11.25V
4463	REAR LEFT MODULE - VOLTAGE OUT OF RANGE	Associated Power Module determines System Overvoltage/Undervoltage, Voltage measurement ≥ 65V or ≤ 12V	Traction modules no longer report fault then controls initialized.
4464	REAR RIGHT MODULE - VOLTAGE OUT OF RANGE	Associated Power Module determines System Overvoltage/Undervoltage, Voltage measurement ≥ 65V or ≤ 12V	Traction modules no longer report fault then controls initialized.
4692	REAR LEFT BRAKE - SHORT TO GROUND OR OPEN CIRCUIT	Associated Power Module detects A4 shorted to ground: at Standby as or at Running (PWM Supplemental info not applicable to this DTC for initiating separate DTC: Power Module detects A4 shorted to ground at Startup as or Power Module detects A2 shorted to ground only at Startup, not detected in Standby or Running.	Power cycle
4693	REAR RIGHT BRAKE - SHORT TO GROUND OR OPEN CIRCUIT	Associated Power Module detects A4 shorted to ground: at Standby as or at Running (PWM Supplemental info not applicable to this DTC for initiating separate DTC: Power Module detects A4 shorted to ground at Startup as or Power Module detects A2 shorted to ground only at Startup, as not detected in Standby or Running.	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
46100	REAR LEFT BRAKE RETURN - SHORT TO BATTERY	Traction Module detects an overcurrent condition on pin A4, indicating a short between B+ and the Electric Brake FET	Power cycle
46130	MAIN CONTACTOR / REAR RIGHT BRAKE RETURN - SHORT TO BATTERY	At Startup, the Master Traction Module detects an overcurrent condition on pin A12, indicating a short between B+ and the Main Contactor. During active traction, the Master Traction Module detects an overcurrent condition on pin A4. Electric Brake FET	Power cycle
46104	REAR LEFT SPEED SENSOR - NOT RESPONDING PROPERLY	Associated Power Module has detected an encoder or directional sensing problem	Power cycle
46105	REAR RIGHT SPEED SENSOR - NOT RESPONDING PROPERLY	Associated Power Module has detected an encoder or directional sensing problem	Power cycle
46108	REAR LEFT SPEED SENSOR - RPM HIGH	Associated Power Module determines an overspeed condition (measured motor speed > DRIVE MAX + 15Hz) has occurred on a motor	Power cycle
46109	REAR RIGHT SPEED SENSOR - RPM HIGH	Associated Power Module determines an overspeed condition (measured motor speed > DRIVE MAX + 15Hz) has occurred on a motor	Power cycle
46136	REAR LEFT BRAKE SUPPLY VOLTAGE – OUT OF RANGE LOW	Associated Power Module determines that a low parking brake supply voltage condition exists.	Power cycle
46137	REAR RIGHT BRAKE SUPPLY VOLTAGE – OUT OF RANGE LOW	Associated Power Module determines that a low parking brake supply voltage condition exists.	Power cycle
662	CANBUS FAILURE - PLATFORM MODULE	UGM does not receive any CAN messages from Platform Module in 250ms	CAN1 messages are received from the PM and controls are initialized
663	CANBUS FAILURE - LOAD SENSING SYSTEM MODULE	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM does not receive any CAN messages from the LSS module in 1000ms	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
6613	CANBUS FAILURE - EXCESSIVE CANBUS ERRORS	UGM observes more than 22 error frames per second for 4 seconds or more than 500 Buss Off conditions since last power cycle.	Power cycle
6635	CANBUS FAILURE - CHASSIS TILT SENSOR	UGM does not receive any CAN1 messages from Chassis Tilt Sensor in 250ms	CAN1 messages are received from the sensor and controls are initialized;
6654	CANBUS FAILURE - REAR LEFT MODULE	After Startup complete, Power Module CAN2 messages are not received in 200ms	UGM receives all traction modules CAN2 messages and shall command main contactor closed; once fault reset, motion permitted after controls are initialized. If CAN messages are lost more than 5 times, the fault shall be latched until Power Cycle.G352
6655	CANBUS FAILURE - REAR RIGHT MODUL	After Startup complete, UGM or Power Modules not receive the designated CAN messages in 200ms (250ms for UGM)	UGM receives all traction modules CAN2 messages and shall command main contactor closed; once fault reset, motion permitted after controls are initialized. If CAN messages are lost more than 5 times, the fault shall be latched until Power Cycle.
6657	CANBUS FAILURE - TEMPERATURE SENSOR	UGM determines that: • MACHINE SETUP → TEMP CUTOUT = YES • UGM does not receive any CAN1 messages from the Low Temperature Cutout sensor in 250ms Suppress DTCs 241 and 242 if this DTC is active.	UGM receives CAN1 messages from the Ambient Temperature sensor; speed restrictions removed after controls initialized

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
7725	PUMP MOTOR - NOT RESPONDING	The Master Traction Module detects that the pump motor feedback is not responding when the pump is being commanded	Power cycle
7730	PUMP MOTOR OUTPUT - OUT OF RANGE HIGH	Master Traction Module detects that the pump motor voltage output is higher than expected (Pump Vmn High; 29/MC Drive Open). Too high with respect to PWM applied.	Power cycle
7731	PUMP MOTOR OUTPUT - OUT OF RANGE LOW	Master Traction Module detects that the pump motor voltage output lower than expected. Too low with respect to PWM applied.	Power cycle
7737	PUMP MOTOR OVERLOADED	UGM detects that Pump Current reported by MTM > 210A for 3000ms (both Constant Data Values); MTM detects pump current > 220A	Currents return to levels below trigger level for same time period as trigger and controls initialized. UGM shall remove Drive Creep speed restriction after controls initialized
7753	REAR LEFT MOTOR STALLED	The UGM or Power Module(s) detects that the motor is stalled during active traction. For the UGM commanded speed ≥ Creep AND (RIGHT) +30 > Steer Angle < -45 (LEFT), the reported avg motor encoder feedback < 70 counts/s for 5 seconds (1.685 Hz). Avg motor encoder feedback evaluate on a 1s running average. For MTM, the encoder-measured motor speed < 0.6Hz for 5 seconds, when applied frequency > 1.5 Hz and Command > 10 Hz	UGM and Left Power Module shall clear the fault after drive joystick returns to neutral (and command returns to zero).
7754	REAR RIGHT MOTOR STALLED	The UGM or Power Module(s) detects that the motor is stalled during active traction. For the UGM commanded speed ≥ Creep AND (RIGHT) +30 > Steer Angle < -45 (LEFT), the reported avg motor encoder feedback < 70 counts/s for 5 seconds (1.685 Hz). Avg motor encoder feedback evaluate on a 1s running average. For MTM, the encoder-measured motor speed < 0.6Hz for 5 seconds, when applied frequency > 1.5 Hz and Command > 10 Hz	UGM and Right Power Module shall clear the fault after drive joystick returns to neutral (and command returns to zero)
7757	REAR LEFT MOTOR OUTPUT - OUT OF RANGE HIGH	Associated Power Module detects at Startup or during active traction that the motor voltage output is higher than expected	Power cycle
7758	REAR RIGHT MOTOR OUTPUT - OUT OF RANGE HIGH	Associated Power Module detects at Startup or during active traction that the motor voltage output is higher than expected	Power cycle
7761	REAR LEFT MOTOR OUTPUT - OUT OF RANGE LOW	Associated Power Module detects at Startup or during active traction that the motor voltage output is lower than expected	Power cycle
7762	REAR RIGHT MOTOR OUTPUT - OUT OF RANGE LOW	Associated Power Module detects at Startup or during active traction that the motor voltage output is lower than expected	Power cycle
7765	REAR LEFT MOTOR - FEEDBACK FAILURE	After main contactor is closed, Power Module detects that the motor voltage feedback circuits are damaged	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
7766	REAR RIGHT MOTOR - FEEDBACK FAILURE	After main contactor is closed, Power Module detects that the motor voltage feedback circuits are damaged	Power cycle
7769	REAR LEFT MOTOR - ROTATION OPPOSITE CONTROL	Associated Power Module detects that the motor is rotating in the direction opposite of the commanded direction and deceleration is less than 15% of deceleration personality setting for a period of more than 0.5 seconds	Power cycle
7770	REAR RIGHT MOTOR - ROTATION OPPOSITE CONTROL	Associated Power Module detects that the motor is rotating in the direction opposite of the commanded direction and deceleration is less than 15% of deceleration personality setting for a period of more than 0.5 seconds	Power cycle
7773	REAR LEFT MOTOR - OPEN CIRCUIT	When motor output is active, the Power Module detects that a motor phase is disconnected/open during active traction	Power cycle
7774	REAR RIGHT MOTOR - OPEN CIRCUIT	When motor output is active, the Power Module detects that a motor phase is disconnected/open during active traction	Power cycle
813	CHASSIS TILT SENSOR NOT CALIBRATED	UGM determines that tilt sensor, • has not been calibrated • serial number does not match stored value unitialized sensor has been installed	Tilt sensor calibrated;
814	CHASSIS TILT SENSOR OUT OF RANGE	Fault CHASSIS TILT SENSOR NOT CALIBRATED (813) is not present and either of the external tilt sensor X or Y axis ? ABS [35 º] for 4 seconds. Not to be reported during Tilt Sensor calibration.	Not all of the trigger conditions are met;
818	TILT SENSOR STAGNANT	UGM shall consider the Tilt Sensor stagnant if neither the X-axis or Y-axis unfiltered reading change by ≥ ±0.05º in 5000ms while the reported Drive speed ≥ Drive Creep Hz for all Traction modules	Power cycle;
821	LSS CELL #1 ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM detects that LSS is reporting error with Cell #1	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
822	LSS CELL #2 ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM detects that LSS is reporting error with Cell #2	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
823	LSS CELL #3 ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM detects that LSS is reporting error with Cell #3	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
824	LSS CELL #4 ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM detects that LSS is reporting error with Cell #4	Not all of the trigger conditions are met; motion restrictions removed after controls initialized
825	LSS HAS NOT BEEN CALIBRATED	MACHINE SETUP -> LOAD SYSTEM ≠ NO The load sensor has not been calibrated, or DTC 992 (LSS EEPROM ERROR) is active, or DTC 9977 (LSS CORRUPT EEPROM) is active	Not all of the trigger conditions are met
826	RUNNING AT CREEP - PLATFORM OVERLOADED	MACHINE SETUP -> LOAD SYSTEM = WARN ONLY; The platform is Overloaded;	UGM determines that the Platform is not Overloaded; motion restrictions removed after controls initialized

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
829	FUNCTIONS CUTOUT - PLATFORM OVER-LOADED	The Platform is Overloaded and MACHINE SETUP -> LOAD SYSTEM = CUTOUT PLATFORM, Platform Mode is active, and conditions of LSS section apply. -or- The Platform is Overloaded and MACHINE SETUP -> LOAD SYSTEM = CUTOUT ALL and conditions of LSS section apply	UGM determines that the Platform is not Over-loaded; motion restrictions removed after con-trols initialized
8211	LSS READING UNDER WEIGHT	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The load sensor has been calibrated and Gross Platform Weight < (0.5 * Empty Platform Weight)	Not all of the trigger conditions are met; full functionality permitted after controls initialized
8664	STEER SENSOR - OUT OF RANGE HIGH	The UGM observes the Master Traction Module reported steer raw voltage signal ≥ 4.5V (Con-stant Data)	UGM observes steer voltage within calibrated range for 1000ms; Drive Creep restriction lifted after fault clears and controls initialized
8665	STEER SENSOR - OUT OF RANGE LOW	The UGM observes the Master Traction Module reported steer raw voltage signal ≤0.3V (Con-stant Data)	UGM observes steer angle voltage within cali-brated range for 1000ms; Drive Creep restriction lifted after fault clears and controls initialized
8666	STEER SENSOR - DECOUPLED	The UGM observes the Master Traction Module reported steer raw voltage 0.3V < signal < 0.5V (Constant Data)	UGM determines steer angle within allowed range; Drive Creep restriction removed after fault clears and controls initialized;
8667	STEER SENSOR - NOT RESPONDING	The UGM determines that the Master Traction Module reported Machine Steer Angle does not change ≥ 1.0° in 4000mS while the steering out-put is being commanded while steer is calibrated and properly reported by MTM in range that is not within 3deg of calibrated MAX.	UGM determines steer angle changes more than trigger amount while in allowed evaluation range; Drive Creep restriction removed after fault clears and controls initialized
8668	STEER SENSOR - NOT CALIBRATED	UGM determines that the steering sensor has not been calibrated; UGM EEPROM values are default, do not match MTM, or UGM fails to successfully read from 0x212, 0x213, or 0x214 three times during Startup	UGM determines that sensor is calibrated
873	MACHINE SAFETY SYSTEM OVERRIDE OCCURRED	UGM determines that an MSSO has occurred	TBD
991	LSS WATCHDOG RESET	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of an anomaly exists that has caused a WatchDog Timer reset.	Power cycle
992	LSS EEPROM ERROR	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of an anomaly that exists in the LSS EEPROM	Power cycle
993	LSS INTERNAL ERROR - PIN EXCITATION	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of improper excitation voltage	Power cycle
994	LSS INTERNAL ERROR - DRDY MISSING FROM A/D	MACHINE SETUP -> LOAD SYSTEM ≠ NO; UGM detects LSS report of an anomaly that exists in the LSS A/D converter operations.	Power cycle
998	EEPROM FAILURE - CHECK ALL SETTINGS	The UGM has detected an anomaly in EEPROM that can not be auto-corrected from the backup EEPROM bank.	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
9910	FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER	The UGM software version type is 'P' The UGM has received valid version information from the PM. The PM software version type is 'P' The UGM software major version number does not match the major version number of the platform software	Not all of the trigger conditions are met
9911	FUNCTIONS LOCKED OUT - LSS MODULE SOFTWARE VERSION IMPROPER	MACHINE SETUP -> LOAD SYSTEM ≠ NO; The UGM determines that the LSS software version is not compatible with existing code per the referenced Software Version Compatibility table.	Power cycle
9919	GROUND SENSOR REF VOLTAGE OUT OF RANGE	The UGM has detected reference voltage is out of range: 2.3V < Reference Voltage < 2.7V(debounced for 100ms)	Power cycle
9920	PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	The UGM detects that its reference voltage being reported by PM out of range (4.8V < voltage < 5.2V); debounced for 100ms	Power cycle
9921	GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY	The UGM footswitch input J7-15 is LOW	Power cycle
9922	PLATFORM MODULE FAILURE - HWFS CODE 1	The PM detects that its V(low) FET has failed and reports this fault to the UGM	Power cycle
9924	FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED	The machine is powered up and no model has been selected yet in the MACHINE SETUP menu	Power cycle
9927	GROUND MODULE CONSTANT DATA UPDATE REQUIRED	The UGM detects one of the following conditions when software type is 'P' or 'B': The Version Verification Word #1 or the Version Verification Word #2 values located in the constant data sector of flash memory (found on constant data spreadsheet tab pstConstantDataVersion) do not match the values located in the code area of flash memory. The Version Major value located in the constant data sector of flash memory (found on constant data spreadsheet tab pstConstantDataVersion) does not match the value located in the code area of flash memory.	A different application code or constant data version is programmed so that the values match; Power cycled
9944	CURRENT FEEDBACK GAINS OUT OF RANGE	One or more of the current feedback gains that are calculated and written to flash memory during the JDES manufacturing test process are detected as being out of range	Power cycle
9945	CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT	The current feedback gains checksum that is calculated and written to flash memory during the JDES manufacturing test process is detected as being incorrect	Power cycle
9949	MACHINE CONFIGURATION OUT OF RANGE - CHECK ALL SETTINGS	UGM has detected an anomaly in EEPROM with regard to the Machine Setup configuration.	Power cycle
9977	LSS CORRUPT EEPROM	MACHINE SETUP ->LOAD SYSTEM ≠ NO and one of the following conditions: UGM determines LSS-stored values for Unloaded weight in Indirect 0x100≠ 0x108 or UGM determines LSS-stored values for Accessory weight in Indirect 0x102≠ 0x10A; UGM determines LSS-stored checksum1 (0x10F) ≠ checksum 2 (0x107)	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
9979	FUNCTIONS LOCKED OUT - GROUND MODULE SOFTWARE VERSION IMPROPER	Ground software has been installed on a UGM with a ST10F274 processor (Hardware Rev < 6), which does not have guaranteed flash storage in the sector where Constant Data is written.	Power cycle
9986	GROUND MODULE VLOW FET FAILURE	VLow FET determined to be failed on Startup; UGM unable to read high-sensing inputs.	Power cycle
99167	PUMP COMMAND ERROR	Master Traction Module determines that an inconsistency has occurred between the Pump Enable bits and the Pump commands; Pump enable bit = set, but Pump Command = 0	Power cycle
99234	REAR LEFT MODULE - EEPROM FAILURE	Applicable Power Module determines at Startup that an internal EEPROM error exists or UGM fails to successfully verify or write to/read back Indirect Table three times	Power cycle
99235	REAR LEFT MODULE - PROTECTION FAILURE	Applicable Power Module determines that an internal failure exists in the hardware protection circuit	Power cycle
99236	REAR LEFT MODULE - CHECK POWER CIRCUITS OR MOSFET SHORT CIRCUITC	Applicable Power Module determines at Startup that a short circuit exists on the power MOSFET outputs	Power cycle
99237	REAR LEFT MODULE - WATCHDOG RESET	Applicable Power Module determines that Watchdog failure/reset has occurred to one if two, or both	Power cycle
99238	REAR LEFT MODULE - WATCHDOG2 RESET	Applicable Power Module determines that Watchdog2 failure/reset has occurred	Power cycle
99239	REAR LEFT MODULE - RAM FAILURE	Applicable Power Module determines that a RAM checksum error has occurred	Power cycle
99240	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that the current gain is incorrect and may cause incorrect data acquisition values	Power cycle
99241	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the data acquisition is in error	Power cycle
99242	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Pump current is being measured is not zero when expected to be zero at Startup or during standby	Power cycle
99243	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Slip Profile is in error	Power cycle
99244	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines that the current feedbacks are out of range at Startup or when in standby	Power cycle
99245	REAR LEFT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that there is a problem with overvoltage/undervoltage detection	Power cycle
99246	REAR LEFT MODULE - CAPACITOR BANK FAULT	The power capacitor bank of the Power Module is not charging properly (increasing voltage) at Startup	Power cycle
99247	REAR LEFT MODULE - A/D FAILURE	Applicable Power Module determines that an internal Analog Input error exists	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
99248	REAR RIGHT MODULE - EEPROM FAILURE	Applicable Power Module determines at Startup that an internal EEPROM error exists or UGM fails to successfully verify or write to/read back Indirect Table three times	Power cycle
99249	REAR RIGHT MODULE - PROTECTION FAILURE	Applicable Power Module determines that an internal failure exists in the hardware protection circuit	Power cycle
99250	REAR RIGHT MODULE - CHECK POWER CIRCUITS OR MOSFET SHORT CIRCUIT	Applicable Power Module determines at Startup that a short circuit exists on the power MOSFET outputs	Power cycle
99251	REAR RIGHT MODULE - WATCHDOG RESET	Applicable Power Module determines that Watchdog failure/reset has occurred to one if two, or both	Power cycle
99252	REAR RIGHT MODULE - WATCHDOG2 RESET	Applicable Power Module determines that Watchdog2 failure/reset has occurred	Power cycle
99253	REAR RIGHT MODULE - RAM FAILURE	Applicable Power Module determines that a RAM checksum error has occurred	Power cycle
99254	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that the current gain is incorrect and may cause incorrect data acquisition values	Power cycle
99255	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the data acquisition is in error	Power cycle
99256	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Pump current is being measured is not zero when expected to be zero at Startup or during standby	Power cycle
99257	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the Slip Profile is in error	Power cycle
99258	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines that the current feedbacks are out of range at Startup or when in standby	
99259	REAR RIGHT MODULE - INTERNAL ERROR	Applicable Power Module determines at Startup that there is a problem with overvoltage/undervoltage detection	Power cycle
99260	REAR RIGHT MODULE - CAPACITOR BANK FAULT	The power capacitor bank of the Power Module is not charging properly (increasing voltage) at Startup	Power cycle
99261	REAR RIGHT MODULE - A/D FAILURE	Applicable Power Module determines that an internal Analog Input error exists	Power cycle
99264	REAR LEFT MODULE - CURRENT MEASUREMENT ERROR	Power Module determines at when traction is active that the current feedback sensors are out of the permitted range and may cause incorrect data acquisition values	Power cycle
99265	REAR RIGHT MODULE - CURRENT MEASUREMENT ERROR	Power Module determines at when traction is active that the current feedback sensors are out of the permitted range and may cause incorrect data acquisition values	Power cycle
99270	REAR RIGHT MODULE - DRIVE COMMAND ERROR	Power Modules determine that an inconsistency has occurred between the Drive direction/enable bits and Drive magnitude/direction command	Power cycle

Table 6-11. Diagnostic Trouble Codes

DTC Cat	DTC Text	Fault Description	Solution
99269	REAR LEFT MODULE - DRIVE COMMAND ERROR	Power Modules determine that an inconsistency has occurred between the Drive direction/enable bits and Drive magnitude/direction command	Power cycle
99273	FUNCTIONS LOCKED OUT – REAR LEFT MODULE SOFTWARE VERSION IMPROPER	The UGM software version type is 'P' The UGM has received valid version information from all Power Modules. The Power Module major version number is not compliant with the version specified on the Software section of this document.	Not all of the trigger conditions are met
99274	FUNCTIONS LOCKED OUT – REAR RIGHT MODULE SOFTWARE VERSION IMPROPER	The UGM software version type is 'P' The UGM has received valid version information from all Power Modules. The Power Module major version number is not compliant with the version specified on the Software section of this document.	Not all of the trigger conditions are met
99281	FUNCTIONS LOCKED OUT - IMPROPER MOTOR PARAMETERS	The UGM determines an incorrect protected Indirect Table value at start-up	Power cycle

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SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

7.1 GENERAL

This section contains basic electrical information and schematics to be used for locating and correcting most of the operating problems which may develop. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

NOTE: *Some of the procedures/connectors shown in this section may not be applicable to all models.*

7.2 MULTIMETER BASICS

A wide variety of multimeter's or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the Voltage source.

Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the Voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

Polarity

Getting a negative Voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the Ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

μ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kW = 1200 W
Example: 50 mA = 0.05 A

Voltage Measurement

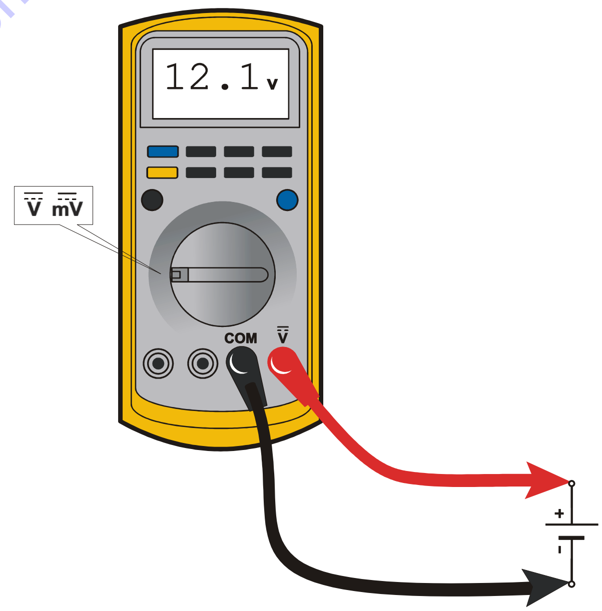


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual).
- Use firm contact with meter leads.

Resistance Measurement

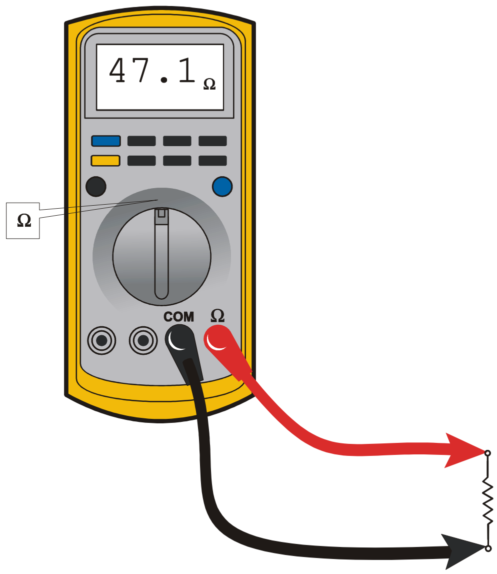


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance).
- Circuit power must be turned OFF before testing resistance.
- Disconnect component from circuit before testing.
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual).
- Use firm contact with meter leads.

Continuity Measurement

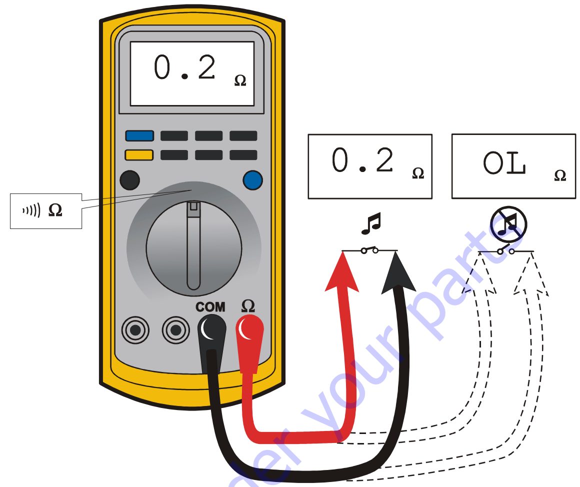


Figure 7-3. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing.
- Circuit power must be turned OFF before testing continuity.
- Disconnect component from circuit before testing.
- Use firm contact with meter leads.
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity.

Current Measurement

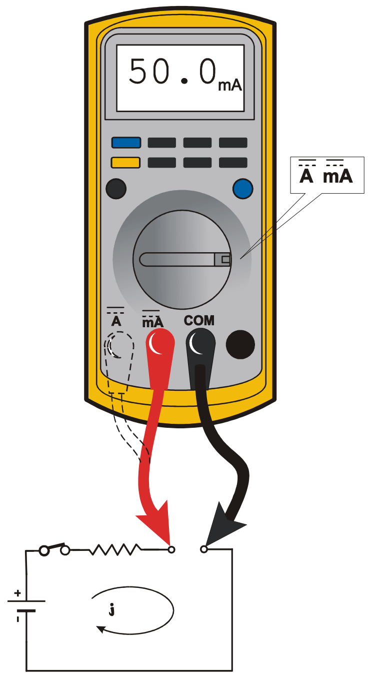


Figure 7-4. Current Measurement (DC)

- Set up the meter for the expected current range.
- Be sure to connect the meter leads to the correct jacks for the current range you have selected.
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual).
- Use firm contact with meter leads.

7.3 CHECKING SWITCHES

Basic Check

The following check determines if the switch is functioning properly, not the circuit in which the switch is placed. A switch is functioning properly when there is continuity between the correct terminals or contacts only when selected.

1. De-energize the circuit.
2. Isolate the switch from the rest of the circuit if possible. If not possible, keep in mind it may affect readings.
3. Access the terminals to the switch.
4. If the switch has two terminals:
    a. Measure resistance across the terminals.
    b. Change the switch position.
    c. Measure resistance again with the leads in the same positions. If the meter was reading short, it should read an open. If the meter was reading open it should read short.
5. If the switch has more than two terminals, consult the schematic or switch diagram to determine what terminals will be connected. The test is similar to testing a switch with two terminals.
    a. Place one meter lead on the common contact and the other on a different contact in the same circuit.
    b. Cycle through all positions of the switch. The meter should read short only when the switch connects the two terminals and open otherwise.
    c. If the switch has more than one common contact repeat the process for that circuit.

Limit Switches

Limit switches are used to control movement or indicate position. Mechanical limit switches are just like manually operated switches except that the moving object operates the switch. These switches can be tested the same way as a standard switch by manually operating the sensing arm.

Another type of limit switch used by JLG is the inductive proximity switch, also referred to as a "prox switch". Inductive proximity switches are actuated only by ferrous metal (metal that contains Iron, such as steel) near the switch. They do not require contact, and must be energized to actuate. These types of switches can be used to detect boom or platform position, for example. These switches have a sensing face where the switch can detect ferrous metal close to it. To find the sensing face, take note how the switch is mounted and how the mechanisms meet the switch. Test this type of switch as follows:

1. Remove proximity switch from its mount.
2. Reconnect harness if it was disconnected for step a, and turn on machine.
3. Hold switch away from metal and observe switch state in the control system diagnostics using the Analyzer. See vehicle or control system documentation on how to do this.
4. Place sensing face of switch on the object to be sensed by the switch. If that is not available, use a piece of ferrous metal physically similar to it. The switch state in the control system diagnostics should change.
5. When reinstalling or replacing switch be sure to follow mounting instructions and properly set the gap between the switch and object sensed.

Automatic Switches

If the switch is actuated automatically, by temperature or pressure for example, find a way to manually actuate the switch to test it. Do this either by applying heat or pressure, for example, to the switch. These switches may need to be energized to actuate.

1. Connect instrumentation to monitor and/or control the parameter the switch is measuring.
2. Observe switch state in control system with the Analyzer. See vehicle or control system documentation on how to do this.
3. Operate system such that the switch actuates. This could be going over a certain pressure or temperature, for example. The state indicated in the control system should change.

Switch Wiring - Low Side, High Side

When controlling a load, a switch can be wired between the positive side of the power source and the load. This switch is called a "high side" switch. The switch supplies the power to the load. When a switch is wired between the negative side of the power source and the load, it is a "low side" switch. The switch provides the ground to the load.

A low side switch will allow voltage to be present on the load. No power is applied because the switch is stopping current flow. This voltage can be seen if the measurement is taken with one test lead on the load and the other on the battery negative side or grounded to the vehicle. What is actually being measured is the voltage drop across the switch. This could mislead a technician into thinking the load is receiving power but not operating. To produce an accurate picture of power or voltage applied to the load, measure voltage across the load's power terminals. Also, the technician can measure the voltage at both power terminals with respect to battery ground. The difference between those two measurements is the voltage applied to the load.

7.4 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

NOTE: *This section is not applicable for battery terminals.*

NOTICE

JLG PN 0100048 DIELECTRIC GREASE (NOVAGARD G661) IS THE ONLY MATERIAL APPROVED FOR USE AS A DIELECTRIC GREASE.

NOTE: *DO NOT apply dielectric grease to the following connections:*

- Main Boom Rotary sensor connections (on Celesco Sensor),
- LSS Modules connections,
- Deutz EMR 2 ECM connection.

Silicone Dielectric Compound must be used on all electrical connections except for those mentioned above for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. This procedure applies to all plug connections not enclosed in a box. Silicone grease should not be applied to connectors with external seals.

1. To prevent oxidation, silicone grease must be packed completely around male and female pins on the inside of the connector prior to assembly. This is most easily achieved by using a syringe.

NOTE: *Over a period of time, oxidation increases electrical resistance at the connection, eventually causing circuit failure.*

2. To prevent shorting, silicone grease must be packed around each wire where they enter the outside of the connector housing. Also, silicone grease must be applied at the joint where the male and female connectors come together. Any other joints (around strain reliefs, etc.) where water could enter the connector should also be sealed.

NOTE: *This condition is especially common when machines are pressure washed since the washing solution is much more conductive than water.*

3. Anderson connectors for the battery boxes and battery chargers should have silicone grease applied to the contacts only.

NOTE: *Curing-type sealants might also be used to prevent shorting and would be less messy, but would make future pin removal more difficult.*

When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease could be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

7.5 DIELECTRIC GREASE APPLICATION

Dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Non-waterproof connectors benefit from the application of dielectric grease.

Installation

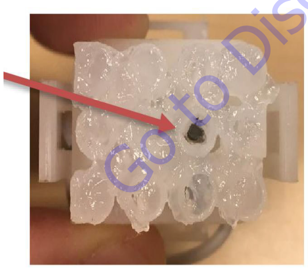
The following is general guidance for the installation of dielectric grease in a connector system.

- Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
- Apply dielectric grease to plug/male connector housing which typically contains sockets contact/female terminals.
- Leave a layer of dielectric grease on the mating face of the connector, completely covering each connector terminal hole. Refer the pictures shown below.
- Assemble the connector system immediately to prevent moisture ingress or dust contamination.

The following connector systems are specifically addressed because of their widespread use at JLG. However, this guidance may be applied to similar devices.

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the general guidance for installation.



Improper

Proper

AMP Faston

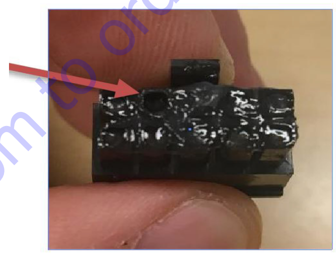
This connector system is typically used on operator switches at JLG. Follow the general guidance for installation.

Improper

Proper

AMP Micro-Fit

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

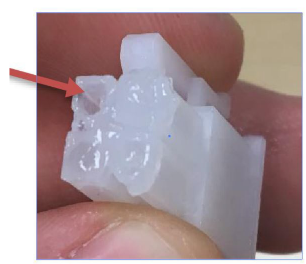


Improper

Proper

AMP Mini Fit Jr

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.

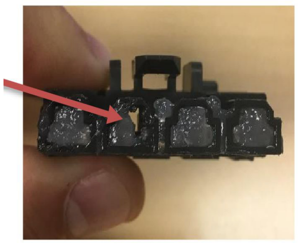


Improper

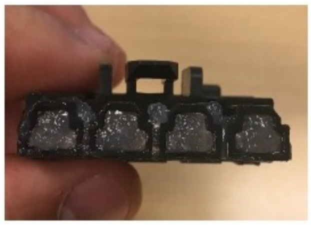
Proper

Mini Fit Sr

This connector system is typically used on control modules at JLG. Follow the general guidance for installation.



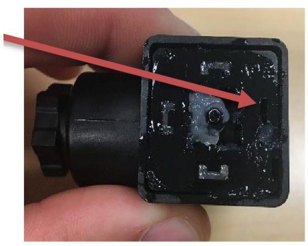
Improper



Proper

DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.



Improper

Proper

Exceptions

Some waterproof connector applications do benefit from dielectric grease, and some non waterproof connectors do not benefit from dielectric grease.

In the exceptions below, we have found dielectric grease is not needed for some applications, and in some cases can interfere with the intended connection. Dielectric grease shall be used as an exception in other applications.

Enclosures

Application of dielectric grease is not required in properly sealed enclosures. To meet criteria, the enclosure must be rated to at least IP56 (dust protected; protected from powerful jets of water).

Carling Switch Connectors

Carling switches may experience high impedance, or discontinuity, due to silicone dielectric grease ingress when switching inductive loads. Therefore, dielectric grease shall not be applied to Carling switch mating connectors unless specifically noted.

7.6 AMP CONNECTOR

Applying Silicone Dielectric Compound to AMP Connectors

Silicone Dielectric Compound must be used on the AMP connections for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors.

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

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-5.). Proceed as follows:

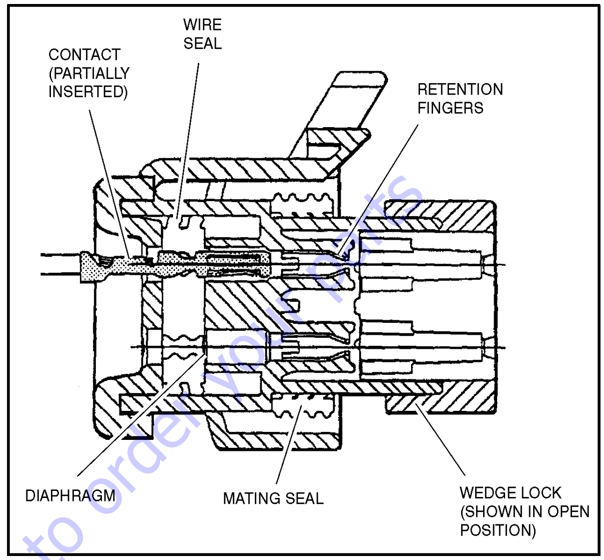


Figure 7-5. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-7.).
2. Pull back on the contact wire with a force of 1 or 2 lb to be sure the retention fingers are holding the contact (See Figure 7-7.).

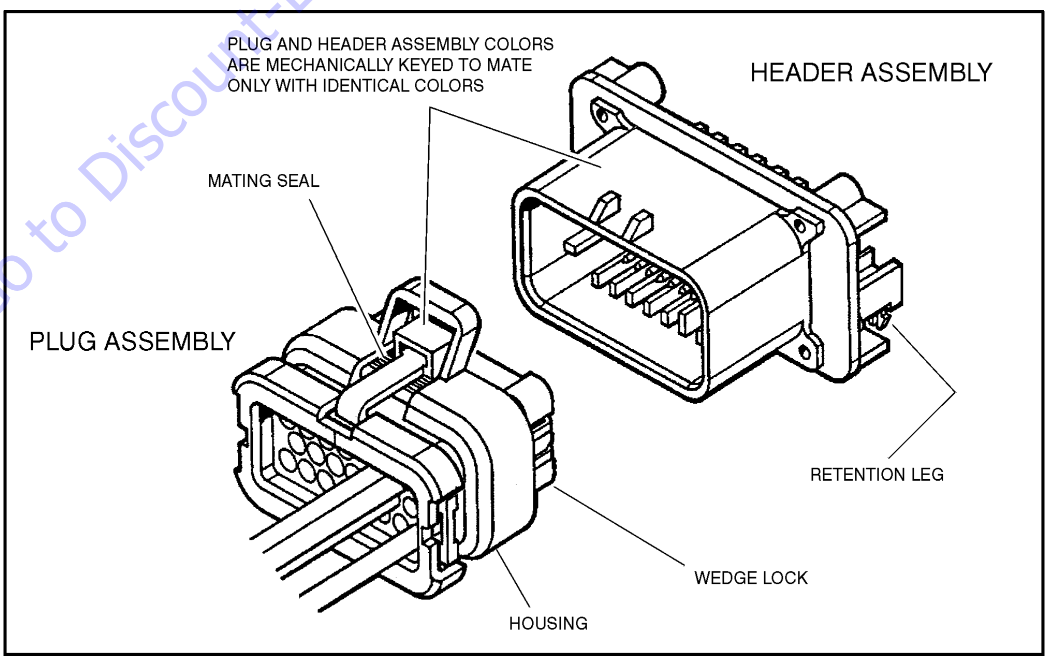


Figure 7-6. AMP Connector

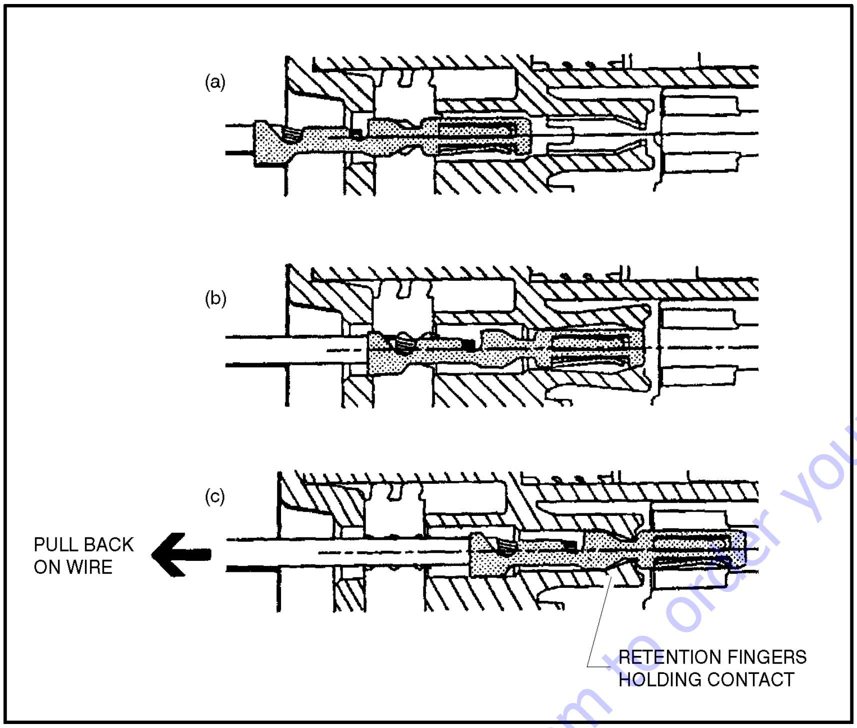


Figure 7-7. Connector Assembly Figure 2

3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (See Figure 7-8.).

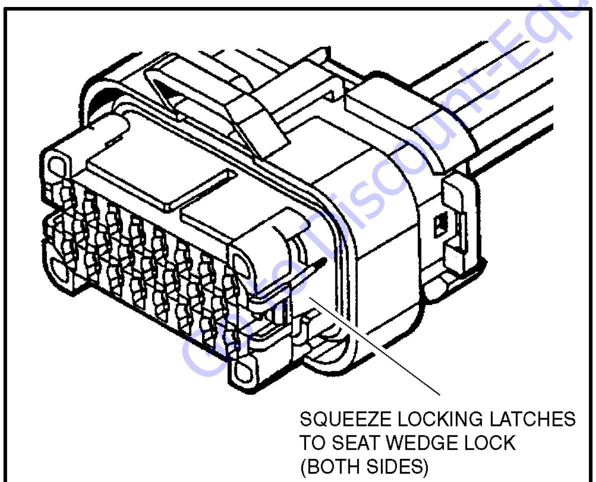


Figure 7-8. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-9.).

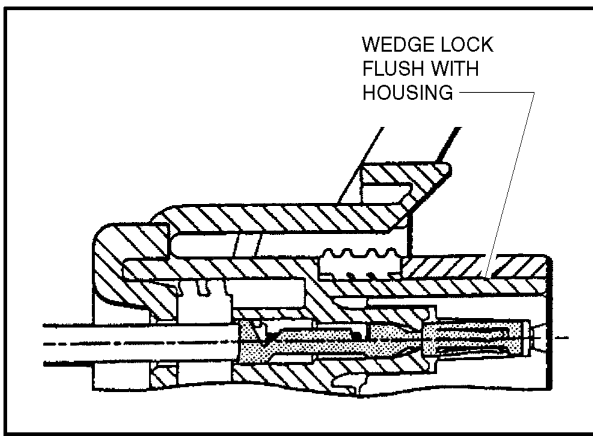


Figure 7-9. Connector Assembly Figure 4

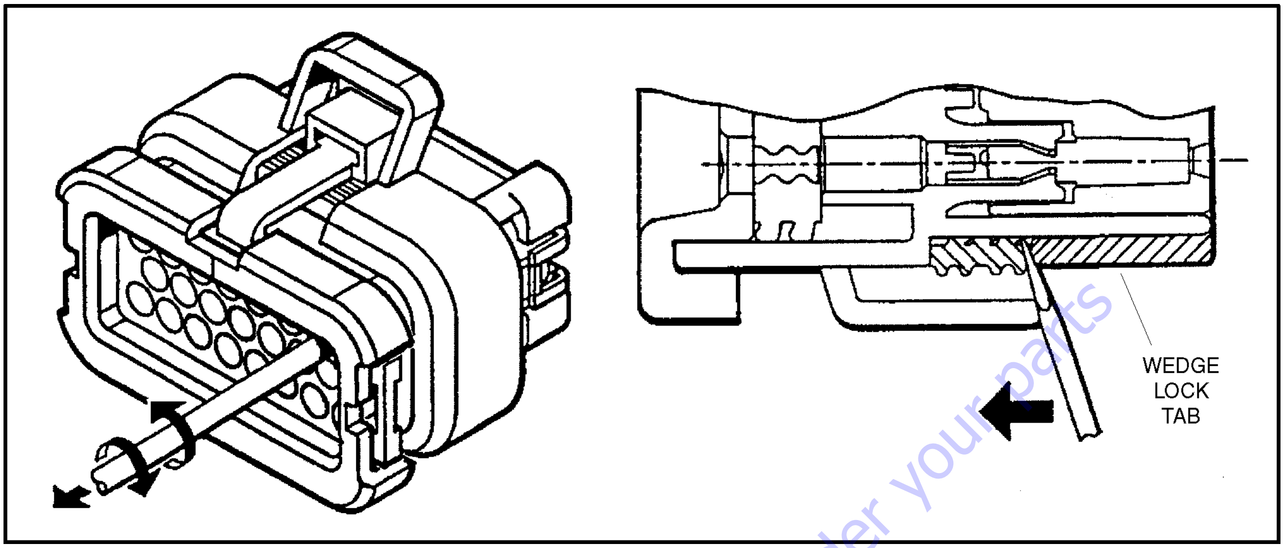


Figure 7-10. Connector Disassembly

Disassembly

1. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
2. Pry open the wedge lock to the open position.
3. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

NOTE: *The wedge lock should never be removed from the housing for insertion or removal of the contacts.*

Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

Service - Voltage Reading

NOTICE

DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMP SEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

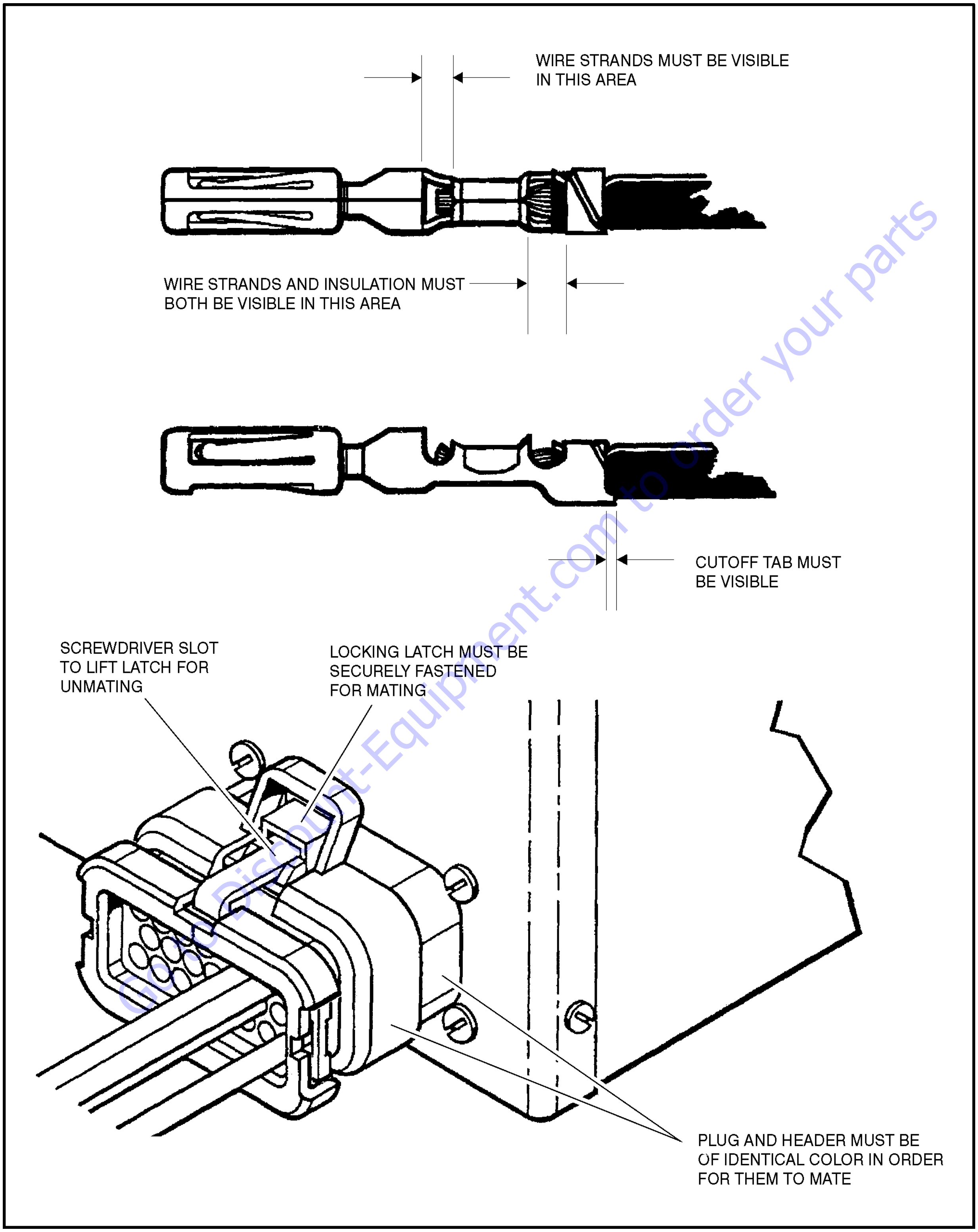


Figure 7-11. Connector Installation

7.7 DEUTSCH CONNECTORS

DT/DTP Series Assembly

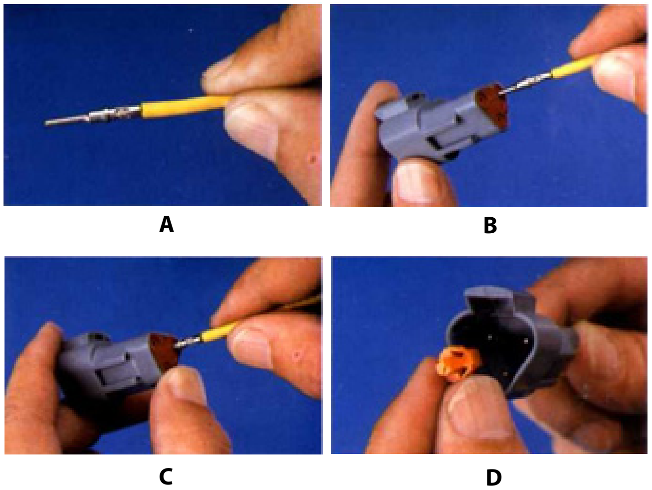


Figure 7-12. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. They may go in either way.

NOTE: *The receptacle is shown - use the same procedure for plug.*

DT/DTP Series Disassembly

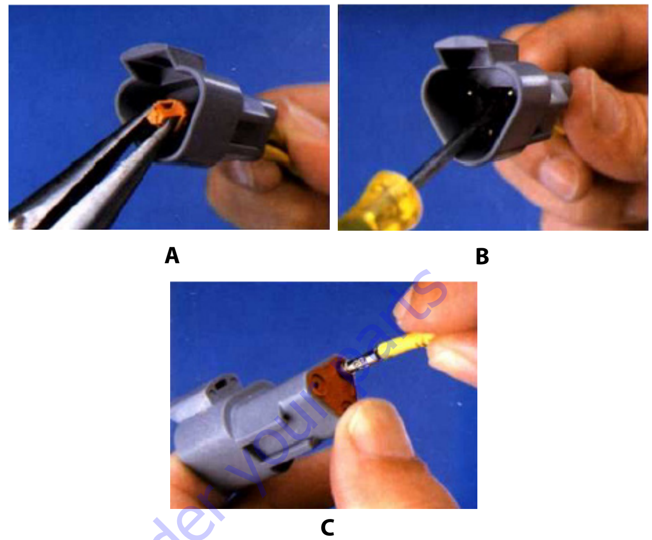


Figure 7-13. DT/DTP Contact Removal

5. Remove wedgelock using needle nose pliers or a hook shaped wire to pull wedge straight out.
6. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.
7. Hold the rear seal in place, as removing the contact may displace the seal.

HD30/HDP20 Series Assembly

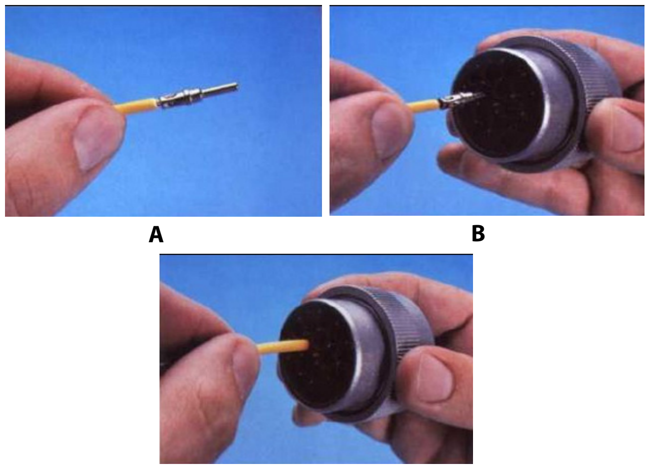


Figure 7-14. HD/HDP Contact Installation

8. Grasp contact about 25mm behind the contact crimp barrel.

9. Hold connector with rear grommet facing you.

10. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

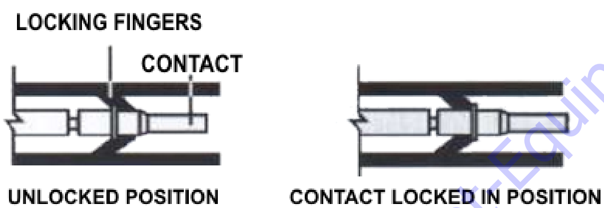


Figure 7-15. HD/HDP Locking Contacts Into Position

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

HD30/HDP20 Series Disassembly

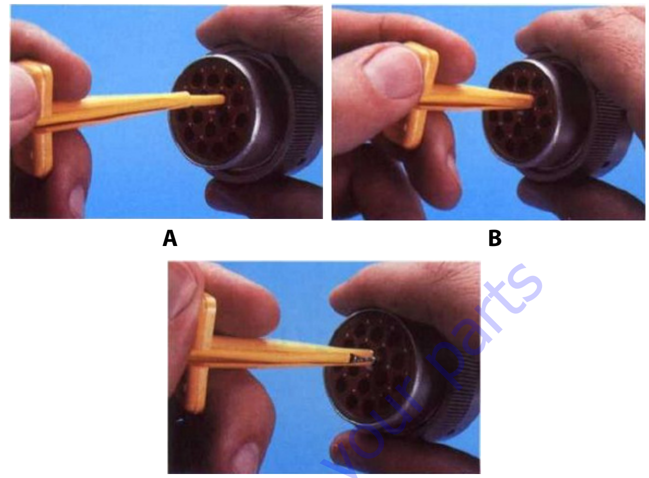


Figure 7-16. HD/HDP Contact Removal

11. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.

12. Slide tool along into the insert cavity until it engages contact and resistance is felt.

13. Pull contact-wire assembly out of connector.

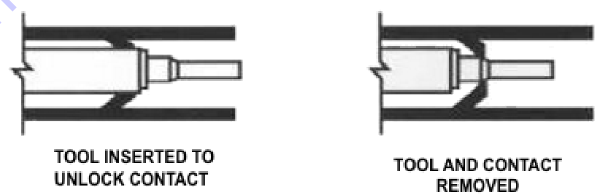


Figure 7-17. HD/HDP Unlocking Contacts

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

7.8 WIRING HARNESS CONNECTOR LABELS

Connector Labels

Connectors between harnesses are identified by the prefix "X" and a sequentially assigned number. An optional suffix (letters & numbers) may be added when multiple terminations occur at one device or when there are optional connections.

Example:

X25 connects to X25 in another harness

X65A, X65B connect to different portions of one device.

X163 connects to X163A in ANSI and X163B in CE machine.

Component Labels

Every component on the vehicle has a unique identification. A standard prefix letter is assigned according to the table below, followed by a unique sequential number. An optional suffix (letters & numbers) may be added when multiple terminations occur at one device.

Terminals that are not loaded into connectors are considered independent components and labeled in the same fashion.

Table 7-1. Wiring Harness Connector Labels

Components	Category	Label
Audible	Alarms	AH
	Horns	
Battery	Batteries	BT
	Battery Terminals	
Control Module	Ground	CO
	LSS	
	Platform	
Engine	Alternator	EC
	Cold Start	
	Controller	
	Coolant Temp	
	Fuel Pump	
	Fuel Solenoid	
	Glow Plugs	
	Oil Pressure	
	Starter	
Fuse & CB Fuse FC	Fuse	FC
	Fusible Link	FC
	Circuit Breaker	CB
Gauge & Display	Board	GD
	Cluster	
	Hour meter	
	LMI	
	Speedometer	
Inline	Resistor	R
	Diode	D
Joystick & Steering	Electronic	JS
	Hydraulic	
Lights	Dome	LB
	Headlights	
	Simple	
	Taillights	
Membrane Panel		MP
Miscellaneous	Radio	MS
	Speakers	
	Splice Blocks	
	T-Connectors	

Table 7-1. Wiring Harness Connector Labels

	Category	Label
Other Switches	Disconnect	SW
	EMS	
	Foot	
	HVAC	WH
	Key	SW
	Park brake	
	Pump pot	
	Push	
	Shifter	
	Turn signal	
Relay	5 Pin	RL
	4 Pin	
	Contactor	
	Power module	
Rocker Switch		SW
Sensor	Angle	SN
	Fuel	
	Length	
	Limit	
	Load	
	Pressure	
	Proximity	
	Speed	
	Temperature	
Terminals	Pins	T
	Sockets	
	Male Blades	
	Female Blades	
	Rings	
	Forks	
Toggle Switch	DPDT	SW
	DPST	
	SPDT	
	SPST	
	Special	
Valves	Simple	HV
	Suppression	

Examples:
T67 is a ring terminal connected during installation.
C01-J3 is the J3 connector for a UGM control module.
EC9 is a glow plug supplied with the engine

7.9 ELECTRICAL HARNESS

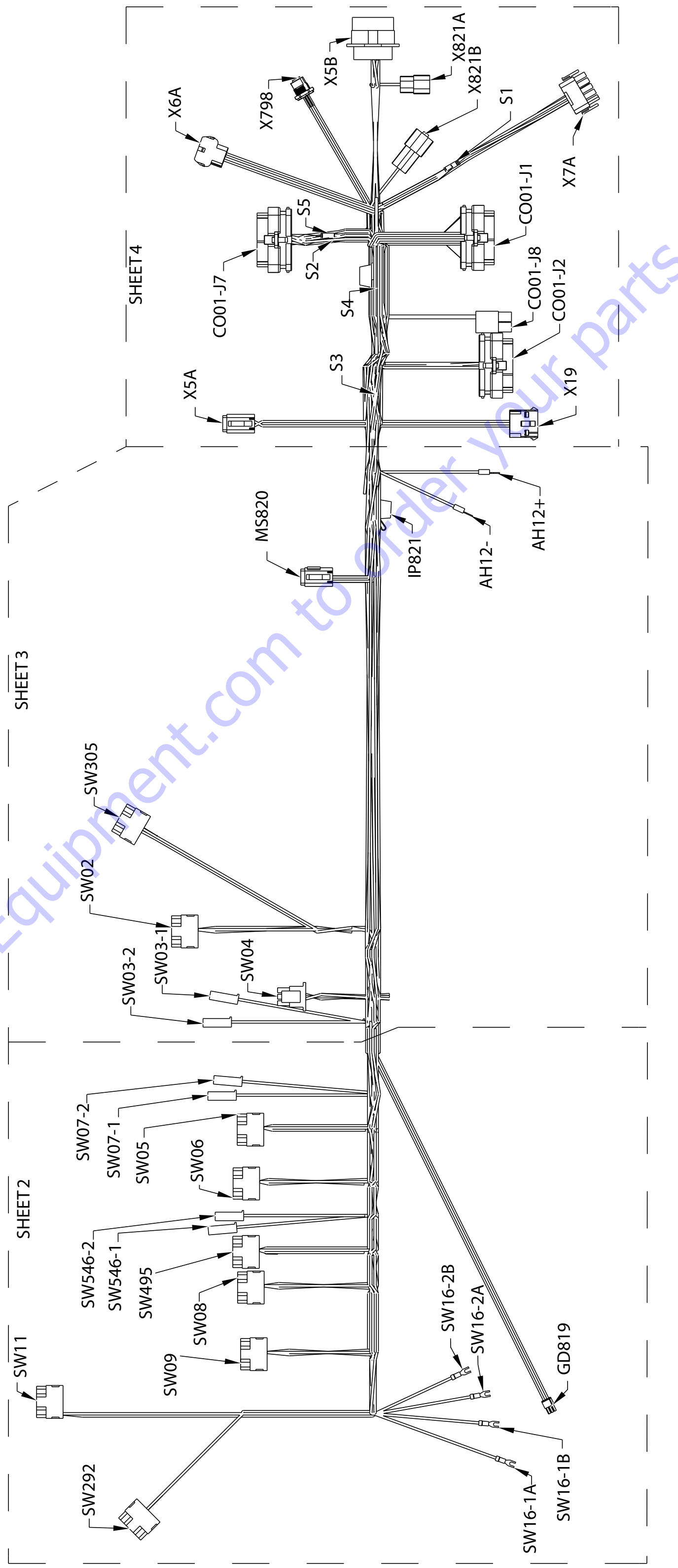


Figure 7-18. Platform Console Harness - Sheet 1 of 5

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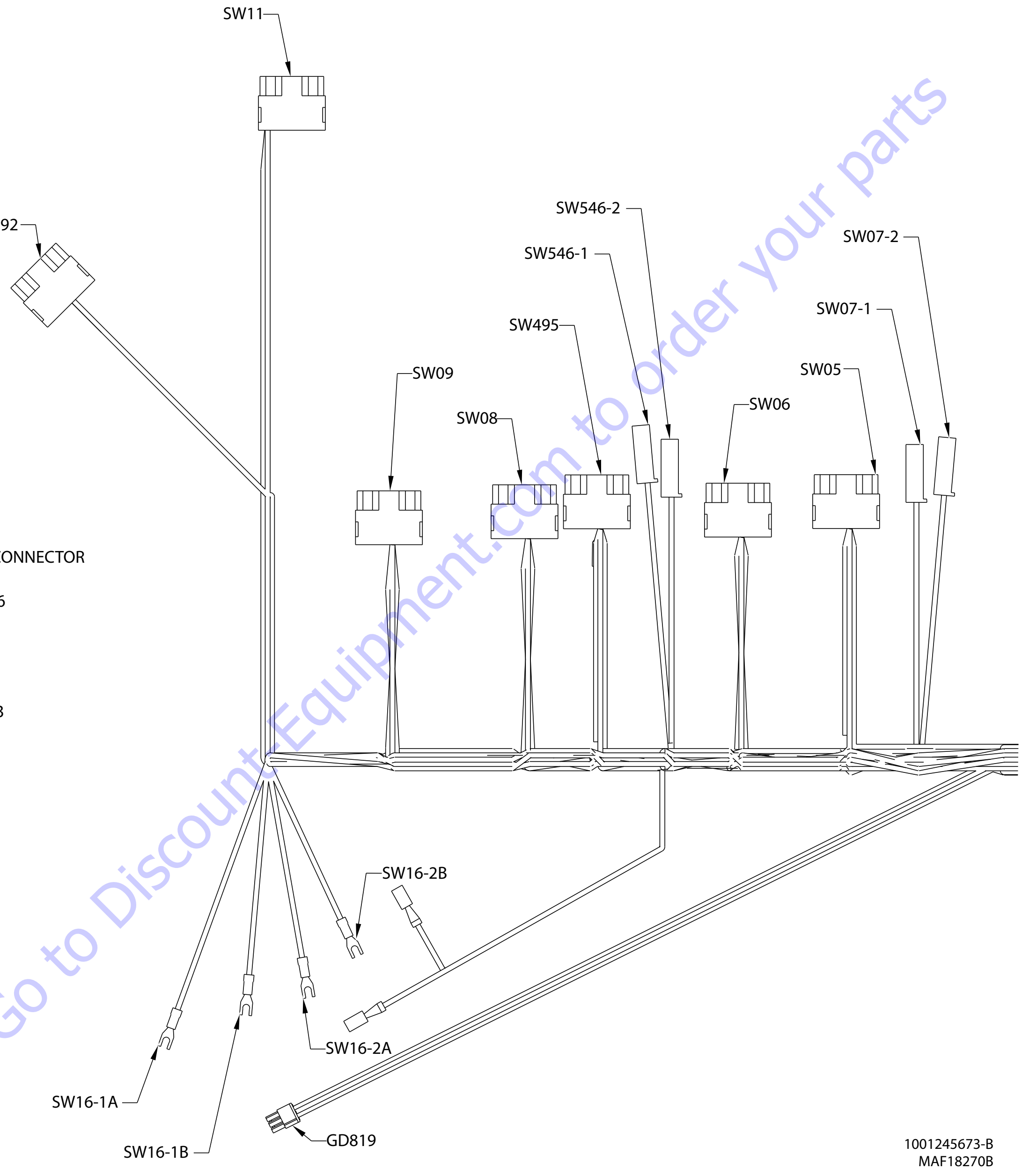

TOP, LOADING VIEW OF CONNECTOR

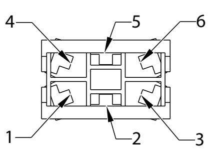

Figure 7-19. Platform Console Harness - Sheet 2 of 5

SW11-DRIVE ORIENT					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	122-1 DOS	18 AWG	GXL	C001-J2 (4)
2	WHT	5-14-10 SW PWR	18 AWG	GXL	SW546-2 (1)
2	WHT	5-14-9 SW PWR	18 AWG	GXL	SW03-1 (1)
3					
4					
5					
6					

SW292 GEN ENABLE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	X5B (7)
3	WHT	8-3 GEN ENABLE	18 AWG	GXL	X5B (5)
4					
5					
6					

SW09-MAIN TELESCOPE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	C001-J1 (6)
2	WHT	5-14-2 SW PWR	18 AWG	GXL	SW06 (2)
2	WHT	5-14-3 SW PWR	18 AWG	GXL	SW05 (2)
3	WHT	13-0 MAIN TELE IN	18 AWG	GXL	C001-J1 (5)
4					
5					
6					

SW16-1A-EMS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1A	WHT	5-11-2	18 AWG	GXL	X5B (9)

SW08-JIB					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	28-0 JIB DN	18 AWG	GXL	C001-J1 (12)
2	WHT	5-14-5 SW PWR	18 AWG	GXL	SW02 (2)
2	WHT	5-14-6 SW PWR	18 AWG	GXL	SW495 (2)
3	WHT	27-0 JIB UP	18 AWG	GXL	C001-J1 (11)
4					
5					
6					

SW16-1B-EMS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1B	WHT	5-2-6	18 AWG	GXL	X5B (13)

SW16-2A-EMS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
2A	WHT	5-11-3	18 AWG	GXL	C001-J7 (2)

SW16-2B-EMS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
2B	WHT	5-2-5	18 AWG	GXL	X5B (15)

SW495-SIDE SWING					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	C001-J1 (26)
2	WHT	5-14-6 SW PWR	18 AWG	GXL	SW08 (2)
2	WHT	5-14-7	18 AWG	GXL	SW04 (1)
3	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	C001-J1 (25)
4					
5					
6					

SW06-TOWER LIFT					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	29-30 TWR LFT DN	18 AWG	GXL	C001-J1 (2)
2	WHT	5-14-1 SW PWR	18 AWG	GXL	SW305 (2)
2	WHT	5-14-2 SW PWR	18 AWG	GXL	SW09 (2)
3	WHT	29-0 TWR LFT UP	18 AWG	GXL	C001-J1 (1)
4					
5					
6					

SW546-1-SKYGUARD/SOFTTOUCH OVERRIDE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	124-3 OVERRIDE	18 AWG	GXL	C001-J1 (29)

SW546-2-SKYGUARD/SOFTTOUCH OVERRIDE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	5-14-10SW PWR	18 AWG	GXL	SW11(2)
1	WHT	5-14-11SW PWR	18 AWG	GXL	SW07-2 (1)

SW05-PLATFORM ROTATE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	23-0 PLAT ROT LFT	18 AWG	GXL	C001-J1 (8)
2	WHT	5-14-3 SW PWR	18 AWG	GXL	SW09 (2)
2	WHT	5-14-4 SW PWR	18 AWG	GXL	SW02 (2)
3	WHT	24-0 PLAT ROT RT	18 AWG	GXL	C001-J1 (7)
4					
5					
6					

SW07-1-HEAD/TAIL LIGHTS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	88-1 HEAD/TAIL LT	18 AWG	GXL	C001-J1 (30)

SW07-2-HEAD/TAIL LIGHTS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	5-14-11 SW PWR	18 AWG	GXL	SW546-2 (1)

GD819					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN1 HIGH	20 AWG	TXL	MS820 (2)
2					
3	WHT	1-90 DISPLAY PWR	20 AWG	TXL	IP821 (1)
4	GRN	CAN1 LOW	20 AWG	TXL	MS820 (8)
5					
6	WHT	1-26 DISPLAY GND	20 AWG	TXL	C001-J2 (18)

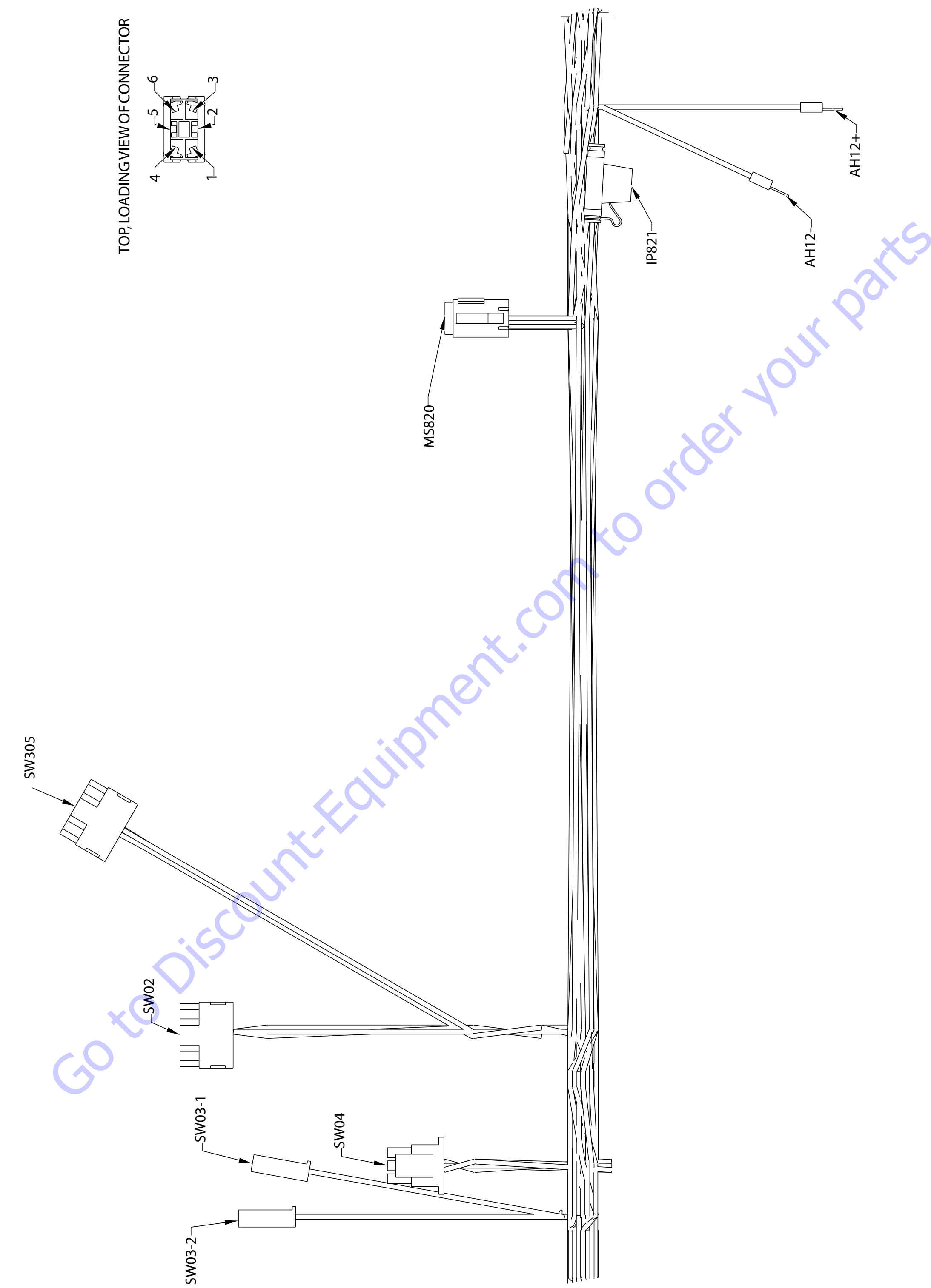

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Figure 7-20. Platform Console Harness - Sheet 3 of 5

SW03-2- HORN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	49-0-1 HORN	18 AWG	GXL	C001-J1 (31)

SW03-1- HORN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	5-14-8 SW PWR	18 AWG	GXL	SW04 (1)
1	WHT	5-14-9 SW PWR	18 AWG	GXL	SW11(2)

SW04-PUMP POT					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	5-14-7	18 AWG	GXL	SW495 (2)
1	WHT	5-14-8 SW PWR	18 AWG	GXL	SW03-1 (1)
2	WHT	5-14 SW PWR	18 AWG	GXL	C001-J1 (18)
3	WHT	125-1 CREEP MODE	18 AWG	GXL	C001-J1 (32)
4	WHT	126-1 PUMP POT PWR	18 AWG	GXL	C001-J1 (34)
5	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	C001-J1 (13)
6	WHT	126-2 PUMP POT CMD	18 AWG	GXL	C001-J1 (35)

SW02-PLATFORM LEVEL					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	26-0 PLAT LVLDN	18 AWG	GXL	C001-J1 (10)
2	WHT	5-14-4 SW PWR	18 AWG	GXL	SW05 (2)
2	WHT	5-14-5 SW PWR	18 AWG	GXL	SW08 (2)
3	WHT	25-0 PLAT LVL UP	18 AWG	GXL	C001-J1 (9)
4					
5					
6					

SW305-TORQUE/SPEED MODE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	120-2 AWDA MAN	18 AWG	GXL	C001-J1 (28)
2	WHT	5-14-1 SW PWR	18 AWG	GXL	SW06 (2)
3	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	C001-J1 (27)
4					
5					
6					

MS820-CAN BUSS BAR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	YEL	CAN1 HIGH	20 AWG	TXL	GD819 (1)
3	YEL	CAN1 HIGH	18 AWG	GXL	C001-J7 (31)
4	GRN	CAN1 LOW	18 AWG	GXL	C001-J7 (30)
5	GRY	CAN1 LOW	20 AWG	CABLE	X798 (5)
6	GRN	CAN1 LOW	18 AWG	GXL	X821B (2)
7	GRN	CAN1 LOW	18 AWG	GXL	X6A(9)
8	GRN	CAN1 LOW	20 AWG	TXL	GD819 (4)
9					
10	BLK	CAN1 HIGH	20 AWG	CABLE	X798 (4)
11	YEL	CAN1 HIGH	18 AWG	GXL	X821B (1)
12	YEL	CAN1 HIGH	18 AWG	GXL	X6A(8)

AH12--ALARM-					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	1-27 ALARM GND	18 AWG	GXL	C001-J7 (20)

AH12+-ALARM+					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	132 PLAT ALARM	18 AWG	GXL	C001-J7 (19)

IP821					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	1-90 DISPLAY PWR	20 AWG	TXL	GD819 (3)
2	WHT	1-90 DISPLAY PWR	18 AWG	GXL	C001-J2 (30)

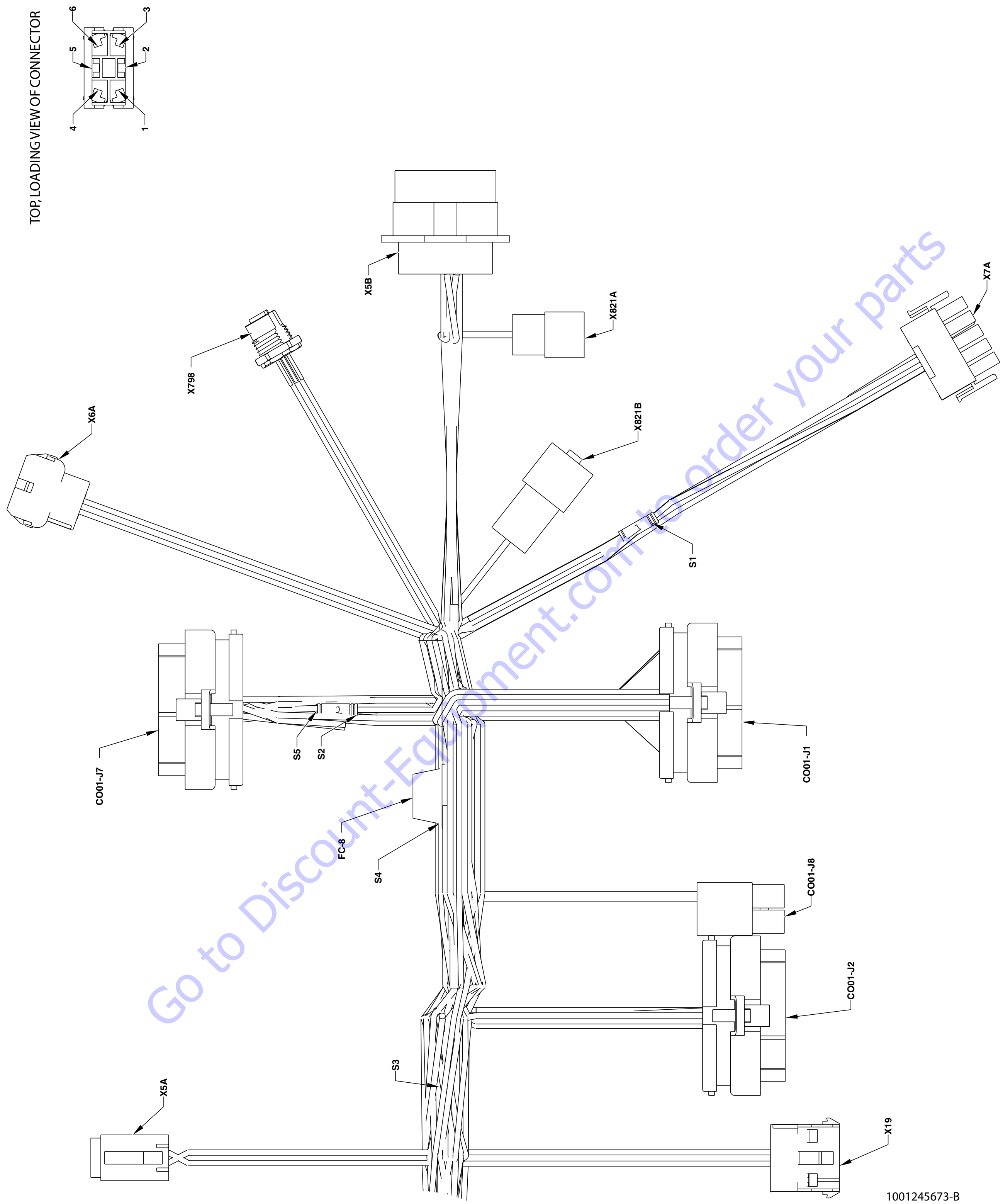

Figure 7-21. Platform Console Harness - Sheet 4 of 5

C001-J7-BLACK					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	81-0GND MODE RX	18 AWG	GXL	X5B (11)
2	WHT	5-11-3	18 AWG	GXL	SW16-2A(2A)
3	WHT	82-0 PLAT TX	18 AWG	GXL	X5B (4)
4	WHT	3-16FOOTSWITCH	18 AWG	GXL	X7A(5)
5					
6					
7	WHT	3-18 SKYG PWR	18 AWG	GXL	S5 (1)
8	WHT	131-1 FOOTSWITCH	18 AWG	GXL	X7A(4)
9					
10					
11					
12					
13					
14					
15					
16	WHT	1-28 LSS GND	18 AWG	GXL	S2 (1)
17					
18	WHT	124-1 SKYG INPUT#1	20 AWG	SXL	X5A (4)
19	WHT	132 PLAT ALARM	18 AWG	GXL	AH12+ (1)
20	WHT	1-27 ALARM GND	18 AWG	GXL	AH12- (1)
21	WHT	25-0-3 PLAT LVL UP	18 AWG	GXL	X6A (13)
22	WHT	26-0-3 PLAT LVL DN	18 AWG	GXL	X6A (14)
23	WHT	1-30 VLV GND	18 AWG	GXL	X6A (5)
24	WHT	1-36 SKYG GND	18 AWG	GXL	X5A (2)
25					
26					
27	WHT	31-0-3 JIB RHT	18 AWG	GXL	X6A (11)
28	WHT	30-0-3 JIB LFT	18 AWG	GXL	X6A (12)
29	WHT	1-29 OPTION GND	18 AWG	GXL	X6A (6)
30	GRN	CAN1 LOW	18 AWG	GXL	MS820 (4)
31	YEL	CAN1 HIGH	18 AWG	GXL	MS820 (3)
32					
33	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	X6A (1)
34	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	X6A (2)
35					

X5A-INTERFACE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	3-18-1 SKYG PWR	20 AWG	GXL	S3 (2)
2	WHT	1-36 SKYG GND	18 AWG	GXL	C001-J7 (24)
3	WHT	3-18-2 SOFTT SENSE	20 AWG	GXL	S3 (2)
4	WHT	124-1 SKYG INPUT#1	20 AWG	GXL	C001-J7 (18)
5	WHT	124-2 SKYG INPUT#2	20 AWG	GXL	C001-J1 (23)
6	WHT	124-5-1 SOFTT OUT	20 AWG	GXL	S4 (2)

X6A-OPTIONS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	23-0-3 PLAT ROT LFT	18 AWG	GXL	C001-J7 (33)
2	WHT	24-0-3 PLAT ROT RHT	18 AWG	GXL	C001-J7 (34)
3					
4					
5	WHT	1-30 VLV GND	18 AWG	GXL	C001-J7 (23)
6	WHT	1-29 OPTION GND	18 AWG	GXL	C001-J7 (29)
7					
8	YEL	CAN1 HIGH	18 AWG	GXL	MS820 (12)
9	GRN	CAN1 LOW	18 AWG	GXL	MS820 (7)
10					
11	WHT	31-0-3 JIB RHT	18 AWG	GXL	C001-J7 (27)
12	WHT	30-0-3 JIB LFT	18 AWG	GXL	C001-J7 (28)
13	WHT	25-0-3 PLAT LVL UP	18 AWG	GXL	C001-J7 (21)
14	WHT	26-0-3 PLAT LVL DN	18 AWG	GXL	C001-J7 (22)
15					

X798-1 CELL LSS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	WHT	3-20-2 LSS PWR	20 AWG	CABLE	S1 (1)
3	BLU	1-28-2 LSS GND	20 AWG	CABLE	S2 (2)
4	BLK	CAN1 HIGH	20 AWG	CABLE	MS820 (10)
5	GRY	CAN1 LOW	20 AWG	CABLE	MS820 (5)

X5B-TO BOOM CABLE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	GRN	CAN1 LOW	18 AWG	GXL	X821A(2)
3	YEL	CAN1 HIGH	18 AWG	GXL	X821A(1)
4	WHT	82-0 PLAT TX	18 AWG	GXL	C001-J7 (3)
5	WHT	8-3 GEN ENABLE	18 AWG	GXL	SW292 (3)
6	WHT	131-3 FOOT PEDAL	18 AWG	GXL	X7A(6)
7	WHT	2-12-2 GEN ENABLE IGN	18 AWG	GXL	SW292 (2)
8					
9	WHT	5-11-2	18 AWG	GXL	SW16-1A(1A)
10					
11	WHT	81-0 GND MODE RX	18 AWG	GXL	C001-J7 (1)
12	WHT	3-8 PLAT IGN	12 AWG	GXL	C001-J8 (2)
13	WHT	5-2-6	18 AWG	GXL	SW16-1B (1B)
14					
15	WHT	5-2-5	18 AWG	GXL	SW16-2B (2B)
16	WHT	1-5 PLAT GND	12 AWG	GXL	C001-J8 (1)
17					
18					
19					

X7A-FOOT SW/LSS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3	WHT	1-551JUMPER	18 AWG	GXL	X7A(13)
4	WHT	131-1 FOOT SWITCH	18 AWG	GXL	C001-J7 (8)
5	WHT	3-16 FOOT SWITCH	18 AWG	GXL	C001-J7 (4)
6	WHT	131-3 FOOT PEDAL	18 AWG	GXL	X5B (6)
7					
8					
9	WHT	3-25 SOFTT PWR	18 AWG	GXL	C001-J2 (31)
10					
11					
12	WHT	124-5-2 SOFTT OUT	20 AWG	GXL	S4 (1)
13	WHT	1-551 JUMPER	18 AWG	GXL	X7A(3)
14	WHT	1-28-1 LSS GND	18 AWG	GXL	S2 (2)
15	WHT	3-20-1 LSS PWR	18 AWG	GXL	S1 (2)

C001-J8					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	1-5 PLAT GND	12 AWG	GXL	X5B (16)
2	WHT	3-8 PLAT IGN	12 AWG	GXL	X5B (12)

X821B					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN1 HIGH	18 AWG	GXL	MS820 (11)
2	GRN	CAN1 LOW	18 AWG	GXL	MS820 (6)
3					

X821A					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN1 HIGH	18 AWG	GXL	X5B (3)
2	GRN	CAN1 LOW	18 AWG	GXL	X5B (2)
3					

S1					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	3-20 LSS PWR	18 AWG	GXL	C001-J2 (32)
1	WHT	3-20-2 LSS PWR	20 AWG	CABLE	X798 (2)
2	WHT	3-20-1 LSS PWR	18 AWG	GXL	X7A(15)

C001-J2-GRAY					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3					
4	WHT	122-1 DOS	18 AWG	GXL	SW11(1)
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16	WHT	1-31 SG/ST	18 AWG	GXL	LB823+ (1)
17					
18	WHT	1-26 DISPLAY GND	20 AWG	TXL	GD819 (6)
19					
20					
21					
22					
23					
24					
25	BLK	1-32 GND	18 AWG	GXL	LB823- (1)
26	RED	51-0 ANALYZER PWR	18 AWG	GXL	X19 (1)
27	BLK	54-0 ANALYZER GND	18 AWG	GXL	X19 (4)
28	GRN	52-0 ANALYZER RX	18 AWG	GXL	X19 (2)
29	WHT	53-0 ANALYZER TX	18 AWG	GXL	X19 (3)
30	WHT	1-90 DISPLAY PWR	18 AWG	GXL	IP821 (2)
31	WHT	3-25 SOFTT PWR	18 AWG	GXL	X7A(9)
32	WHT	3-20 LSS PWR	18 AWG	GXL	S1 (1)
33					
34					
35					

S2					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	1-28LSS GND	18 AWG	GXL	C001-J7 (16)
2	WHT	1-28-1 LSS GND	18 AWG	GXL	X7A(14)
2	BLU	1-28-2 LSS GND	20 AWG	CABLE	X798 (3)

S3					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK		14 AWG	GXL	FC-8 (2)
2	WHT	3-18-1 SKYG PWR	20 AWG	GXL	X5A(1)
2	WHT	3-18-2 SOFTT SENSE	20 AWG	GXL	X5A(3)

S4					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	124-5 SOFTT	20 AWG	GXL	C001-J1 (20)
1	WHT	124-5-2 SOFTT OUT	20 AWG	GXL	X7A(12)
2	WHT	124-5-1 SOFTT OUT	20 AWG	GXL	X5A(6)

S5					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	3-18 SKYG PWR	18 AWG	GXL	C001-J7 (7)
2	BLK		14 AWG	GXL	FC-8 (1)

FC-8-5A SKYG FUSE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK		14 AWG	GXL	S5 (2)
2	BLK		14 AWG	GXL	S3 (1)

X19-ANALYZER					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	51-0 ANALYZER PWR	18 AWG	GXL	C001-J2 (26)
2	GRN	52-0 ANALYZER RX	18 AWG	GXL	C001-J2 (28)
3	WHT	53-0 ANALYZER TX	18 AWG	GXL	C001-J2 (29)
4	BLK	54-0 ANALYZER GND	18 AWG	GXL	C001-J2 (27)

C001-J1-NATURAL					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	29-0 TWR LFT UP	18 AWG	GXL	SW06 (3)
2	WHT	29-30 TWR LFT DN	18 AWG	GXL	SW06 (1)
3					
4					
5	WHT	13-0 MAIN TELE IN	18 AWG	GXL	SW09 (3)
6	WHT	14-0 MAIN TELE OUT	18 AWG	GXL	SW09 (1)
7	WHT	24-0 PLAT ROT RT	18 AWG	GXL	SW05 (3)
8	WHT	23-0 PLAT ROT LFT	18 AWG	GXL	SW05 (1)
9	WHT	25-0 PLAT LVL UP	18 AWG	GXL	SW02 (3)
10	WHT	26-0 PLAT LVL DN	18 AWG	GXL	SW02 (1)
11	WHT	27-0 JIB UP	18 AWG	GXL	SW08 (3)
12	WHT	28-0 JIB DN	18 AWG	GXL	SW08 (1)
13	WHT	1-23 PUMP POT RETURN	18 AWG	GXL	SW04 (5)
14					
15					
16					
17					
18	WHT	5-14 SW PWR	18 AWG	GXL	SW04 (2)
19					
20	WHT	124-5 SOFTT	20 AWG	GXL	S4 (1)
21					
22					
23	WHT	124-2 SKYG INPUT#2	20 AWG	GXL	X5A(5)
24					
25	WHT	32-0 SIDE SWING RIGHT	18 AWG	GXL	SW495 (3)
26	WHT	31-0 SIDE SWING LEFT	18 AWG	GXL	SW495 (1)
27	WHT	120-1 TORQUE/SPEED MODE	18 AWG	GXL	SW305 (3)
28	WHT	120-2AWDA MAN	18 AWG	GXL	SW305 (1)
29	WHT	124-3 OVER RIDE	18 AWG	GXL	SW546-1 (1)
30	WHT	88-1 HEAD/TAIL LT	18 AWG	GXL	SW07-1 (1)
31	WHT	49-0-1 HORN	18 AWG	GXL	SW03-2 (1)
32	WHT	125-1 CREEP MODE	18 AWG	GXL	SW04 (3)
33					
34	WHT	126-1 PUMP POT PWR	18 AWG	GXL	SW04 (4)
35	WHT	126-2 PUMP POT CMD	18 AWG	GXL	SW04 (6)

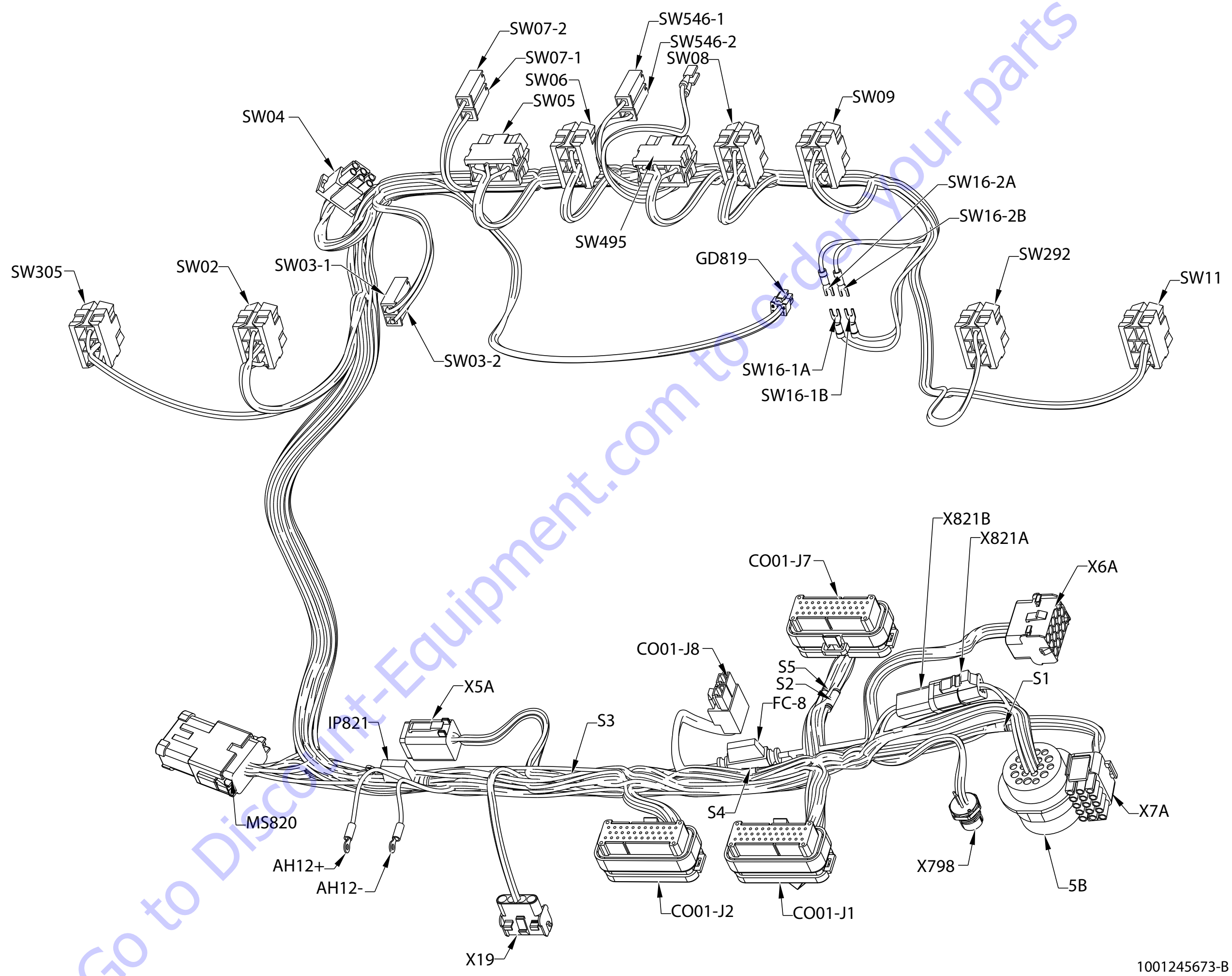

Figure 7-22. Platform Console Harness - Sheet 5 of 5

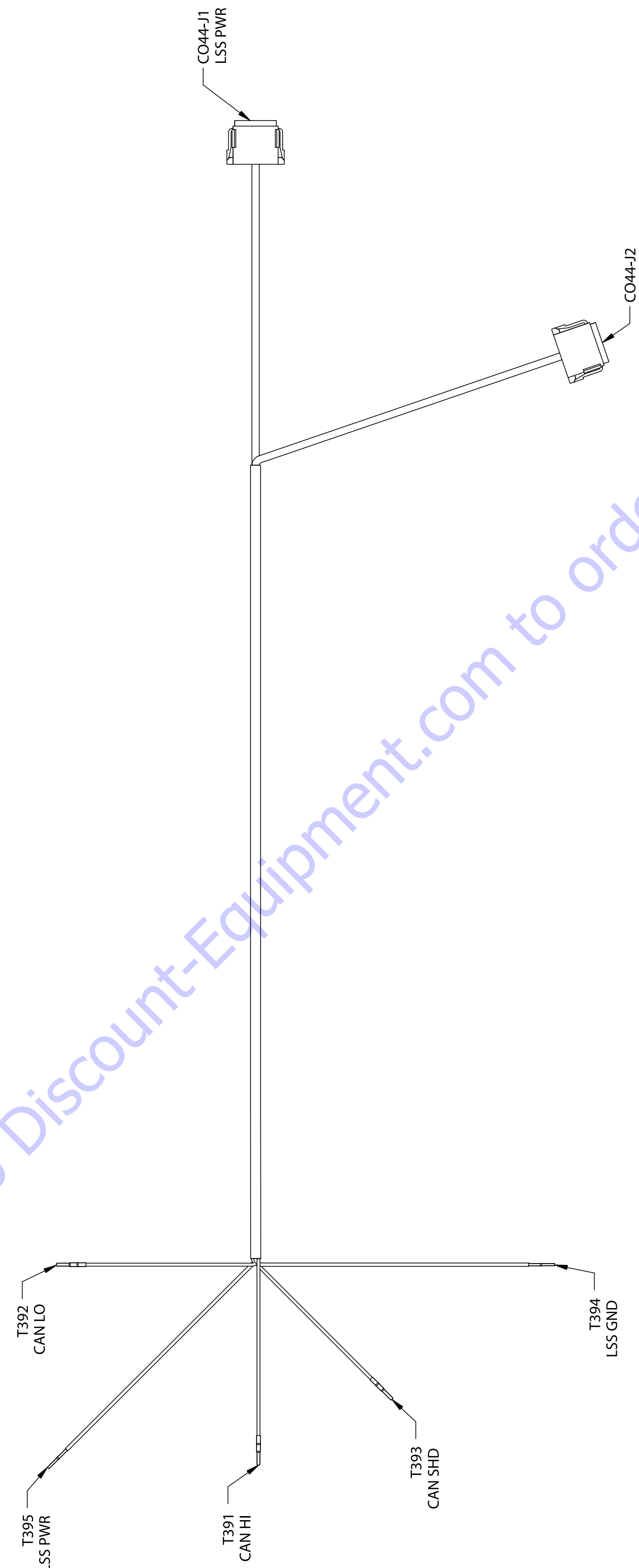

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Figure 7-23. Load Sensing System Harness (LSS) - Sheet 1 of 2

T394 - LSS GND							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	1-28 LSS GND	18 AWG	GXL	N/A		CO44-J1 (2)

T395 - LSS PWR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-20 LSS PWR	18 AWG	GXL	N/A		CO44-J1 (1)

T393 - CAN SHD							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHLD	TP CAN CABLE	20 AWG	J1939 CABLE	N/A		CO44-J2 (NC)

T392 - CAN LO							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	GRN	TP CAN CABLE	20 AWG	J1939 CABLE	N/A		CO44-J2 (9)

T391 - CAN HI							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	TP CAN CABLE	20 AWG	J1939 CABLE	N/A		CO44-J2 (4)

CO44-J2 - LSS CAN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460466		
2					4460466		
3					4460466		
4	YEL	TP CAN CABLE	20 AWG	J1939 CABLE	4460944		T391 (1)
5					4460466		
6					4460466		
7					4460466		
8					4460466		
9	GRN	TP CAN CABLE	20 AWG	J1939 CABLE	4460944		T392 (1)
10					4460466		
11					4460466		
12					4460466		
NC	SHLD	TP CAN CABLE	20 AWG	J1939 CABLE	N/A		T393 (1)

CO44-J1 - LSS PWR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-20 LSS PWR	18 AWG	GXL	4460465		T395 (1)
2	WHT	1-28 LSS GND	18 AWG	GXL	4460465		T394 (1)
3					4460466		
4					4460466		
5					4460466		
6					4460466		
7					4460466		
8					4460466		
9					4460466		
10					4460466		
11					4460466		
12					4460466		

Figure 7-24. Load Sensing System Harness (LSS) - Sheet 2 of 2

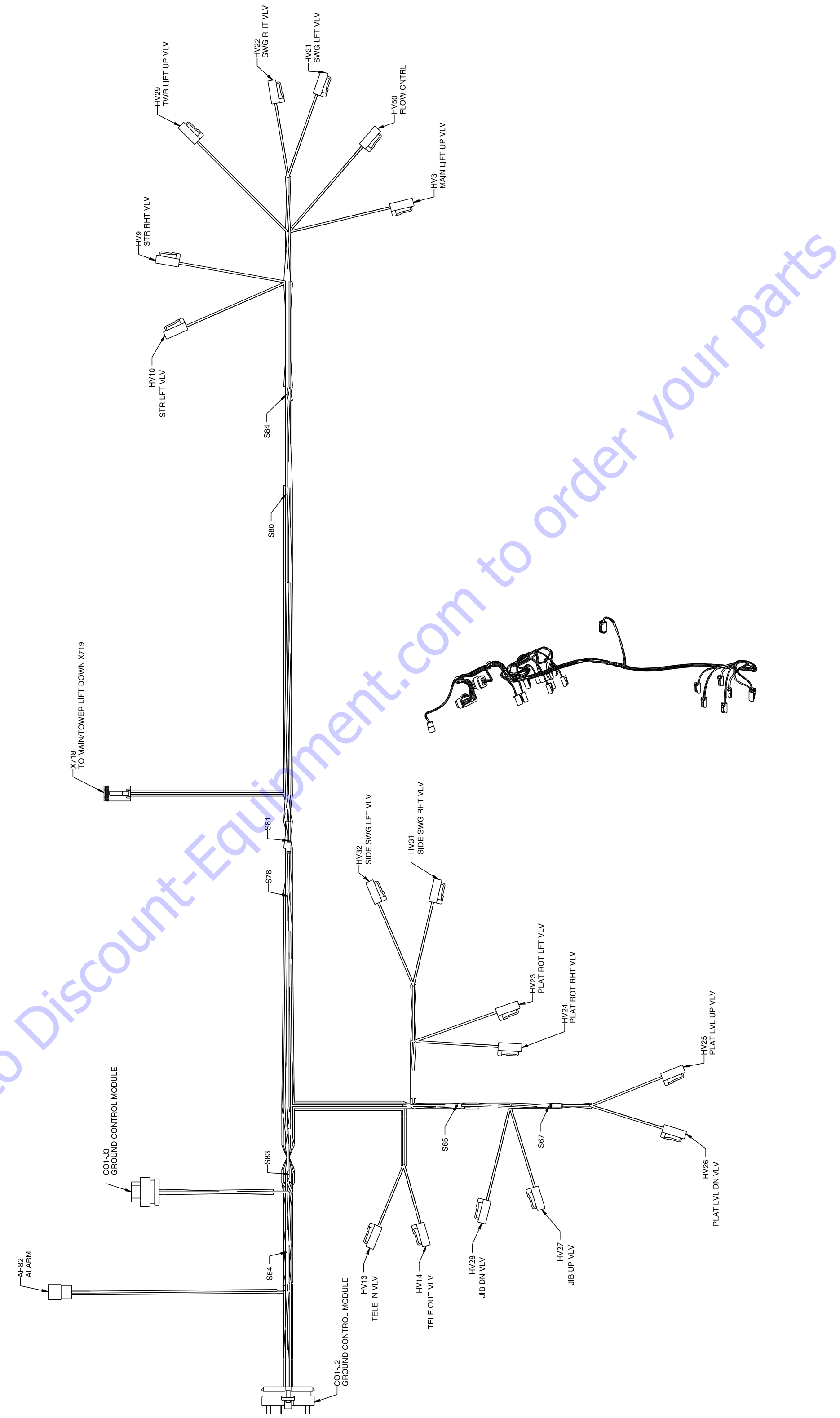

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Figure 7-25. Main Valve Harness - Sheet 1 of 3

AH82 - ALARM

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	WHT	38-4 ALARM POWER	18 AWG	GXL	4460465		CO1-J3 (7)
B	WHT	49-2 ALARM SIGNAL	18 AWG	GXL	4460465		CO1-J2 (27)
C	BLK	4-42 RTN	18 AWG	GXL	4460465		CO1-J2 (29)

CO1-J3 - GROUND CONTROL MODULE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2	WHT	38-3 CURNT FBACK	18 AWG	GXL	4460871		S81 (2)
3					4460905		
4	WHT	38-5 CURNT FBACK	18 AWG	GXL	4460871		S84 (2)
5	WHT	38-1 CURNT FBACK	18 AWG	GXL	4460871		S78 (2)
6	WHT	38-0 CURNT FBACK	18 AWG	GXL	4460871		HV50 (1)
7	WHT	38-4 ALARM POWER	18 AWG	GXL	4460871		AH82 (A)
8					4460905		
9					4460905		
10					4460905		
11					4460905		
12					4460905		
13					4460905		
14					4460905		

S64

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-27-1 RTN	16 AWG	GXL	N/A		S67 (2)
1	BLK	4-27-2 RTN	16 AWG	GXL	N/A		S65 (1)
2	BLK	4-27 RTN	16 AWG	GXL	N/A		CO1-J2 (14)

S83

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-13-1 RTN	18 AWG	GXL	N/A		HV14 (2)
1	BLK	4-13-2 RTN	18 AWG	GXL	N/A		HV13 (2)
2	BLK	4-13 RTN	18 AWG	GXL	N/A		CO1-J2 (17)

S65

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-27-2 RTN	16 AWG	GXL	N/A		S64 (1)
1	BLK	4-27-2-3 RTN	18 AWG	GXL	N/A		HV32 (2)
1	BLK	4-27-2-4 RTN	18 AWG	GXL	N/A		HV31 (2)
2	BLK	4-27-2-1 RTN	18 AWG	GXL	N/A		HV27 (2)
2	BLK	4-27-2-2 RTN	18 AWG	GXL	N/A		HV28 (2)

HV13 - TELE IN VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	13-0-3 TELE IN	18 AWG	GXL	4460465		CO1-J2 (3)
2	BLK	4-13-2 RTN	18 AWG	GXL	4460465		S83 (1)

HV14 - TELE OUT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	14-0-3 TELE OUT	18 AWG	GXL	4460465		CO1-J2 (15)
2	BLK	4-13-1 RTN	18 AWG	GXL	4460465		S83 (1)

HV28 - JIB DN VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	28-0-4 JIB DN	18 AWG	GXL	4460465		CO1-J2 (23)
2	BLK	4-27-2-2 RTN	18 AWG	GXL	4460465		S65 (2)

HV27 - JIB UP VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	27-0-4 JIB UP	18 AWG	GXL	4460465		CO1-J2 (12)
2	BLK	4-27-2-1 RTN	18 AWG	GXL	4460465		S65 (2)

S80

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-40-1 RTN	18 AWG	GXL	N/A		HV10 (1)
1	BLK	4-40-2 RTN	18 AWG	GXL	N/A		HV9 (2)
2	BLK	4-40 RTN	18 AWG	GXL	N/A		CO1-J2 (28)

S84

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-5-1 CURNT FBACK	18 AWG	GXL	N/A		HV21 (2)
1	WHT	38-5-2 CURNT FBACK	18 AWG	GXL	N/A		HV22 (2)
2	WHT	38-5 CURNT FBACK	18 AWG	GXL	N/A		CO1-J3 (4)

S81

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-3-1 CURNT FBACK	18 AWG	GXL	N/A		HV3 (2)
1	WHT	38-3-2 CURNT FBACK	18 AWG	GXL	N/A		X718 (4)
2	WHT	38-3 CURNT FBACK	18 AWG	GXL	N/A		CO1-J3 (2)

CO1-J2 - GROUND CONTROL MODULE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2					4460905		
3	WHT	13-0-3 TELE IN	18 AWG	GXL	4460871		HV13 (1)
4	WHT	32-0-4 SIDE SWG RHT	18 AWG	GXL	4460871		HV31 (1)
5	WHT	25-0-4 PLAT LVL UP	18 AWG	GXL	4460871		HV25 (1)
6					4460905		
7	WHT	26-0-4 PLAT LVL DN	18 AWG	GXL	4460871		HV26 (1)
8					4460905		
9	WHT	30-0-3 TWR DN	18 AWG	GXL	4460871		X718 (1)
10	WHT	23-0-4 PLAT ROT LFT	18 AWG	GXL	4460871		HV23 (1)
11	WHT	11-0-2 MAIN LIFT UP	18 AWG	GXL	4460871		HV3 (1)
12	WHT	27-0-4 JIB UP	18 AWG	GXL	4460871		HV27 (1)
13					4460905		
14	BLK	4-27 RTN	16 AWG	GXL	4460871		S64 (2)
15	WHT	14-0-3 TELE OUT	18 AWG	GXL	4460871		HV14 (1)
16	WHT	31-0-4 SIDE SWG LFT	18 AWG	GXL	4460871		HV32 (1)
17	BLK	4-13 RTN	18 AWG	GXL	4460871		S83 (2)
18					4460905		
19					4460905		
20	WHT	29-0-3 TWR UP	18 AWG	GXL	4460871		HV29 (1)
21	WHT	24-0-4 PLAT ROT RHT	18 AWG	GXL	4460871		HV24 (1)
22	WHT	12-0-2 MAIN LIFT DN	18 AWG	GXL	4460871		X718 (3)
23	WHT	28-0-4 JIB DN	18 AWG	GXL	4460871		HV28 (1)
24					4460905		
25					4460905		
26					4460905		
27	WHT	49-2 ALARM SIGNAL	18 AWG	GXL	4460871		AH82 (B)
28	BLK	4-40 RTN	18 AWG	GXL	4460871		S80 (2)
29	BLK	4-42 RTN	18 AWG	GXL	4460871		AH82 (C)
30					4460905		
31	WHT	50-0-1 FLOW CNTRL	18 AWG	GXL	4460871		HV50 (2)
32	WHT	9-2 STEER RT	18 AWG	GXL	4460871		HV9 (1)
33	WHT	10-1 STEER LT-1	18 AWG	GXL	4460871		HV10 (2)
34	WHT	21-0-1 SWG LFT	18 AWG	GXL	4460871		HV21 (1)
35	WHT	22-0-1 SWG RHT	18 AWG	GXL	4460871		HV22 (1)

S78

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	38-1-1 CURNT FBACK	18 AWG	GXL	N/A		HV29 (2)
1	WHT	38-1-2 CURNT FBACK	18 AWG	GXL	N/A		X718 (2)
2	WHT	38-1 CURNT FBACK	18 AWG	GXL	N/A		CO1-J3 (5)

HV10 - STR LFT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-40-1 RTN	18 AWG	GXL	4460465		S80 (1)
2	WHT	10-1 STEER LT-1	18 AWG	GXL	4460465		CO1-J2 (33)

HV9 - STR RHT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	9-2 STEER RT	18 AWG	GXL	4460465		CO1-J2 (32)
2	BLK	4-40-2 RTN	18 AWG	GXL	4460465		S80 (1)

Figure 7-26. Main Valve Harness - Sheet 2 of 3

HV25 - SWG RHT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	222 SWG RHT	21 AWG	GXL	4460468		CO1-J2 (38)
5	WHT	38-49 CURNT FBACK	21 AWG	GXL	4460468		S84 (4)

HV24 - SWG LFT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	212 SWG LFT	21 AWG	GXL	4460468		CO1-J2 (37)
5	WHT	38-48 CURNT FBACK	21 AWG	GXL	4460468		S84 (4)

HV53 - FLOW CNTRL

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	383 CURNT FBACK	21 AWG	GXL	4460468		CO1-J3 (9)
5	WHT	502 FLOW CNTRL	21 AWG	GXL	4460468		CO1-J2 (34)

HV6 - MAIN LIFT UP VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	111 MAIN LIFT UP	21 AWG	GXL	4460468		CO1-J2 (14)
5	WHT	38-28 CURNT FBACK	21 AWG	GXL	4460468		S81 (4)

HV32 - TWR LIFT UP VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	29-00 TWR UP	21 AWG	GXL	4460468		CO1-J2 (23)
5	WHT	38-8 CURNT FBACK	21 AWG	GXL	4460468		S78 (4)

X721 - TO MAIN/TOWER LIFT DOWN X722

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	30-00 TWR DN	21 AWG	GXL	4460468		CO1-J2 (12)
5	WHT	38-9 CURNT FBACK	21 AWG	GXL	4460468		S78 (4)
6	WHT	121 MAIN LIFT DN	21 AWG	GXL	4460468		CO1-J2 (25)
7	WHT	38-29 CURNT FBACK	21 AWG	GXL	4460468		S81 (4)

HV26 - PLAT ROT LFT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	23-0-1 PLAT ROT LFT	21 AWG	GXL	4460468		CO1-J2 (13)
5	BLK	4-27-10 RTN	21 AWG	GXL	4460468		S67 (5)

HV27 - PLAT ROT RHT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	24-0-1 PLAT ROT RHT	21 AWG	GXL	4460468		CO1-J2 (24)
5	BLK	4-27-1-1 RTN	21 AWG	GXL	4460468		S67 (5)

HV29 - PLAT LVL DN VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	26-0-1 PLAT LVL DN	21 AWG	GXL	4460468		CO1-J2 (10)
5	BLK	4-27-9 RTN	21 AWG	GXL	4460468		S67 (4)

HV28 - PLAT LVL UP VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	25-0-1 PLAT LVL UP	21 AWG	GXL	4460468		CO1-J2 (8)
5	BLK	4-27-8 RTN	21 AWG	GXL	4460468		S67 (4)

HV34 - SIDE SWG RHT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	32-0-1 SIDE SWG RHT	21 AWG	GXL	4460468		CO1-J2 (7)
5	BLK	4-27-2-1 RTN	21 AWG	GXL	4460468		S65 (4)

HV35 - SIDE SWG LFT VLV

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	WHT	31-0-1 SIDE SWG LFT	21 AWG	GXL	4460468		CO1-J2 (19)
5	BLK	4-27-20 RTN	21 AWG	GXL	4460468		S65 (4)

S70

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
4	BLK	4-27-8 RTN	21 AWG	GXL	N/A		HV25 (5)
4	BLK	4-27-9 RTN	21 AWG	GXL	N/A		HV26 (5)
5	BLK	4-268 RTN	19 AWG	GXL	N/A		S64 (4)
5	BLK	4-27-10 RTN	21 AWG	GXL	N/A		HV23 (5)
5	BLK	4-27-1-1 RTN	21 AWG	GXL	N/A		HV24 (5)

Figure 7-27. Main Valve Harness - Sheet 3 of 3

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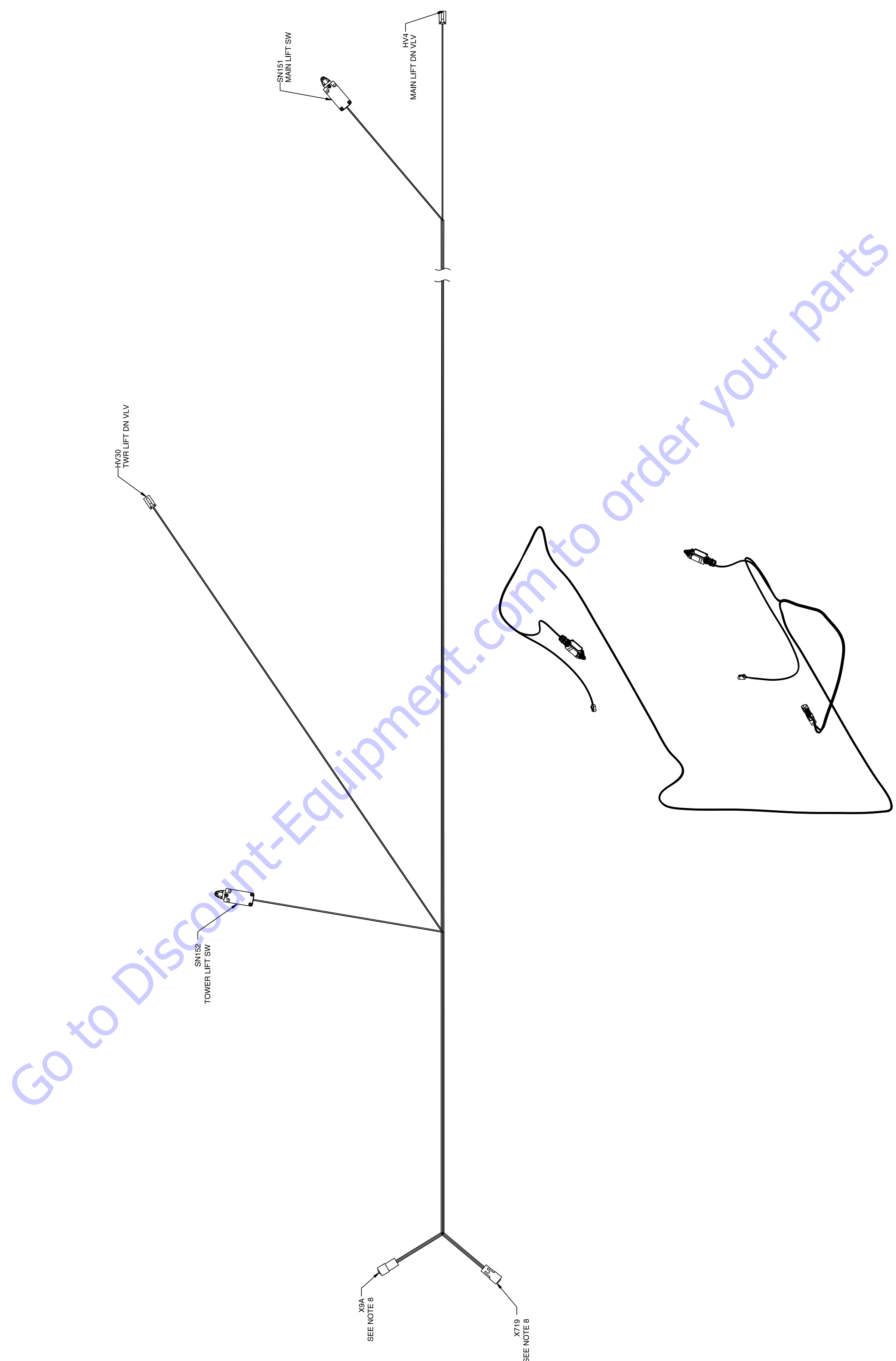


Figure 7-28. Boom Valve Harness - Sheet 1 of 2

HV30 - TWR LIFT DN VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	30-0-3 TWN DN	18 AWG	GXL	4460465		X719 (1)
2	WHT	38-1-2 CURNT FBACK	18 AWG	GXL	4460465		X719 (2)

SN152 - TOWER LIFT SW							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
21	BLK	5-33-2 LOWER LIM SW 1	18 AWG	GXL			X9A (3)
22	WHT	58-0 LOWER LIM SW 2	18 AWG	GXL			X9A (4)
NC							
NC1							

X9A - TO TURN TABLE HARNESS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	57-0 UPPER LIM SW 1	18 AWG	GXL	4460464		SN151 (21)
2	BLK	5-33-1 UPPER LIM SW 2	18 AWG	GXL	4460464		SN151 (22)
3	BLK	5-33-2 LOWER LIM SW 1	18 AWG	GXL	4460464		SN152 (21)
4	WHT	58-0 LOWER LIM SW 2	18 AWG	GXL	4460464		SN152 (22)

HV4 - MAIN LIFT DN VLV							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	12-0-2 MAIN LIFT DN	18 AWG	GXL	4460465		X719 (3)
2	WHT	38-3-2 CURNT FBACK	18 AWG	GXL	4460465		X719 (4)

SN151 - MAIN LIFT SW							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
21	WHT	57-0 UPPER LIM SW 1	18 AWG	GXL			X9A (1)
22	BLK	5-33-1 UPPER LIM SW 2	18 AWG	GXL			X9A (2)
NC							
NC1							

X719 - TO VALVE HARNESS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	30-0-3 TWN DN	18 AWG	GXL	1001116693		HV30 (1)
2	WHT	38-1-2 CURNT FBACK	18 AWG	GXL	1001116693		HV30 (2)
3	WHT	12-0-2 MAIN LIFT DN	18 AWG	GXL	1001116693		HV4 (1)
4	WHT	38-3-2 CURNT FBACK	18 AWG	GXL	1001116693		HV4 (2)

Figure 7-29. Boom Valve Harness - Sheet 2 of 2

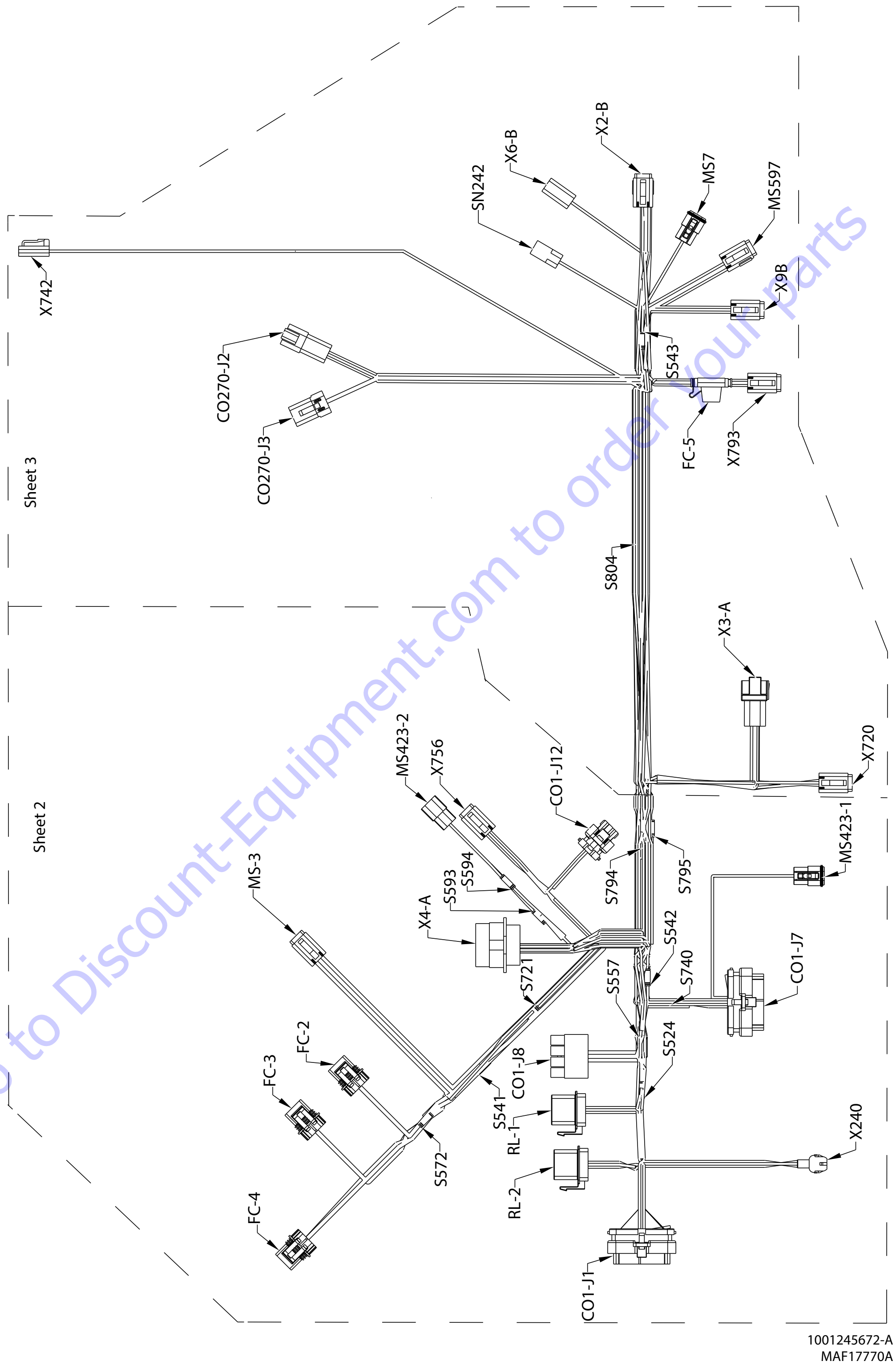


Figure 7-30. Turntable Harness - Sheet 1 of 4

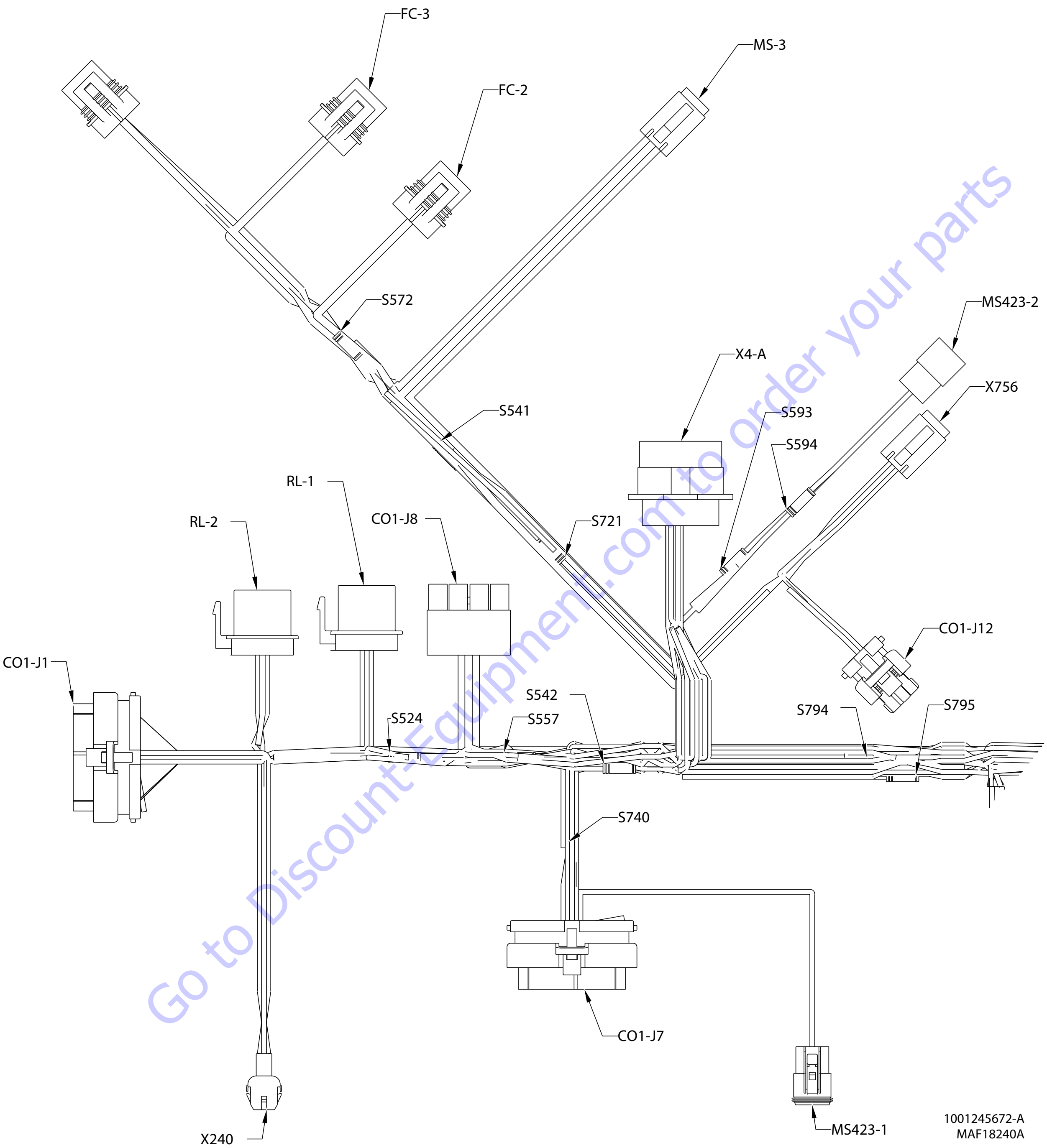


Figure 7-31. Turntable Harness - Sheet 2 of 4

X4-A-BOOM CABLE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	GRN	CAN 1 LO	18 AWG	GXL	S593(2)
3	YEL	CAN 1 HI	18 AWG	GXL	S594(2)
4	WHT	82-0 PLAT TX	18 AWG	GXL	S740(2)
5					
6	WHT	131-3 FOOTSWITCH	18 AWG	GXL	C01-J7(15)
7					
8					
9	YEL	5-11-1-1 IGN PLAT	18 AWG	GXL	S795(2)
10	YEL	5-6	14 AWG	GXL	MS597(5)
11	WHT	81-0 GND MODE RX	18 AWG	GXL	C01-J7(14)
12	YEL	PLATFORM PWR	12 AWG	GXL	C01-J8(4)
13	YEL	5-2-6	18 AWG	GXL	X3-A(3)
14					
15	YEL	5-2-5 IGN	18 AWG	GXL	S542(1)
16	BLK	PLAT GND	12 AWG	GXL	C01-J8(3)
17					
18	BLK	4-20	14 AWG	GXL	MS597(2)
19					

S795					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-11-1 IGN PLAT	18 AWG	GXL	X3-A(5)
1	YEL	5-11-1-2 IGN PLAT	18 AWG	GXL	X793(4)
2	YEL	5-11-1-1 IGN PLAT	18 AWG	GXL	X4-A(9)

S542					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-2-1 IGN MODE	18 AWG	GXL	X3-A(4)
1	YEL	5-2-5 IGN	18 AWG	GXL	X4-A(15)
2	WHT	5-2-2 IGN	18 AWG	GXL	RL-1(2)

MS423-2-CAN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CAN1 HI	18 AWG	GXL	S594 (1)
B	GRN	CAN1 LO	18 AWG	GXL	S593 (1)
C					

MS423-1-CAN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CAN1 HI	18 AWG	GXL	C01-J7 (13)
B	GRN	CAN1 LO	18 AWG	GXL	C01-J7 (24)
C					

X240-ANALYZER					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	51-1 ANALYZER PWR	18 AWG	GXL	C01-J1 (28)
2	WHT	52-1 ANALYZER RS-232 RX	18 AWG	GXL	C01-J1 (29)
3	WHT	53-1 ANALYZER RS-232 TX	18 AWG	GXL	C01-J1 (30)
4	WHT	54-1 ANALYZER GND	18 AWG	GXL	C01-J1 (31)

S594					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN1 HI	18 AWG	GXL	MS423-2 (A)
2	YEL	CAN1 HI	18 AWG	GXL	X4-A(3)
2	YEL	CAN1 HI	18 AWG	GXL	X6-B (1)

S593					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	GRN	CAN1 LO	18 AWG	GXL	MS423-2 (B)
2	GRN	CAN1 LO	18 AWG	GXL	X4-A(2)
2	GRN	CAN1 LO	18 AWG	GXL	X6-B (2)

S794					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	FC-2 (2)
2	RED	3-0-1 CONSTANT 12V	12 AWG	GXL	X3-A(1)
2	RED	3-0-2 CONSTANT 12V	18 AWG	GXL	X793 (1)

C01-J12					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3	YEL	83-1-1 CAN2 HIGH	18 AWG	GXL	X756 (2)
4	GRN	84-1-1 CAN2 LOW	18 AWG	GXL	X756 (3)
5					
6					
7					
8	WHT	80-0 MSSO	18 AWG	GXL	X3-A(7)
NC					

RL-1-IGNRELAY					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3					
4					
5					

RL-2-VOTE RELAY					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3					
4					
5					

C01-J1-NATURAL					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2	WHT	300-1 ALERT PWR	18 AWG	GXL	X742 (1)
3					
4	BLK	300-2 ALERT GND	18 AWG	GXL	X742 (2)
5					
6					
7					
8					
9					
10					
11					
12					
13	WHT	49-10 VOTE RELAY	18 AWG	GXL	RL-2 (2)
14					
15					
16					
17					
18					
19	WHT	4-52 INSTR GND	18 AWG	GXL	RL-2 (5)
20					
21					
22					
23					
24					
25					
26					
27					
28	WHT	51-1 ANALYZER PWR	18 AWG	GXL	X240 (1)
29	WHT	52-1 ANALYZER RS-232 RX	18 AWG	GXL	X240 (2)
30	WHT	53-1 ANALYZER RS-232 TX	18 AWG	GXL	X240 (3)
31	WHT	54-1 ANALYZER GND	18 AWG	GXL	X240 (4)
32					
33					
34					
35					

MS-3-CONVERTER					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	1-0-1 B+	12 AWG	GXL	S524 (1)
2	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	S721 (1)
3	WHT	2-0 B-	12 AWG	GXL	X2-B (1)
4	RED	3-0 CONSTANT 12V	12 AWG	GXL	FC-2 (1)
5	YEL	5-10-0 IGN	12 AWG	GXL	S572 (1)
6	BLK	4-0INSTR GRND	12 AWG	GXL	S557 (1)

FC-2-15A 12V SYSTEM					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	MS-3 (4)
2	RED	3-0 CONSTANT 12V	12 AWG	GXL	S794 (1)

FC-3-5A OPTION FUSE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-10-2 IGN	12 AWG	GXL	S572 (2)
2	YEL	5-10-2 IGN	12 AWG	GXL	MS597 (4)

FC-4-20AIGN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-10-1 IGN	12 AWG	GXL	S572 (2)
2	WHT	5-10-1 IGN	12 AWG	GXL	S541 (2)

C01-J8					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	4-0-1 INSTR GND	12 AWG	GXL	S557 (2)
2	YEL	5-10-1-1 SWITCHED PWR	12 AWG	GXL	S541 (1)
3	BLK	PLAT GND	12 AWG	GXL	X4-A(16)
4	YEL	PLATFORM PWR	12 AWG	GXL	X4-A(12)

X756-CAN TERM					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	83-1 CAN2 HIGH	18 AWG	GXL	MS7 (A)
2	YEL	83-1-1 CAN2 HIGH	18 AWG	GXL	C01-J12 (3)
3	GRN	84-1-1 CAN2 LOW	18 AWG	GXL	C01-J12 (4)
4	GRN	84-1 CAN2 LOW	18 AWG	GXL	MS7 (B)

S541					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-10-1-1 SWITCHED PWR	12 AWG	GXL	C01-J8 (2)
1	YEL	5-10-1-2 IGN	12 AWG	GXL	X3-A(2)
1	YEL	5-10-1-3 SW PWR	14 AWG	GXL	S804 (1)
2	WHT	5-10-1 IGN	12 AWG	GXL	FC-4 (2)

S572					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-10-0 IGN	12 AWG	GXL	MS-3 (5)
2	YEL	5-10-1 IGN	12 AWG	GXL	FC-4 (1)
2	YEL	5-10-2 IGN	12 AWG	GXL	FC-3 (1)

C01-J7-BLACK					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	82-2 PLAT TX	18 AWG	GXL	S740 (1)
2	WHT	82-1 PLAT TX	18 AWG	GXL	S740 (1)
3	YEL	5-10-6	18 AWG	GXL	X3-A(6)
4	WHT	57-0 UPPER BOOM	18 AWG	GXL	X9B (1)
5					
6					
7	WHT	58-0 LOWER BOOM	18 AWG	GXL	X9B (4)
8					
9					
10					
11	YEL	5-5	18 AWG	GXL	SN242 (2)
12					
13	YEL	CAN1 HI	18 AWG	GXL	MS423-1 (A)
14	WHT	81-0 GND MODE RX	18 AWG	GXL	X4-A(11)
15	WHT	131-3 FOOTSWITCH	18 AWG	GXL	X4-A(6)
16					
17					
18					
19					
20					
21					
22					
23					
24	GRN	CAN1 LO	18 AWG	GXL	MS423-1 (B)
25	BLK	4-55	18 AWG	GXL	X2-B (10)
26					
27					
28					
29	YEL	5-50	18 AWG	GXL	X2-B (9)
30	YEL	5-33 IGN LIM SW	18 AWG	GXL	S543 (2)
31					
32	WHT	59-0 DOS	18 AWG	GXL	SN242 (1)
33					
34					
35					

S557					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	4-0 INSTR GRND	12 AWG	GXL	MS-3 (6)
1	BLK	4-0-3 INSTR GND	14 AWG	GXL	MS597 (1)
2	BLK	4-0-1 INSTR GND	12 AWG	GXL	C01-J8 (1)
2	WHT	4-0-2 INSTR GND	18 AWG	GXL	RL-1 (5)

S721					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	MS-3 (2)
2	YEL	6-2 IGN 48 VOLT	18 AWG	GXL	RL-1 (4)
2	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	X2-B (4)

S740					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	82-1 PLAT TX	18 AWG	GXL	C01-J7 (2)
1	WHT	82-2 PLAT TX	18 AWG	GXL	C01-J7 (1)
2	WHT	82-0 PLAT TX	18 AWG	GXL	X4-A (4)

S524					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	1-0 B+	12 AWG	GXL	X2-B (2)
1	RED	1-0-1 B+	12 AWG	GXL	MS-3 (1)
2	RED	1-0-2 B+	18 AWG	GXL	RL-1 (1)
2	RED	1-0-3 B+	16 AWG	GXL	RL-2 (1)

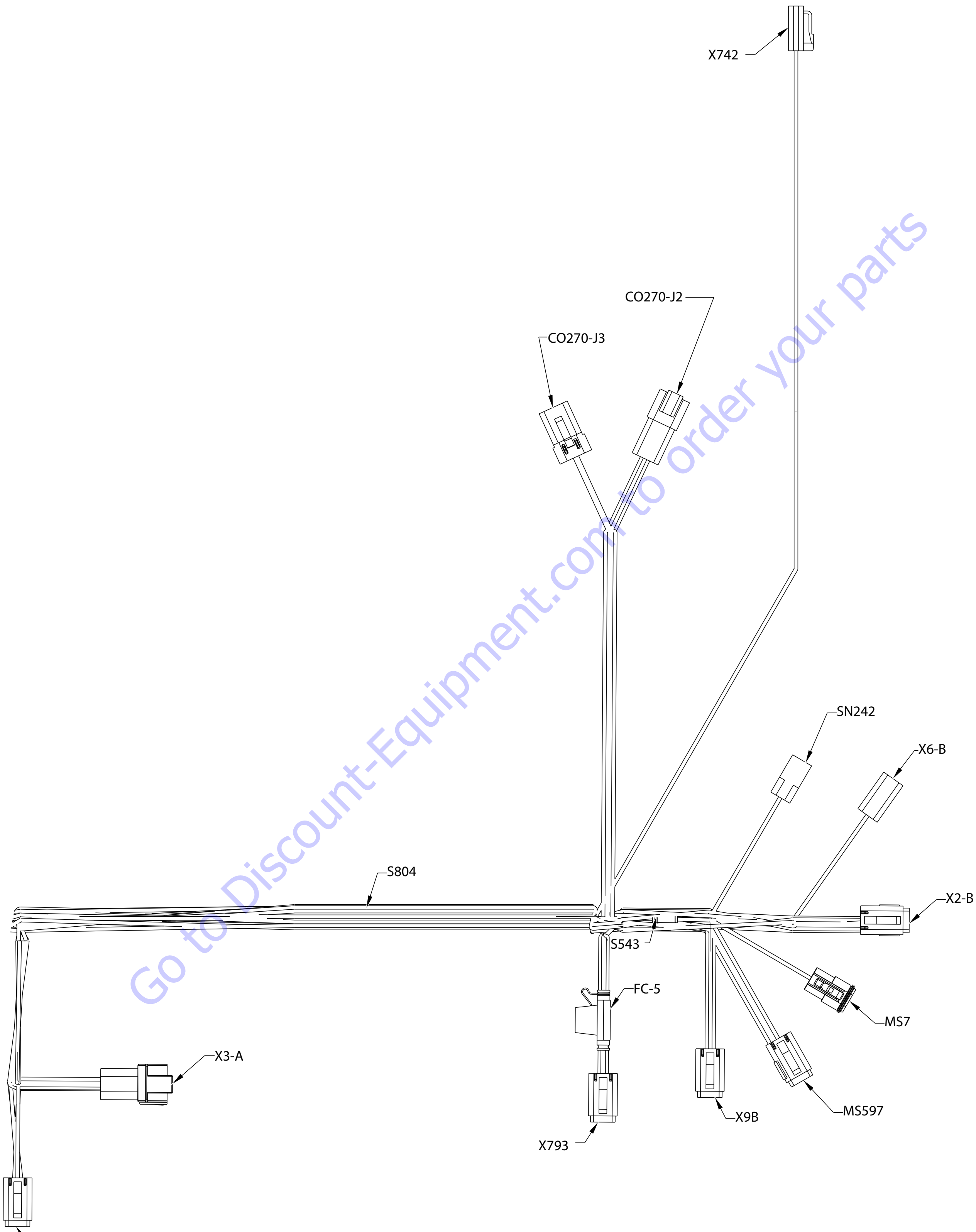


Figure 7-32. Turntable Harness - Sheet 3 of 4

X2-B-TO CHAS HARN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	2-0 B-	12 AWG	GXL	MS-3 (3)
2	RED	1-0 B+	12 AWG	GXL	S524 (1)
3	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	C0270-J2 (8)
4	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	S721 (2)
5	YEL	VOTE-RLY-NO	16 AWG	GXL	RL-2 (4)
6	RED	1-7	12 AWG	GXL	C0270-J3 (1)
7	BLK	2-2	12 AWG	GXL	C0270-J3 (3)
8	WHT	CHARG-STAT	18 AWG	GXL	C0270-J2 (1)
9	YEL	5-50	18 AWG	GXL	C01-J7 (29)
10	BLK	4-55	18 AWG	GXL	C01-J7 (25)
11					
12					

X3-A-GND CNTL PNL					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	3-0-1 CONSTANT 12V	12 AWG	GXL	S794 (2)
2	YEL	5-10-1-2 IGN	12 AWG	GXL	S541 (1)
3	YEL	5-2-6	18 AWG	GXL	X4-A (13)
4	YEL	5-2-1 IGN MODE	18 AWG	GXL	S542 (1)
5	YEL	5-11-1 IGN PLAT	18 AWG	GXL	S795 (1)
6	YEL	5-10-6	18 AWG	GXL	C01-J7 (3)
7	WHT	80-0 MSSO	18 AWG	GXL	C01-J12 (8)
8					

X793-TELEMATICS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	3-0-2 CONSTANT 12V	18 AWG	GXL	S794 (2)
2	BLK	1-8 GND	18 AWG	GXL	MS597 (3)
3	BLK		14 AWG	GXL	FC-5 (2)
4	YEL	5-11-1-2 IGN PLAT	18 AWG	GXL	S795 (1)

FC-5-5A TM FUSE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK		14 AWG	GXL	S804 (2)
2	BLK		14 AWG	GXL	X793 (3)

X720-GND CNTL PNL LED					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	205 RED LED	18 AWG	GXL	C0270-J2 (3)
2	WHT	206 YEL LED	18 AWG	GXL	C0270-J2 (4)
3	WHT	207GRN LED	18 AWG	GXL	C0270-J2 (6)
4	BLK	4-56	18 AWG	GXL	C0270-J2 (5)

X9B-UP/LO LIM SW					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	57-0 UPPER BOOM	18 AWG	GXL	C01-J7 (4)
2	WHT	5-33-1 IGN LIM SW	18 AWG	GXL	S543 (1)
3	WHT	5-33-2 IGN LIM SW	18 AWG	GXL	S543 (1)
4	WHT	58-0 LOWER BOOM	18 AWG	GXL	C01-J7 (7)

SN242-DOS CONNECTOR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	59-0 DOS	18 AWG	GXL	C01-J7 (32)
2	YEL	5-5	18 AWG	GXL	C01-J7 (11)

S543					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	5-33-1 IGN LIM SW	18 AWG	GXL	X9B (2)
1	WHT	5-33-2 IGN LIM SW	18 AWG	GXL	X9B (3)
2	YEL	5-33 IGN LIM SW	18 AWG	GXL	C01-J7 (30)

S804					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	5-10-1-3 SW PWR	14 AWG	GXL	S541 (1)
2	BLK		14 AWG	GXL	FC-5 (1)

MS597-IGN/GND 12V BUSS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	4-0-3 INSTR GND	14 AWG	GXL	S557 (1)
2	BLK	4-20	14 AWG	GXL	X4-A(18)
3	BLK	1-8 GND	18 AWG	GXL	X793 (2)
4	YEL	5-10-2 IGN	12 AWG	GXL	FC-3 (2)
5	YEL	5-6	14 AWG	GXL	X4-A(10)
6					
7					
8					
9					
10					
11					
12					

C0270-J3-DELTA-Q CHARGER PWR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	1-7	12 AWG	GXL	X2-B (6)
2					
3	BLK	2-2	12 AWG	GXL	X2-B (7)
4					

X6-B-CAN TO/FROM TILT SENSOR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN1 HI	18 AWG	GXL	S594 (2)
2	GRN	CAN1 LO	18 AWG	GXL	S593 (2)

MS7-CAN					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	83-1 CAN2 HIGH	18 AWG	GXL	X756 (1)
B	GRN	84-1CAN2 LOW	18 AWG	GXL	X756 (4)
C					

X742-ALERT					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	300-1 ALERT PWR	18 AWG	GXL	C01-J1 (2)
2	BLK	300-2 ALERT GND	18 AWG	GXL	C01-J1 (4)

C0270-J2-DELTA-Q CHARGER SIG					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	CHARG-STAT	18 AWG	GXL	X2-B (8)
2					
3	WHT	205 RED LED	18 AWG	GXL	X720 (1)
4	WHT	206 YEL LED	18 AWG	GXL	X720 (2)
5	BLK	4-56	18 AWG	GXL	X720 (4)
6	WHT	207 GRN LED	18 AWG	GXL	X720 (3)
7					
8	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	X2-B (3)

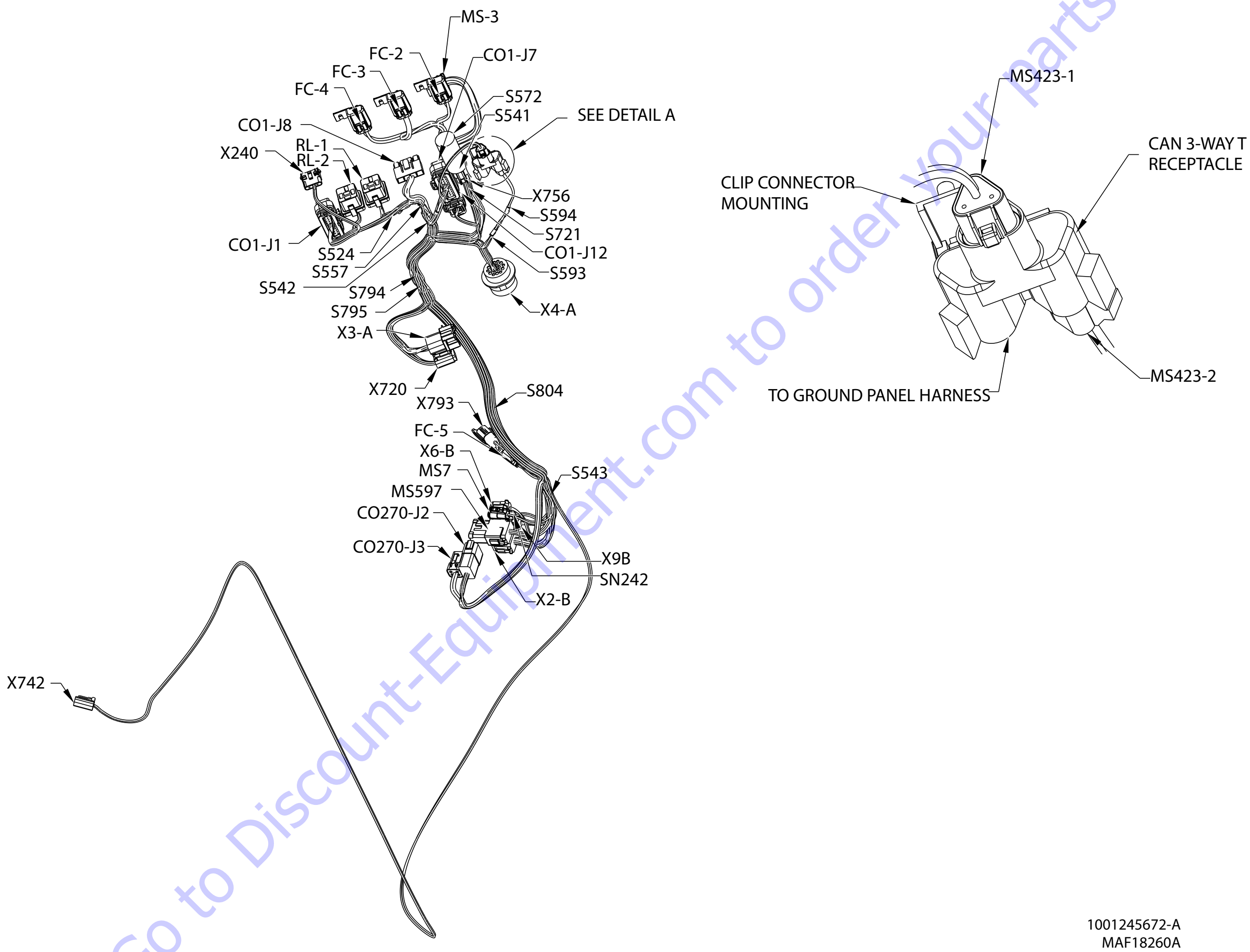
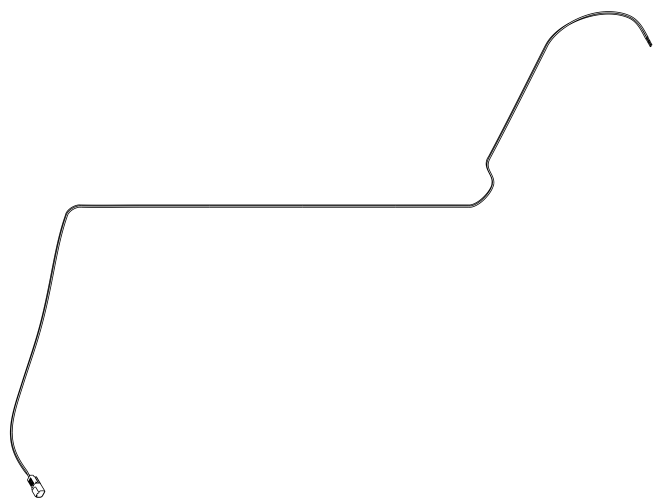
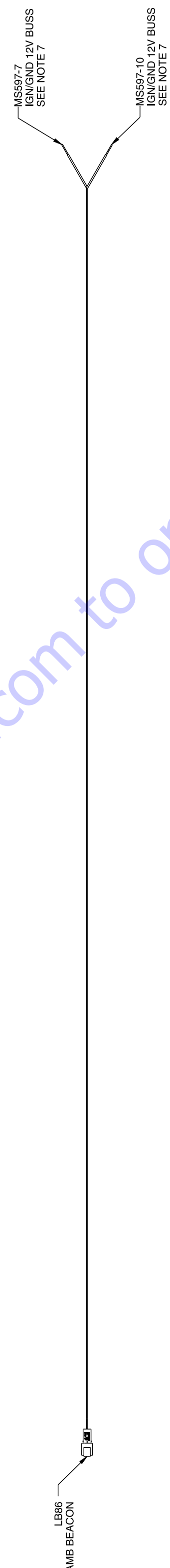


Figure 7-33. Turntable Harness - Sheet 4 of 4





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LB86 - AMB BEACON							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	2-12 STROBE	18 AWG	GXL	4460464		MS597-7 (1)
2	BLK	1-7 GND	18 AWG	GXL	4460464		MS597-10 (1)

MS597-7 - IGN/GND 12V BUSS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	2-12 STROBE	18 AWG	GXL	N/A		LB86 (1)

MS597-10 - IGN/GND 12V BUSS							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	1-7 GND	18 AWG	GXL	N/A		LB86 (2)

Figure 7-34. Amber Beacon Harness

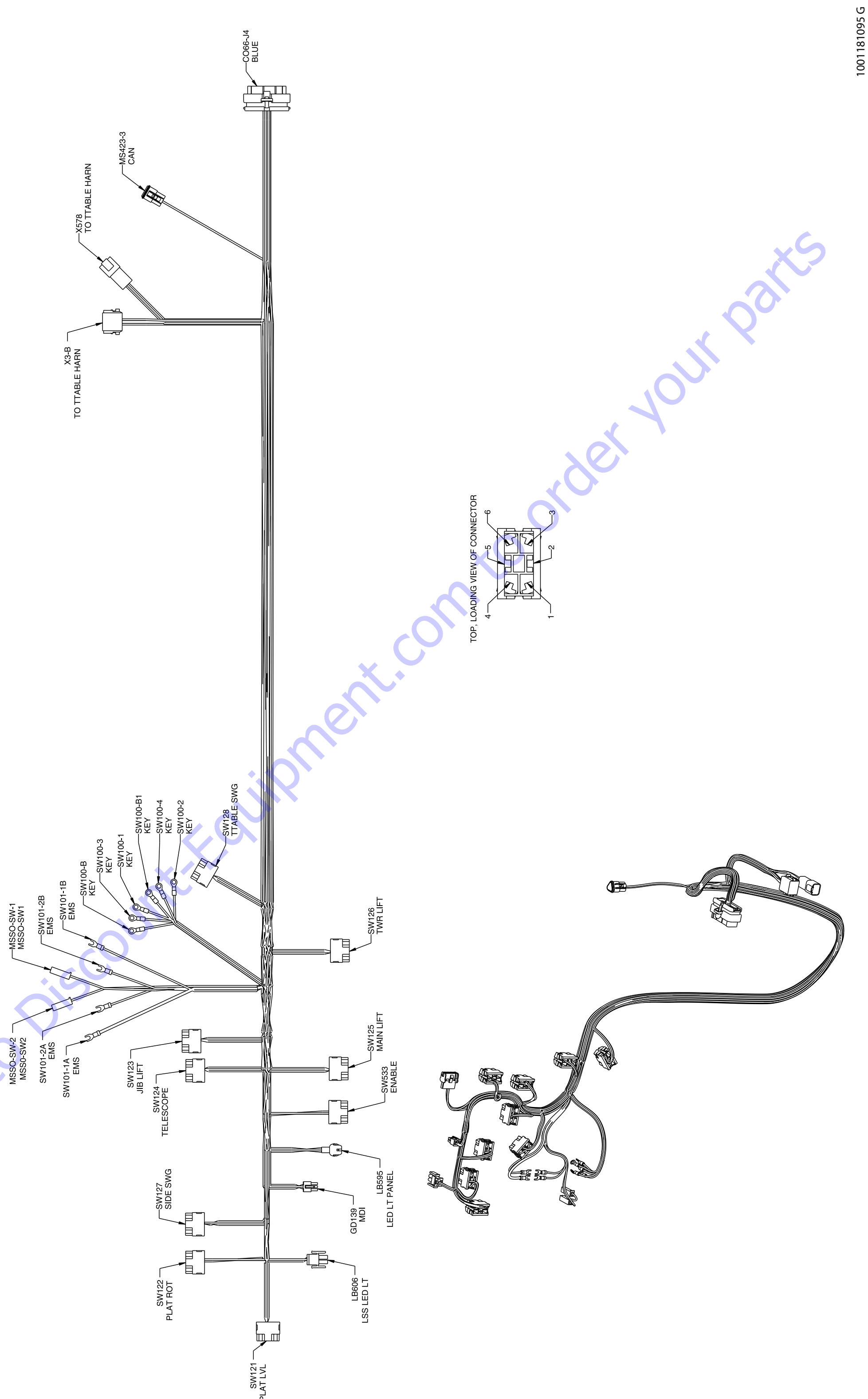


Figure 7-35. Ground Panel Harness - Sheet 1 of 3

GD139 - MDI

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1		METER PWR METER PWR	18 AWG	GXL	4460877		CO66-J4 (24)
2		METER GND METER GND	18 AWG	GXL	4460877		CO66-J4 (32)
3		CAN1 LO	18 AWG	GXL	4460877		MS423-3 (B)
4		CAN1 HI	18 AWG	GXL	4460877		MS423-3 (A)
5							
6							

SW121 - PLAT LVL

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	25-0-1 PLAT LVL UP	18 AWG	GXL	1001159186		CO66-J4 (17)
2	YEL	5-15-7	18 AWG	GXL	4460419		SW122 (2)
2	YEL	5-15-9	18 AWG	GXL	4460419		SW127 (2)
3	WHT	26-0-1 PLAT LVL DN	18 AWG	GXL	1001159186		CO66-J4 (5)
4							
5							
6							

SW122 - PLAT ROT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	24-0-1 PLAT ROT RHT	18 AWG	GXL	1001159186		CO66-J4 (18)
2	YEL	5-15-7	18 AWG	GXL	1001159186		SW121 (2)
3	WHT	23-0-1 PLAT ROT LFT	18 AWG	GXL	1001159186		CO66-J4 (6)
4							
5							
6							

SW123 - JIB LIFT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	27-0-1 JIB UP	18 AWG	GXL	1001159186		CO66-J4 (19)
2	YEL	5-15-5	18 AWG	GXL	4460419		SW125 (2)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW127 (2)
3	WHT	28-0-1 JIB DN	18 AWG	GXL	1001159186		CO66-J4 (8)
4							
5							
6							

SW124 - TELESCOPE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	14-0-2 TELE OUT	18 AWG	GXL	1001159186		CO66-J4 (30)
2	YEL	5-15-1	18 AWG	GXL	4460419		SW533 (2)
2	YEL	5-15-2	18 AWG	GXL	4460419		SW128 (2)
3	WHT	13-0-2 TELE IN	18 AWG	GXL	1001159186		CO66-J4 (7)
4							
5							
6							

SW125 - MAIN LIFT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	3-1 MAIN LIFT UP	18 AWG	GXL	1001159186		CO66-J4 (23)
2	YEL	5-15-4	18 AWG	GXL	4460419		SW126 (2)
2	YEL	5-15-5	18 AWG	GXL	4460419		SW123 (2)
3	WHT	4-1 MAIN LIFT DN	18 AWG	GXL	1001159186		CO66-J4 (33)
4							
5							
6							

SW126 - TWR LIFT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	29-0-2 TWR UP	18 AWG	GXL	1001159186		CO66-J4 (10)
2	YEL	5-15-3	18 AWG	GXL	4460419		SW128 (2)
2	YEL	5-15-4	18 AWG	GXL	4460419		SW125 (2)
3	WHT	30-0-2 TWR DN	18 AWG	GXL	1001159186		CO66-J4 (21)
4							
5							
6							

SW127 - SIDE SWG

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	31-0-1 SIDE SWG RHT	18 AWG	GXL	1001159186		CO66-J4 (20)
2	YEL	5-15-6	18 AWG	GXL	4460419		SW123 (2)
2	YEL	5-15-9	18 AWG	GXL	4460419		SW121 (2)
3	WHT	32-0-1 SIDE SWG LFT	18 AWG	GXL	1001159186		CO66-J4 (9)
4							
5							
6							

SW128 - TTABLE SWG

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	22-1 SWG RHT	18 AWG	GXL	1001159186		CO66-J4 (35)
2	YEL	5-15-2	18 AWG	GXL	4460419		SW124 (2)
2	YEL	5-15-3	18 AWG	GXL	4460419		SW126 (2)
3	WHT	21-1 SWG LFT	18 AWG	GXL	1001159186		CO66-J4 (34)
4							
5							
6							

SW533 - ENABLE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	99-0 ENABLE	18 AWG	GXL	1001159186		CO66-J4 (16)
2	YEL	5-15	18 AWG	GXL	4460419		CO66-J4 (25)
2	YEL	5-15-1	18 AWG	GXL	4460419		SW124 (2)
3							
4							
5							
6							

MSSO-SW-1

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-23	18 AWG	GXL	4460259		LB606 (2)

MSSO-SW-2

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	80-0 MSSO	18 AWG	GXL	4460259		X3-B (7)

SW101-1A - EMS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1A	RED	3-0 CONSTANT 12V	12 AWG	GXL	N/A		X3-B (1)

SW101-2A - EMS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2A	YEL	5-1 IGN	18 AWG	GXL	N/A		SW100-B1 (1)

SW101-1B - EMS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1B	YEL	5-10-3 IGN	18 AWG	GXL	N/A		X3-B (2)

SW101-2B - EMS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
2B	YEL	2-26 IGN	18 AWG	GXL	N/A		SW100-B (1)

Figure 7-36. Ground Panel Harness - Sheet 2 of 3

SW100-1 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	5-11-1 IGN PLAT	18 AWG	GXL	N/A		X3-B (5)

SW100-2 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-2-6 IGN	18 AWG	GXL	N/A		X3-B (3)

SW100-3 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-10-6 IGN GMODE	18 AWG	GXL	N/A		X3-B (6)

SW100-4 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-2-1 IGN GMODE	18 AWG	GXL	N/A		X3-B (4)

SW100-B - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	2-26 IGN	18 AWG	GXL	N/A		SW101-2B (2B)

SW100-B1 - KEY							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-1 IGN	18 AWG	GXL	N/A		SW101-2A (2A)

LB595 - LED LT PANEL							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	4-56	18 AWG	GXL	4460226		X578 (4)
2	WHT	206 YEL LED	18 AWG	GXL	4460226		X578 (2)
3	WHT	207 GRN LED	18 AWG	GXL	4460226		X578 (3)
4	WHT	205 RED LED	18 AWG	GXL	4460226		X578 (1)

LB606 - LSS LED LT							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	108-0 LSS LAMP	18 AWG	GXL	4460227		CO66-J4 (14)
2	BLK	4-22	18 AWG	GXL	4460267		CO66-J4 (31)
2	BLK	4-23	18 AWG	GXL	4460267		MSSO-SW-1 (1)

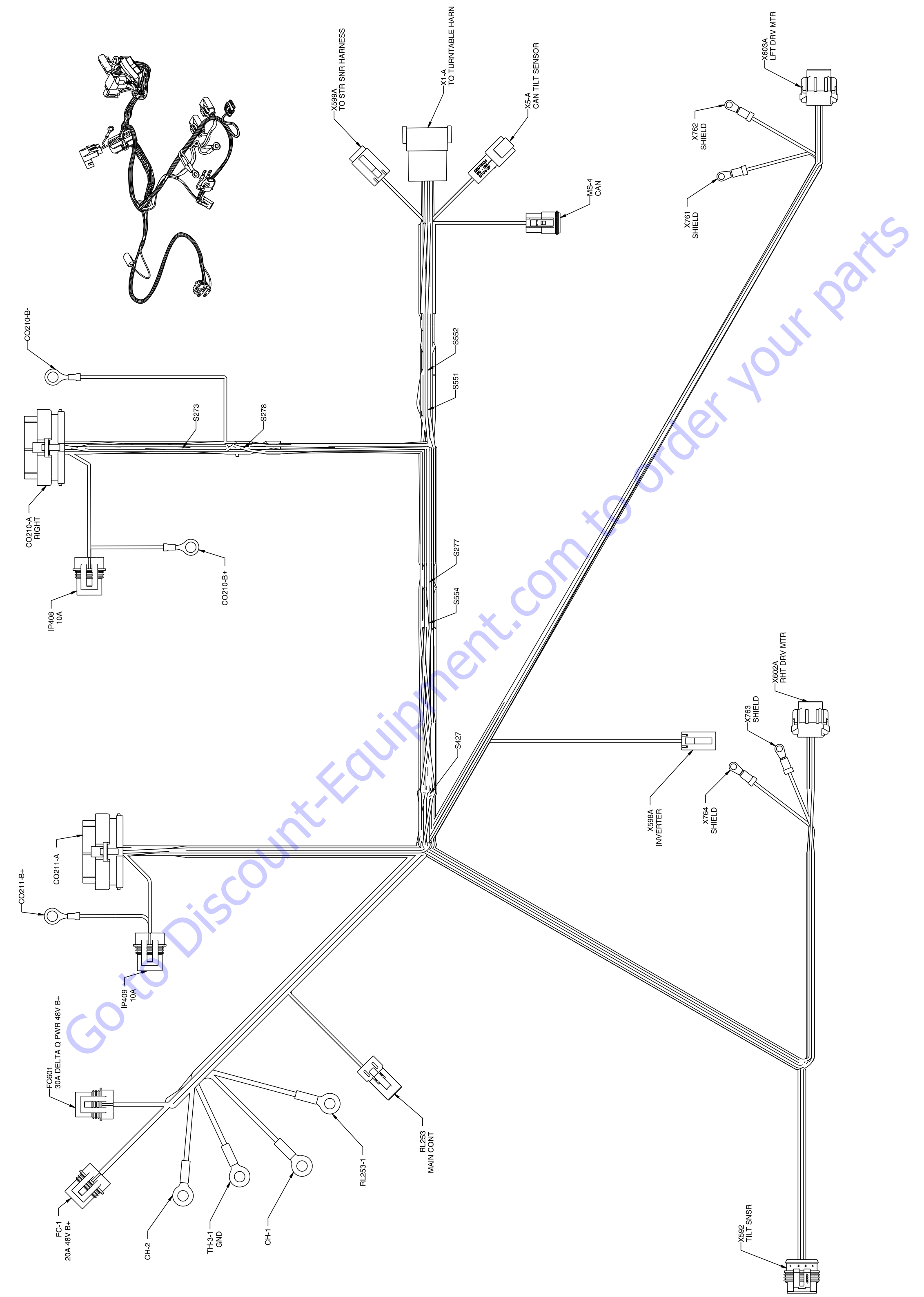
X578 - TO TTABLE HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	205 RED LED	18 AWG	GXL	1001116693		LB595 (4)
2	WHT	206 YEL LED	18 AWG	GXL	1001116693		LB595 (2)
3	WHT	207 GRN LED	18 AWG	GXL	1001116693		LB595 (3)
4	BLK	4-56	18 AWG	GXL	1001116693		LB595 (1)

X3-B - TO TTABLE HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	3-0 CONSTANT 12V	12 AWG	GXL	1001157890		SW101-1A (1A)
2	YEL	5-10-3 IGN	18 AWG	GXL	1001116692		SW101-1B (1B)
3	YEL	5-2-6 IGN	18 AWG	GXL	1001116692		SW100-2 (1)
4	YEL	5-2-1 IGN GMODE	18 AWG	GXL	1001116692		SW100-4 (1)
5	WHT	5-11-1 IGN PLAT	18 AWG	GXL	1001116692		SW100-1 (1)
6	YEL	5-10-6 IGN GMODE	18 AWG	GXL	1001116692		SW100-3 (1)
7	WHT	80-0 MSSO	18 AWG	GXL	1001116692		MSSO-SW-2 (1)
8					4460466		

MS423-3 - CAN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A		CAN1 HI	18 AWG	GXL	4460944		GD139 (4)
B		CAN1 LO	18 AWG	GXL	4460944		GD139 (3)
C					4460466		

CO66-J4 - BLUE							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2					4460905		
3					4460905		
4					4460905		
5	WHT	26-0-1 PLAT LVL DN	18 AWG	GXL	4460871		SW121 (3)
6	WHT	23-0-1 PLAT ROT LFT	18 AWG	GXL	4460871		SW122 (3)
7	WHT	13-0-2 TELE IN	18 AWG	GXL	4460871		SW124 (3)
8	WHT	28-0-1 JIB DN	18 AWG	GXL	4460871		SW123 (3)
9	WHT	32-0-1 SIDE SWG LFT	18 AWG	GXL	4460871		SW127 (3)
10	WHT	29-0-2 TWR UP	18 AWG	GXL	4460871		SW126 (1)
11					4460905		
12					4460905		
13					4460905		
14	WHT	108-0 LSS LAMP	18 AWG	GXL	4460871		LB606 (1)
15					4460905		
16	WHT	99-0 ENABLE	18 AWG	GXL	4460871		SW533 (1)
17	WHT	25-0-1 PLAT LVL UP	18 AWG	GXL	4460871		SW121 (1)
18	WHT	24-0-1 PLAT ROT RHT	18 AWG	GXL	4460871		SW122 (1)
19	WHT	27-0-1 JIB UP	18 AWG	GXL	4460871		SW123 (1)
20	WHT	31-0-1 SIDE SWG RHT	18 AWG	GXL	4460871		SW127 (1)
21	WHT	30-0-2 TWR DN	18 AWG	GXL	4460871		SW126 (3)
22					4460905		
23	WHT	3-1 MAIN LIFT UP	18 AWG	GXL	4460871		SW125 (1)
24	WHT	METER PWR METER PWR	18 AWG	GXL	4460871		GD139 (1)
25	YEL	5-15	18 AWG	GXL	4460871		SW533 (2)
26					4460905		
27					4460905		
28					4460905		
29					4460905		
30	WHT	14-0-2 TELE OUT	18 AWG	GXL	4460871		SW124 (1)
31	BLK	4-22	18 AWG	GXL	4460871		LB606 (2)
32	BLK	METER GND METER GND	18 AWG	GXL	4460871		GD139 (2)
33	WHT	4-1 MAIN LIFT DN	18 AWG	GXL	4460871		SW125 (3)
34	WHT	21-1 SWG LFT	18 AWG	GXL	4460871		SW128 (3)
35	WHT	22-1 SWG RHT	18 AWG	GXL	4460871		SW128 (1)

Figure 7-37. Ground Panel Harness - Sheet 3 of 3



1001192110 H

Figure 7-38. Chassis Traction Harness - Sheet 1 of 3

IP409

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE2-IN	16 AWG	GXL	1001116733		CO211-A (3)
2	RED	BRAKE2-IN-2	16 AWG	GXL	1001116733		CO211-B+ (1)

CO211-B+

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE2-IN-2	16 AWG	GXL	N/A		IP409 (2)

RL253 - MAIN CONT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	VOTE-RLY-NO	18 AWG	GXL	1001126008		X1-A (5)
2	WHT	CNTACTOR-LS	18 AWG	GXL	1001126008		CO210-A (12)

CO211-A - LEFT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2	WHT	100 LFT BRK	18 AWG	GXL	4460871		X603A (7)
3	RED	BRAKE2-IN	16 AWG	GXL	4460871		IP409 (1)
4	BLK	1-2 LFT BRK GND	18 AWG	GXL	4460871		X603A (8)
5	BLK	2-1	18 AWG	GXL	4460871		S273 (2)
6	YEL	6-2-4 IGN 48 VOLT	18 AWG	GXL	4460871		S427 (2)
7					4460905		
8					4460905		
9					4460905		
10	YEL	6-2-6 IGN 48 VOLT	18 AWG	GXL	4460871		S427 (2)
11					4460905		
12					4460905		
13	GRN	18/4 CABLE	18 AWG	CABLE	4460871		X603A (2)
14	WHT	18/4 CABLE	18 AWG	CABLE	4460871		X603A (3)
15					4460905		
16					4460905		
17					4460905		
18					4460905		
19					4460905		
20					4460905		
21					4460905		
22	RED	18/2 STP	18 AWG	CABLE	4460871		X603A (5)
23					4460905		
24					4460905		
25	RED	18/4 CABLE	18 AWG	CABLE	4460871		X603A (1)
26					4460905		
27	GRN	CAN2 LO	18 AWG	GXL	4460871		S552 (2)
28	YEL	CAN2 HI	18 AWG	GXL	4460871		S551 (2)
29					4460905		
30					4460905		
31					4460905		
32					4460905		
33					4460905		
34					4460905		
35					4460905		
NC	SHIELD	18/4 CABLE	18 AWG	SHLD	N/A		X761 (1)
NC	SHIELD	18/2 CABLE	18 AWG	SHLD	N/A		X762 (1)

FC-1 - 20A 48V B+

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0-1 B+	12 AWG	GXL	1001116734		RL253-1 (1)
2	RED	1-0 B+	12 AWG	GXL	1001116734		X1-A (2)

FC601 - 30A DELTA Q PWR 48V B+

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-6 B+	12 AWG	GXL	1001116734	8220159	CH-1 (1)
2	RED	1-7 B+	12 AWG	GXL	1001116734	8220159	X1-A (6)

RL253-1

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-0-1 B+	12 AWG	GXL	N/A		FC-1 (1)

CH-1

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	1-6 B+	12 AWG	GXL	N/A		FC601 (1)

CH-2

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-2	12 AWG	GXL	N/A		X1-A (7)

TH-3-1 - GND

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	B- 2-0	12 AWG	GXL	N/A		X1-A (1)

IP408

CONNECTOR PART NUMBER: 1001217843
MUST INCLUDE JLG P/N: 1001217842 COVER AND 8229234 FUSE

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE1-IN	16 AWG	GXL	1001116733		CO210-A (3)
2	RED	BRAKE1-IN-2	16 AWG	GXL	1001116733		CO210-B+ (1)

CO210-B+

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	BRAKE1-IN-2	16 AWG	GXL	N/A		IP408 (2)

S273

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	18/4 CABLE	18 AWG	CABLE	N/A		X603A (4)
1	BLK	18/2 STP	18 AWG	CABLE	N/A		X603A (6)
2	BLK	2-1	18 AWG	GXL	N/A		CO211-A (5)

S427

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	6-2-2 IGN 48 VOLT	18 AWG	GXL	N/A		S554 (1)
1	WHT	6-2-5 IGN 48 VOLT	16 AWG	GXL	N/A		CO210-A (10)
2	YEL	6-2-4 IGN 48 VOLT	18 AWG	GXL	N/A		CO211-A (6)
2	YEL	6-2-6 IGN 48 VOLT	18 AWG	GXL	N/A		CO211-A (10)

X598A - INVERTER

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	43-1 INVERTER	18 AWG	GXL	4460465		S554 (1)
2					4460466		

X592 - TILT SNSR

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	5-50	18 AWG	GXL	1001107854	1001104498	X1-A (9)
2	BLK	4-55	18 AWG	GXL	1001107854	1001104498	X1-A (10)
3	YEL	CAN1 HI	18 AWG	GXL	1001107854	1001104498	X5-A (1)
4	GRN	CAN1 LO	18 AWG	GXL	1001107854	1001104498	X5-A (2)

X761 - SHIELD

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/4 CABLE	18 AWG	SHLD			CO211-A (NC)

X762 - SHIELD

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/2 CABLE	18 AWG	SHLD			CO211-A (NC)

X763 - SHIELD

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/2 STP	18 AWG	SHLD			CO210-A (NC)

X764 - SHIELD

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/4 CABLE	18 AWG	SHLD			CO210-A (NC)

Figure 7-39. Chassis Traction Harness - Sheet 2 of 3

X603A - LFT DRV MTR

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	18/4 CABLE	18 AWG	CABLE	1001126008		CO211-A (25)
2	GRN	18/4 CABLE	18 AWG	CABLE	1001126008		CO211-A (13)
3	WHT	18/4 CABLE	18 AWG	CABLE	1001126008		CO211-A (14)
4	BLK	18/4 CABLE	18 AWG	CABLE	1001126008		S273 (1)
5	RED	18/2 STP	18 AWG	CABLE	1001126008		CO211-A (22)
6	BLK	18/2 STP	18 AWG	CABLE	1001126008		S273 (1)
7	WHT	100 LFT BRK	18 AWG	GXL	1001126008		CO211-A (2)
8	BLK	1-2 LFT BRK GND	18 AWG	GXL	1001126008		CO211-A (4)
NC							

CO210-B-

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	GND-ADDR	18 AWG	GXL	N/A		CO210-A (6)

CO210-A - RIGHT

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					4460905		
2	WHT	200 RT BRK	18 AWG	GXL	4460871		X602A (7)
3	RED	BRAKE1-IN	16 AWG	GXL	4460871		IP408 (1)
4	BLK	2-6 RT BRK GND	18 AWG	GXL	4460871		X602A (8)
5	BLK	GND1-0	18 AWG	GXL	4460871		S278 (1)
6	BLK	GND-ADDR	18 AWG	GXL	4460871		CO210-B- (1)
7					4460905		
8					4460905		
9					4460905		
10	WHT	6-2-5 IGN 48 VOLT	16 AWG	GXL	4460871		S427 (1)
11					4460905		
12	WHT	CNTACTOR-LS	18 AWG	GXL	4460871		RL253 (2)
13	GRN	18/4 CABLE	18 AWG	CABLE	4460871		X602A (2)
14	WHT	18/4 CABLE	18 AWG	CABLE	4460871		X602A (3)
15	BLU	STEER-SIG	18 AWG	GXL	4460871		X599A (2)
16	WHT	CHRG-STAT	18 AWG	GXL	4460871		X1-A (8)
17					4460905		
18					4460905		
19					4460905		
20					4460905		
21					4460905		
22	RED	18/2 STP	18 AWG	CABLE	4460871		X602A (5)
23					4460905		
24					4460905		
25	WHT	201-2 RT SNR PWR	18 AWG	GXL	4460871		S277 (1)
26					4460905		
27	GRN	CAN2 LO	18 AWG	GXL	4460871		S552 (2)
28	YEL	CAN2 HI	18 AWG	GXL	4460871		S551 (2)
29					4460905		
30					4460905		
31					4460905		
32					4460905		
33					4460905		
34					4460905		
35					4460905		
NC	SHIELD	18/2 STP	18 AWG	SHLD	N/A		X763 (1)
NC	SHIELD	18/4 CABLE	18 AWG	SHLD	N/A		X764 (1)

S552

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	GRN	CAN2 LO	18 AWG	GXL	N/A		MS-4 (B)
2	GRN	CAN2 LO	18 AWG	GXL	N/A		CO210-A (27)
2	GRN	CAN2 LO	18 AWG	GXL	N/A		CO211-A (27)

X1-A-TO TURNTABLE HARN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	B- 2-0	12 AWG	GXL	1001157891		TH-3-1 (1)
2	RED	1-0 B+	12 AWG	GXL	1001157891		FC-1 (2)
3	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	4460464		S554 (1)
4	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	4460464		S554 (2)
5	YEL	VOTE-RLY-NO	18 AWG	GXL	4460464		RL253 (1)
6	RED	1-7 B+	12 AWG	GXL	1001157891		FC601 (2)
7	BLK	2-2	12 AWG	GXL	1001157891		CH-2 (1)
8	WHT	CHRG-STAT	18 AWG	GXL	4460464		CO210-A (16)
9	YEL	5-50	18 AWG	GXL	4460464		X592 (1)
10	BLK	4-55	18 AWG	GXL	4460464		X592 (2)
11					4460466		
12					4460466		

X599A - TO STR SNR HARNESS

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	201-1 STR SNR	18 AWG	GXL	4460465		S277 (1)
2	BLU	STEER-SIG	18 AWG	GXL	4460465		CO210-A (15)
3	BLK	GND1-3	18 AWG	GXL	4460465		S278 (2)
4					4460466		

MS-4 - CAN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	CAN2 HI	18 AWG	GXL	4460944		S551 (1)
B	GRN	CAN2 LO	18 AWG	GXL	4460944		S552 (1)
C					4460466		

X5-A - CAN TILT SENSOR

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HI	18 AWG	GXL	4460464		X592 (3)
2	GRN	CAN1 LO	18 AWG	GXL	4460464		X592 (4)

S551

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN2 HI	18 AWG	GXL	N/A		MS-4 (A)
2	YEL	CAN2 HI	18 AWG	GXL	N/A		CO210-A (28)
2	YEL	CAN2 HI	18 AWG	GXL	N/A		CO211-A (28)

S278

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	GND1-0	18 AWG	GXL	N/A		CO210-A (5)
2	BLK	18/4 CABLE	18 AWG	CABLE	N/A		X602A (4)
2	BLK	18/2 STP	18 AWG	CABLE	N/A		X602A (6)
2	BLK	GND1-3	18 AWG	GXL	N/A		X599A (3)

S277

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	201-1 STR SNR	18 AWG	GXL	N/A		X599A (1)
1	WHT	201-2 RT SNR PWR	18 AWG	GXL	N/A		CO210-A (25)
2	RED	18/4 CABLE	18 AWG	CABLE	N/A		X602A (1)

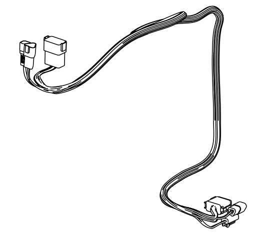
X602A- RHT DRV MTR

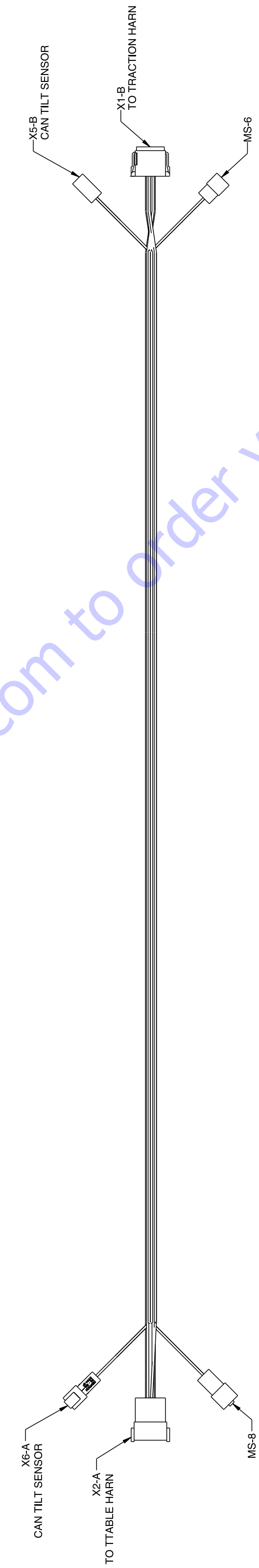
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	18/4 CABLE	18 AWG	CABLE	1001126008		S277 (2)
2	GRN	18/4 CABLE	18 AWG	CABLE	1001126008		CO210-A (13)
3	WHT	18/4 CABLE	18 AWG	CABLE	1001126008		CO210-A (14)
4	BLK	18/4 CABLE	18 AWG	CABLE	1001126008		S278 (2)
5	RED	18/2 STP	18 AWG	CABLE	1001126008		CO210-A (22)
6	BLK	18/2 STP	18 AWG	CABLE	1001126008		S278 (2)
7	WHT	200 RT BRK	18 AWG	GXL	1001126008		CO210-A (2)
8	BLK	2-6 RT BRK GND	18 AWG	GXL	1001126008		CO210-A (4)
NC							

S554

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	6-2-2 IGN 48 VOLT	18 AWG	GXL	N/A		S427 (1)
1	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	N/A		X1-A (3)
1	WHT	43-1 INVERTER	18 AWG	GXL	N/A		X598A (1)
2	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	N/A		X1-A (4)

Figure 7-40. Chassis Traction Harness - Sheet 3 of 3





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X2-A - TO TTABLE HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-0 B-	12 AWG	GXL	1001157891		X1-B (1)
2	RED	1-0 B+	12 AWG	GXL	1001157891		X1-B (2)
3	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	4460464		X1-B (3)
4	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	4460464		X1-B (4)
5	YEL	49-10 VOTE-RLY-NO	18 AWG	GXL	4460464		X1-B (5)
6	RED	1-7	12 AWG	GXL	1001157891		X1-B (6)
7	BLK	2-2	12 AWG	GXL	1001157891		X1-B (7)
8	WHT	CHRG-STAT	18 AWG	GXL	4460464		X1-B (8)
9	YEL	5-50	18 AWG	GXL	4460464		X1-B (9)
10	BLK	4-55	18 AWG	GXL	4460464		X1-B (10)
11					4460466		
12					4460466		

MS-8							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	83-1 CAN2 HIGH	18 AWG	GXL	4460943		MS-6 (A)
B	GRN	84-1 CAN2 LOW	18 AWG	GXL	4460943		MS-6 (B)
C					4460466		

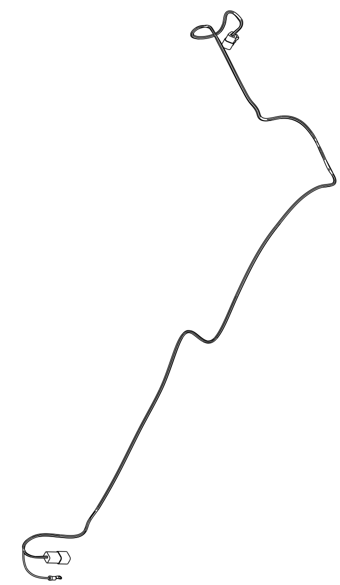
X6-A - CAN TILT SENSOR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HI	18 AWG	GXL	4460464		X5-B (1)
2	GRN	CAN1 LO	18 AWG	GXL	4460464		X5-B (2)

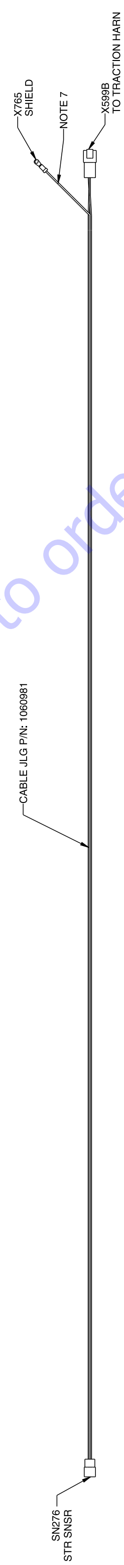
MS-6							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
A	YEL	83-1 CAN2 HIGH	18 AWG	GXL	4460944		MS-8 (A)
B	GRN	84-1 CAN2 LOW	18 AWG	GXL	4460944		MS-8 (B)
C					4460466		

X5-B - CAN TILT SENSOR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	YEL	CAN1 HI	18 AWG	GXL	4460465		X6-A (1)
2	GRN	CAN1 LO	18 AWG	GXL	4460465		X6-A (2)

X1-B - TO TRACTION HARN							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	BLK	2-0 B-	12 AWG	GXL	1001157890		X2-A (1)
2	RED	1-0 B+	12 AWG	GXL	1001157890		X2-A (2)
3	YEL	6-8 IGN PWR 48 VOLT	18 AWG	GXL	4460465		X2-A (3)
4	YEL	6-2-3 IGN 48 VOLT	18 AWG	GXL	4460465		X2-A (4)
5	YEL	49-10 VOTE-RLY-NO	18 AWG	GXL	4460465		X2-A (5)
6	RED	1-7	12 AWG	GXL	1001157890		X2-A (6)
7	BLK	2-2	12 AWG	GXL	1001157890		X2-A (7)
8	WHT	CHRG-STAT	18 AWG	GXL	4460465		X2-A (8)
9	YEL	5-50	18 AWG	GXL	4460465		X2-A (9)
10	BLK	4-55	18 AWG	GXL	4460465		X2-A (10)
11					4460466		
12					4460466		

Figure 7-41. Chassis Traction to Turntable Harness





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SN276 - STR SNSR

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	18/3 CABLE	18 AWG	CABLE	4460465		X599B (1)
2	BLU	18/3 CABLE	18 AWG	CABLE	4460465		X599B (2)
3	BLK	18/3 CABLE	18 AWG	CABLE	4460465		X599B (3)
NC	SHIELD	18/3 CABLE	18 AWG	SHLD	N/A		X765 (1)

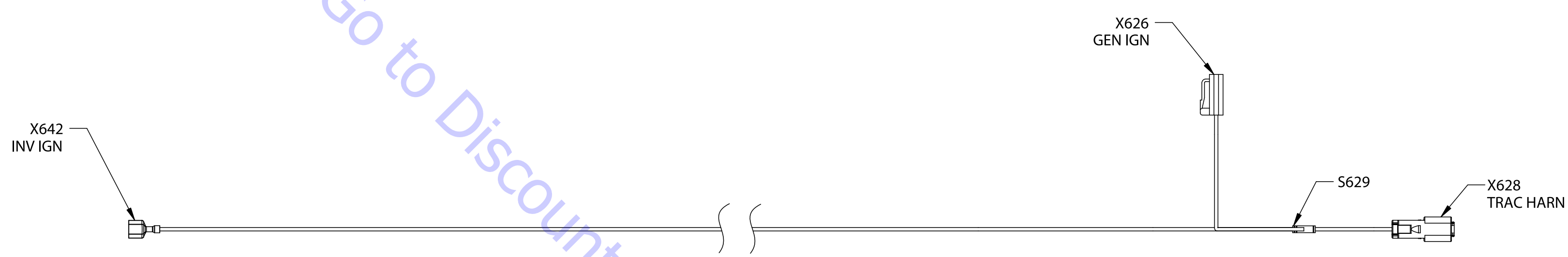
X765-SHIELD

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	SHIELD	18/3 CABLE	18 AWG	SHLD	4460142		SN276 (NC)

X599B - TO TRACTION HARN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	18/3 CABLE	18 AWG	CABLE	4460464		SN276 (1)
2	BLU	18/3 CABLE	18 AWG	CABLE	4460464		SN276 (2)
3	BLK	18/3 CABLE	18 AWG	CABLE	4460464		SN276 (3)
4					4460466		

Figure 7-42. Steering Sensor Harness



X642 - INV IGN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	IGN 48V	18 AWG	GXL	1001193545		S629 (2)

X628 - TRAC HARN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-8-1	18 AWG	GXL	4460464		S629 (1)
2					4460466		

X626 - GEN IGN

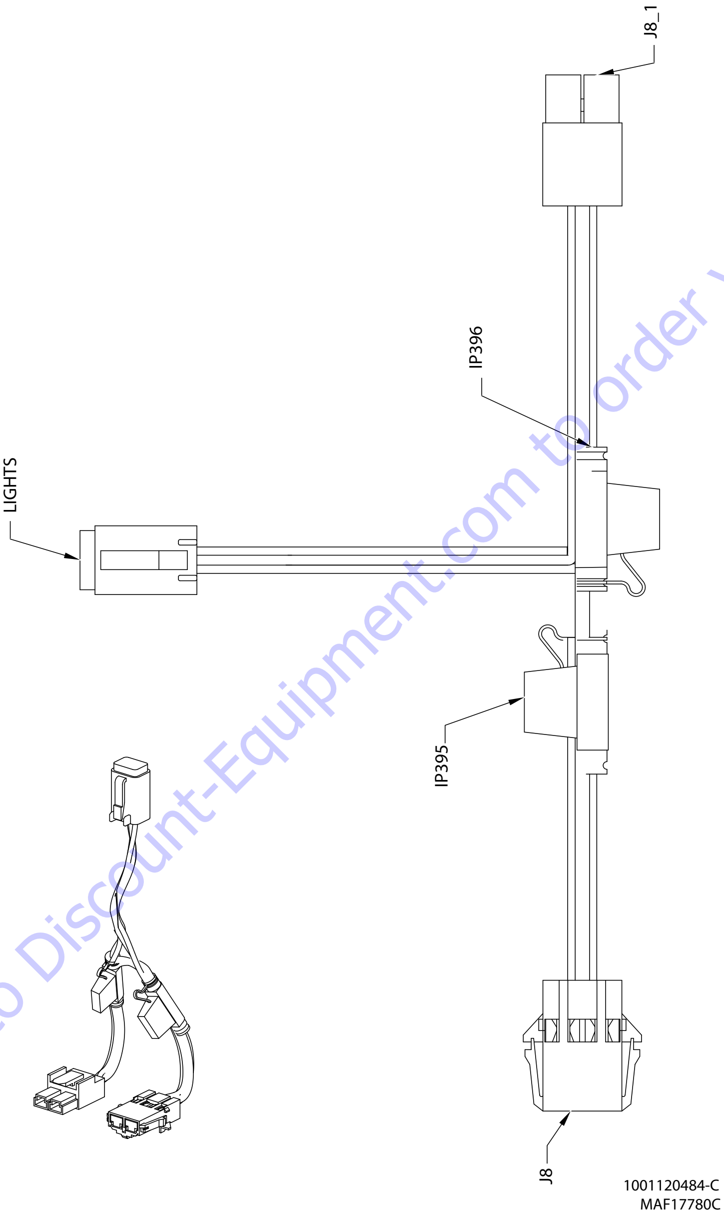
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-8-3	18 AWG	GXL	4460465		S629 (2)
2					4460466		

S629

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	8-8-1	18 AWG	GXL	N/A		X628 (1)
2	WHT	IGN 48V	18 AWG	GXL	N/A		X642 (1)
2	WHT	8-8-3	18 AWG	GXL	N/A		X626 (1)

1001192293 C

Figure 7-43. Inverter IGN Harness



NOTE: *The wire referenced is part of fuse holder*

Figure 7-44. Platform Work Light Harness

J8_1					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	-	12 AWG	GXL	J8(1)
1	BLK	-	16 AWG	GXL	LIGHTS(3)
2	YEL/RED	-	12 AWG	GXL	J8(2)
2	-	SEE NOTE			IP396(2)

IP396					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	-	SEE NOTE			LIGHTS(4)
2	-	SEE NOTE			J8_1(2)

LIGHTS					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	-	16 AWG	GXL	J8(1)
2	-	SEENOTE			IP395(1)
3	BLK	-	16 AWG	GXL	J8_1(1)
4	-	SEENOTE			IP396(1)

IP395					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	-	SEE NOTE			LIGHTS(2)
2	-	SEE NOTE			J8(2)

J8					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	BLK	-	12 AWG	GXL	J8_1(1)
1	BLK	-	16 AWG	GXL	LIGHTS(1)
2	YEL/RED	-	12 AWG	GXL	J8_1(2)
2	-	SEE NOTE			IP395(2)

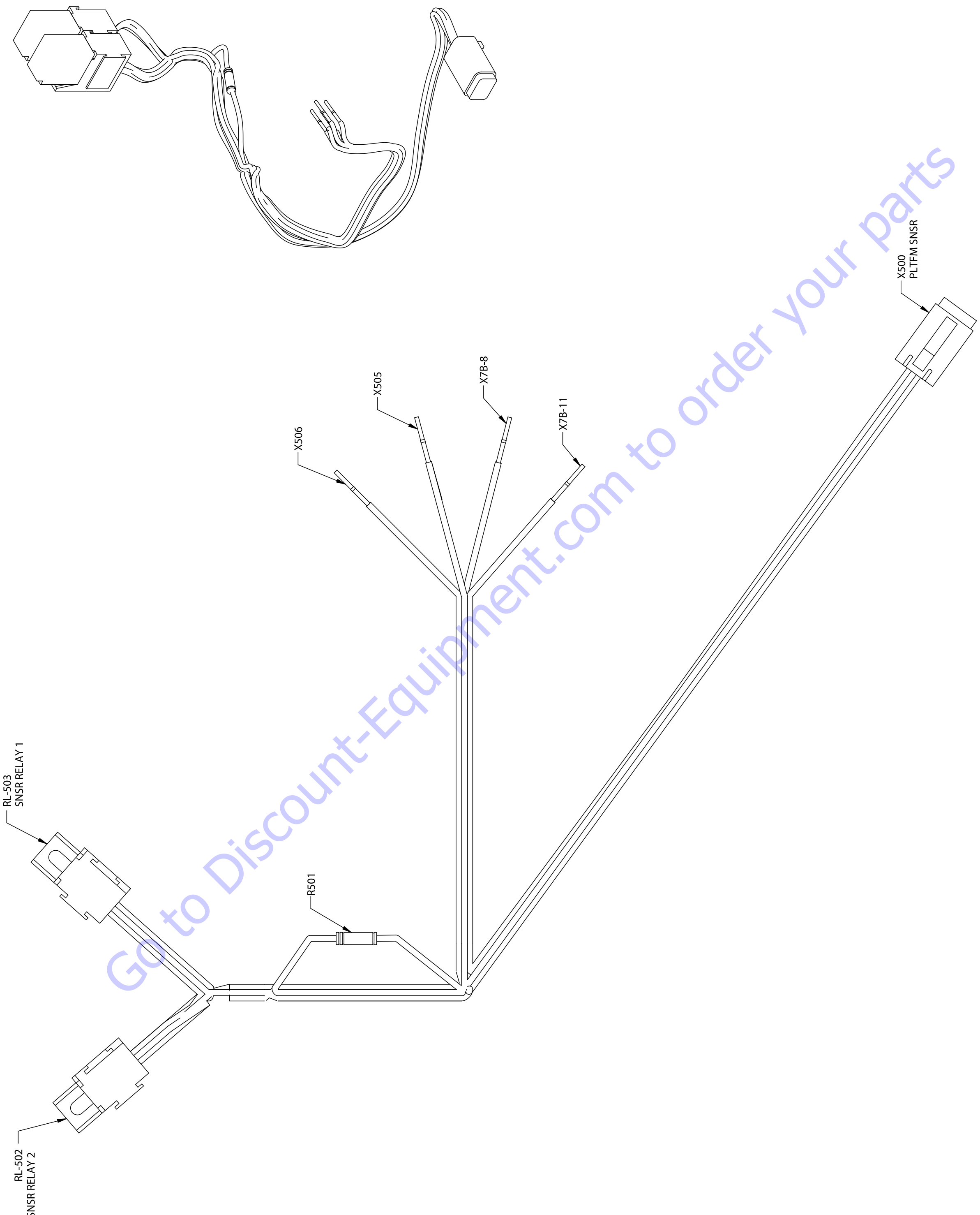


Figure 7-45. SkyGuard Harness - Sheet 1 of 2

X506							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P1	18 AWG	GXL			RL-503 (87)

X505							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P2	18 AWG	GXL			R501 (1)
1	WHT	P9	18 AWG	GXL			RL-503 (30)

X7B-8							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P6	18 AWG	GXL			X500 (2)

X7B-11							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P3	18 AWG	GXL			RL-502 (87)

X500 - PLTFM SNSR							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P10	18 AWG	GXL	4460465		R501 (2)
2	WHT	P6	18 AWG	GXL	4460465		X7B-8 (1)
3	WHT	P4	18 AWG	GXL	4460465		RL-502 (86)
4	WHT	P5	18 AWG	GXL	4460465		RL-502 (85)

RL-502 - SNSR RELAY 2							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
30	WHT	P9-1	18 AWG	GXL	1001116720		RL-503 (30)
85	WHT	P5	18 AWG	GXL	1001116720		X500 (4)
85	WHT	P5-1	18 AWG	GXL	1001116720		RL-503 (85)
86	WHT	P4	18 AWG	GXL	1001116720		X500 (3)
86	WHT	P4-1	18 AWG	GXL	1001116720		RL-503 (86)
87	WHT	P3	18 AWG	GXL	1001116720		X7B-11 (1)
87a							

RL-503 - SNSR RELAY 1							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
30	WHT	P9	18 AWG	GXL	1001116720		X505 (1)
30	WHT	P9-1	18 AWG	GXL	1001116720		RL-502 (30)
85	WHT	P5-1	18 AWG	GXL	1001116720		RL-502 (85)
86	WHT	P4-1	18 AWG	GXL	1001116720		RL-502 (86)
87	WHT	P1	18 AWG	GXL	1001116720		X506 (1)
87a							

R501							
CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	P2	18 AWG	GXL	N/A		X505 (1)
2	WHT	P10	18 AWG	GXL	N/A		X500 (1)

Figure 7-46. SkyGuard Harness - Sheet 2 of 2

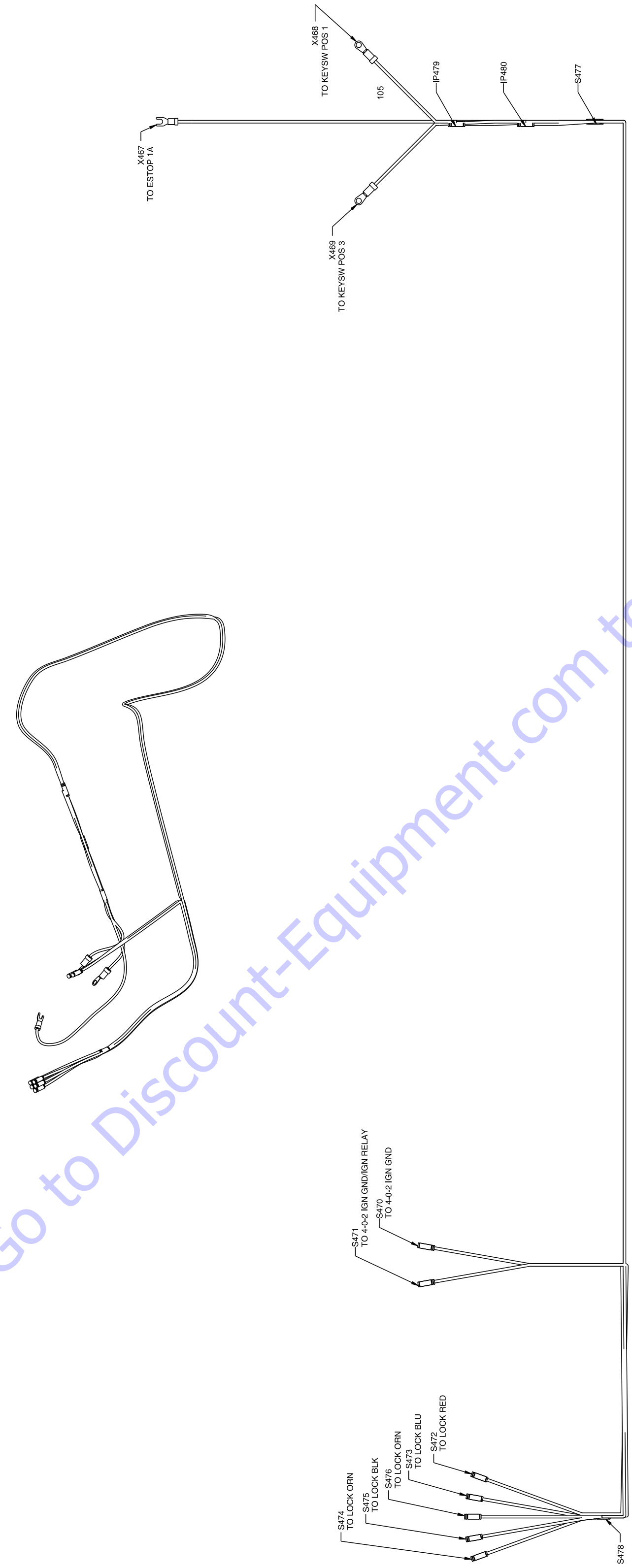


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Figure 7-47. Security Lock Harness - Sheet 1 of 2

S472 - TO LOCK RED

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	2-16 12V+	16 AWG	GXL	N/A		X467 (1)
2					N/A		

S473 - TO LOCK BLU

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1 LOCK	16 AWG	GXL	N/A		S477 (2)
2					N/A		

S474 - TO LOCK ORN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-2-1 LOCK	16 AWG	GXL	N/A		S478 (2)
2					N/A		

S475 - TO LOCK BLK

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-2-2 LOCK	16 AWG	GXL	N/A		S478 (2)
2					N/A		

S476 - TO LOCK ORN

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-3 LOCK	16 AWG	GXL	N/A		S471 (2)
2					N/A		

S470 - TO 4-0-2 IGN GND

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					N/A		
2	WHT	90-2 LOCK	16 AWG	GXL	N/A		S478 (1)

S471 - TO 4-0-2 IGN GND/IGN RELAY

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1					N/A		
2	WHT	90-3 LOCK	16 AWG	GXL	N/A		S476 (1)

S478

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-2 LOCK	16 AWG	GXL	N/A		S470 (2)
2	WHT	90-2-1 LOCK	16 AWG	GXL	N/A		S474 (1)
2	WHT	90-2-2 LOCK	16 AWG	GXL	N/A		S475 (1)

S477

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1-1 LOCK	16 AWG	GXL	N/A		IP479 (1)
1	WHT	90-1-2 LOCK	16 AWG	GXL	N/A		IP480 (1)
2	WHT	90-1 LOCK	16 AWG	GXL	N/A		S473 (1)

X467 - TO ESTOP 1A

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	RED	2-16 12V+	16 AWG	GXL	N/A		S472 (1)

X468 - TO KEYSW POS 1

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1-1 LOCK	16 AWG	GXL	N/A		IP479 (2)

X469 - TO KEYSW POS 3

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1-2 LOCK	16 AWG	GXL	N/A		IP480 (2)

IP479

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1-1 LOCK	16 AWG	GXL	N/A		S477 (1)
2	WHT	90-1-1 LOCK	16 AWG	GXL	N/A		X468 (1)

IP480

CONN POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TERMINAL P/N	SEAL P/N	TO
1	WHT	90-1-2 LOCK	16 AWG	GXL	N/A		S477 (1)
2	WHT	90-1-2 LOCK	16 AWG	GXL	N/A		X469 (1)

Figure 7-48. Security Lock Harness - Sheet 2 of 2

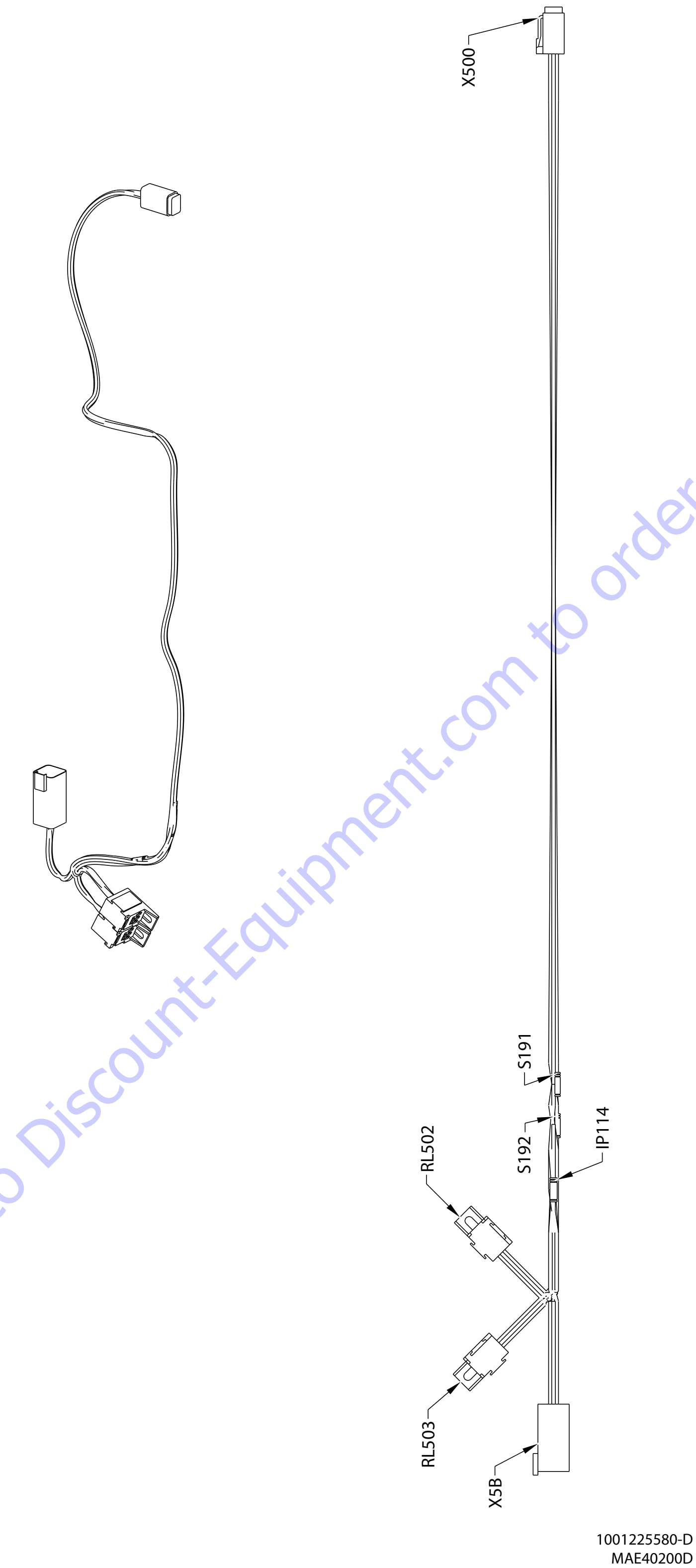


Figure 7-49. Skyguard (Bar) 6 Pin Harness

X5B-INTERFACE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	P2	18 AWG	GXL	IP114 (1)
2	WHT	P6	18 AWG	GXL	X500 (2)
3					
4	WHT	P1	18 AWG	GXL	RL503 (87)
5	WHT	P3	18 AWG	GXL	RL502 (87)
6					

RL503-SKYGUARD RELAY #1					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
30	WHT	P9-1	18 AWG	GXL	IP114 (1)
85	WHT	P5-1	18 AWG	GXL	S191 (1)
86	WHT	P4-1	18 AWG	GXL	S192 (1)
87	WHT	P1	18 AWG	GXL	X5B (4)
87A					

RL502-SKYGUARD RELAY #2					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
30	WHT	P9-2	18 AWG	GXL	IP114 (1)
85	WHT	P5-2	18 AWG	GXL	S191 (1)
86	WHT	P4-2	18 AWG	GXL	S192 (1)
87	WHT	P3	18 AWG	GXL	X5B (5)
87A					

S192					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	P4-1	18 AWG	GXL	RL503 (86)
1	WHT	P4-2	18 AWG	GXL	RL502 (86)
2	WHT	P4	18 AWG	GXL	X500 (3)

S191					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	P5-1	18 AWG	GXL	RL503 (85)
1	WHT	P5-2	18 AWG	GXL	RL502 (85)
2	WHT	P5	18 AWG	GXL	X500 (4)

X500-PLAT SENSOR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	P10	18 AWG	GXL	IP114 (2)
2	WHT	P6	18 AWG	GXL	X5B (2)
3	WHT	P4	18 AWG	GXL	S192 (2)
4	WHT	P5	18 AWG	GXL	S191 (2)

IP114					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	WHT	P2	18 AWG	GXL	X5B (1)
1	WHT	P9-1	18 AWG	GXL	RL503 (30)
1	WHT	P9-2	18 AWG	GXL	RL502 (30)
2	WHT	P10	18 AWG	GXL	X500 (1)

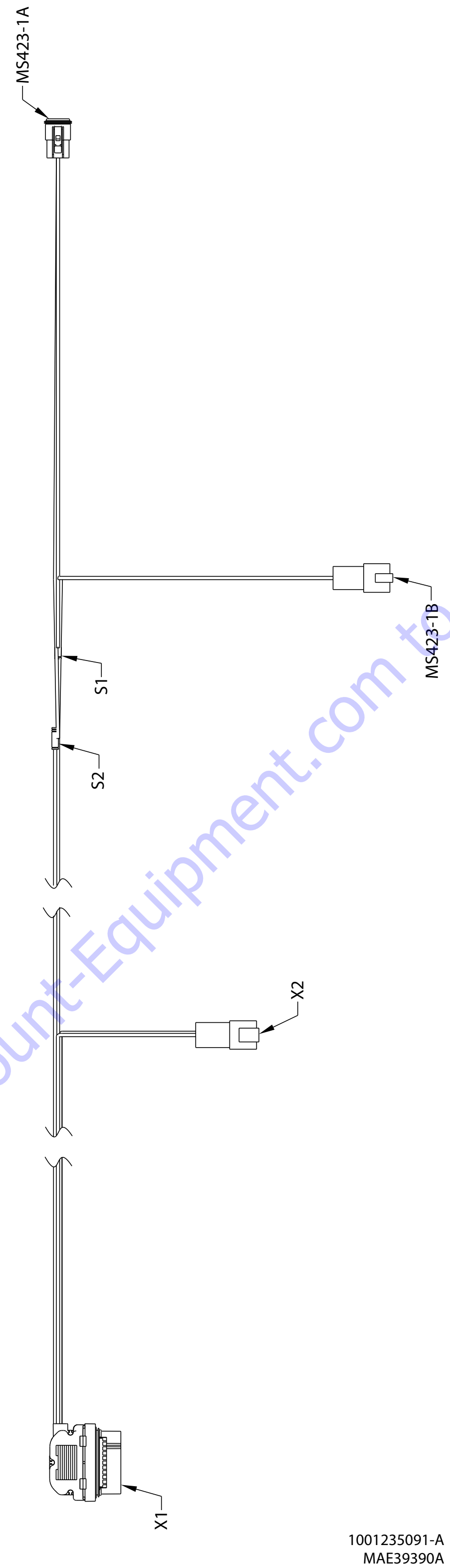


Figure 7-50. Eboom Clearsky CAN Harness

X1-TCU					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1					
2					
3					
4	ORG	2-0 IGN	18 AWG	GXL	X2 (3)
5					
6					
7	GRN	CAN IL-3	18 AWG	GXL	S2 (1)
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18	YEl	CAN IH-3	18 AWG	GXL	S1 (1)
19					
20					
21					
22					
23	BLK	0-0 GND	18 AWG	GXL	X2 (2)
24	RED	1-0 BAT	18 AWG	GXL	X2 (1)

X2-CONNECT TMR					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	RED	1-0 BAT	18 AWG	GXL	X1 (24)
2	BLK	0-0 GND	18 AWG	GXL	X1 (23)
3	ORG	2-0 IGN	18 AWG	GXL	X1 (4)
4					

S2					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	GRN	CAN IL-3	18 AWG	GXL	X1 (7)
2	GRN	CAN IL-2	18 AWG	GXL	MS423-1A (B)
2	GRN	CAN IL-1	18 AWG	GXL	MS423-1B (B)

S1					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
1	YEL	CAN IH-3	18 AWG	GXL	X1 (18)
2	YEL	CAN IH-2	18 AWG	GXL	MS423-1A (B)
2	YEL	CAN IH-1	18 AWG	GXL	MS423-1B (B)

MS423-1B - FROM CAN TEE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CAN IH-1	18 AWG	GXL	S1 (2)
B	GRN	CAN IL-1	18 AWG	GXL	S2 (2)
C					

MS423-1A - TO CAN TEE					
CONN-POS	WIRE COLOR	WIRE LABEL	GAUGE	JACKET	TO
A	YEL	CAN IH-2	18 AWG	GXL	S1 (2)
B	GRN	CAN IL-2	18 AWG	GXL	S2 (2)
C					

7.10 ELECTRICAL SCHEMATICS

SHEET 2: FUNCTION ABBREVIATION

SHEET 3: PLATFORM CONSOLE WIRING
Console Harness with SKYGUARD and 1 Cell LSS

SHEET 4: PLATFORM AND BOOM COMPONENTS
LSS

SHEET 5: TURNTABLE, AND UGM WIRING
Main Valve Harness
Boom Valves Harness
Turntable Harness
Amber Beacon

SHEET 6: GROUND CONTROL WIRING
Ground Panel Harness

SHEET 7: CHASSIS WIRING
Traction Harness
Traction to Turntable Harness
Steering Sensor

SHEET 8: OPTIONS
Inverter IGN
Platform Work Light
Sky Guard
Security Lock

SHEET 9: PLATFORM INTERFACE
Gen 2 Plat Interface
Harness, Eboom Clearsky CAN

SHEET 1

1001245671-A

Abbreviation	Description
C03-J1-RL	LEFT POWER MODULE
C04-J1-RL	RIGHT POWER MODULE
FC-1	10 AMP FUSE
FC-2	CONSTANT 12 V
MS-1	RIGHT BRAKE
MS-2	LEFT BRAKE
MS-3	DC TO DC CONVERTER
MS-4	CAN 2 POWER MODULES
MS-5	POWER MODULE TERMINATION RESISTOR
MS-6	CAN 2 TO UGM
MS-7	CAN 2 TO CHASSIS
RL-1	IGNITION RELAY
RL-2	VOTE RELAY
RL-3	MAIN CONTACTOR
SN-1	RIGHT ENCODER
SN-2	RIGHT THERMAL
SN-3	LEFT ENCODER
SN-4	LEFT THERMAL
SN-5	STEER SENSOR
T-1	RIGHT POWER MODULE ADDRESS B+ 48
T-2	RIGHT POWER MODULE B-
T-3	LEFT POWER MODULE ADDRESS B+ 48
T-4	LEFT POWER MODULE B-
X1-A	CHASSIS, TURNTABLE JUMPER HARNESS CONNECTION
X1-B	CHASSIS, TURNTABLE JUMPER HARNESS CONNECTION
X2-A	TURNTABLE AND UGM JUMPER HARNESS CONNECTION
X2-B	TURNTABLE AND UGM JUMPER HARNESS CONNECTION
X2A-7	SKYGUARD POWER CONNECTION TO UGM
X1A-15	LLS POWER CONNECTION TO UGM
X1A-9	SOFT TOUCH POWER TO UGM CONNECTION
X2B-7	SKYGUARD POWER CONNECTION TO X2A
X1B-15	LLS POWER CONNECTION TO X2A
X1B-9	SOFT TOUCH POWER TO X1A
X3-A	TO GROUND CONTROL
X3-B	TO TURNTABLE AND UGM
X4-A	TO PLATFORM
X4-B	TO TURNTABLE AND UGM
X5-A	BOOM CONTROL CONNECTION
X6-A	TO PLATFORM
X6-B	TO BOOM CONTROL CABLE
X1A-11	SKY GUARD TO UGM
X1A-12	SOFT TOUCH TO UGM
X1B-11	SKY GUARD TO X1A CONNECTOR

Abbreviation	Description
X1B-12	SOFT TOUCH TO X1A CONNECTOR
HV-13	TEL IN
HV-14	TEL OUT
HV-21	SWING LEFT
HV-22	SWING RIGHT
HV-39	SWING ARREST
HV-26	PLAT LEVEL DOWN
HV-23	PLAT ROT LEFT
HV-24	PLAT ROT RIGHT
HV-27	JIB UP
HV-28	JIB DOWN
HV-32	SIDE SWING LEFT
HV-31	SIDE SWING RIGHT
HV-3	MAIN LIFT UP
HV-29	TOWER LIFT UP
HV-30	TOWER LIFT DOWN
HV-50	FLOW CONTROL
HV-10	STEER LEFT
HV-9	STEER RIGHT
HV-41	P. BYPASS
SW 305	SPEED MODE
SW 06	TOWER LIFT
SW 09	MAIN TELESCOPE
SW 05	PLAT ROTATE
SW02	PLAT LEVEL
SW08	JIB
SW495	SIDE SWING
SW04	PUMP POT
B_SW03-2	HORN
B_SW03-1	HORN
SW11	DOS
SW546-2	SKY GUARD
SW546-1	SKYGUARD
SW07-2	HEAD TAIL
SW07-1	HEAD TAIL
SW292	MANUAL START

SHEET 2
1001245671-A

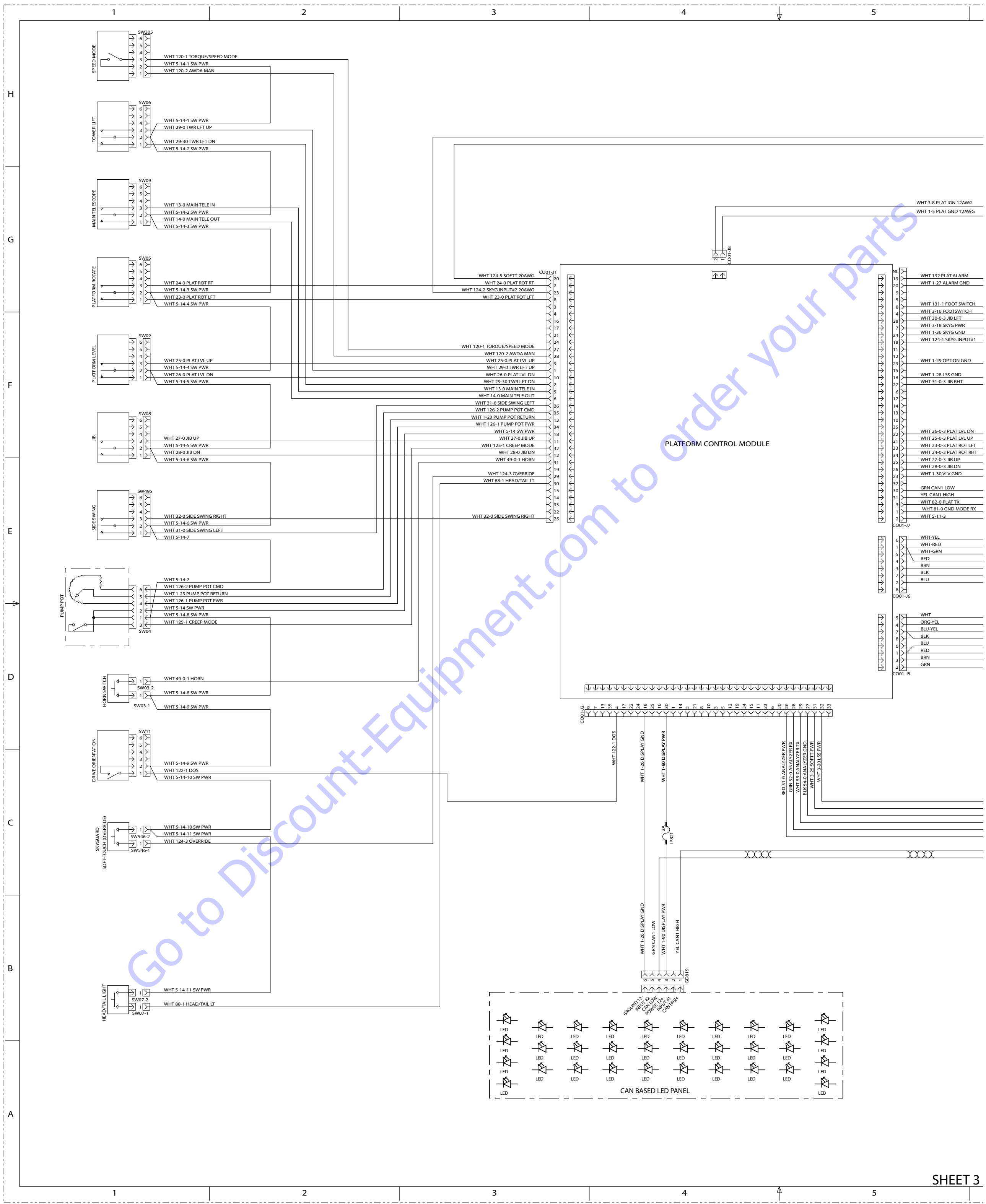


Figure 7-51. Electrical Schematic - Sheet 1 of 14

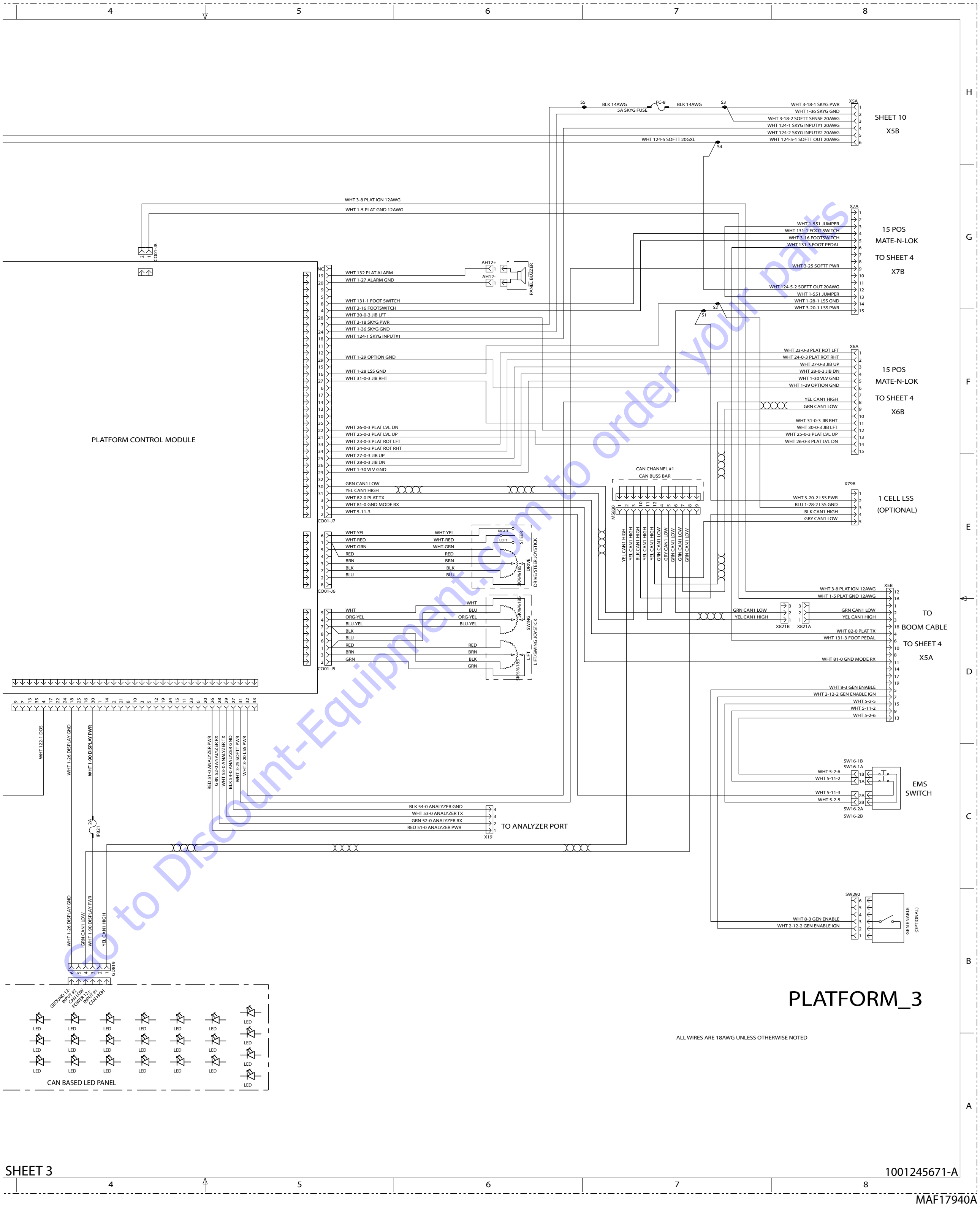


Figure 7-52. Electrical Schematic - Sheet 2 of 14

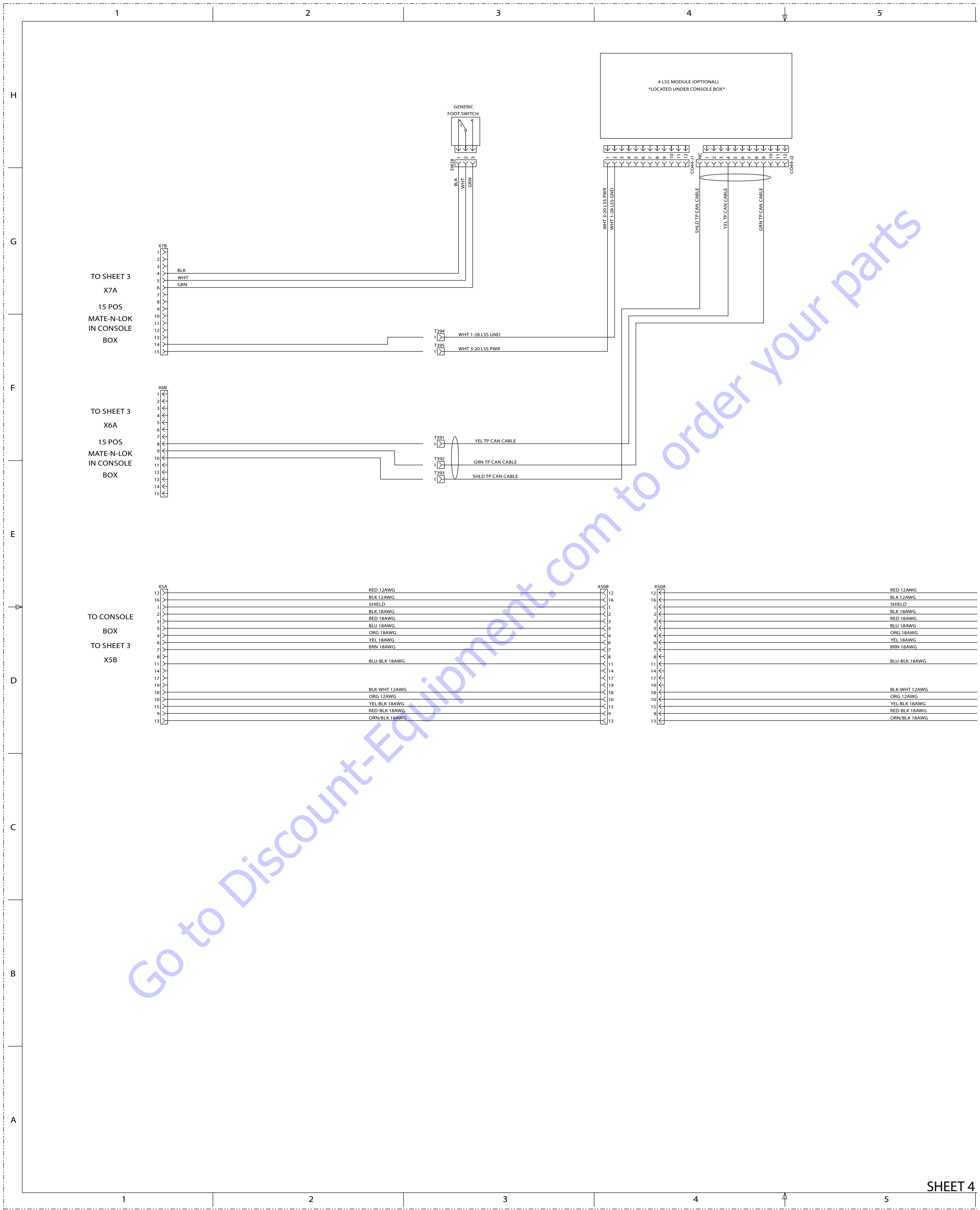


Figure 7-53. Electrical Schematic - Sheet 3 of 14

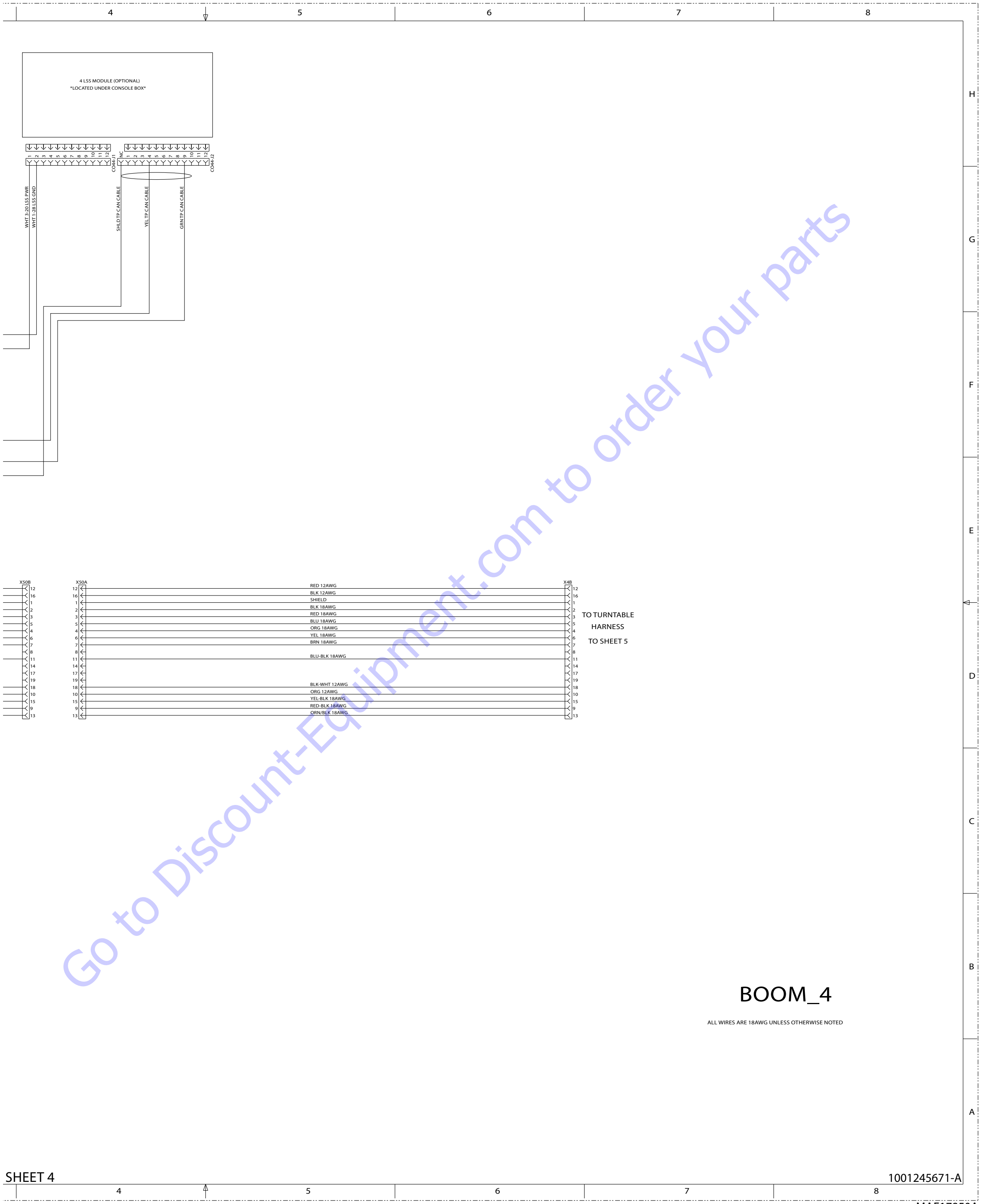


Figure 7-54. Electrical Schematic - Sheet 4 of 14

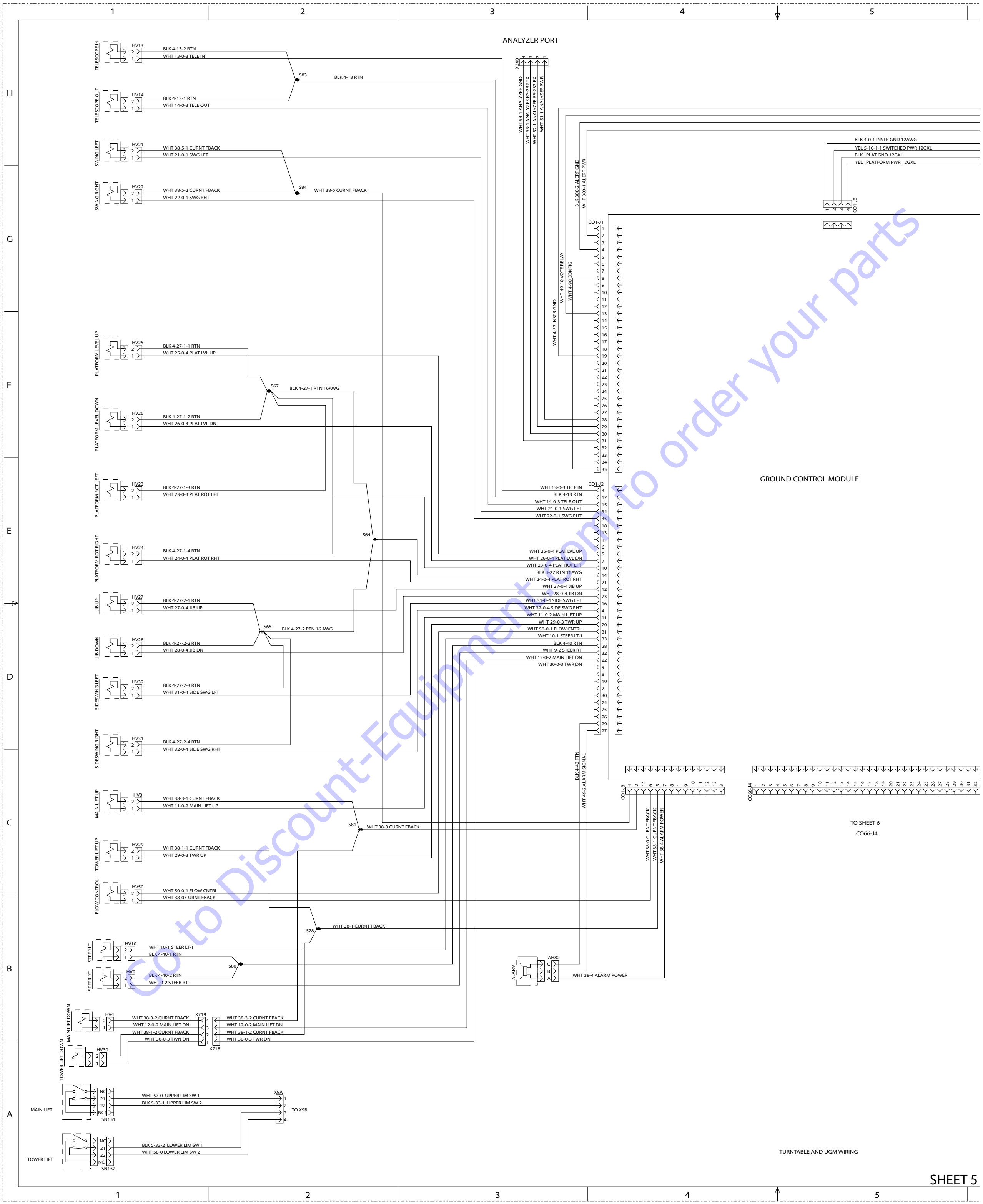


Figure 7-55. Electrical Schematic - Sheet 5 of 14

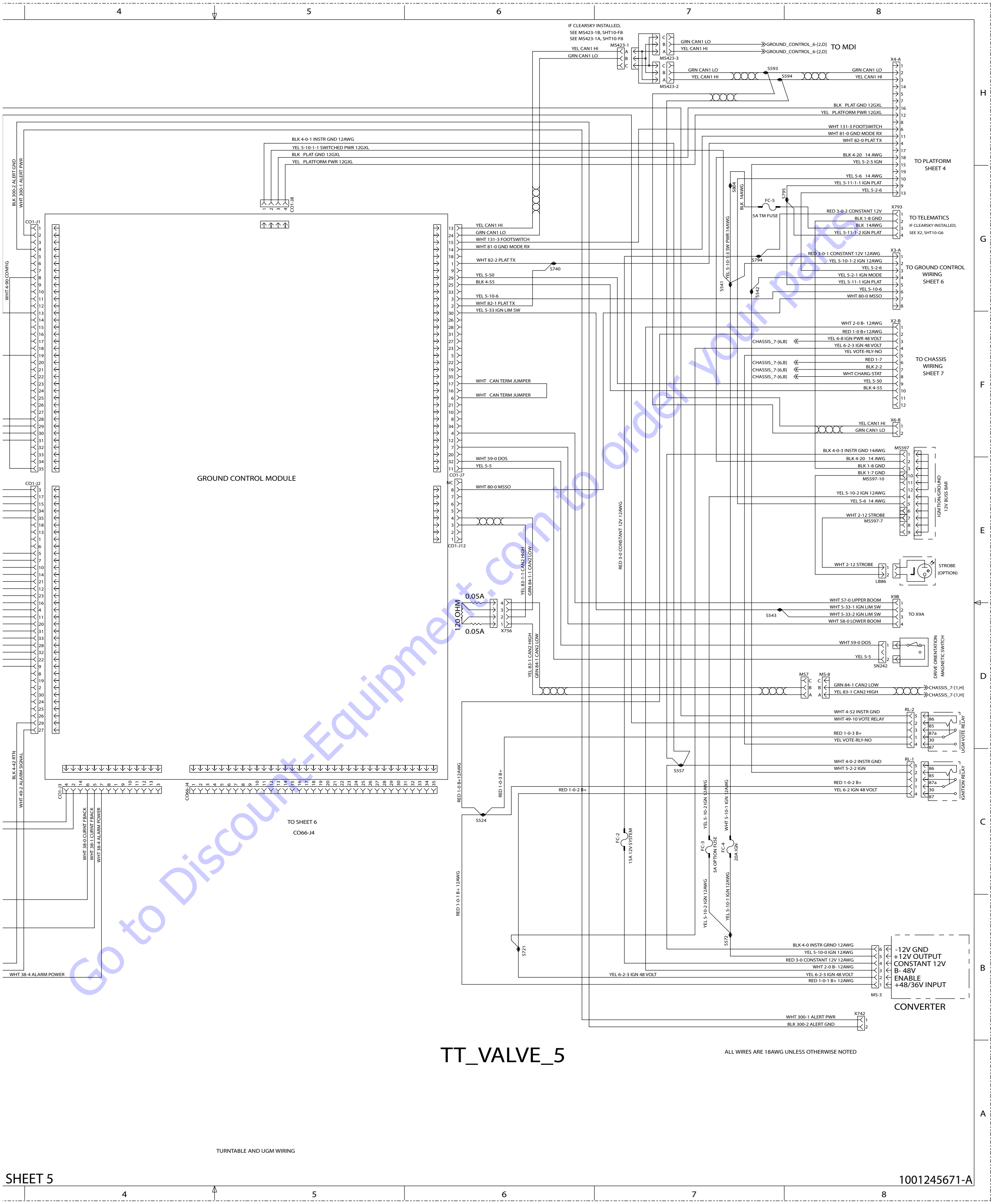


Figure 7-56. Electrical Schematic - Sheet 6 of 14

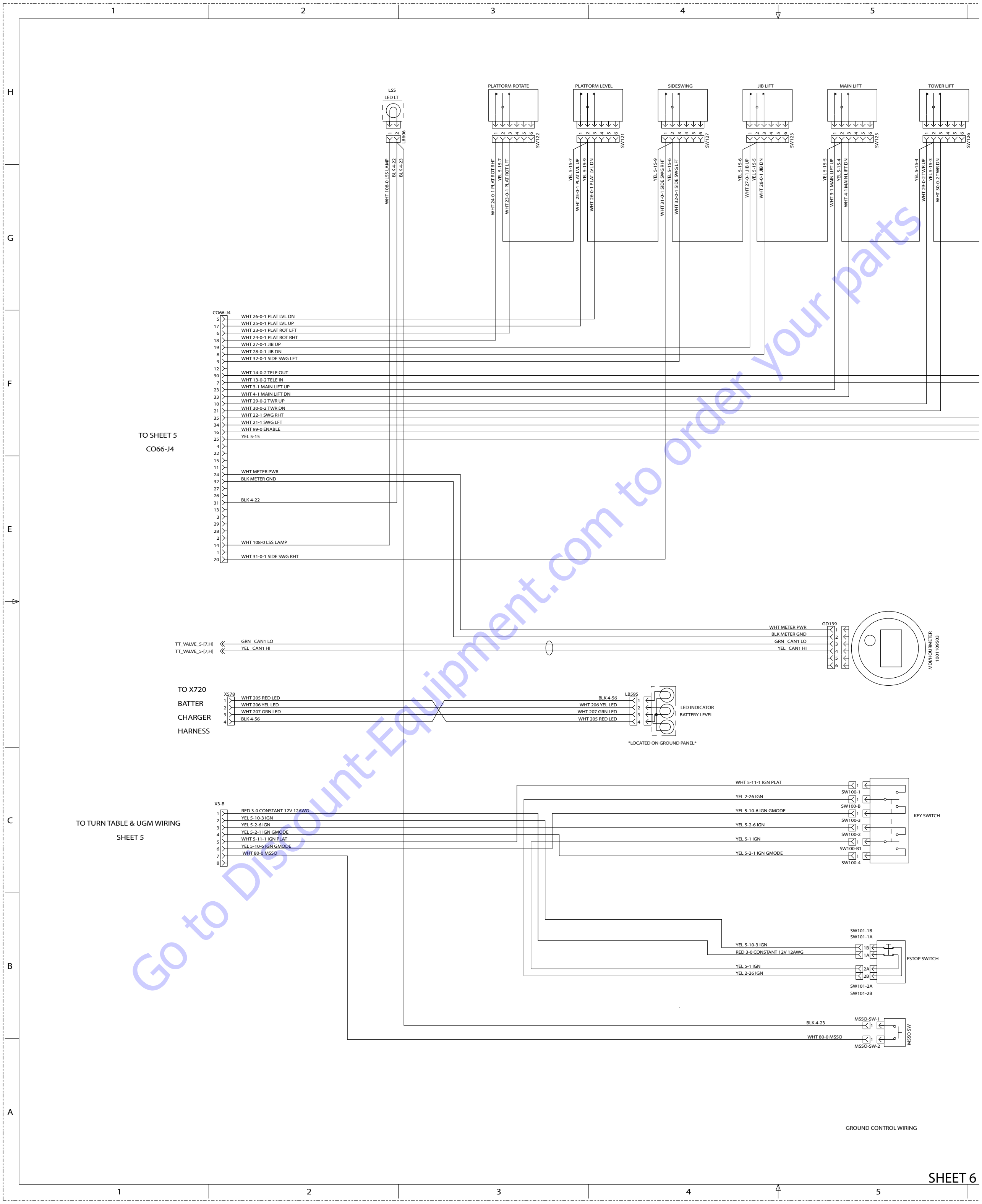


Figure 7-57. Electrical Schematic - Sheet 7 of 14

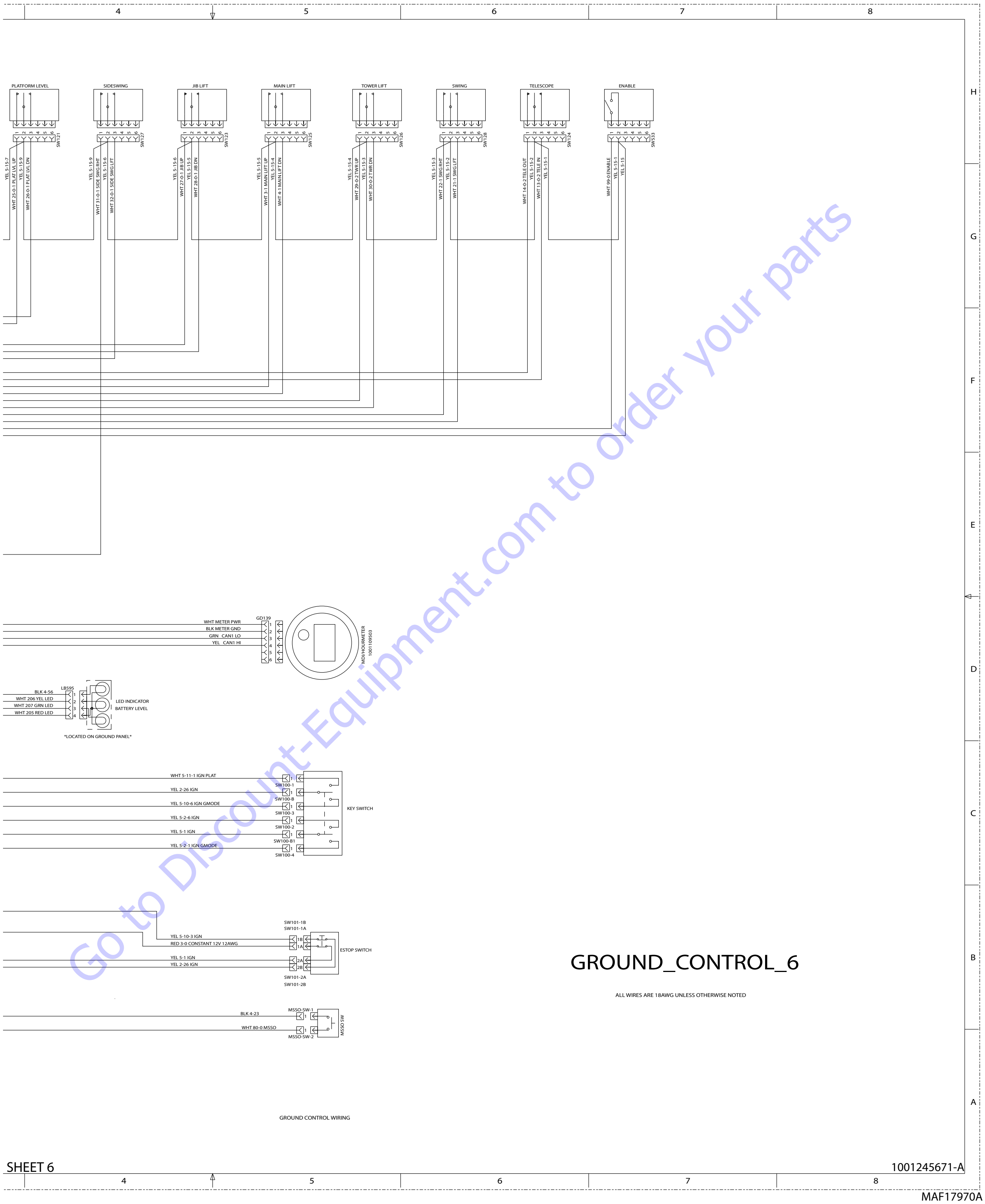


Figure 7-58. Electrical Schematic - Sheet 8 of 14

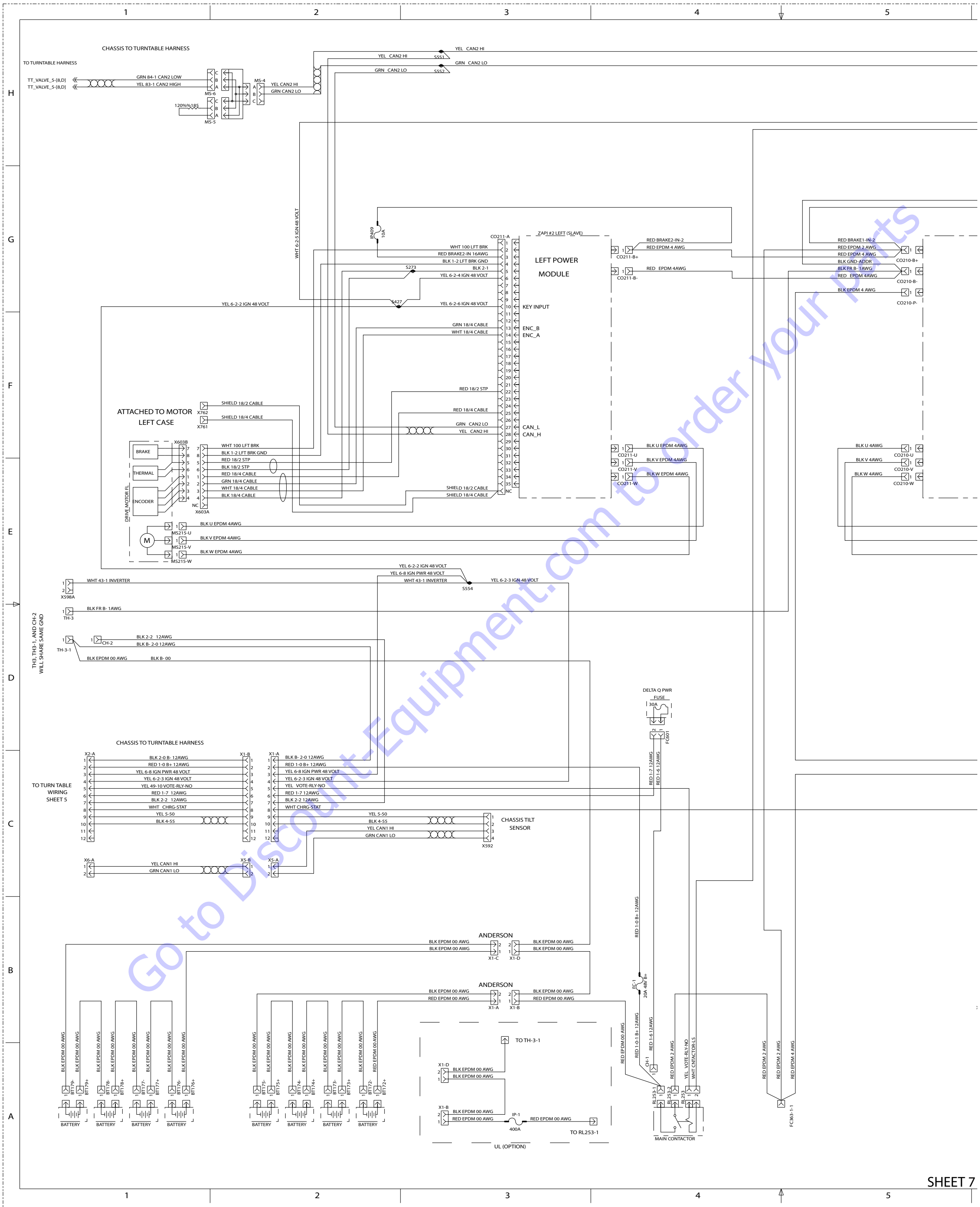


Figure 7-59. Electrical Schematic - Sheet 9 of 14

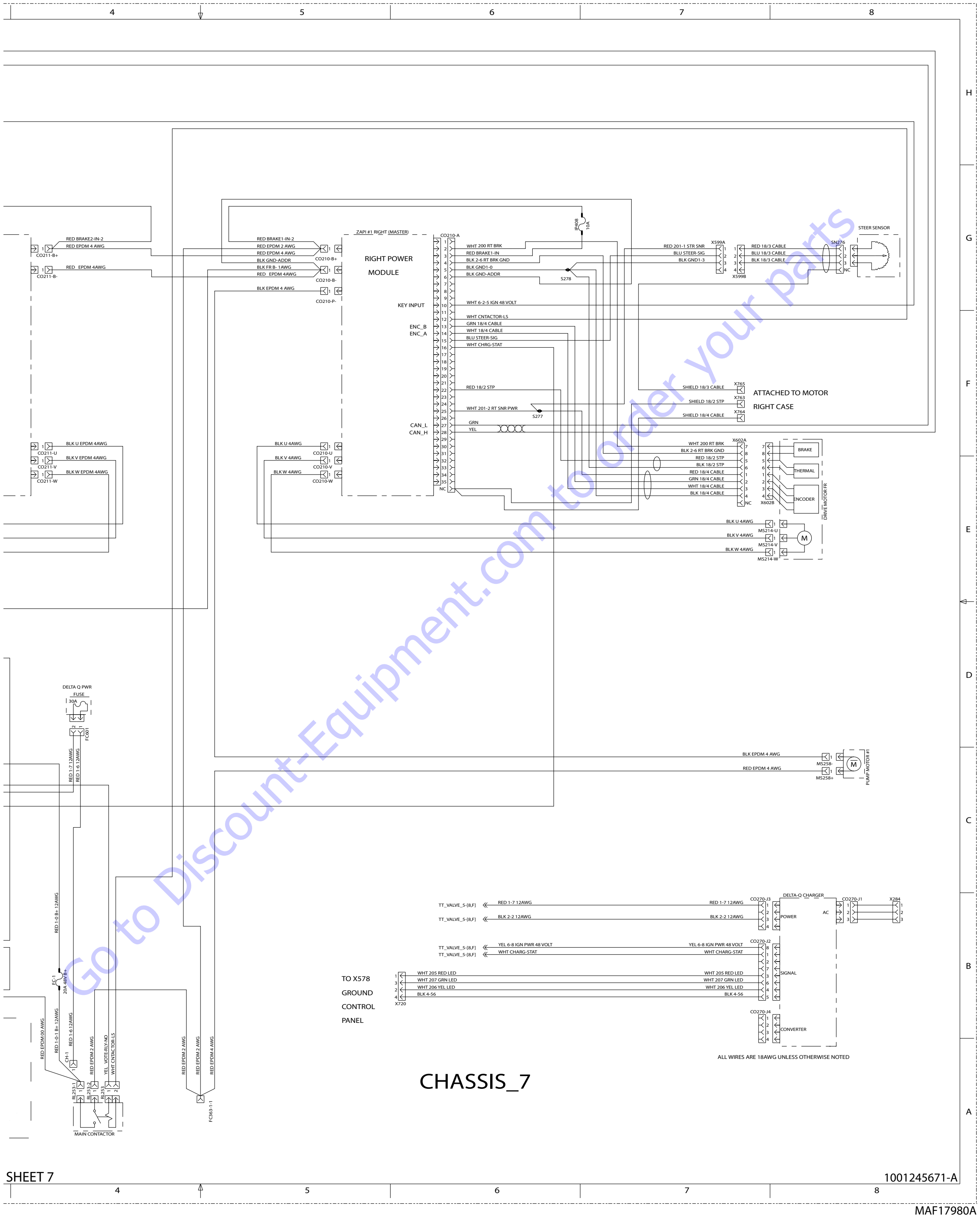


Figure 7-60. Electrical Schematic - Sheet 10 of 14

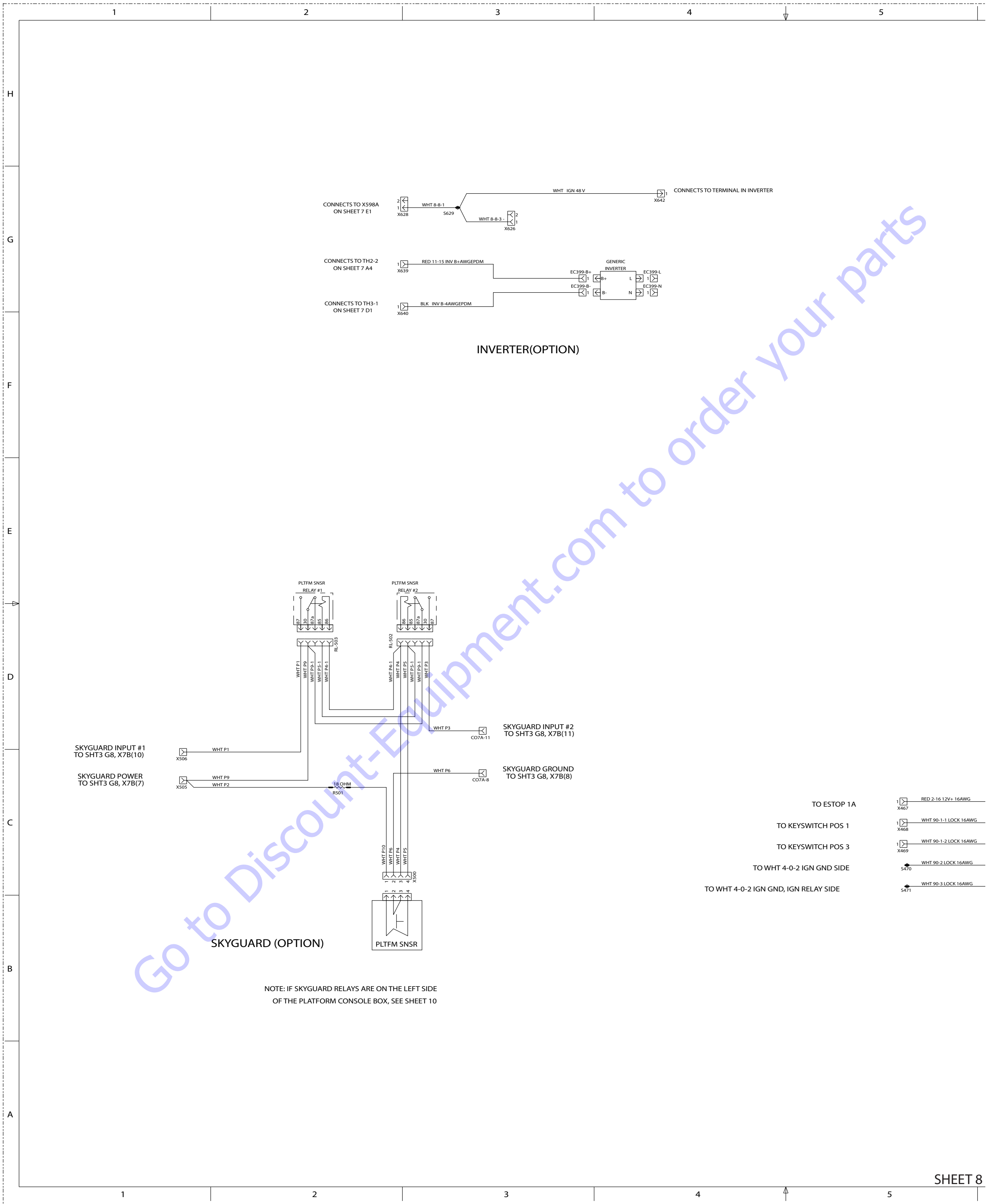
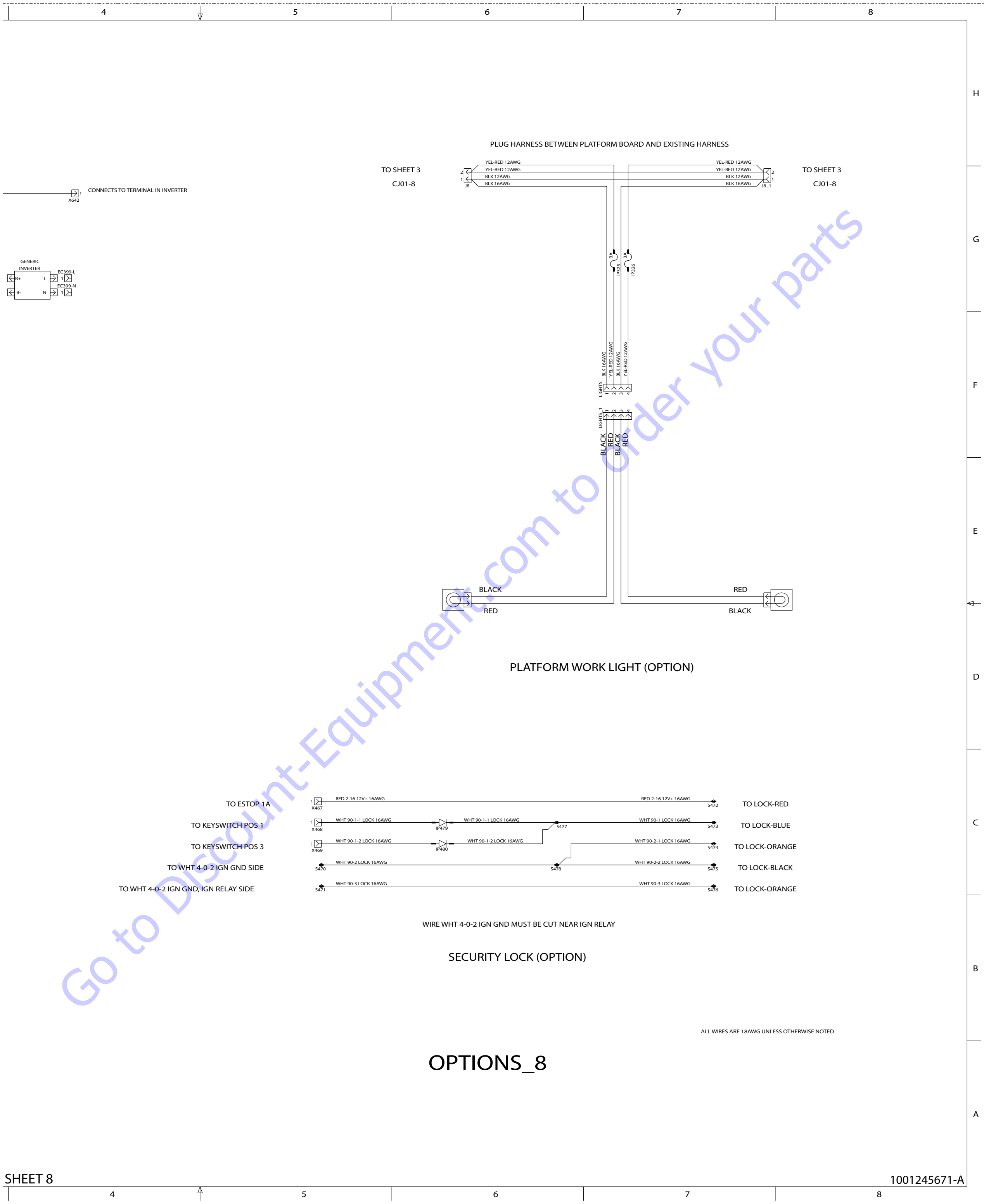


Figure 7-61. Electrical Schematic - Sheet 11 of 14



MAF17990A

Figure 7-62. Electrical Schematic - Sheet 12 of 14

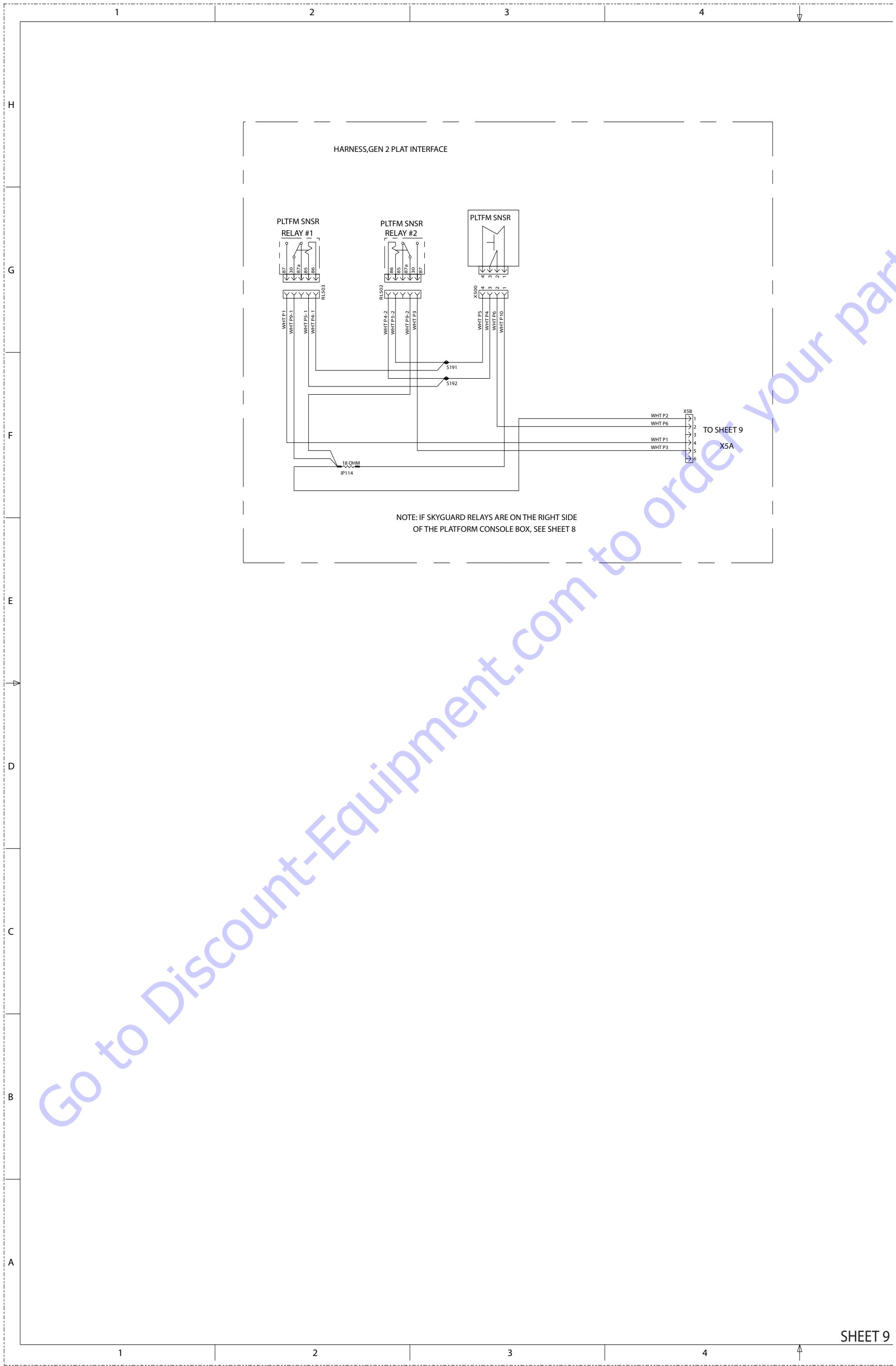


Figure 7-63. Electrical Schematic - Sheet 13 of 14

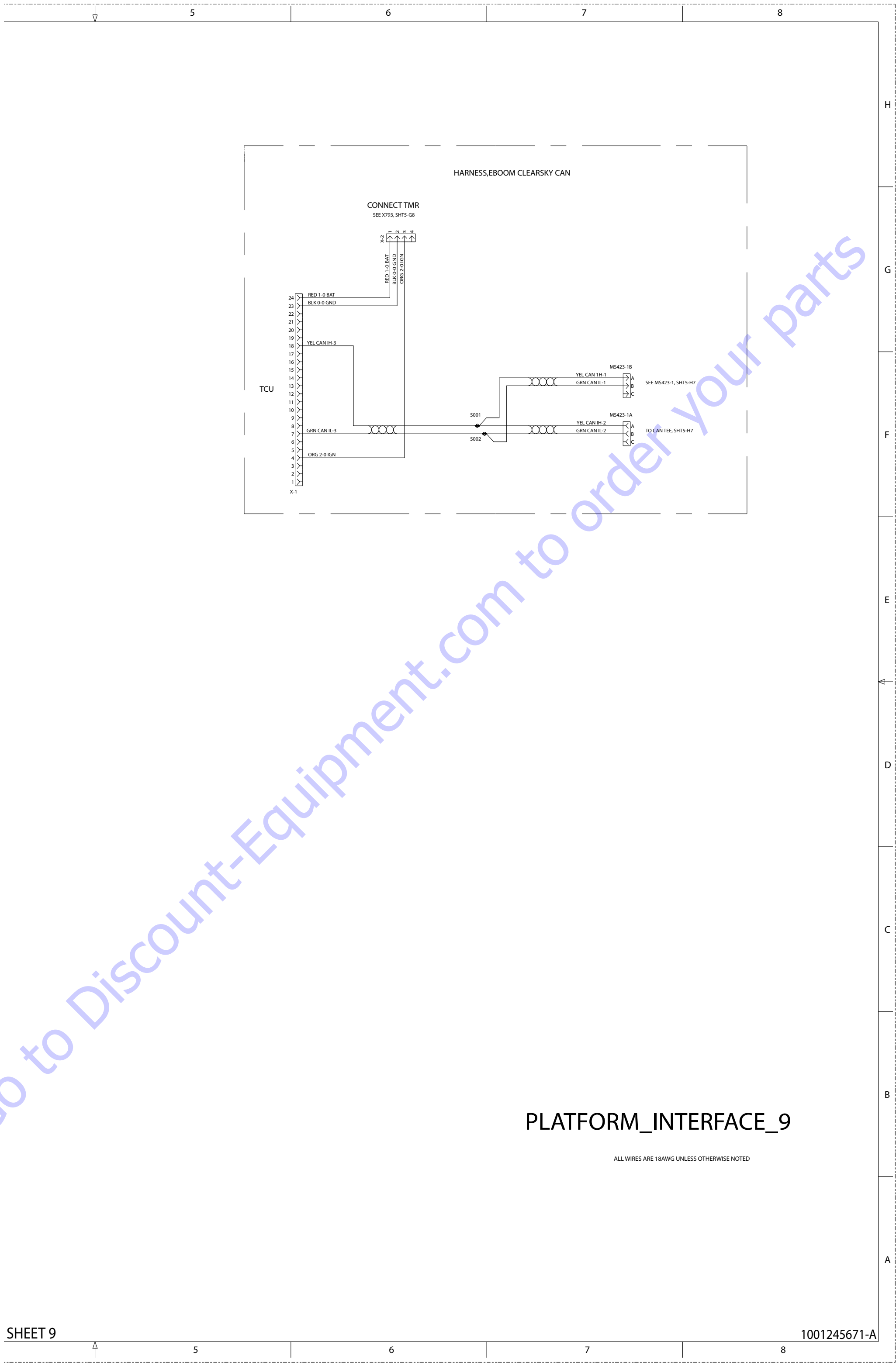
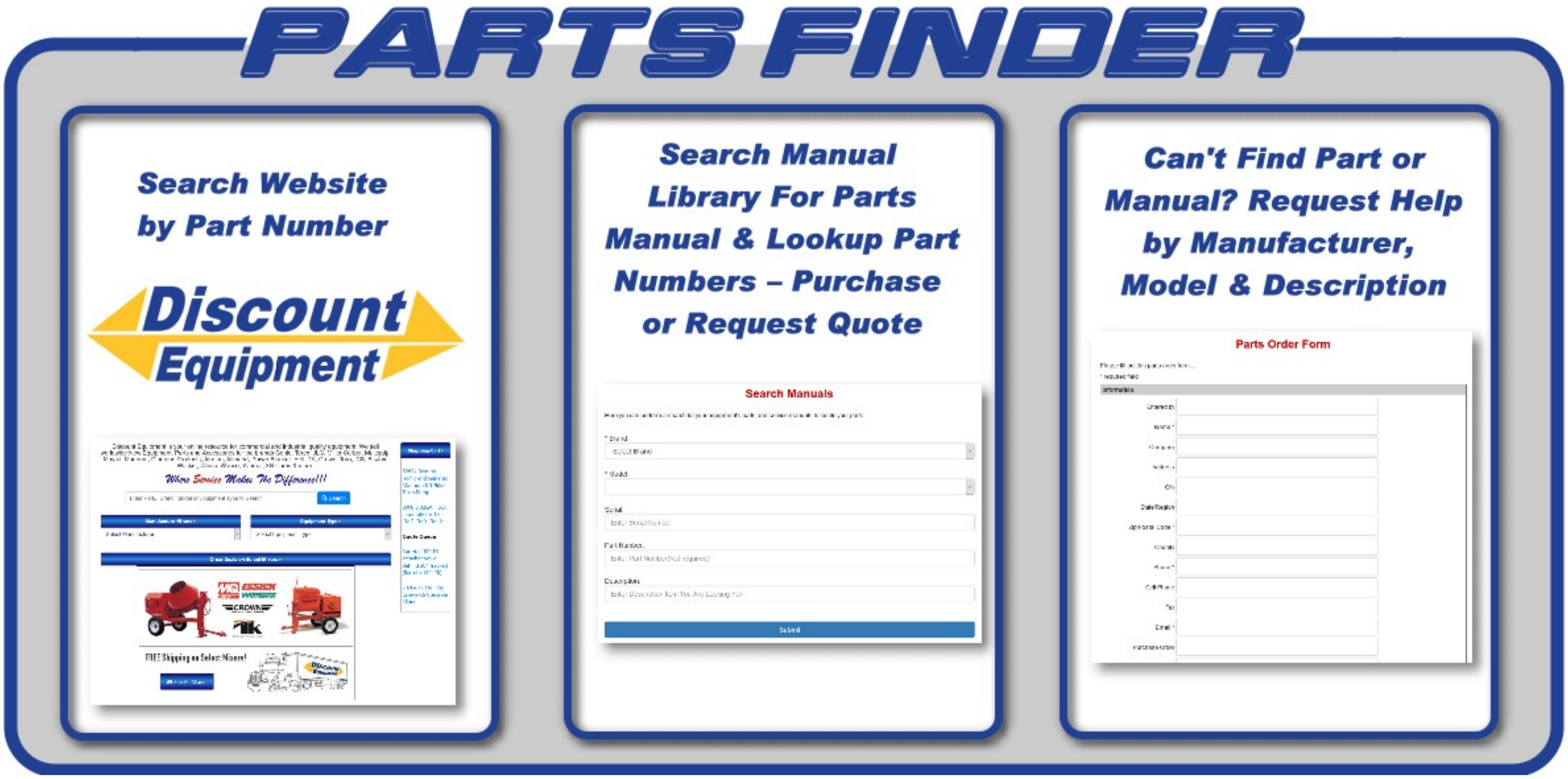


Figure 7-64. Electrical Schematic - Sheet 14 of 14



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